ITTC2024
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Report of the Quality Systems Group

Quality Systems Group

1. INTRODUCTION

1.1 Membership and Meetings

The members of the Quality Systems Group of the 30th ITTC are:

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Quality Systems Group meetings have been held during the work period:

No in person meetings have been held. The work was performed by video conferences and mail exchange

1.2 Tasks

The recommendations for the work of the Quality Systems Group as given by the 29th ITTC were as follows:

1. During the first six months after the conference:

A) Perform a detailed review of all ITTC Recommended Procedures and Guidelines for compliance with ITTC quality requirements with regard to format, references, symbols, terminology, uncertainty analysis and parameter lists
B) Either update the procedures in these aspects or cooperate with the relevant committee on these updates.
C) Submit the updated procedures to the Advisory Council (AC) before 31.12.2021.

2. During the first six months after the conference:

A) Perform a detailed review of all uncertainty analysis procedures for compliance with ITTC quality requirements about format, references, symbols, terminology and parameter lists.
B) Check that all uncertainty analysis procedures contain a worked example based on the current versions of model test procedures.
C) Cooperate with the relevant technical committees on updating the procedures, including a worked example.
D) Submit a status report on this task to the Advisory Council before 31.12.2021, updating expected to be completed before 30.06.2022.

3. Review the titles and numbering of technical procedures and propose changes, if any, for approval by the Advisory Council before 31.12.2021.
4. Maintain the Register of ITTC Recommended Procedures and Guidelines.
5. Introduce New Uncertainty Analyses Guidelines to include data anomalies in Machine Learning Algorithms for Autonomous and Intelligent ships.
6. Observe the development or revision of ISO Standards regarding Quality Control.
7. Update the ITTC Symbols and Terminology List.
8. Update the Uncertainty Analysis section of the Symbols & Terminology List.
9. Update the ITTC Dictionary of Hydromechanics.
10. Expand the content of current ITTC dictionary version, considering CFD, MASS, etc.
11. Support the technical committees dealing with stochastic processes with guidance on development, revision, and update of procedures for the inclusion of confidence bands on their computational and experimental results.
12. Observe BIPM/JCGM standards for uncertainty analysis, in particular the uncertainty analysis terminology.
13. Review developments in metrology theory and uncertainty analysis and issue appropriate procedures.
14. Setup an effective way to collect benchmark data.
15. Upload all the collected and verified benchmark data into the ITTC benchmark data repository.
16. Liaise with relevant technical committees to complete a questionnaire about the demand and use of benchmarks, not to be limited to model scale.
17. Cooperate with technical committees to establish the ITTC benchmarks, including definition, raw data, data format, etc.

18. Prepare a procedure on the internal calibration of steel rulers or a practical way to check length measurement.

2. PERFORMED TASKS

2.1 Perform a detailed review of all ITTC Recommended Procedures and Guidelines for compliance with ITTC quality requirements with regard to format, references, symbols, terminology, uncertainty analysis and parameter lists.

A detailed review of the documents under the paragraph 7.5 Process Control of the Quality Systems Manual - Version 2021 has been undertaken.

114 documents have been analysed and checked against procedure 4.2.3-01-01 Guide for the Preparation of ITTC Recommended Procedures.

Procedure 4.2.3-01-01 prescribed a rigid scheme for ITTC Procedures.

The outcome of the review is produced in detail in Appendix A. and summarized as follows:

No. of documents	Structure of documents
14	slightly different
65	different
35	strongly different

and not a single document is fully compliant with the prescribed structure.

Following this, the AC decided to modify procedure 4.2.3-01-01 Guide for the Preparation of ITTC Recommended Procedures.

AC decided also that a complete revision of all procedures and guidelines to follow the ITTC standard would not be possible this term. It will be part of the Terms of Reference for the next term.

As regards Procedures/guidelines missing the Parameters/Symbols paragraph AC decided to ask the concerned committees to fill in missing symbols in this term.

2.2 Perform a detailed review of all uncertainty analysis procedures for compliance with ITTC quality requirements about format, references, symbols, terminology and parameter lists.

A detailed review of the uncertainty analysis procedures under the paragraph 7.5 Process Control of the Quality Systems Manual - Version 2021 has been undertaken.

The elements of the review included the following six items:

- Format
- References
- Terminology
- Symbols
- Parameters List
- Example

A total of 113 procedures was reviewed and a summary is included in Appendix B. . Three of the six items (Example, Reference, and Symbol) are included as columns in the appendix. Additional discussion is in the Comment column.

2.3 Review the titles and numbering of technical procedures and propose changes, if any, for approval by the Advisory Council before 31.12.2021.

The review of numbering, titles, and classification of the documents under the paragraph 7.5 Process Control of the Quality Systems Manual - Version 2021 has been undertaken.

Procedures in the following table were found to have a wrong classification since their content is rather a Guideline than a Procedure.

7.5-02-01-03	P	Fresh Water and Seawater Properties
7.5-02-05-04.1	P	Excerpt of ISO 2631, Seasickness and Fatigue
7.5-03-02-02	P	Benchmark Database for CFD Validation for Resistance and Propulsion

Following this their classification has been changed.

As regards Procedure

7.5-02-05-05	P	Evaluation and Documentation of HSMV

the document is a rather a Guideline than a Procedure and its classification has been changed. The name was misleading and has beeen changed into: Evaluation and Documentation of High-Speed Marine Vehicle (HSMV) Manoeuvrability

Procedure

7.5-02-05-06	P	HSMV Structural Loads

had a misleading name that has been changed into: High-Speed Marine Vehicle (HSMV) Model Tests for Prediction of Structural Loads

The AC concurred on the need to implement the proposed changes that are being finalised during this conference.

The Resistance and Propulsion committee suggested that guideline 7.5-02-03-02.5 Experimental Wake Scaling Methods could be renamed “Experimental Wake Scaling Methods for a Cavitation Test” and renumbered to sit within the 7.5-02-03-03 Cavitation section.

The suggestion was accepted and a new guideline 7.5-02-03-03.10 Experimental Wake Scaling Methods for a Cavitation Test has been added to the Register.

2.4 Maintain the Register of ITTC Recommended Procedures and Guidelines.

During the second meeting the Advisory Council decided that on the front page of all ITTC Recommended Procedures and Guidelines there should be a remark regarding copyright. Additional to this, there should be provided a placeholder for the DOI Number.

Following this request the front page of Procedures/Guidelines has been updated and substituted to the existing one in most of the updated documents.

Accordingly, also procedure 4.2.3-01-01 Guide for the Preparation of ITTC Recommended Procedures and Work instruction 4.2.3-01-03 Work Instruction for Formatting ITTC Recommended Procedures have been updated.

As an example of the new format requirements application Guideline 7.5-02-01-03 Fresh Water and Seawater Properties has been updated.

The revision of the Manual of ITTC Recommended Procedures and Guidelines included 81 documents:

- 2 existing procedures were deleted.
- 7 new Procedures/Guidelines have been approved.
- 72 existing procedures have been reviewed or updated.
- 34 cover pages have been updated to the new format.
- Procedures 7.5-02-02-01 Resistance Tests and 7.5-02-03-01.4 1978 ITTC Performance Prediction Method have been corrected for small typographic errors.

The table of “Revision Outcomes” is illustrated in Appendix C.

2.5 Introduce New Uncertainty Analyses Guidelines to include data anomalies in

Machine Learning Algorithms for Autonomous and Intelligent ships.

Task 5 has not been performed. This task was proposed by QSG following a suggestion of Ahmed Derradji-Aouat, the only QSG member with the relevant expertise. No member of the current QSG possess the required knowledge and AC agreed to postpone this task.

