Quality Systems group

2017-2021

Chairman : Marco Ferrando
Members : Joel Park, Joel Sena Sales, Art Reed, Daisuke Kitazawa, Weimin Chen, Lanfranco Benedetti (Secretary), Jesus Valle, Gregory Grigoropoulos, Ahmed Derradji-Aouat

Quality Systems Group

Membership and Meetings

Lanfranco Benedetti, CNR-INM (Secretary)
Weimin Chen, SSSRI
Ahmed Derradji-Aouat NRCC
Marco Ferrando, Genova U. (Chair)
Gregory Grigoropoulos NTUA
Daisuke Kitazawa UTokyo
Joel Park, NSWCCD
Art Reed, NSWCCD
Joel Sena Sales Jr., UFRJ
Jesus Valle CEHIPAR

On August 8th 2019, Ahmed Derradji-Aouat Joined the Quality Systems Group

On September 1st 2020, Jesus Valle left the Quality Systems Group

Quality Systems Group

Membership and Meetings

The Group held four meetings as follows:

- September 22nd 2017, Wuxi,
- June 25th to 26th 2018, Madrid
- September 2nd to 3rd 2019, Athens
- February 20th to 21st 2020, Rome

29th QSG Terms of Reference

- The list of QSG Terms of reference comprehends 13 items, which will be addressed specifically in the following slides

Quality Systems Group

1. Update all ITTC Recommended Procedures and Guidelines to conform to the requirements of Recommended Procedure 4.2.3-01-03, Work Instruction for Formatting ITTC Recommended Procedures and Guidelines.

This task was already performed during the 28th ITTC. Its insertion into the 29th QSG ToR is probably due to a “Cut and Paste” problem in drafting 29th ITTC QSG ToR

Quality Systems Group

2. Support the Technical Committees in their work on Recommended Procedures. Supply the chairmen of the new committees with the MS Word versions of the relevant procedures.

A total of 58 MS Word files containing the procedures to be updated, together with the template to be used for drafting new procedures has been sent to the Chairmen of the ITTC Committees.

QSG co-operated with 29th Conference Chairman to produce the template for Committee report to be distributed for the next Conference

Quality Systems Group

3. Maintain the Manual of ITTC Recommended Procedures and Guidelines. Co-ordinate the modification and re-editing of the existing procedures according to the comments made by ITTC member organizations at the Conference and by the Technical Committees.

The revision of the Manual of ITTC Recommended Procedures and Guidelines included 84 documents:

- 9 existing procedures were deleted
- 13 new Procedures/Guidelines have been approved
- 62 existing procedures have been reviewed or updated.
- 125 disclaimers have been inserted in ITTC recommended Procedures and Guidelines as per Executive Committee request
- 82 Recommended Procedures and Guidelines have been updated translating equations from the old MathType format to the MS Word equation editor format.

During the activity connected with this ToR the QSG realized that a number of procedures need further revision; especially when dealing with UA. Some procedures require extensive updates to conform to BIPM (2008) GUM. Some procedures still refer to the ISO GUM.

A proposal for future work has been added to this effect.

Quality Systems Group

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

QSG reviewed the current work of the ISO Technical Committees (TC) and Sub-Committees (SC), and established a list of those Working Groups (WG) which are working on items within the scope of ITTC.

- eleven relevant documents were under preparation by ISO/TC8 (“Ships and marine technology”)
- one by ISO/TC043 (“Acoustics”)
- three by ISO/TC188 (“Small craft”).

There are another 66 ISO/WG working on Uncertainty Analysis on procedures not directly associated with ITTC scope of interest.

Quality Systems Group

5. Update the ITTC Symbols and Terminology List.

As regards the Symbols & Terminology List QSG decided to start a systematic check to be sure that symbols used in the standing procedures are contained in the S&T List.

