Quality Control Group

Committee Chair: Dr. E. Baba
Session Chair: Prof. C-M. Lee

I DISCUSSIONS

On the Recommendation to the Conference

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I highly appreciate that the Quality Control Group (QCG) has made extensive efforts to develop common understandings for the role of the ITTC to support member organizations relating to the ISO 9000 certification.

As stated in the Report, the ISO 9000 family may most likely be the one to manage the quality control in tankery business, for which discussions have keenly been made in the ITTC during the last several years. Therefore it may greatly be beneficial for member organizations that the ITTC has developed and shown relevant procedures and codes of practice.

I basically support the above mentioned activities in the ITTC. However, most of member organizations may not ask the ITTC to develop standard procedures which should conform to ISO 9000 certification. Furthermore the ITTC should not impose member organizations to use those procedures and codes of practice as guides for quality management. This is because the role of ITTC with respect to the quality control should be to support member organizations by providing those materials of the QCG activities so that member organizations can maintain the credibility with regard to quality assurance of their products and services, as stated in the Rules of Organization of the 21st ITTC. The decision how to use those materials should be entrusted to each member organization taking the aspects of cost performance and time efficiency etc. into consideration.

In this context, I would like to make comments on the following two points.

(1) The last phrase of the first statement of the QCG Recommendations to the conference "xxx by use of the ISO 9000 as a guide for quality management." should be replaced by "xxx with the reference to procedures and codes of practice provided by relevant technical committees.".

(2) In the procedures and codes of practices provided in the Technical Committee Report, there may be found some descriptions which may practically be impossible or which may be applicable to only limited extent. It is requested that the QCG of the 22nd ITTC should check these points and make an effort to improve them.

Quality Assurance System In The Ship Hydromechanics Division Of The Ship Design And Research Centre

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Introduction of the QA System into the Ship Hydromechanics Division

The introduction process of the quality assurance system in the Ship Hydromechanics Division began at the end of 1990. It was assumed that this quality assurance system should be based on the following internationally recognised set of standards:

- European Standard CEN/CENTELEC No EN 45001: General Criteria for the Operation of Testing Laboratories
- Guide ISO/IEC No 25:1990: General

Requirements for the Technical Competency of Testing Laboratories.

Requirements of the both above mentioned documents are based on:

- ISO 9000: Quality Management and Quality Assurance Standards -Guidelines for Selection and Use,
- ISO 9002 : Quality Systems - Model for Quality Assurance in Final Inspection and Test.

The introduction process of this system was connected with many actions of different kinds, among which the most important were :

- appointment of the working group to elaborate the QA System,
- intensive training of the staff,
- elaboration of the system principles,
- introduction of some organisational changes, particularly appointment of new posts, e.g. senior officer of quality system and engineering manager of the Division responsible for measuring and tests equipment,
- completion of the tests and measuring equipment,
- preparation of necessary documents (Quality Manual, general procedures, research procedures and instructions).

Implementation of the system proceeded as follows)with some breaks):

Nov. 1990 - Oct. 1992 : appointment of the working group, elaboration of the system and its preliminary implementation
Oct. 1992: preliminary external audit
Oct. 1992-Jun. 1994: corrective actions
Jun. 1994: final audit
Nov. 1994: accreditation.

On Nov. the 5th 1994 the Ship Hydromechanics Division received the Certificate of Testing Laboratory Accreditation No L 15/1/944 issued by the Polish Centre for Testing and Certification. Thus an independent institution has acknowledged the Division competence for performance of the following, exactly defined, model tests:

- hull resistance of displacement ships in calm water,
- propulsion of displacement ships in calm water,
- nominal wake of displacement ships,
- streamline of displacement ships,
- hydrodynamic characteristics of ship propellers or ship propellers in nozzles.

All activity of the Division is controled by the QA System, but only the above mentioned model tests are within the scope of acreditation.

2. Description of the QA System

According to the requirements of the above mentioned standards the following documents have been prepared:

- Quality Manual,
- eleven general procedures,
- six research procedures,
- 24 research instructions as well as standard forms etc.

The main chapters of Quality Manual contain presentation of the following problems:

- Quality Policy,
- general description of the Ship Hydromechanics Division,
- presentation of Quality Manual,
- quality assurance system,
- staff,
- accommodations and environment of the Division,
- measuring and test equipment,
- research methods and procedures,
- co-operation with the customer,
- protection of research confidentiality and rights of property,
- proceeding with research objects,
- sub-contracting,
- research documentation,
- claims,
- quality system documentation and records,
- co-operation in improving the quality system.

The Quality Manual includes also:

- organisation scheme,
- list of staff,
- detailed scope of duties, rights and responsibilities of the management,
- samples of standard forms.