2.6 Observe the development or revision of ISO Standards regarding Quality Control.

The member of the QCG GG organized the 42nd ISO/TC8 Plenary Meeting in Athens during September 18-22, 2023. The active Sub-Committees (SC) and Working Groups (WG) and their context within ISO/TC8 are listed in the following two tables (the published standards of the SGs are given in parentheses):

SC1	Maritime Safety (56)
SC2	Marine Environment Protection (32)
SC3	Piping and Machinery (57)
SC4	Outfitting and Deck Machinery (80)
SC6	Navigation and Ship Operations (42)
SC7	Inland Navigation Vessels (34)
SC8	Ship Design (66)
SC11	Intermodal & Short Sea Shipping (8)
SC12	Large Yachts (12)
SC13	Marine Technology (15)
SC25	Maritime GHG reduction (4)

WG3	Special Offshore Structures and Support Vessels
WG4	Maritime Security
WG6	Ship Recycling
WG8	Liquid and Gas Fuelled Vessels
WG10	Smart Shipping
WG11	Dredger
WG12	Aquatic Nuisance Species
WG14	Maritime Education and Training

During this meeting the development trends of maritime standards were discussed by representative of various stakeholders (shipowners, class societies, shipbuilders). Reduction of polluting emissions, alternative fuels, sustainable energy resources and automation affect directly ship operation. To this goal standards for the following items must be developed or updated:

- Alternative fuels (biofuels, synthetic fuels, green fuels, hydrogen, ammonia, methanol)
- Carbon capture on board
- Transportation of CO_2, or its transformation to other substances.
- Transportation of H_2, NH_3 and biofuels.
- Use of various Energy Saving Devices.
- Air-Assisted Propulsion (sails, kite, Flettner rotors)
- Alternative auxiliary propulsion devices (flapping foils, ducts etc.)
- Digitalization and onboard information
- AI-driven operations onboard
- Cyber-security in data handling and transfer
- Electrification in ship operation

- Other ISO/TCs of interest to ITTC are:
  - ISO/TC188 Small Craft (97 published standards; 14 of them refer on personal safety equipment)
  - ISO/TC204 Intelligent Trasport Systems (340 published standards)
  - ISO /TC43 Acoustics (221 published standards)
  - ISO/TC067 Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries (203 published standards; 22 of them refer to Offshore structures and 6 to Arctic operations)

Finally, an ongoing discussion is occurring in the ISO/TC8/SC6/WG17 enhanced by representatives from ITTC for updating ISO15016:2015 on Speed/Power Trials Procedure & Analysis.

2.7 Update the ITTC Symbols and Terminology List.

During meeting 30:2 the Advisory Council decided that additional to the symbols in the symbols list also acronyms can be given. To this effect QSG has been requested to add a relevant column in the Symbols and Terminology List replacing the existing column named Computer Symbol.

An acronyms list is incompatible with the table format in ITTC (2021a). A separate table of acronyms has been prepared for ITTC (2021a):

Acronym	Definition
AC	Advisory Council
EC	Executive Council
BIPM	Bureau International des Poids et Mesures
CFD	Computational fluid dynamics
EFD	Experimental fluid dynamics
GUM	Guide to the expression of Uncertainty in Measurement
HSMV	High-speed marine vehicle
IMO	International Maritime Organization
ISO	International Organization for Standardization
JCGM	Joint Committee for Guides in Metrology
JCGM-WG1	JCGM Working Group 1
JCGM-WG2	JCGM Working Group 2
LDV	Laser Doppler velocimetry
MSC	Marine Safety Committee
NMI	National Metrology Institute
PIV	Particle imaging velocimetry
SPIV	Stereo-PIV
UV	Underwater vehicle
V&V	Verification and validation
VIM	International vocabulary of metrology
VIM	Vortex induced motion
VIV	Vortex induced vibration

A section on verification and validation (V&V) should be added. The V&V equation as provided by ASME (2009) is as follows:

$$E = S - D \quad (1)$$

where E is the validation error, S is the simulation result, and D is the experimental data. The V&V ITTC procedures appear to follow this definition but do not reference ASME (2009). The procedures should be consistent. In some locations the definition is reversed: $E = D - S$. Example V&V ITTC procedures are ITTC (2021b, c) 7.5-03-01-01 and 7.5-03-04-02. ITTC (2021c) 7.5-03-04-02 has been reviewed by QSG for the Manoeuvring Committee.

The equations written using Math Type were transformed into MS Equation format.

2.8 Update the Uncertainty Analysis section of the Symbols & Terminology List.

The uncertainty symbols list is on pages 5 through 12 in section 1.1.1 Uncertainty of ITTC (2021a). This table contains numerous errors and should be replaced with Annex J of JCGM 100:2008. This table has been revised to align with the contents of JCGM 100:2008-Annex J

2.9 Update the ITTC Dictionary of Hydromechanics.

The ITTC structured dictionary and alphabetical dictionary have been reviewed and the following corrections have been made:

The year of the version in the upper right corner was written as 202 or 2017, so it has been corrected to 2021. These dictionaries are updated this year, so finally they are revised to 2024.

Some formulas and variables were written in the old equation editor, so they were rewritten in the new equation editor. Also, some variables have been changed to italics.

Some pages were written in two columns, so they were all changed to one column. The order of some figures has been adjusted accordingly.

Regarding links to figures, the links with misaligned figure numbers and links to different figures have been corrected. In Chapter 9, links

to figures have been inserted as in the other chapters.

Some typos and omissions have been corrected.

The descriptions such as "(which see)" and others have been found. They will be specified in the future.

2.10 Expand the content of current ITTC dictionary version, considering CFD, MASS, etc.

Explanation of keywords related to Computational Fluid Dynamics (CFD) has been add-ed. Keywords were extracted from 12 CFD-related procedures from 7.5-03-01-01 to 7.5-03-04-02. Keywords explained in other chapters of existing dictionaries were omitted. In the end, 76 keywords were extracted and explained with reference to specialized books on CFD. These keywords are first consolidated into ITTC structured dictionary, and the overall index of titles is updated. It is then integrated into the ITTC alphabetical dictionary.

2.11 Support the technical committees dealing with stochastic processes with guidance on development, revision, and update of procedures for the inclusion of confidence bands on their computational and experimental results.

No request has been received on this topic.

QSG assisted in reviewing procedure 7.5-02-05-03.3, revised by the Resistance and Propulsion Committee, as regard Uncertainty Analysis matters.

QSG also assisted Specialist Committee on Ice about an UA procedure for ice resistance tests.

2.12 Observe BIPM/JCGM standards for uncertainty analysis, in particular the uncertainty analysis terminology.

The international standard for uncertainty analysis is the Guide to the expression of Uncertainty in Measurement or GUM. The GUM is managed by the Joint Committee for Guides in Metrology (JCGM) of the Bureau International des Poids et Mesures (BIPM) in Sèvres, France. The JCGM consists of two working groups. Working Group 1 (WG1) manages the GUM, while Working Group 2 (WG2) manages the International Vocabulary of Metrology (VIM).

The GUM consists of the following six (6) documents with details in the References. The web page for downloading JCGM documents is as follows:
https://www.bipm.org/en/committees/jc/jcgm/publications .

JCGM 100:2008
JCGM 101:2008
JCGM 102:2011
JCGM 106:2012
JCGM GUM-1:2023
JCGM GUM-6:2020

WG1 is in the process of developing two revisions with a new numbering system. The following information is from the WG1 Newsletter dated May 2024. JCGM-1:2023 replaces JCGM 104:2009.

JCGM GUM-5:202x “Guide to the expression of uncertainty in measurement – Part 5: Examples of uncertainty evaluation.” A draft is expected by spring 2024.

JCGM GUM-7:202x “Guide to the expression of uncertainty in measurement – Part 7: Propagation of distributions using a Monte Carlo method.” This document will be a re-publication of JCGM 101:2008. An advanced working draft is under discussion.

The JCGM 200:2012 (VIM) is being revised. A draft of the 4th Edition dated July 2023 is being reviewed.

2.13 Review developments in metrology theory and uncertainty analysis and issue appropriate procedures.

New ITTC uncertainty procedures are not provided for this report. A number of journals contain information on metrology and an uncertainty analysis. The number of papers is very large. Summarizing the papers would be a challenge. The following is a list with links to some journals:

1. Metrologia. A journal of BIPM. Volumes 58-60 (2021-2023) has about 16 relevant articles: https://iopscience.iop.org/journal/0026-1394
2. Journal of Verification, Validation, and Uncertainty Quantification. A journal of the American Society of Mechanical Engineers (ASME): https://asmedigitalcollection.asme.org/verification
3. Ocean Engineering. An Elsevier publication: https://www.sciencedirect.com/journal/ocean-engineering

ASME has an annual conference on Verification, Validation, and Uncertainty Quantification (VVUQ). No technical papers are published. The web page for the most recent conference is https://event.asme.org/VandV

2.14 Setup an effective way to collect benchmark data.

2.14.1 Definition

Benchmark model, either physical or numerical, is a standardized model to calibrate the results from model test configuration or numerical simulations. The main significance of Benchmark model is to provide a recognized benchmark for evaluating and comparing the performance and effects of ships at various stages, including design, construction, and operation. It can serve as a foundation for researching and developing new methods, based on validation and verification.