A total of 70 documents have been checked. The result of the check has been disappointing, since many documents make use of symbols not included into the Symbols and Terminology list or of incorrect symbols with respect to those included in the List.
Changes made to the Symbols & Terminology List are as follows:

- The definition of C_{DA} has been updated following an AC suggestion.
- $H_{w1/3}$, $H_{w1/3d}$, $H_{w1/3u}$ need to be checked against the procedures and eventually deleted as non-necessary symbols. The new symbols will be: $H_{w1/3}$, $H_{1/3w}$ (for waves) and $H_{1/3s}$ (swells), in procedure 7.5-04-01-01.1.
- The left-hand coordinate axes system has been removed from the Symbols and Terminology List.
- Several other symbols have been added, including: Linear momentum (P) and Angular momentum (L).
- A number of new symbols have been added according to a Resistance and Propulsion Committee proposal.

Quality Systems Group

6. Update the ITTC Dictionary of Hydromechanics.

A new section has been developed and added to the ITTC Dictionary of Hydrodynamics, it is: Offshore Engineering. This initial version of the new section has focused on offshore oil and gas production, all from the perspective of hydrodynamics — those platforms, vessels and components for which model testing and/or performance related calculations would be performed. Those components for which no hydrodynamic issues or requirements would be expected (e.g., blowout preventers) are not included, which is not to say that these components are not critical parts of the entire system.

The contributions to the new section end with specific components involved in offshore platforms and some of the performance issues that they may experience. The particular components included are: Risers, Helical Strakes, Bottom Templates or Guides, and Mooring systems. The particular issues particular to offshore platforms are Vortex induced vibration (VIV) and Vortex Induced motion (VIM).

Quality Systems Group

7. Revise and update the existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference. 1/9

The QSG updated 8 documents:

Number	P / G	Title
4.2.3-01-01	P	Guide for the Preparation of ITTC Recommended Procedures
4.2.3-01-03	W	Work Instruction for formatting ITTC Recommended Procedures and Guidelines
7.5-02-01-06	P	Determination of a type A uncertainty estimate of a mean value from a single time series measurement
7.5-02-01-07	G	Guideline to Practical Implementation of Uncertainty Analysis
7.5-02-02-02	G	General Guideline for Uncertainty Analysis in Resistance Tests
7.5-02-02-02.1	G	Example for Uncertainty Analysis of Resistance Tests in Towing Tanks
7.6-02-08	W	Calibration of Weights
7.6-02-09	W	Calibration of Load Cells

7. Revise and update the existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference. 2/9

The review process involved the following11 documents:

4.2.3-01-01 Guide for the Preparation of ITTC Recommended Procedures: this procedure did not contain a reference section and consequently has been updated.

4.2.3-01-03 Work Instruction for formatting ITTC Recommended Procedures and Guidelines: this work instruction has been updated to correct minor errors and inconsistencies.

7.5-02-01-06 Determination of a type A uncertainty estimate of a mean value from a single time series measurement: the first version of the document only included the equations for analog computations and the purposes of this revision was to include the equations for digital data processing. Martin van Rijsbergen, one of the original authors agreed to participate to the revision process. This procedure has been updated and includes the most recent recommendations of the Manoeuvring Committee.

Quality Systems Group

7. Revise and update the existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference. 3/9

7.5-02-01-07 Guideline to Practical Implementation of Uncertainty Analysis: Equations (9) and (12) have been corrected; data were corrected in tables; a Central finite difference form was added as Equation (4); the Reference list has been updated

7.5-02-02-02 General Guideline for Uncertainty Analysis in Resistance Tests: this guideline has been reviewed for consistency with guideline 7.5-02-02-02.1 and updated.
Significant revisions have been made, and some editorial changes by the Resistance and Propulsion Committee were included. The following sections were added:

- Outlier and non-linear detection methods
- Force computation from mass loading for dynamometers in a calibration fixture
- Distinction between methods for confidence limits and prediction limits with relevant equations
- A running sinkage and trim section was added
- List of symbols was added