The general procedures describe:

- Order Review and Order Execution ,
- Securing the Personnel Qualifications,
- Proceeding with Research Equipment,
- Internal Audit,.
- Creation and Application of Procedures and Instructions,

Documentation and Filing the Tests,
- Co-operation with Subcontractor,
- Proceeding Concerning Customer's Claims,
- Proceeding with Standardisation Documents,
- Quality System Review,
- Assessment and Documentation of Research Capacity of the Division.

The research procedures present the principles of proceeding in testing and measuring work including the parts of organisational and technical process. The testing and measuring instructions are documents dealing with the appropriate research procedures and determining in detailes all operations connected with the preparation and conduction of typical model tests. ITTC recommendation are referred to in the research procedures and instructions.

The research documents are subdivided into the following categories:

- research reports including only bare results of model tests,
- technical reports including predictions for the ship, assessment of the results and comments for the customer.

When a technical report contains verification of design elaborated by the Division, a special statement informs that this verification involved personnel other than those responsible for the design under consideration.

The action documenting the research capacity of the Division concerns such particular topics as:

- repeatability tests with use of master hull model and master propeller models (the master hull is used occasionally for the resistance and propulsion tests several times a year, the master propeller is tested before each open water test of the new designed propeller),
  reproducibility tests by using the results of the comparative model tests carried out in foreign model tanks.

The QA System is based on the following principles:

1. The Division accepts the ordered services, particularly model tests, covered by accreditation scheme, on the basis of agreements with the customer.
2. The Division executes the services, according to recognised procedure or the procedure agreed with the customer (if there is no recognised procedure).
3. The Division will not accept the service, particularly the research work, unless it can be made in accordance with the requirements of Quality Assurance System and will not take any action which could deceive the trust in independent and honest research.
4. The Division guarantees that the service, particularly the model tests, will be executed by properly qualified personnel. The employees of Ship Hydromechanics Division when executing the service are independent from any pressures, including commercial and financial considerations, which could affect the results of their work.
5. The Division uses for its research work only reliable and documented testing and measuring equipment ensuring the necessary accuracy.
6. The Division guarantees the system of permanent quality inspection with multilevel supervision including:
   internal quality inspection concerning the specific service (research or measurements) as well as the inspection of components necessary for execution of this service (methods, personnel, testing equipment)
   external quality inspection including the inter-laboratory tests.
7. The Division carries out the documentation and filing of model tests and their results in the way ensuring the full possibility of its identification, confidentiality and exclusive rights of property according to requirements and conditions specified by the customer.
8. If, with approval of the customer, a part of tests has to be made in other research laboratory, the Division guarantees the honest results of tests made by the sub-contractor.
9. In the case of a claim or complaint by the customer, the Division proceeds according to principles formulated respectively in the appropriate documents.
10. In order to secure the correctnes and effectivenes of the System, i.e. for maintenance of proper standard of

research quality, the management of Ship Design and Research Centre, as well as the Head of Division carry out regular and - if needed - special audits and reviews; if necessary - they order proper corrective actions.

3. Advantages from the QA System

The Quality Assurance System ensures:

- improvement of the standard of organisation, particularly establishing the clear domain of duties and responsibilities of all members of staff,
- improvement of qualifications and efficiency of employees,
- better exploitation of the research equipment,
- improvement of the research quality and co-operation with the customer,
- reduction in rework and duplication of work.

4. Plans for the Future

The Division carries on works at extending the accreditation on other type of model test, in particular: propeller cavitation tests, seakeeping and manoeuvring tests of displacement ships as well as resistance and propulsion tests of HSMV in calm water. It is also intended to certify the QA System by two independent institutions, i.e. apart from a Polish institution also by a foreign one.

5. Expectations Addressed to ITTC

Ship Design & Research Centre is of the opinion that the Technical Committees and Groups of the 22nd ITTC should intensively continue their efforts to help members organisation practise quality control in their everyday operations.

a) The ITTC could collect and update the existing recommended procedures and quidelines as well as could elaborate - if needed - new recommended procedures concerning:

- typical model test supporting ship design process,
- recalculation of tests results from model to ship,
- numerical predictions of hydrodynamic qualities of ship as a part of CADsystem.

These procedures should be published by the QSG as official ITTC documents.

b) The ITTC could elaborate recommended procedures concerning uncertainty analyses of numerical methods, model tests and full-scale trials in accordance with the ISO „Guide to the expression of uncertainty in measurement" issued in 1993. If so, „Guidelines for uncertainty analysis in measurement" issued on 19th ITTC by the Panel of Validation Procedures should be updated and republished.

c) The ITTC could initiate the inter-laboratory comparative tests, than could collect and publish their results as the bench-mark data; this should be done both for experiments and calculations.

d) The ITTC could also initiate the exchange of experiences between members organisations possessing certified quality assurance systems; and international workshop devoted to QA Systems in towing tanks would be highly appreciated.