Currently, ITTC is paying more attention on benchmark. “benchmark”, the word became common in TOR, and most of the committee has at least one task related to benchmark.

General Terms：All committees shall endeavor to identify benchmark data and submit these to the ITTC Secretary for inclusion in the benchmark data repository on the ITTC website.

Resistance and Propulsion Committee: the committee report should include sections on new benchmark data; conduct a benchmark study.

Manoeuvring Committee: collect the benchmark data

Seakeeping Committee: the committee report should include sections on new benchmark data; organize a benchmark experimental campaign

Ocean Engineering Committee: the committee report should include sections on new benchmark data; develop specifications for a benchmark test, and the benchmark study may also include CFD comparisons

Stability in waves Committee: the committee report should include sections on new benchmark data; continue the identification of benchmark data for validation of stability-in-waves predictions

Full-Scale Ship Performance Committee: the committee report should include sections on new benchmark data; collect full scale data obtained through relevant benchmark tests

Specialist Committee on Ocean Renewable Energy: Assess level of support for a benchmark study of comparisons

Specialist Committee on Cavitation and Noise: Review the currently available CFD benchmark data

Specialist Committee on Ice: continue work on uncertainty analysis including conducting benchmarking study among ice model basins.

Specialist Committee on Combined CFD and EFD Methods: review the outcome of ongoing CFD benchmark campaigns; develop a standard process of performing a CFD benchmark study within ITTC.

2.14.2 Data type

Regarding as the data type, it may combine with two aspects.

The first aspect is related to profession, which includes resistance, propulsion, seakeeping ability, manoeuvrability, cavitation, offshore, etc. All those typically include a complete set of design parameters, such as main dimensions, parameters, body lines, geometry, as well as major equipment and propulsion systems, like main engines, propulsion systems, and steering devices, etc. It also includes a series of data of ship performance which deprived from model test or numerical simulations, as well as sea trail data.

The second aspect is scope. That is international and regional benchmark for different purpose. International benchmarking data, as a second variant of a Korean VLCC KVLCC2, a Korean container ship KCS, a Japan Bulk Carrier JBC are widely used to verify the performance of new measuring system or new simulation method, while regional benchmarking data are normally for specific research or purpose, as Joint industry project. Some results from Joint Industrial Projects (JIP) could also be used widely after authorized.

2.14.3 Data source

At present, the benchmark data can be mainly downloaded from internet.

Some are from international conference and adopted as benchmark data for various validation and verification. Such as KVLCC, KCS, and JBC, are widely used in many international workshops for calibrations.

Some are from specific project or joint industry project, for a certain research purpose, such as the Joint Research Project JORES project [https://jores.net].

All those data could be defined as benchmark.

2.14.4 Sharing mechanism

Benchmark data normally created from international conference and could be acquired for free. While some benchmark data are obtained from business demand with confidential agreement therefore, they could only be shared within a small-scale party. Therefore, an effective sharing mechanism shall be established within ITTC.

2.14.5 Maintenance and support

Furthermore, a specific group is needed to maintain the benchmark. As learned that benchmark repository has already existed in ITTC website, therefore, it is easy for ITTC member to reach the access. Since many committees have the task related to benchmark, the outputs could be shared in a mutual agreed framework.

2.14.6 Conclusions

The establishment of a benchmark requires a clear understanding of the research needs and objectives. After collecting and cleaning data for a particular type of ship, the characteristic parameters and specifications of the benchmark ship are determined. The benchmark ship should

possess the typical characteristics of its ship type but should not have specific features assigned by a particular shipbuilder or operator, making it a common standard. Once established, a benchmark ship can be widely used and studied by researchers and ship designers. This process involves accumulating data from relevant water tank tests and numerical simulations.

Currently, lots of research has been performed related with full-scale ships; therefore, to establish a database is essential with full scale data, which is more useful compared with model scale. All the ITTC community have to work on it step by step.

2.14.7 Question

For the future work, since many technical committees are working on benchmark, the data format and data standard shall be established in the first place.

Meanwhile, data collection and classification shall also be paid more attention.

Last but not least, benchmark work needs support from all technical committee. An operational mechanism shall be discussed.

2.15 Upload all the collected and verified benchmark data into the ITTC benchmark data repository.

Two series benchmark data have been investigated, and the data has also been collected.

- Gothenburg 2010 Workshop on Numerical Ship Hydrodynamics was held in Gothenberg on 8-10 December, 2010 and the purpose has been to assess the performance of contemporary CFD codes used in hydrodynamic. The addressed designs were:
  - a US combatant DTMB5415 with 5 different cases
  - a Korean container ship KCS with 9 different cases
  - a second variant of a Korean VLCC KVLCC2 with 7 different cases
- Tokyo 2015 Workshop on CFD in Ship Hydrodynamics was held in Tokyo on December 2-4, 2015, with the objective to compare results of state-of-the-art numerical methods for a number of well specified test cases to assess the capabilities of the methods and to find the best way forward . The addressed designs were:
  - Japan Bulk Carrier JBC with 9 different cases
  - KRISO Container Ship KCS with 5 different cases
  - ONR Tumblehome model 5613 ONRT with 3 different cases

All the data is ready, an upload procedure is needed.

Test cases	Series No.	JBC 1	KCS 2	ONRT 3
Calm water：Reistance				
w/o ESD: resistance, sinkage and trim	1	1.1	2.1*	
With ESD: resistance, sinkage and trim	2	1.2		
w/o ESD: time-averaged velocity field, turbulence, wave pattern	3	1.3		
with ESD: time-averaged velocity field, turbulence	4	1.4		
w/o ESD: thrust, torque, sinkage and trim	5	1.5	2.5*	
Calm water: Self-propulsion				
with ESD: thrust, torque, sinkage and trim	6	1.6		
w/o ESD: time-averaged velocity field, turbulence	7	1.7	2.7*	

with ESD: time-averaged velocity field, turbulence	8	1.8		
Calm water: Free Self-propulsion				
thrust, torque, sinkage and trim	9			3.9
Regular wave: head waves				
motion response, added resistance	10		2.10	
Regular wave: other headings				
motion response, added resistance	11		2.11	
Regular wave: head waves				
thrust, torque, RPS, motion response, speed loss	12			3.12
Regular wave: other headings				
thrust, torque, RPS, motion response, speed loss	13			3.13

2.16 Liaise with relevant technical committees to complete a questionnaire about the demand and use of benchmarks, not to be limited to model scale.

In order to investigate the demand and use of benchmark, a questionnaire was issued and sent to the ITTC community to learn about what is focused and what is concerned.

Eight (8) questions are listed in the questionnaire. Herein, the results are summarized.

Kind of benchmark (Demand of the benchmark)

- Question：What are your interests on benchmark data?

Answer: Most of the participants show their interests on benchmark data related with resistance, seakeeping, manoeuvrability, CFD, full scale.

Data type of benchmark (Demand of the benchmark)

- Question：What are your interests on the data type of the benchmark?

Answer: Most of the participants show their interests on raw data, geometry, analysed data, tables. The choice of Mesh and Figures is in second place.

Source of data

- Question: What is the effective and feasible way to collect the benchmark data?

Answer: Colleagues, publications, conference, and internet are all the best choices.

Application of Benchmark

- Question: What is your purpose to use benchmark data?

Answer: Main purpose is to calibrate the model test results and calibrate the CFD results. Comparison of extrapolation method, calibration of geometry and calibration of CFD calculation policy take the second place.

Sharing of benchmark

- Question: what kind of way you like to share the benchmark with others

Answer: most participants would like to share on request of independent email or from ITTC benchmark repository. Publications, conference, internet is the second choice.

Data sharing

- Question: what kind of data you like to share with other?

Answer: Analyzed data, tables and figures are selected mostly. Raw data, geometry and mesh may not be widely accepted yet.

Sharing of working mechanism

- Question: What is your idea to work with ITTC community to develop benchmark?

Answer: most of the participants choose to work with TC. Part of them would like to work with AC, and liaise with QSG.