7. Revise and update the existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference. 4/9

7.5-02-02-02.1 Example for Uncertainty Analysis of Resistance Tests in Towing Tanks: The guideline has been reviewed for consistency with guideline 7.5-02-02-02 and updated. The main changes are as follows:

- Force reported in Newton (N) rather than kilogram force (kgf)
- Uncertainty estimates in expanded uncertainty, U, rather than standard uncertainty, u.
- Sinkage and trim data processing equations with uncertainty analysis
- Equations for confidence limits and prediction limits
- List of symbols
- Reference list updated

For repeat tests, a distinction is made between confidence limit and prediction limit. An uncertainty estimate for a series of tests is computed from the standard deviation of the mean value. The uncertainty estimate for total resistance, RT, is from the 95 % confidence limit

$$U_{\bar{R}_T} = k\, s_{R_T}/\sqrt{N}$$

where *k* is the coverage factor, *s* the computed standard deviation of *N* samples. For a small number of samples, the coverage factor *k* can be the Student-t distribution $t_{0.025,\ N-1}$ at the 95 % confidence level

7. Revise and update the existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference. 5/9

However, if the uncertainty is applied to some future event such as an uncertainty estimate for a single sample from a previous estimate of the standard deviation or estimate at full-scale from model-scale, then the uncertainty from the prediction limit is

$$U = ks\sqrt{1 + 1/N}$$

or for a large number of samples at the 95 % prediction limit $U = 2s$.

7.5-02-05-05 Evaluation and Documentation of HSMV: this procedure was updated regarding symbols usage. The revision number remains 02 and the date of approval 2014.

7.5-02-06-04 Uncertainty Analysis for Manoeuvring Predictions based on Captive Manoeuvring Tests: this procedure has been reviewed by QSG as regards format issues. The updated document has been forwarded to the Manoeuvring Committee for further review.

7. Revise and update the existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference. 6/9

7.5-02-06-05 Uncertainty Analysis for Free Running Model Tests: this procedure has been reviewed and updated by QSG as regards format issues. The updated document has been forwarded to the Maneuvering Committee for further review.

7.6-02-01 Calibration of a Steel Ruler: After a long discussion QSG reconsidered its proposal to review the document. Considering that UA procedures prescribe traceability to a National Metrology Laboratory, internal calibration of steel rulers cannot be used anymore.
To this effect, QSG proposed to delete the document.
That proposal has been rejected by the AC, which asked QSG to prepare a procedure on the internal calibration of steel rulers or a practical way to check length measurement devices in towing tanks.
QSG did not manage to produce this document on time and this task has been inserted into the Recommendations for Future Work

7.6-02-08 Calibration of Weights: This working instruction has been updated with modifications for consistency with other documents. The minimum tolerance for weights was changed to OIML Class M_2.

7. Revise and update the existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference. 7/9

7.6-02-09 Calibration of Load Cells: This working instruction has been greatly simplified. A calibration example is included that compares random to sequential loading of weights on a calibration stand. The following equation is included for the conversion of mass in kg to force in N.

$$F = mg(1 - \rho_A/\rho_M)$$

where *m* is the mass in kg, *g* is local acceleration of gravity in m/s^2, ρ_A is air density, and ρ_M is the density of the weight in kg/m^3. The nominal values for the preceding equation are as follows:

g	9.80665 m/s^2 for standard gravity
ρ_A	1.2 kg/m^3
ρ_M	8000 kg/m^3

Local gravity is typically less than standard gravity. The last term in the preceding equation is an air buoyancy correction from Archimedes principle and is typically 0.017 %.