Uncertainty Analysis In Towing Tank Practice

by D. Garofallidis, G. Tzabiras, T. Loukakis and G. Grigoropoulos
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This contribution presents the conclusions in the area of Experimental Uncertainty that have been drawn from the work conducted during the last five years at the Laboratory for Ship and Marine Hydrodynamics of the National Technical University of Athens (N.T.U.A.).

An extensive set of measurements was obtained at N.T.U.A., to serve as a database for CFD validation purposes and to assist the development of a new method for the extrapolation of total resistance values from the model to the ship scale. The measurements were performed on a L_{PP} = 3.048 metres Series 60, c_B = 0.60 model [1] and included :

- Total resistance, running trim and sinkage.
- Wave surface around the model.
- Flow field values at the bow and stern area.
- Pressure fields on the hull.

The database should be considered as complementary to other data sets [2]. It should be noted that some of the measurements were taken with very high resolution. However, the innovation in the work (which was part of a Ph.D Thesis [3]) is the effort to ascertain in detail the measurement accuracy of the different acquired parameters. For this purpose the guidelines proposed by the Panel on Validation Procedures of the 19th I.T.T.C. [4], significantly extended where required to cover more complicated tasks, were followed.

Resistance tests are everyday work in towing tanks. In spite of this, the following remarks can be made. At present there exists no definitive rule about the selection of the proper type and size of the turbulence stimulator devices. A case study presented in ref. [3] shows that the usage of trip wires gives resistance recordings that occasionally are comparable to results with cylindrical studs. The comparison is based on the I.T.T.C. Cooperative Experimental Program results (see *Figure 1*). Another important issue is the uncertainty associated with the parasitic drag of the stimulators. In one case it was found to exceed the drag loss due to the laminar flow area at the bow, leading to increased drag measurements over the entire Froude number range. At the low Froude numbers significant scatter was observed. On the contrary, at the design speed, the results were not only highly repeatable and comparable, but also the effects of the various types of turbulence stimulators on the total resistance were significantly reduced. These observations suggest that, for this model size, application of the form factor method includes high uncertainties, while Froude's method is much more trustworthy.

The error assessment for the resistance experiments was carried out using two techniques. At first, the I.T.T.C.'s Panel on Validation Procedure proposal was followed deriving bias and precision error estimates which were later combined to an uncertainty interval with 95% confidence level. The results are 2.1% and 3.0% for the simple addition rule and route sum square respectively. The same test was repeated until a statistical independent population sample was obtained (40 recordings at V_M = 1.357 m/sec). From these data the final uncertainty estimate reads 0.2%. This difference suggests that the resistance measurements are biased and that the latter estimate should be attributed to precision errors only.

Measurements for the free surface could not be made using one technique only, with the instrumentation available. By dividing the surface in three areas it became possible to apply different techniques on each of them. First the wave profiles on the hull were measured, then the wave surface close the bow and the stern areas was determined and lastly the rest of the surface was covered using stationary surface elevation monitors. By combining the various measurement sets a number of accurate wave surfaces at various Froude numbers was obtained. The relevant error assessment leads to the conclusion that the expected uncertainty interval cannot become lower than ±2 mm. This is partly due to the various limitations of the instrumentation and partly to the unstable nature of the surface (flickering). Since the definition of the surface is actually reduced to the definition of individual points, the corresponding Uncertainty Analysis was performed in the 3D space and not in the vertical direction only. This proved to be very useful, enabling the proposal of several improvements on the design of the instruments. For example, it was found that the metal lines, which form the static resistance-type wave monitors, are significantly bent when the model passes next to them because of the hydrodynamic forces that are induced by the wake. To solve this problem one has just to add a stiffer support and keep the lines under constant tension.

Among the analyses conducted for the various measurements the most complicated was found to be the one for the flow field values (3D velocity vector and pressure field). For these measurements a five-hole Pitot tube was used. Before using the probe, it has to be calibrated. Usually, this is done in wind tunnels as it is much easier. In the case of ref. [3] it was done in the towing tank using exactly the same setup as in the measurements that followed. The calibration of the five hole Pitot probes has to be done with great care, as any errors at this stage enter the calibration diagrams and propagate until the final result. By analysing the various sources of error during the calibration it was found that the uncertainty interval in both directions of the velocity vector was about ±2.5°. When the error sources that appear during the measurements are introduced, this estimate increases to about ±3.4°.