Participation to benchmark work

- Question: Would you like to take part in the research work about benchmark?
- Answer: most of the participants are willing to join such work.

Conclusions:

Almost all the participants show strong interests on the benchmark data.

Lots of participants are concerned with the ITTC repository.

Most of participants would like to work with TC to develop benchmark data.

Most of participants would like to take part in the work related with benchmark data.

2.17 Cooperate with technical committees to establish the ITTC benchmarks, including definition, raw data, data format, etc.

Since most of the TC have their own benchmarking work within TOR, less work could be done by QSG.

Communication between QSG and CFD/EFD has been established and benchmark research has been investigated on bow wave breaking experiments for CFD and EFD. And the essay has been published in 34th Symposium on Naval Hydrodynamics Washington, D.C., June 26 – July 1, 2022, with title "KCS Unsteady Bow Wave Breaking Experiments for Physics and CFD Validation".

2.18 Prepare a procedure on the internal calibration of steel rulers or a practical way to check length measurement.

Work Instructions 7.6-02-01 has been prepared to guide the verification of a new steel ruler or for the verification of a ruler in production or in service.

3. CONCLUSIONS

For the purpose of the format, a complete revision of all procedures and guidelines to follow the ITTC standard is required, with special attention in including the Parameters/Symbols paragraph.

During the second meeting the Advisory Council decided that additional to the symbols in the symbols list also acronyms can be given. Acronyms are not to be in equations. Furthermore, a separate table of acronyms not connected to ITTC Symbols is recommended.

The list of symbols for Uncertainty Analysis should be expanded.

Consideration should be given by the Conference to new emerging technologies in artificial intelligence (such as machine learning techniques) respect to data quality assessment.

Consideration should be given by the Conference to further development of liaison with International Ship and Offshore Structures Congress (ISSC) for the purpose harmonization and common understanding of the state of the art in Uncertainty Analysis.

4. RECOMMENDATIONS TO THE 30TH ITTC

The 30th ITTC Quality Systems Group recommends the following:

Adopt the revised procedures and guidelines and work instructions:

- 4.2.3-01-01 – Guide for the Preparation of ITTC Recommended Procedures
- 4.2.3-01-03 - Work Instruction for Formatting ITTC Recommended Procedures
- 7.5-02-01-03 - Fresh Water and Seawater Properties
- 7.6-02-01 – Verification of Steel Rulers

5. RECOMMENDATIONS FOR FUTURE WORK

1. Maintain the Register of ITTC Recommended Procedures and Guidelines.
2. Introduce New Uncertainty Analyses Guidelines to include data anomalies in Machine Learning Algorithms for Autonomous and Intelligent ships.
3. Observe the development or revision of ISO Standards regarding Quality Control.
4. Update the ITTC Symbols and Terminology List.
5. Harmonize the uncertainty symbols list with Annex J of JCGM 100:2008
6. Update the ITTC Dictionary of Hydromechanics.
7. Support the technical committees dealing with stochastic processes with guidance on development, revision, and update of procedures for the inclusion of confidence bands on their computational and experimental results.
8. Observe BIPM/JCGM standards for uncertainty analysis, in particular the uncertainty analysis terminology.
9. Review developments in metrology theory and uncertainty analysis and issue appropriate procedures.
10. Upload all the collected and verified benchmark data into the ITTC benchmark data repository.
11. Cooperate with technical committees to establish the ITTC benchmarks, including definition, raw data, data format, etc.

6. REFERENCES

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Appendix A. OUTCOME OF THE REVIEW OF ITTC RECOMMENDED PROCEDURES AND GUIDELINES FOR COMPLIANCE WITH ITTC QUALITY REQUIREMENTS

Number		Title	Effective Date	Revision	§ 1. PURPOSE	§ 2. DESCRIP-TION	§ 3 VALIDATION	§ 4 PARAM/SYM B	§ 5 REFER-ENCES	§ = paragraph NA=Not Appl.
7.5-01		**TEST PREPARATION**								
7.5-01-01		**Ship Models**								
7.5-01-01-01	P	Ship Models	2017	4	√	in § 3	NA	in § 2	in § 4	Structure **different**
7.5-01-02		**Propeller Models**								
7.5-01-02-01	P	(Terminology and Nomenclature for Propeller Geometry) Deleted	2017	Deleted						
7.5-01-02-02	P	Propeller Model Accuracy	2017	1	√	wrong name	NA	in § 3	√	Structure **different**
7.5-01-03		**Instrumentation, Calibration**								
7.5-01-03-01	P	Uncertainty Analysis, Instrument Calibration	2017	2	√	in various §	NA	missing	in § 8	Structure **strongly different**
7.5-01-03-02	P	Uncertainty Analysis, Laser Doppler Velocimetry Calibration	2008	0	√	in various §	embedded in text	in § 7	in § 8	Structure **strongly different**
7.5-01-03-03	G	Guideline on the Uncertainty Analysis for Particle Image Velocimetry	2014	1	√	in various §	embedded in text	missing	in § 7	Structure **strongly different**
7.5-01-03-04	G	Benchmark for PIV(2C) and SPIV(3C) setups	2017	1	√	in various §	NA	missing	in § 6	Structure **strongly different**
7.5-02		**TESTING AND EXTRAPOLATION METHODS**								
7.5-02-01		General								
7.5-02-01-01	P	Guide to the Expression of Uncertainty in Experimental Hydrodynamics	2014	2	√	in various §	in various §	√	in § 18	Structure **strongly different**
7.5-02-01-02		(Uncertainty Analysis in EFD, Guidelines for Resistance Towing Tank Tests) Replaced by 7.5-02-02-02	2011	Deleted						
7.5-02-01-03	P	Fresh Water and Seawater Properties	2011	2	wrong name	in various §	in various §	in § 6	√	Structure **different**
7.5-02-01-04	G	Guideline on Best Practices for the Applications of PIV/SPIV in Towing Tanks and Cavitation Tunnels	2014	0	√	missing	NA	missing/NA	in § 12	Structure **strongly different**

Number		Title	Effective Date	Revision	§ 1. PURPOSE	§ 2. DESCRIP-TION	§ 3 VALIDATION	§ 4 PARAM/SYMB	§ 5 REFER-ENCES	§ = paragraph NA=Not Appl.
7.5-02-01-05	G	(Model-Scale Propeller Cavitation Noise Measurements) Moved to 7.5-02-03-03.9	2021	Deleted						
7.5-02-01-06	P	Determination of a type A uncertainty estimate of a mean value from a single time series measurement	2021	1	√	√	missing	missing	in § 6	Structure **different**
7.5-02-01-07	G	Guideline to Practical Implementation of Uncertainty Analysis	2021	1	√	NA	NA	missing	in § 7	Structure **different**
7.5-02-01-08	P	Single Significant Amplitude and Confidence Intervals for Stochastic Processes	2017	0	√	in various §	NA	missing	in § 8	Structure **different**
7.5-02-02		**Resistance**								
7.5-02-02-01	P	Resistance Tests	2021	5	√	in § 3	in § 4	in § 2	√	Structure **different**
7.5-02-02-02	G	General Guidelines for Uncertainty Analysis in Resistance Tests	2021	3	√	NA	NA	int § 6	in § 7	Structure **different**
7.5-02-02-02.1	G	Example for Uncertainty Analysis of Resistance Tests in Towing Tanks	2021	1	√	in various §	NA	missing	in § 6	Structure **different**
7.5-02-02-02.2	G	Practical Guide for Uncertainty Analysis of Resistance Measurements in Routine Tests	2021	1	√	wrong name	embedded in various §	missing	in § 6	Structure **strongly different**
7.5-02-02-03	G	Resistance and Propulsion Test and Performance Prediction with Skin Frictional Drag Reduction Techniques	2017	0	√	in various §	NA	in § 2	in § 7	Structure **strongly different**
7.5-02-02-04		Wave Profile Measurement and Wave Pattern Resistance Analysis	2021	0	√	in § 3	in § 6	in § 2	in § 7	Structure **strongly different**
7.5-02-03		**Propulsion**								
7.5-02-03-01		**Performance**								
7.5-02-03-01.1	P	Propulsion/ Bollard pull Test	2021	6	√	in § 3	Partly mentioned in § 4	in § 2	√	Structure **slightly different**
7.5-02-03-01.2	P	(Uncertainty Analysis Example for Propulsion Test) Deleted	2021	Deleted						
7.5-02-03-01.3	P	Podded Propulsor Tests and Extrapolation	2021	2	√	√	NA	missing	√	Structure **different**
7.5-02-03-01.4	P	1978 ITTC Performance Prediction Method	2021	5	√	√	Full scale data	in § 2.2	in § 4	Structure **slightly different**
7.5-02-03-01.5	G	Predicting Powering Margins	2017	2	√	in various §	NA	in § 2	√	Structure **strongly different**
7.5-02-03-01.6	G	Hybrid Contra-Rotating Shaft Pod Propulsors Model Test	2017	1	√	in § 3	Partly mentioned in § 4	in § 2	√	Structure **different**
7.5-02-03-01.7	P	Performance Prediction Method for Unequally Loaded, Multiple Propeller Vessels	2021	1	√	√	Partly mentioned in § 2	in § 2	in § 4	Structure **strongly different**