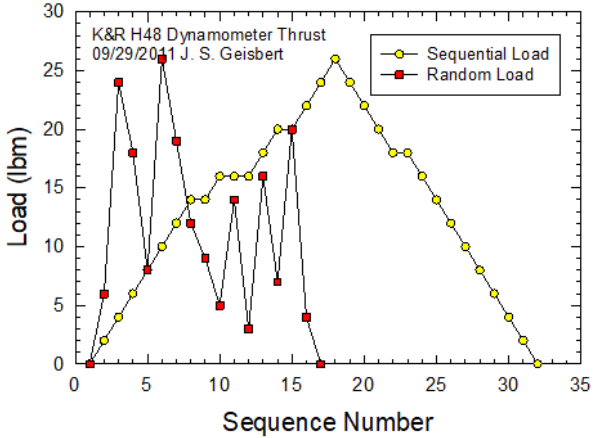
7. Revise and update the existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference. 8/9

The mass in the preceding equation is the sum of the weights added to the calibration stand.

$$m = \sum_{i=1}^{n} m_i$$

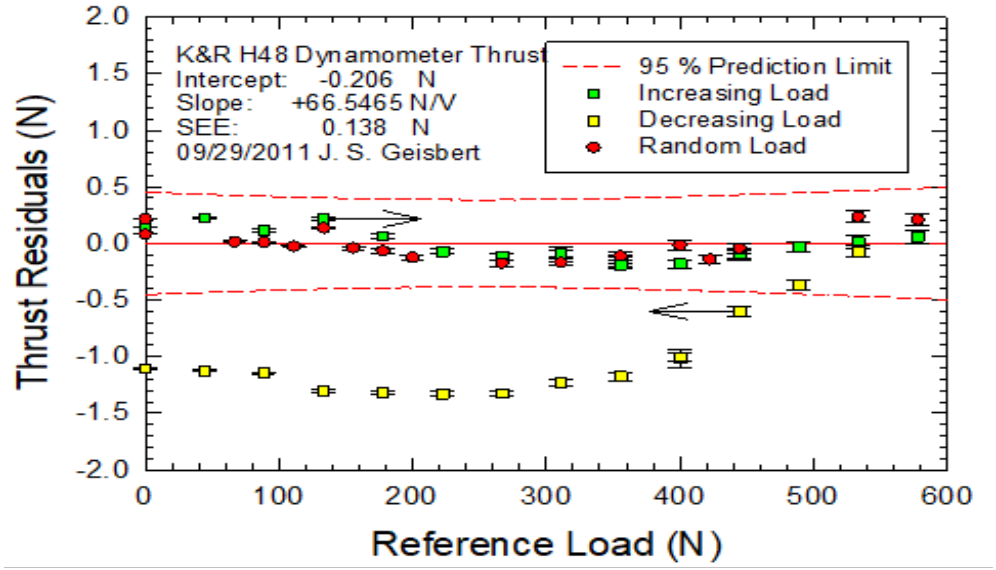
If the tolerance of the weights is applied as the uncertainty estimate, the uncertainty is the tolerance of the total mass, *m*.

The procedure also includes an example for the comparison of sequential loading to random loading. An example of the loading is given in the figure where the sequential loading and the random loading sequences are illustrated



7. Revise and update the existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference. 9/9

The calibration result is presented in the following figure as a residual plot. By a hypothesis test, the calibration constants are statistically the same for the two methods, but the uncertainty is significantly less by the random method.



Quality Systems Group

8. After the third AC Meeting, review and edit new ITTC Recommended Procedures with regard to formal Quality System requirements including format and compliance of the symbols with the ITTC Symbols and Terminology List.

The QSG review process examined 56 existing and 13 new procedures adding to a total of 69 documents.

The document 0.0 Register has been updated accordingly.

A template in word format has been prepared for writing new procedures during the next ITTC period. To prepare a new procedure, an author will open the new file with the following template: ProcTemplate.dotx.

The file will be available on the ITTC Web site.

Quality Systems Group

9. Support the Technical Committees with guidance on development, revision and update of uncertainty analysis procedures.