Vibrations were found to affect significantly the uncertainty of the pressure measurements. During the analysis of the uncertainty interval for the static pressures on the surface of the hull it is shown that they have a dominant role in the result. Unfortunately, in the towing tank one cannot avoid this problem since they are induced by the carriage wheels. The problem is mostly important for the static pressures at the surface of the stern area and in the vicinity of the wake, where the pressure values are very low. In such areas the uncertainty interval can reach the 18% in value, with a confidence level of 95%.

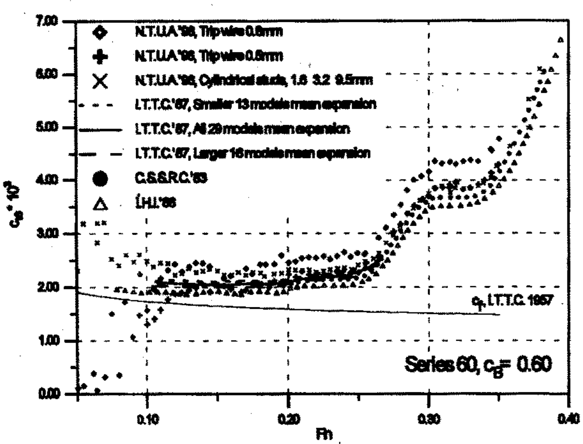
References

[1] **F. H. Todd**, *"Series 60 Methodical Experiments with Models of Single-Screw Merchant Ships"*, David Taylor Model Basin Report No. 1712, 1963.

[2] **Y. Toda, F. Stern, J. Longo**, *"Mean-Flow Measurements in the Boundary Layer and Wave Field of a Series 60 c_B = .6 Model Ship for Froude numbers .16 and .316"*, I.I.H.R. Report No. 352, Iowa Institute of Hydraulic Research, The University of Iowa, 1991.

[3] **D. Garofallidis**, *"Experimental and Numerical Investigation of the Flow around a Ship Model at Various Froude numbers"*, Ph. D. Thesis, Dept. of Naval Architects and Marine Engineers, National Technical Univ. of Athens, 1996.

[4] **Proc. 19th I.T.T.C.**, *"Report of the Panel on Validation Procedures"*, 1990.



Notes : Data are for the ship scale.
Expansion was made using the I.T.T.C.'57 correlation line.
The length taken for the expansion is L_{PP} = 121.92 m.
Salt water, 15°Celsius in temperature.

Figure 1 : Total ship resistance coefficient

Comments to the Quality Control Group Committee Report

by Dr. J.E.W. Wichers

I would like to thank the QCG Committee for their review of the QA and QC work. The following comments are meant to complement the QCG report in the area of tankery work.

In order to develop a Quality Assurance system for tankery work it is of importance to describe procedures for standard activities. The descriptions of basic procedures ensure consistency and reproducibility of model test results as carried out by members of the ITTC. In order to develop the test procedures the Ocean Engineering Committee has started to develop recommendations on test procedures on model tests on mooring systems.

For this purpose and as a start the following basic test procedures were considered by MARINTEK, IMD and MARIN:

1) Calibration of current
2) Calibration of waves in the presence of current
3) Adjustment of wind in the basin
4) Installation and static load-deflection curve of a mooring system
5) Sign convention for tanker motions and wind, wave and current directions.

The results of the descriptions of these basic test procedures are given in the Ocean Engineering Report. It is proposed that these procedures will be incorporated in the QA manual as ITTC-standards for test procedures. As said before this set of test procedures is a start and has to be followed by many more.

Further to ensure consistency and reproducibility of model test results by members of the ITTC not only the test procedure specifications as applied to the tankery work must be considered but also attention have to be paid to the statistical treatment of the signals as measured during the tests. This is of importance for the correct interpretation of the results. At least the filtering techniques, sampling, number of spectral lines applied to the measured wave and low frequency signals have to be considered.

It will be welcomed if similar procedures may be undertaken by the Seakeeping Committee. For instance the followed procedures to calibrate and analyze irregular waves, as reported by the OE Committee, may also be expected of great importance for the interpretation of the results of seakeeping research in the area of greenwater and slamming.

Discussion of Quality Control Group Final Report and Recommendations to the 21st ITTC

by Everett L. Woo
DTMB Resistance and Powering Department

The Quality Control Group is to be congratulated for their thought provoking and thorough study on how ISO 9000 can be applied to the organizations and technical committees that support and comprise ITTC, respectively. The research conducted by this committee validates the recommendations of the 20th ITTC Quality Control Group whereby the ITTC community use the International Standards Organization to standardize ITTC procedures and code of practice. The trends among Advisory Council members, clients of ITTC members and companies show a marked movement towards ISO 9000 certification and hence a common international standard upon which their day-to-day processes may be compared against.