Number		Title	Effective Date	Revision	§ 1. PURPOSE	§ 2. DESCRIP-TION	§ 3 VALIDATION	§ 4 PARAM/SYMB	§ 5 REFER-ENCES	§ = paragraph NA=Not Appl.
7.5-02-03-01.8	G	Scaling Method for ship wake fraction with pre-swirl devices	2021	0	√	√	NA	in § 2	in § 3	Structure **strongly differ-ent**
7.5-02-03-02		**Propulsor**								
7.5-02-03-02.1	P	Open Water Test	2021	4	√	in § 3, named procedure	in § 4	in § 2	√	Structure **strongly differ-ent**
7.5-02-03-02.2	P	(Uncertainty Analysis, Example for Open Water Test) Deleted	2021	Deleted						
7.5-02-03-02.3	P	Nominal Wake Measurements by LDV, Model Scale Experiments	2014	1	√	in § 3, named differently	NA	in § 2	missing	Structure **strongly differ-ent**
7.5-02-03-02.4	P	Nominal Wake Measurement by a 5-Hole Pi-tot Tube	2011	1	√	in § 4	UA in § 5	in § 2	in § 6	Structure **strongly differ-ent**
7.5-02-03-02.5	G	Experimental Wake Scaling Methods	2017	1	√	In various §	in § 7	in § 2	in § 8	Structure **strongly differ-ent**
7.5-02-03-03		**Cavitation**								
7.5-02-03-03.1	P	Model-Scale Cavitation Test	2017	4	√	wrong name	in § 4	in § 3	missing	Structure **differ-ent**
7.5-02-03-03.2	P	Description of Cavitation Appearances	2014	2	√	wrong name	in § 4	in § 3	missing	Structure **differ-ent**
7.5-02-03-03.3	P	Cavitation Induced Pressure Fluctuations Model Scale Experiments	2014	5	√	wrong name	in § 4	in § 3	missing	Structure **differ-ent**
7.5-02-03-03.4	P	Cavitation Induced Pressure Fluctuations Nu-merical Prediction Methods	2014	2	√	wrong name	in § 4	in § 3	√	Structure **slightly different**
7.5-02-03-03.5	P	Cavitation Induced Erosion on Propellers, Rudders and Appendages Model Scale Exper-iments	2011	2	√	wrong name	in § 5	in § 3	in § 6	Structure **differ-ent**
7.5-02-03-03.6	G	Podded Propulsor Model Scale Cavitation Test	2011	2	√	wrong name	NA	√	missing	Structure **differ-ent**
7.5-02-03-03.7	P	Prediction of Cavitation Erosion Damage for Unconventional Rudders or Rudders Behind Highly-Loaded Propellers	2017	1	√	wrong name	in § 6	missing	in § 7	Structure **differ-ent**
7.5-02-03-03.8	P	Modelling the Behaviour of Cavitation in Waterjets	2008	0	√	wrong name	missing	missing	√	Structure **strongly differ-ent**
7.5-02-03-03.9	G	Model-Scale Propeller Cavitation Noise Mea-surements	2021	2	√	wrong name	in § 5	√	in § 6	Structure **differ-ent**
7.5-02-04		**Ice Testing**								
7.5-02-04-01	G	General Guidance and Introduction to Ice Model Testing	2021	3	√	wrong name	Benchmark tests	in § 2.5	in § 4	Structure **differ-ent**

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7.5-02-04-02	P	Test Methods for Model Ice Properties	2021	3	√	wrong name	missing	in § 1.3	in § 11	Structure **strongly differ-ent**
7.5-02-04-02.1	P	Resistance Tests in Ice	2017	2	√	wrong name	in § 4 Bench-mark tests	missing	missing	Structure **strongly differ-ent**
7.5-02-04-02.2	P	Propulsion Tests in Ice	2017	1	√	wrong name	in § 4	in § 3	missing	Structure **differ-ent**
7.5-02-04-02.3	PC	Manoeuvring Tests in Ice	2021	1	√	wrong name	in § 5	√	in § 6	Structure **differ-ent**
7.5-02-04-02.4	P	(Tests in Deformed Ice) Deleted	2017	Deleted						
7.5-02-04-02.5	P	Experimental Uncertainty Analysis for Ship Resistance in Ice Tank Testing	2005	0	√	In various §	in § 8	missing	in § 9	Structure **strongly differ-ent**
7.5-02-04-03	G	Guidelines for Modelling of Complex Ice En-vironments	2021	1	√	In various §	NA	missing	in § 9	Structure **strongly differ-ent**
7.5-02-05		**High Speed Marine Vehicles**								
7.5-02-05-01	P	High Speed Marine Vehicles Resistance Test	2017	3	√	in § 3	in § 5	in § 2	in § 6	Structure **differ-ent**
7.5-02-05-02	P	High Speed Marine Vehicle Propulsion Test	2017	3	√	wrong name	in § 4	in § 3	√	Structure **differ-ent**
7.5-02-05-03.1	P	Waterjet Propulsive Performance Prediction - Propulsion Test and Extrapolation	2011	2	√	√	√	missing	in § 4	Structure **differ-ent**
7.5-02-05-03.2	P	Waterjet System Performance	2017	2	√	√	√	missing	in § 4	Structure **differ-ent**
7.5-02-05-03.3	P	Uncertainty Analysis - Example for Waterjet Propulsion Test	2017	2	√	in § 3	NA	in § 2	in § 4	Structure **differ-ent**
7.5-02-05-04	P	Seakeeping Tests	2021	2	√	wrong name	in § 4	in § 3	√	Structure **differ-ent**
7.5-02-05-04.1	P	Excerpt of ISO 2631, Seasickness and Fatigue	1999	0	√	NA	NA	NA	missing	Structure **strongly differ-ent**
7.5-02-05-05	P	Evaluation and Documentation of HSMV	2014	2	√	√	NA	in § 3	√	Structure **strongly differ-ent**
7.5-02-05-06	P	HSMV Structural Loads	2021	1	√	wrong name	in § 4	in § 3	√	Structure **strongly differ-ent**
7.5-02-05-07	P	(Dynamic Instability Tests) Withdrawn	2021	Deleted						
7.5-02-06		**Manoeuvrability**								
7.5-02-06-01	P	Free Running Model Tests	2021	4	√	√	in § 5 Bench-mark tests	in § 3	in § 5	Structure **differ-ent**
7.5-02-06-02	P	Captive Model Test Procedure	2021	6	√	In various §	in § 5	missing	in § 6	Structure **differ-ent**