QSG liaised with **Stability in Waves Committee** on:

- ❑ the revision of procedures:
  - 7.5-02-07-04.3 - Predicting the Occurrence and Magnitude of Parametric Rolling
  - 7.5-02-07-04.4 - Simulation of Capsize Behavior of Damaged Ships in Irregular Beam Seas
  - 7.5-02-07-04.5 - Estimation of Roll Damping
- ❑ their proposed change of formulation in ITTC Procedure 7.5-03-02-03 - Practical Guidelines for ship CFD application
- ❑ the development of new ITTC Procedures:
  - 7.5-02-07-04.7 - Inclining Tests
  - 7.5-02-07-04.6 - Extrapolation for direct assessment stability in waves

Maneuvering Committee supplied a revised version of procedure 7.5-02-01-06 for QSG check

QSG assisted the **Ocean Engineering Committee** on the uncertainty analysis of a benchmark test.

Quality Systems Group

10. Observe ISO standards for uncertainty analysis, in particular the uncertainty analysis terminology.
11. Review developments in metrology theory and uncertainty analysis and issue appropriate Procedures.

BIPM New Standard for SI Units

- *Metrologia* — BIPM journal published by IOP Science
- The International System of Units (SI), 20 May 2019, 9th Edition
  - the unperturbed ground state hyperfine transition frequency of the caesium 133 atom ΔvCs is 9 192 631 770 Hz (s^{-1}),
  - the speed of light in vacuum c is 299 792 458 m/s,
  - the Planck constant h is 6.626 070 15 × 10^{-34} J s (kg m^2 s^{-1}),
  - the elementary charge e is 1.602 176 634 × 10−19 C (A s),
  - the Boltzmann constant k is 1.380 649 × 10−23 J/K (kg m^2 s^{-1} K^{-1}),
  - the Avogadro constant NA is 6.022 140 76 × 1023 mol^{-1},
  - the luminous efficacy of monochromatic radiation of frequency 540 × 1012 Hz, Kcd, is 683 lm/W,

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New SI Unit Definitions

- Second, s

$$1\ \text{s} = 9\ 192\ 631\ 770/\Delta\upsilon_{Cs}$$

- Metre, m

$$1\ \text{m} = (c/299\ 792\ 458)\text{s}$$

- Kilogram, kg

$$1\ \text{kg} = (h/6.\ 070\ 15\times10^{-34})\ \text{m}^{-2}\ \text{s}$$

Quality Systems Group

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11. Review developments in metrology theory and uncertainty analysis and issue appropriate Procedures.

BIPM Joint Committee on Guides in Metrology 1/3

- JCGM Working Group on the Expression of Uncertainty in Measurement (GUM) – WG1
  - JCGM 100:2008. Guide to the expression of uncertainty in measurement, GUM 1995, with minor modifications
  - JCGM 101:2008. Evaluation of measurement data — Supplement 1 to the “Guide to the expression of uncertainty in measurement” — Propagation of distributions using a Monte Carlo method
  - JCGM 102:2011. Evaluation of measurement data — Supplement 2 to the “Guide to the expression of uncertainty in measurement” — Extension to any number of output quantities
  - JCGM 104:2009. Evaluation of measurement data — An introduction to the “Guide to the expression of uncertainty in measurement” and related documents

Quality Systems Group

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BIPM Joint Committee on Guides in Metrology 2/3

- JCGM Working Group on the Expression of Uncertainty in Measurement (GUM), continued
  - JCGM 106:2012. Evaluation of measurement data — The role of measurement uncertainty in conformity assessment
  - Documents in preparation
    - JCGM 100 – Guide to uncertainty in measurement. Draft revision rejected in 2014. Focus on co-existing documents.
    - JCGM 103 – Evaluation of measurement data — Supplement 3 to the “Guide to the expression of uncertainty in measurement” — Developing and using measurement models. First draft available.
    - JCGM 105 – Evaluation of measurement data — Concepts, principles and methods for the evaluation of measurement uncertainty
    - Guide to the expression of uncertainty in measurement — Introduction