By taking on the role of an ISO advisory group/mentor to other ITTC technical committees, I believe that the 21st ITTC QCG has taken the correct approach for nurturing and encouraging the implementation of ISO 9000. The QCG has indicated that ISO 9001 is the standard that is most comprehensive and the one most likely to be adapted by ITTC organizations since it contains a section on design and development. As such, a more complete discussion or explanation about the standard and how it can be applied would prove helpful. Each technical committee or organization will have to develop its own unique process documentation using this recommended standard. Hence I concur with the conclusions of this committee that each member organization will have to determine how far to pursue their quality system; i.e., how important quality control is for business, whether a quality manual is developed and distributed, and whether certification of their quality system is necessary.

Lastly, from an ISO 9001 standpoint, the concept of servicing relates to a finished product and it's scheduled maintenance, warranty repair and/or replacement. The QCG has indicated that servicing or service is a product category, i.e., a test in a facility. The examples of service indicated are in actuality processes the organization performs to generate a product. A sponsor may ask a test facility to determine the effects of a propeller on the powering characteristics of a ship. The test and how it is conducted are part of an organization's process. The report, which details the results of the test, is the product. After the report/product is delivered to the sponsor and new information is found effecting the test results, the report must be recalled or reissued. I believe that this is what the ISO standard considers servicing. Any thoughts to clarify this issue would be welcome.

Again, the Committee should be congratulated on their insightful recommendations towards implementing ISO within the ITTC community. They have laid the groundwork for standardized procedures which when implemented will lead to efficiencies in ship research, development, cost and production.

ISO 9002 Certification of Quality System on KRISO Experimental Tank Tests

by Seung-Il Yang and Eun-Chan Kim
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The Korea Research Institute of Ships and Ocean Engineering established as a non-profit organization in November 1976 by the Government has been playing an important role for the advancement of technologies in ship and ocean engineering fields. The KRISO became a member organization of ITTC in 1978 and a member of the Advisory Council in 1984 and has been much interested in the ITTC activities.

According to the recommendation of the 20th ITTC QCG, the KRISO decided to achieve ISO 9000 standards as a guideline for the quality control and organized a task force in November 1994 to develop a quality management system. The task force consisted of three groups: firstly, the system preparation group for the preparation of the quality manual, the quality procedure and certification process, secondly, the system management group for the calibration of instrumentation, the maintenance of facilities and the implementation of the quality system, and thirdly, the internal audit group for the audit and evaluation of the quality system.

A task force started the work from November 1994 and the registration approval process by the Det Norske Veritas (DNV) was finished in October 1995 (described in below table).

The quality system was prepared by reviewing and documenting the related business, regulations and forms in order to satisfy the ISO 9000 requirements. Also, education on ISO concepts and on-the-job training for ISO operation have been arranged since the successful operation of the quality system depends upon the positive intentions of management and staffs.

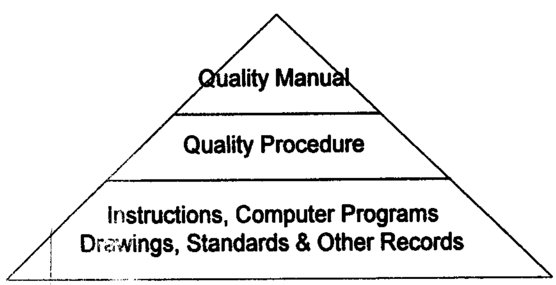
Job Description		'94 11/	12/	'95 1/	2/	3/	4/	5/	6/	7/	8/	9/	10/
I Preparation	1. References and Information	===	===	===									
	2. Organization and Education of Task Force	=	=										
	3. Review of Registration Process		===										
II Documentation	4. Selection of Certification Body			===									
	5. Preparation of Quality Manual		===	===				===					
	6. Preparation of Procedure and Instruction				===	===	===	===					
III Operation	7. On-The-Job Training					=	=	=					
	8. Operation of Quality System								===	===	===	===	===
	9. Internal Audit and Management Review											===	
IV Registration	10. Application for Registration Audit				=								
	11. Pre-Assessment Audit								=				=
	12. Registration												==

The KRISO was awarded certification to the ISO 9002 quality management system on the experimental towing tank in November 1995 by DNV accredited by Dutch Council for Certification (RVC). The quality management system covers ship and offshore structure model tests in the towing tank and the cavitation tunnel as follows:

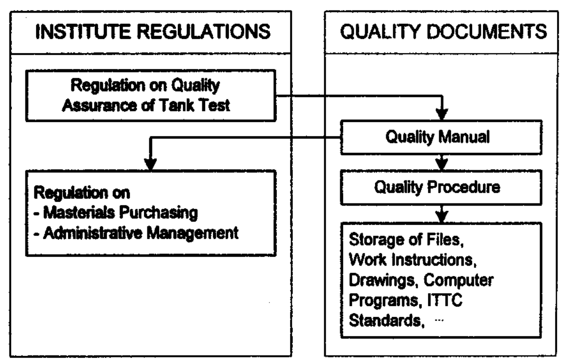
i) propulsion test (resistance and self-propulsion tests)
ii) propeller open-water test
iii) wake test
iv) ship motion test
v) manoeuvring test (PMM and rudder torque tests)
vi) propeller cavitation test

The work process related to the above tests was tabulated in Fig. 1 and classified as the administrative business (job no. 1 ~ no. 9), model manufacture (job no. 10 ~ no. 19), model test (job no. 20 ~ no. 39) and report (job no. 40 ~ no. 42).