Number		Title	Effective Date	Revision	§ 1. PURPOSE	§ 2. DESCRIP-TION	§ 3 VALIDATION	§ 4 PARAM/SYM B	§ 5 REFER-ENCES	§ = paragraph NA=Not Appl.
7.5-02-06-03	P	Validation of Manoeuvring Simulation Models	2021	4	√	In various §	in § 4	missing	√	Structure **different**
7.5-02-06-04	P	Uncertainty Analysis for manoeuvring predictions based on captive manoeuvring tests	2021	3	√	In various §	Example in Appendixes	missing	in § 4	Structure **different**
7.5-02-06-05	G	Uncertainty Analysis for free running model tests	2021	2	wrong name	In various §	wrong name	missing	in § 8	Structure **different**
7.5-02-06-06	G	Benchmark Data for Validation of Manoeuvring Predictions	2021	0	√	In various §	NA	missing	√	Structure **different**
7.5-02-06-07	G	Captive Model Test for Underwater Vehicles	2021	0	√	in § 4	in § 5	in § 2	in § 6	Structure **different**
7.5-02-07		**Loads and Responses**								
7.5-02-07-01		**Environmental Modelling**								
7.5-02-07-01.1	G	Laboratory Modelling of Multidirectional Irregular Wave Spectra	2017	1	√	In various §	NA	in § 3	in § 6	Structure **different**
7.5-02-07-01.2	G	Laboratory Modelling of Waves	2021	1	√	In various §	NA	missing	in § 4	Structure **different**
7.5-02-07-01.3	G	(Guidelines for Modelling of Complex Ice Environments) Moved to 7.5-02-04-03	2021	Deleted						
7.5-02-07-01.4	P	Confidence Intervals for Significant Wave Height and Modal Period	2017	0	√	In various §	NA	missing	in § 4	Structure **different**
7.5-02-07-01.5	G	Laboratory Modelling of Wind	2021	0	√	In various §	NA	missing	√	Structure **different**
7.5-02-07-01.6	G	Laboratory Modelling of Currents	2021	0	√	In various §	NA	missing	in § 6	Structure **different**
7.5-02-07-02		**Seakeeping**								
7.5-02-07-02.1	P	Seakeeping Experiments	2021	7	√	√	in § 4	in § 3	√	Structure **slightly different**
7.5-02-07-02.2	P	Predicting of Power Increase in Irregular Waves from Model Tests	2021	6	√	In various §	in § 7	in § 6	in § 8	Structure **different**
7.5-02-07-02.3	P	Experiments on Rarely Occurring Events	2021	6	√	wrong name	in § 4	in § 3 no symbols	√	Structure **slightly different**
7.5-02-07-02.4	P	(Validation of Seakeeping Computer Codes in the Frequency Domain) Deleted	2014	Deleted						
7.5-02-07-02.5	P	Verification and Validation of Linear and Weakly Nonlinear Seakeeping Computer Codes	2021	3	√	In various §	in § 7 Benchmark tests	missing	in § 8	Structure **different**
7.5-02-07-02.6	P	Global Loads Seakeeping Procedure	2021	2	√	wrong name	in § 4	in § 3	√	Structure **slightly different**
7.5-02-07-02.7	P	Sloshing Model Tests	2021	1	√	wrong name	in § 4	in § 3	√	Structure **slightly different**
7.5-02-07-02.8	P	Calculation of the weather factor f_w for decrease of ship speed in waves	2021	1	√	In various §	in § 7 Benchmark tests	in § 2	in § 8	Structure **strongly different**
7.5-02-07-03		**Ocean Engineering**								

Number		Title	Effective Date	Revision	§ 1. PURPOSE	§ 2. DESCRIP-TION	§ 3 VALIDATION	§ 4 PARAM/SYM B	§ 5 REFER-ENCES	§ = paragraph NA=Not Appl.
7.5-02-07-03.1	P	Floating Offshore Platform Experiments	2021	3	√	wrong name	in § 4	in § 3	√	Structure **slightly different**
7.5-02-07-03.10	G	Guideline for VIV Testing	2021	1	√	in § 5	UA in § 6	in § 3	in § 7	Structure **differ-ent**
7.5-02-07-03.11	G	Guideline for Model Tests of Stationary Multi-Bodies Operating in Close Proximity	2021	1	√	√	UA in § 4	in § 3	√	Structure **slightly different**
7.5-02-07-03.12	G	Uncertainty Analysis for a Wave Energy Con-verter	2021	1	√	in various §	example in § 8	missing	in § 9	Structure **strongly differ-ent**
7.5-02-07-03.13	G	Guideline for VIM Testing	2021	1	√	in § 5	UA in § 6	missing	in § 7	Structure **strongly differ-ent**
7.5-02-07-03.14	P	Analysis Procedure of Model Tests in Irregu-lar Waves	2021	1	√	wrong name	described in §4	in § 3 but varia-bles are not listed	√	Structure **differ-ent**
7.5-02-07-03.15	G	Uncertainty analysis - Example for horizontal axis turbines	2021	1	√	in various §	NA	partly in §5.1 wrong name	in § 6	Structure **differ-ent**
7.5-02-07-03.16	G	Model Construction of Offshore Systems	2021	0	√	in various §	partly described in §6	in § 2.1	in § 8	Structure **differ-ent**
7.5-02-07-03.17	G	Uncertainty Analysis for Model Testing of Offshore Wind Turbines	2021	0	√	in various §	example in §4	missing	√	Structure **differ-ent**
7.5-02-07-03.18	G	Practical guidelines for numerical modelling of wave energy converters	2021	0	√	in various §	in § 6.3	missing	in § 7	Structure **differ-ent**
7.5-02-07-03.2	P	Analysis Procedure for Model Tests in Regu-lar Waves	2021	3	√	wrong name	NA	in § 3	in § 6	Structure **differ-ent**
7.5-02-07-03.3	P	(Model Tests on Tanker-Turret Systems) De-leted	2014	Deleted						
7.5-02-07-03.4	P	(Active Hybrid Model Tests of Floating Off-shore Structures with Mooring Lines) Deleted	2021	Deleted						
7.5-02-07-03.5	P	Passive Hybrid Model Tests of Floating Off-shore Structures with Mooring Lines	2021	3	√	√	in § 4	in § 3	in § 6	Structure **slightly different**
7.5-02-07-03.6	P	Dynamic Positioning System Model Test Ex-periments	2021	2	√	in § 3	UA in § 5	in § 2 no sym-bols	in § 6	Structure **differ-ent**
7.5-02-07-03.7	G	Wave Energy Converter Model Test Experi-ments	2021	2	√	in § 3	UA in § 3.7	missing	in § 4	Structure **differ-ent**
7.5-02-07-03.8	P	Model Tests for Offshore Wind Turbines	2021	2	in § 2	in § 4	UA in § 4.4	missing	√	Structure **strongly differ-ent**
7.5-02-07-03.9	P	Model Tests for Current Turbines	2021	2	√	in § 3	UA in § 3.6	√	√	Structure **slightly different**
7.5-02-07-04		**Stability**								
7.5-02-07-04.1	P	Model Tests on Intact Stability	2008	2	√	in various §	described in §4	missing	missing	Structure **differ-ent**
7.5-02-07-04.2	P	Model Tests on Damage Stability in Waves	2017	3	√	√	described in §4	in § 3 but varia-bles are not listed	√	Structure **slightly different**

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7.5-02-07-04.3	G	Predicting the Occurrence and Magnitude of Parametric Rolling	2021	3	√	in various §	example in Appendix	in § 6	in § 7	Structure **different**
7.5-02-07-04.4	P	Simulation of Capsize Behaviour of Damaged Ships in Irregular Beam Seas	2021	3	√	in various §	in §4	missing	√	Structure **different**
7.5-02-07-04.5	P	Estimation of Roll Damping	2021	1	√	in various §	in §5	in Appendix B	in § 7	Structure **different**
7.5-02-07-04.6	P	Extrapolation for Direct Stability Assessment in Waves	2021	0	√	in various §	embedded in text	in § 5	in § 6	Structure **different**
7.5-02-07-04.7	P	Inclining Tests	2021	0	√	in various §	§4	NA	in § 8	Structure **different**
7.5-03		**CFD**								
7.5-03-01		**General**								
7.5-03-01-01	P	Uncertainty Analysis in CFD, Verification and Validation Methodology and Procedures	2021	4	√	in various §	NA	missing	in § 6	Structure **different**
7.5-03-01-02	G	Quality Assurance in Ship CFD Application	2021	2	√	in § 3	in § 4-5	missing	in § 6	Structure **different**
7.5-03-01-03	P	(CFD User's Guide) Deleted	2021	deleted						
7.5-03-01-04	P	(CFD Verification) Deleted	2021	deleted						
7.5-03-02		**Resistance and Flow**								
7.5-03-02-01	P	Uncertainty Analysis in CFD, Examples for Resistance and Flow	2017	1	√	in various §	in § 2.3 and 2.4	missing	in § 3	Structure **different**
7.5-03-02-02	P	Benchmark Database for CFD Validation for Resistance and Propulsion	2021	2	√	√	NA	missing	in § 3	Structure **different**
7.5-03-02-03	G	Practical Guidelines for Ship CFD Applications	2014	1	different name	in various §	in § 4.2	missing in § 2.3.1,§ 2.3.6	√	Structure **different**
7.5-03-02-04	G	Practical Guidelines for Ship Resistance CFD	2021	1	different name	√	NA	missing	√	Structure **slightly different**
7.5-03-02-05	G	Use of CFD methods to calculate wind resistance coefficient	2021	0	different name	in various §	in § 8	in § 2	in § 9	Structure **strongly different**
7.5-03-03		**Propulsion**								
7.5-03-03-01	G	Practical Guidelines for Ship Self-propulsion CFD	2014	0	different name	in various §	in § 6	missing	in § 7	Structure **strongly different**
7.5-03-03-02	G	Practical Guidelines for RANS Calculation of Nominal Wakes	2014	0	different name	In various §	in § 3.4	missing	in § 4	Structure **strongly different**
7.5-03-04		**Manoeuvrability**								
7.5-03-04-01	G	Guideline on Use of RANS Tools for Manoeuvring Prediction	2021	2	√	√	in § 4 Examples	missing	√	Structure **slightly different**
7.5-03-04-02	G	Validation and Verification of RANS Solutions in the Prediction of Manoeuvring Capabilities	2021	2	√	In various §	in § 5	missing	in § 6	Structure **strongly different**