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BIPM Joint Committee on Guides in Metrology 3/3

- JCGM Working Group on the Expression of Uncertainty in Measurement (GUM), continued
  - Future documents
    - JCGM 107 – Evaluation of measurement data — Applications of the least-squares method
    - JCGM 108 – Evaluation of measurement data — Supplement 4 to the “Guide to the expression of uncertainty in measurement” – Bayesian methods.
    - JCGM 109 – Statistical Models and Data Analysis for Inter-Laboratory Studies.
    - JCGM 110 – Examples of uncertainty evaluation.
- JCGM Working Group on the International Vocabulary of Metrology (VIM) – WG2
  - JCGM 200:2012 (JCGM 200:2008 with minor corrections) (VIM3)
  - VIM4 First draft end of 2019
- WG1 and WG2 Meetings – Two per Year
- Bureau International des Poids Mesures (BIPM), Sèvres, France
  - Web page: http://www.bipm.org/en/committees/jc/jcgm/

Quality Systems Group

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American Society of Mechanical Engineers

- Verification and Validation Symposium
  - ASME V&V 2012 Symposium, first annual symposium
  - ASME V&V 2021 Symposium, 19–20 May 2021, Virtual Conference
    - Web page: https://event.asme.org/VandV
- ASME *Journal of Verification, Validation, and Uncertainty Quantification*
  - First issue March 2016, published quarterly
  - Editor, Christopher J. Freitas, Southwest Research Institute
- ASME Standards
  - Test Uncertainty, PTC 19.1-2018
  - Standard for Verification and Validation in Computational Fluid Dynamics and Heat Transfer, V&V 20-2009

Quality Systems Group

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11. Review developments in metrology theory and uncertainty analysis and issue appropriate Procedures.

Local Acceleration of Gravity

- Requirements for local g and its uncertainty
  - Froude Number
  - Force transducer calibration by mass
- Computation of elevation from address
  - Web page https://elevation.maplogs.com/
- Gravity computation by latitude, longitude, and elevation
  - Physikalisch Technische Bundesanstalt (PTB) international web page deleted https://www.ptb.de/cms/en/ptb/fachabteilungen/abt1/fb-11/fb-11-sis.html
  - Bundesamt für Kartographie und Geodäsie (BKG) web page Germany only http://gibs.bkg.bund.de/geoid/gscomp.php?p=s
  - Bureau Gravimétrique International (BGI) web page international http://bgi.obs-mip.fr/data-products/outils/prediction-of-gravity-value/
  - National Geodetic Survey (NGS) web page USA only https://geodesy.noaa.gov/cgi-bin/grav_pdx.prl
- Example calculations on following slide

$$Fr = V/\sqrt{gL}$$

$$F = mg(1 - \rho_A/\rho_M)$$

Quality Systems Group

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Examples for Local Acceleration of Gravity

ITTC Laboratory	Elevation (m)	Acceleration of Gravity, g (m/s²)			
		BGI	BKG	NGS	PTB
AMC, Newnham, Tasmania, Australia	21.0	9.80282			
CSSRC, Wuxi, China	5.0				9.79439
HSVA, Hamburg, Germany	13.0	9.81378	9.80378		
CNR-INM, Rome, Italy	55.0	9.80347			
NSWCCD, Bethesda, Maryland, USA	41.2 40.0	9.80112		9.80108	9.80106

Quality Systems Group

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11. Review developments in metrology theory and uncertainty analysis and issue appropriate Procedures.