The quality management system was to be documented consisting of three levels, that is, the quality manual, the quality procedures and the related documents (shown below).



For the enforcement of the quality management system, a regulation on quality assurance of tank tests was newly legislated and the existing regulations on materials purchasing and administrative management were referred to the quality system documents (shown below).



The quality manual was prepared in compliance with the 20 elements of ISO 9000. The essential document of the quality system is the quality procedure. Figure 2 shows the list of the quality procedures with ID numbers in the KRISO experimental tank tests. The procedures can be prepared in a descriptive question and answer form or a check list form. Two examples are given: Manufacture of Ship Model (QP 120) in Fig. 3 and Propulsion Test (QP 223) in Fig. 4, respectively. It is noted that these samples are the check list forms.

Since the current ISO 9002 certification is to be assessed every 6 months and approved every 3 years, the management reviews are of the quality procedures with ID numbers in the KRISO experimental tank tests. The procedures can be prepared in a descriptive question and answer form or a check list form. Two examples are given: Manufacture of Ship Model (QP 120) in Fig. 3 and Propulsion Test (QP 223) in Fig. 4, respectively. It is noted that these samples are the check list forms.

Since the current ISO 9002 certification is to be assessed every 6 months and approved every 3 years, the management reviews are very essential. To continue ISO standards as a guideline for the quality control, the followings are to be taken:

- supplement of quality management system
- addition of new work instructions
- continuing effort to improve the tests
- application of computerized management information system
- modification by ITTC recommendations

References

Eun-Chan Kim and Soo-In Park "Certification of ISO 9002 Quality System on KRISO Experimental Tank Test", J. of Ships & Ocean Engineering, KRISO, Vol. 21, Dec. 1995 (in Korean)