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7.5-04		**Full Scale Measurements**								
7.5-04-01		**Speed and Power Trials**								
7.5-04-01-01.1	P	Preparation, Conduct and Analysis of Speed/Power Trials	2021	7	√	in various §	NA	in Appendix L	in § 13	Structure **strongly differ-ent**
7.5-04-01-01.2	P	(Analysis of Speed/Power Trial Data) Merged into 7.5-04-01-01.1	2017	deleted						
7.5-04-02		**Manoeuvrability**								
7.5-04-02-01	P	Full Scale Manoeuvring Trials Procedure	2021	3	√	in various §	in § 4, wrong name	in § 3 no sym-bols	√	Structure **differ-ent**
7.5-04-02-02	G	UV Full Scale Manoeuvring Trials	2021	0	√	in various §	in § 4, wrong name	in § 3 no sym-bols	√	Structure **differ-ent**
7.5-04-03		**Ice Testing**								
7.5-04-03-01	IP	Ship Trials in Ice	1999	0	√	in various §	in § 4	in § 3 no sym-bols	missing	Structure **differ-ent**
7.5-04-04		**Hydrodynamic Noise**								
7.5-04-04-01	G	Underwater Noise from Ships, Full Scale Measurements	2021	2	√	in various §	missing	missing	in § 6	Structure **strongly differ-ent**
7.5-04-05		**Model-ship correlation**								
7.5-04-05-01	G	Guideline on the determination of model-ship correlation factors	2021	1	different name	in § 3	NA	in § 2	in § 4	Structure **differ-ent**
7.6-01		**Measuring Equipment**								
7.6-01-01	P	Control of Inspection, Measuring and Test Equipment	1999	0	√	in various §	NA	missing	missing	Structure **strongly differ-ent**

Appendix B. OUTCOME OF THE REVIEW OF UNCERTAINTY ANALYSIS PROCEDURES FOR COMPLIANCE WITH ITTC QUALITY REQUIREMENTS.

No.	Rev	Year	Example	Reference	Symbol	Comment
7.5-01-01-01	4	2017	n	n	n	Expand to include model measurements with uncertainty estimates
7.5-01-02-01						Deleted
7.7-01-02-02	1	2017	n	n	n	Expand to include model measurements with uncertainty estimates
7.5-01-03-01	2	2017	y	y	y	
7.5-01-03-02	0	2008	y	y	y	Update GUM reference
7.5-01-03-03	1	2014	n	n	n	Discusses UA in general terms but has no UA references or examples
7.5-01-03-04	1	2017	n	n	n	Benchmark tests should include UA
7.5-02-01-01	2	2014	y	y	y	Add prediction limit and add 7.5-02-01-07 as reference
7.5-02-01-03	2	2011	y	y	y	
7.5-02-01-04	0	2014	n	n	n	No uncertainty analysis or UA reference. Symbols and nomenclature unique to PIV.
7.5-02-01-06	1	2021	y	y	y	
7.5-02-01-07	1	2021	y	y	y	
7.5-02-01-08	0	2017	y	y	n	UA not applicable. Var and SSA not in the symbols list. Distinction should be made between confidence and prediction intervals.
7.5-02-02-01	5	2021	n	n	y	UA and examples covered in separate procedures. Depth *Fr* should be corrected as Fr_h.
7.5-02-02-02	3	2021	y	y	y	UA for resistance test, but no model test results. Example is separate procedure that has been revised.
7.5-02-02-02.1	1	2021	y	y	y	Revision in review. This procedure was revised and is an example of a resistance test.
7.5-02-02-02.2	1	2021	y	y	y	UA for resistance test, but no model test results. Example as separate procedure has been deleted, and reference should be deleted. Reference list should be updated.
7.5-02-02-04	0	2021	n	y	y	Only has UA references.
7.5-02-03-01.1	6	2021	n	y	y	Only has UA references.
7.5-02-03-01.3	2	2021	n	n	y	
7.5-02-03-01.4	5	2021	n	n	y	On page 8, physical units should be in regular font. Nm should be N·m.
7.5-02-03-01.5	2	2017	n	n	y	No uncertainty analysis or UA reference. Reference list is numerical and should be alphabetical.
7.5-02-03-01.6	1	2017	n	n	y	States UA procedures should be followed. Nm should be N·m.
7.5-02-03-01.7	1	2021	n	n	y	No UA or reference. Nm should be N·m.
7.5-02-03-01.8	0	2021	n	n	y	No UA or reference.
7.5-02-03-02.1	4	2021	n	y	y	Only has UA references. Nm should be N·m.
7.5-02-03-02.3	1	2014	n	n	n	Only generic discussion of UA. Symbols may be unique to LDV and not reviewed in detail.

No.	Rev	Year	Example	Reference	Symbol	Comment
7.5-02-03-02.4	1	2011	n	n	n	Outdated discussion of UA. Pitch and yaw symbols not consistent with ITTC. Procedure should be revised.
7.5-02-03-02.5	1	2017	n	n	n	
7.5-03-01-01	4	2021	n	y	n	Current GUM referenced. V&V consistent with ASME. Symbols consist with ASME. ITTC Symbols not relevant. How to include in ITTC Symbols should be reviewed.
7.5-03-01-02	2	2021	n	n	n	Procedure does not reference the GUM. A section title is Assessment of total uncertainty. Total uncertainty is not in the GUM. The appropriated terminology is combined and expanded uncertainty
7.5-03-02-01	1	2017	y	n	n	Procedure should be updated. Does not reference GUM. Equation numbers start with (33) and should begin with (1). Coleman and Steele (1999) in text is out of date and not in Reference list.
7.5-03-02-03	1	2014	n	n	y	Procedure should be updated. Does not reference GUM. Equation numbers start with (33) and should begin with (1). Coleman and Steele (1999) in text is out of date and not in Reference list.
7.5-03-02-04	1	2021	n	n	y	
7.5-03-02-05	0	2021	n	n	y	
7.5-03-03-01	0	2014	n	n	y	Equation numbers are all (0) and should be renumbered. References should be updated. V&V section is vague and should be updated with information from 7.5-03-03-03.
7.5-03-03-02	0	2014	y	n	y	Procedure has numerical example but no uncertainty analysis. V&V section is general. Reference list should be updated and include 7.5-03-01-01.
7.5-03-04-01	2	2021	y	n	y	Up to date procedure with several examples. No discussion of UA or V&V. ITTC 7.5-03-04-02 is effectively a companion procedure and should be included in the Reference list.
7.5-03-04-02	2	2021	y	y	y	ITTC procedures should be added to Reference list. This procedure is effectively a companion to 7.5-03-04-01 and should be included as a Reference.

Appendix C. OUTCOME OF THE MANUAL OF ITTC RECOMMENDED PROCEDURES AND GUIDELINES MAINTENANCE.