Uncertainty Analysis Calculators

- National Physical Laboratory (NPL)
  - MATLAB programs
  - Web page: https://www.npl.co.uk/resources/software/measurement-uncertainty-evaluation
- National Institute of Standards and Technology (NIST)
  - NIST Uncertainty Machine, On-Line GUM Uncertainty Calculator
  - Web page: https://uncertainty.nist.gov/
  - Features
    - Multiple PDF (16): Table 2, p. 14, Larfarge & Possolo (2018)
    - Monte-Carlo
- Reference: Larfarge, Thomas, and Possolo, Antonio, 2018, “NIST Uncertainty Machine — User’s Manual,” National Institute of Standards and Science (NIST), Gaithersburg, MD USA.

Quality Systems Group

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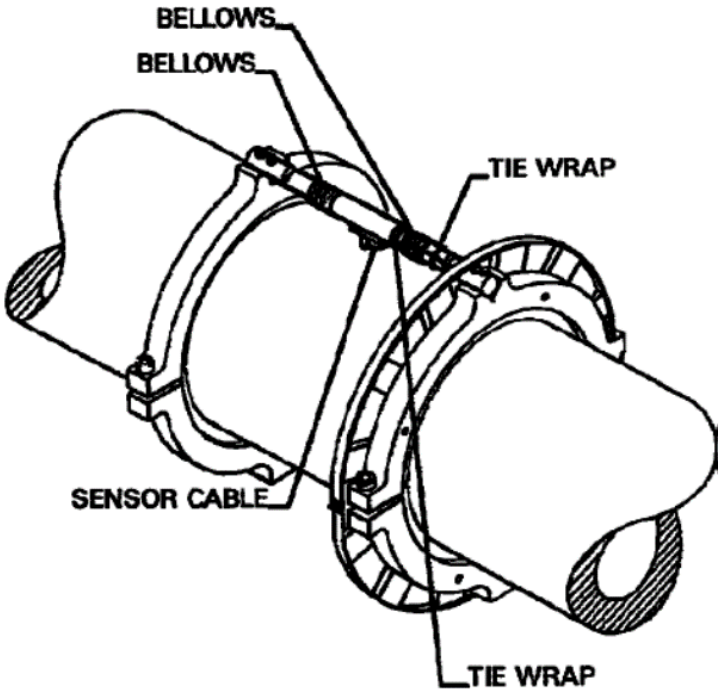
Future Work

- Develop new procedure on torsionmeter calibration with uncertainty from 27th QSG final report
  - Q=δGJ/(RL)
  - δ Displacement
  - G Modulus of rigidity
  - J Polar moment of inertia
  - R Radial distance to displacement sensor
  - L Distance between rings
- Update ITTC procedures with GUM from JCGM (2008)



10. Observe ISO standards for uncertainty analysis, in particular the uncertainty analysis terminology.
11. Review developments in metrology theory and uncertainty analysis and issue appropriate Procedures.

Final note

The QSG observes that the **ITTC focuses on uncertainty, while neglecting the incorporation of confidence bands in the results from committees dealing with stochastic processes**.

The size of the confidence bands will in general be significantly larger than the uncertainty bounds.

Half or more (if the Maneuvering Committee is dealing with maneuvering in waves) of the General Committees are working with stochastic processes.

Quality Systems Group

12. Continue to maintain the online Wiki keeping it up to date and in line with the adopted documents of the ITTC.

In ITTC (2011), when the ITTC-wiki was established, some positive feedback visits and returning visitors were counted, as time has passed, the level of feedback has been continuously decreasing.

The thrust of the wiki tool has been to build, refine and review concepts and notions around the definitions contained in the Dictionary of Hydromechanics through collective knowledge.

However, because the content of the Dictionary of Hydromechanics is endorsed by the Conference such interactions and modification of the wiki tool were quite limited, defeating the wiki approach.

Furthermore, the Wiki server was down for various technical problems during most of the period between the two ITTC conferences.

In view of the abovementioned considerations **it is proposed to discontinue the wiki tool** and to maintain the Dictionary updated, maintained and furtherly expanded as necessary; and freely available for download on the ITTC website.