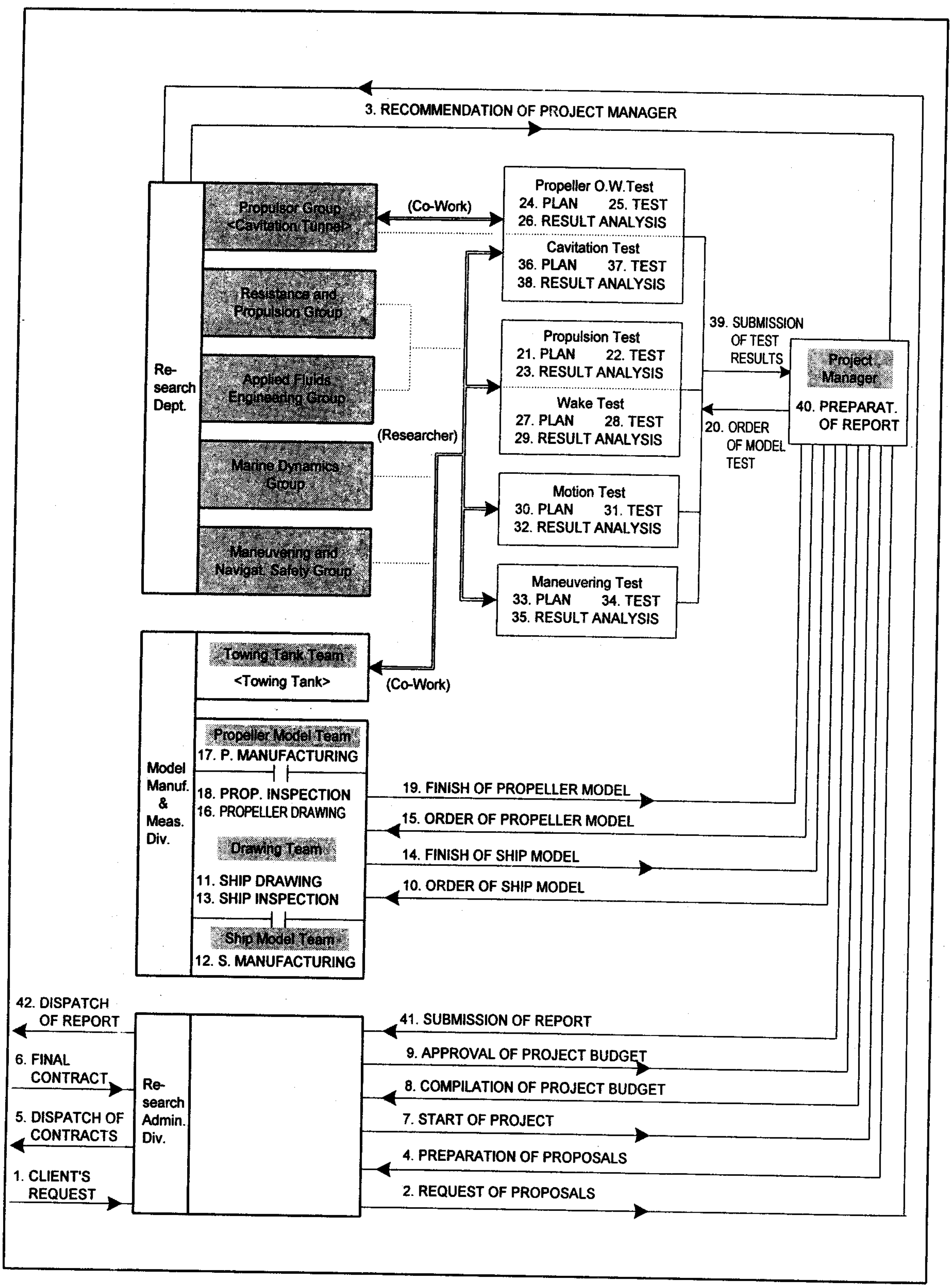


Fig. 1 Work Process of KRISO Tank Tests

ID No.	Name of Quality Procedure	ID No.	Name of Quality Procedure
QP000A	Revision List	QP360	Plan of Cavitation Test
QP000B	Contents	QP370	Cavitation Test (Observation)
QP001	Work Flow of Test	QP380	Analysis of Cavitation Test Results
QP002	Storage of Files	QP390	Submission of Test Results
QP003	Authorities of Work	QP400	Preparation of Report
QP010	Review of Contracts	QP801	Management Review
QP020	Preparation of Proposal	QP802	Corrective Action
QP040	Submission of Proposal	QP803	Preventative Action
QP100	Order & Drawings of Ship Model	QP804	Nonconformity Review
QP120	Manufacture of Ship Model	QP811	Plan of Internal Quality Audits
QP130	In-Process Inspection of Ship Model	QP812	Internal Quality Audits
QP140	Final Inspection of Ship Model	QP821A	Job Specifications A
QP150	Order & Drawing of Propeller Model	QP821B	Job Specifications B
QP170	Manufacture Propeller Model	QP821C	Job Specifications C
QP180	In-Process Inspection of Propeller Model	QP821D	Job Specifications D
QP190	Final Inspection of Propeller Model	QP821E	Job Specifications E
QP200	Order of Model Test	QP821F	Job Specifications F
QP210	Plan of Propulsion Test	QP821G	Job Specifications G
QP221	Propulsion Test (Preparation)	QP821H	Job Specifications H
QP222	Propulsion Test (Resistance Test)	QP821I	Job Specifications I
QP223	Propulsion Test (Self-Propulsion Test)	QP822	Plan of Train and Education
QP230	Analysis of Propulsion Test Results	QP823	Train and Education
QP240	Plan of Propeller Open-Water Test	QP831	Materials Purchasing
QP250	Propeller Open-Water Test	QP832	Maintenance of Test Equipment
QP260	Analysis of Propeller O-W Test Results	QP833A	Management of Sub-Contractors
QP270	Plan of Wake Test	QP841	Distribution of Manual and Procedure
QP280	Wake Test	QP842	Approval and Issue of Documents
QP290	Analysis of Wake Test Results	QP843	Register of Computer Program
QP300	Plan of Ship Motion Test	QP844	Standards by ITTC's Recommendation
QP311	Ship Motion Test (Preparation)	QP851	Maintenance Plan of Towing Tank
QP312	Ship Motion Test (Motion Test)	QP852	Maintenance Plan of Cavitation Tunnel
QP320	Analysis of Ship Motion Test Results	QP901	Master List of Dynamometer Calibration
QP331	Plan of Maneuvering Test (Model)	QP902	Master List of General Receipt Document
QP332	Plan of Maneuvering Test (Calibration)	QP903	Master List of Client's Receipt Document
QP333	Plan of Maneuv.Test (Rudder Torque)		
QP334	Plan of Maneuvering Test (PMM)		
QP341	Maneuvering Test (Preparation)		
QP342	Maneuvering Test (Calibration)		
QP343	Maneuvering Test (Static Test)		
QP344	Maneuvering Test (Dynamic Test)		
QP345	Maneuvering Test (Inertia Test)		
QP350	Analysis of Maneuvering Test Results		