New/ Rev./ Del	Number	P /G	Title	Effec-tive Date
R	4.2.3-01-01	P	Guide for the Preparation of ITTC Recommended Procedures	2024
R	4.2.3-01-03	W	Work Instruction for Formatting ITTC Recommended Procedures	2024
R	7.5-01-01-01	P	Ship Models	2024
R	7.5-02-01-03	G	Fresh Water and Seawater Properties	2024
R	7.5-02-01-04	GC	Guideline on Best Practices for the Applications of PIV/SPIV in Towing Tanks and Cavitation Tunnels	2024
R	7.5-02-01-08	P	Single Significant Amplitude and Confidence Intervals for Stochas-tic Processes	2024
N	7.5-02-01-09	P	Avoiding self-repeating effect in time-domain numerical simulation of ship motion	2024
N	7.5-02-01-10	P	Procedure of Estimation of Frequency of Random Events by Direct Counting	2024
N	7.5-02-01-11	P	Statistical Validation of Extrapolation Methods for Time Domain Numerical Simulation of Ship Motions	2024
R	7.5-02-03-01.8	G	Scaling Method for ship wake fraction with pre-swirl devices	2024
N	7.5-02-03-01.9	G	Guidelines for Predicting the power saving of a wind propulsion ship on a route at design stage	2024
D	7.5-02-03-02.5	G	(Experimental Wake Scaling Methods) - Moved to 7.5-02-03-03.10	2024
R	7.5-02-03-03.1	P	Model-Scale Cavitation Test	2024
R	7.5-02-03-03.2	P	Visual Description and Measurement of Cavitation Events	2024
R	7.5-02-03-03.3	P	Cavitation Induced Pressure Fluctuations Model Scale Experiments	2024
R	7.5-02-03-03.4	P	Cavitation Induced Pressure Fluctuations Numerical Prediction Methods	2024
R	7.5-02-03-03.5	P	Cavitation Induced Erosion on Propellers and Rudders, Model Scale Experiments and Numerical Guidance	2024
R	7.5-02-03-03.6	G	Podded Propulsor Model Scale Cavitation Test	2024
D	7.5-02-03-03.7	P	(Prediction of Cavitation Erosion Damage for Unconventional Rud-ders or Rudders Behind Highly Loaded Propellers) Merged in 7.5-02-03-03.5	2024
R	7.5-02-03-03.8	P	Modelling the Behaviour of Cavitation in Waterjets	2024
R	7.5-02-03-03.9	G	Model-Scale Propeller Cavitation Noise Measurements	2024
R	7.5-02-04-02	P	Test Methods for Model Ice Properties	2024
R	7.5-02-04-02.1	P	Resistance Tests in Ice	2024
R	7.5-02-04-02.3	PC	Manoeuvring Tests in Ice	2024
R	7.5-02-04-03	G	Guidelines for Modelling of Complex Ice Environments	2024
R	7.5-02-05-01	P	High Speed Marine Vehicles Resistance Test	2024
R	7.5-02-05-04	P	HSMV Seakeeping Tests	2024
R	7.5-02-05-04.1	G	Excerpt of ISO 2631-1&3:1985, Seasickness and Fatigue	2024
R	7.5-02-05-05	G	Evaluation and Documentation of HSMV Manoeuvrability	2024
R	7.5-02-05-06	P	HSMV Model Tests for Prediction of Structural Loads	2024
R	7.5-02-06-01	P	Free Running Model Tests	2024
R	7.5-02-06-02	P	Captive Model Test Procedure	2024
R	7.5-02-06-03	P	Validation of Manoeuvring Simulation Models	2024
R	7.5-02-06-04	P	Uncertainty Analysis for manoeuvring predictions based on captive manoeuvring tests	2024
R	7.5-02-06-05	G	Uncertainty Analysis for free running model tests	2024
R	7.5-02-06-06	G	Benchmark Data for Validation of Manoeuvring Predictions	2024
R	7.5-02-06-07	G	Captive Model Test for Underwater Vehicles	2024
R	7.5-02-07-01.4	P	Confidence Intervals for Significant Wave Height and Modal Period	2024

R	7.5-02-07-01.5	G	Laboratory Modelling of Wind	2024
R	7.5-02-07-01.6	G	Laboratory Modelling of Currents	2024
R	7.5-02-07-02.1	P	Seakeeping Experiments	2024
R	7.5-02-07-02.2	P	Predicting of Power Increase in Irregular Waves from Model Tests	2024
R	7.5-02-07-02.3	P	Experiments on Rarely Occurring Events	2024
R	7.5-02-07-02.5	P	Verification and Validation of Linear and Weakly Nonlinear Seakeeping Computer Codes	2024
R	7.5-02-07-02.6	P	Global Loads Seakeeping Procedure	2024
R	7.5-02-07-02.7	P	Sloshing Model Tests	2024
R	7.5-02-07-02.8	P	Calculation of the weather factor f_w for decrease of ship speed in waves	2024
R	7.5-02-07-03.5	P	Passive Hybrid Model Tests of Floating Offshore Structures with Mooring Lines	2024
R	7.5-02-07-03.6	P	Dynamic Positioning System Model Test Experiments	2024
R	7.5-02-07-03.7	G	Wave Energy Converter Model Test Experiments	2024
R	7.5-02-07-03.8	P	Model Tests for Offshore Wind Turbines	2024
R	7.5-02-07-03.9	P	Model Tests for Current Turbines	2024
R	7.5-02-07-03.11	G	Guideline for Model Tests of Stationary Multi-Bodies Operating in Close Proximity	2024
R	7.5-02-07-03.12	G	Uncertainty Analysis for a Wave Energy Converter	2024
R	7.5-02-07-03.15	G	Uncertainty analysis - Example for horizontal axis turbines	2024
R	7.5-02-07-03.16	G	Model Construction of Offshore Systems	2024
R	7.5-02-07-03.17	G	Uncertainty Analysis for Model Testing of Offshore Wind Turbines	2024
R	7.5-02-07-03.18	G	Practical guidelines for numerical modelling of wave energy converters	2024
R	7.5-02-07-04.1	P	Model Tests on Intact Stability	2024
R	7.5-02-07-04.2	P	Model Tests on Damage Stability in Waves	2024
R	7.5-02-07-04.3	G	Predicting the Occurrence and Magnitude of Parametric Rolling	2024
R	7.5-02-07-04.4	P	Simulation of Capsize Behaviour of Damaged Ships in Irregular Beam Seas	2024
R	7.5-02-07-04.5	P	Estimation of Roll Damping	2024
N	7.5-02-07-04.8	P	Computational procedure for instantaneous GZ curve during time-domain numerical simulation in irregular waves	2024
R	7.5-03-01-01	P	Uncertainty Analysis in CFD, Verification and Validation Methodology and Procedures	2024
R	7.5-03-02-01	P	Uncertainty Analysis in CFD, Examples for Resistance and Flow	2024
R	7.5-03-02-02	G	Benchmark Database for CFD Validation for Resistance and Propulsion	2024
R	7.5-03-02-03	G	Practical Guidelines for Ship CFD Applications	2024
R	7.5-03-02-04	G	Practical Guidelines for Ship Resistance CFD	2024
R	7.5-03-02-05	G	Guideline on the CFD-based Determination of Wind Resistance Coefficients	2024
R	7.5-03-03-01	G	Practical Guidelines for Ship Self-propulsion CFD	2024
R	7.5-03-03-02	G	Practical Guidelines for RANS Calculation of Nominal Wakes	2024
R	7.5-03-04-01	G	Guideline on Use of RANS Tools for Manoeuvring Prediction	2024
R	7.5-03-04-02	G	Validation and Verification of RANS Solutions in the Prediction of Manoeuvring Capabilities	2024
R	7.5-04-01-01.1	P	Preparation, Conduct and Analysis of Speed/Power Trials	2024
N	7.5-04-01-02	P	Conduct and Analysis of Sea Trial for Wind Assisted Ships	2024
R	7.5-04-02-01	P	Full Scale Manoeuvring Trials	2024
R	7.5-04-02-02	G	UV Full Scale Manoeuvring Trials	2024
R	7.5-04-03-01	G	Guidelines for Ship Trials in Ice	2024
R	7.5-04-04-01	G	Underwater Noise from Ships, Full Scale Measurements	2024
N	7.6-02-01	W	Verification of Steel Rulers	2024
R	4.2.3-01-01	P	Guide for the Preparation of ITTC Recommended Procedures	2024