Quality Systems Group

13. At the beginning of the period, organize an electronic repository of information and data on the benchmarks cases. ITTC member organizations should then be invited to participate in the adoption of the benchmark and contribute to the data-base.

- The ITTC web page now contains a link to the Benchmark repository.
- The data structure to host data pertaining to benchmarks was defined during the 26th ITTC

The work of 29th QSG has been to review the benchmarks and their data as much as possible. After discussing with relative technical committee members and ITTC community, frequently used benchmarks were identified.

As the survey has only engaged with a small part of ITTC community, and information has been collected from several conference websites, QSG would like to develop a more comprehensive picture.

Therefore, QSG would like to setup a questionnaire for all of the ITTC committees at the start of the next term to obtain the definition, objective, data format and other information of the various benchmarks.

Many of the technical committees are engaged in collecting benchmarks. Therefore, an inter-committee liaison mechanism shall be established to communicate the demands and application of benchmarks, as well as the data sources. The QSG shall be involved in this organization, and will establish a standard format for the use of all the ITTC committees and community.

Quality Systems Group

The QSG recommends the Full Conference:

- 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
  - 7.5-02-01-06 – Determination of a type A uncertainty estimate of a mean value from a single time series measurement
  - 7.5-02-01-07 – Guideline to Practical Implementation of Uncertainty Analysis
  - 7.5-02-02-02 – General Guidelines for Uncertainty Analysis in Resistance Tests
  - 7.5-02-02-02.1 – Example for Uncertainty Analysis of Resistance Tests in Towing Tanks
  - 7.6-02-08 – Calibration of Weights
  - 7.6-02-09 – Calibration of Load Cells
- Adopt the revised Symbols and Terminology List Version 2021;
- Adopt the revised ITTC Dictionary of Hydromechanics Version 2021.

Quality Systems Group

The following future work is recommended

1. Support the Technical Committees in their work on Recommended Procedures. Supply the chairmen of the new committees with the MS Word versions of the relevant procedures.
2. Maintain the Manual of ITTC Recommended Procedures and Guidelines. Co-ordinate the modification and re-editing of the existing procedures according to the comments made by ITTC member organizations at the Conference and by the Technical Committees.
3. After the third AC Meeting, review and edit new ITTC Recommended Procedures and Guidelines with regard to formal Quality System requirements including format and compliance of the symbols with the ITTC Symbols and Terminology List.
4. Revise and update existing ITTC Recommended Procedures according to the comments of Advisory Council, Technical Committees and the Conference.
5. Observe the development or revision of ISO Standards regarding Quality Control.
6. Update the ITTC Symbols and Terminology List.

Quality Systems Group

The following future work is recommended (Cont'd)

7. Update the ITTC Dictionary of Hydromechanics.
8. Expand the content of current ITTC dictionary version, considering CFD, MASS, etc.
9. Support the Technical Committees with guidance on development, revision and update of uncertainty analysis procedures.
10. 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.
11. Observe BIPM/JCGM standards for uncertainty analysis, in particular the uncertainty analysis terminology.
12. Introduce New Uncertainty Analyses Guidelines to include data anomalies in Machine Learning Algorithms for Autonomous and Intelligent ships.
13. Review developments in metrology theory and uncertainty analysis and issue appropriate Procedures.

Quality Systems Group

The following future work is recommended (Cont'd)

14. Update the Uncertainty Analysis section of the Symbols & Terminology List.
15. Setup an effective way to collect benchmark data.
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. Upload all the collected and verified benchmark data into the ITTC benchmark data repository
19. Prepare a procedure on the internal calibration of steel rulers or a practical way to check length measurement devices in towing tanks.
20. Update ITTC procedures and Guidelines still referring to the ISO GUM to conform to BIPM (2008) GUM

The 29th ITTC Quality Systems Group

Thanks You for Your Kind Attention

Stay Safe, Stay Healthy, Stay Sane