Fig. 2 Contents of the Procedure

KRISO Experimental Tank Test QP120.2	Project No.:	Project Name:
120 Manufacture of Ship Model	Authority of Manufacture: (Sign)	Starting Date: 199 Y M D
!!! SAMPLE ONLY !!!	Authority of Review/Approval: (Sign)	Review/Approval Date: 199 Y M D

Dimension			Manufacturing Criteria
	Full Scale	Model Scale	Manuf. : ☐New ☐Mod. ☐Assemb.☐Others( )
Ship Name			Material :☐Wood ☐FRP ☐Form ☐Others( )
(English)	( )		Freeboard : ☐Max.Draft+120mm ☐Others(+ mm)
Ship M. No.	KS		Stimulator : ☐19st & Midbulb ☐Others( )
No.of Prop.			Allowance : Length: ±2.0mm Depth: ±1.0mm
Scale 1 /			Laminated Depth : mm
L_{PP}	(m)	(m)	
B	(m)	(m)	

Drawing, Marking and Test Condition : Refer to QP100

Check List for Ship Model Manufacturing			
Works	Contents	Judge(O/X)	Nonconforming
Cutting	Receiving date of cutting plans	199 Y M D	
	Good quality of wooden plate ?		
	Cutting margin within 5 10 mm ?		
Laminating	Correct mixed ratio of adhesive ?		
	Any gap between plates ?		
Milling	Receiving date of punching tape	199 Y M D	
	Correct baseline for milling machine ?		
	Any damage to model by machine ?		
Shaping	Receiving date of templates	199 Y M D	
	Any wrong cutting of templates ?		
	Clearance within 0.8 mm ?		
	Good fairings between stations ?		
	Good surface roughness ?		
Inprocess Inspection Painting Marking	Date of inprocess inspection	199 Y M D	
	Inspection by QP130 ?		
	Good surface after final painting ?		
	Receiving date of marking data	199 Y M D	
	Marks of station, WLs, draft, name, no. ?		
Final Inspection	Date of final inspection	199 Y M D	
	Inspection by QP140 ?		
Appendage	Appendages ready ?		

Remarks
Revision 2 (1995.7.10.) : Amendment of units for length and breadth of ship model

Fig. 3 Sample Procedure: Manufacture of Ship Model

KRISO Experimental Tank Test QP223.3	Project No.:	Project Name:
223 Propulsion Test (Self-Propulsion)	Authority of Towing Tank: (Sign)	Sub-Manager: 199 Y M D
	Conducting Date: 199 Y M D	
!!! SAMPLE ONLY !!!		

					Acquisition
SP Test No.			S	S	Ship Speed
Number of Propeller					Thrust
Propeller Model no.			KP		Torque
Test Condition		Draft Condition			Towing Force
		Scale Ratio			
		Water Temperature (C)			
Computer Program		Data Acquisition Program			
Calibration		Thrust	Torque	Towing Force	
	Inclination A				
	Intercept. B				

Check List for Self-Propulsion Test		Judge (O/X)	Nonconforming
Instrument	Correct cabling for dynamometer ?		
	Correct channel of amplifier ?		
	Correct gain of amplifier ?		
Program and Input	Correct acquisition program ?		
	Correct calibration data ?		
	Correct input of test condition and dimensions ?		
Measurement	Correct output of measurement ?		
Before Correction	At least 1 min. operation at design revolution ?		
	Measurement over 6 points including -3 rpm ?		
Main Test	Correct time interval (C_B<0.75 : 10min, C_B>0.75 : 12.5min) ?		
	Measurement after 70m-point of towing tank ?		
	Masurement over 5 times of ship length ?		
	Two dummy test runs at initial speed ?		
	Overload test at min, design and max. speeds ?		
	Confirming test at design speed ?		
	Any problem of detaching propeller ?		
After Correction	Measurement over 6 points including -3 rpm ?		
	Difference of dummy trques between corrections within 1%?		

Remarks
Revision 2(1995.9.23.) : Deletion of dimension of Ship and propeller

Fig. 4 Sample Procedure: Propulsion Test (Self-Propulsion Test)

II REPLIES

Reply to M. Abe

The Quality Control Group would like to thank Dr. Abe for supporting the efforts of the ITTC technical committees in their work to recommend procedures and codes of practice. The 20 requirements specified in the ISO 9000 standard address WHAT subjects must be considered, not HOW they are to be considered. HOW the requirements are satisfied is the responsibility of each organization. The ITTC committees can provide general procedures only as a guide, and as Dr. Abe says, in support of member organizations.

The Advisory Council has insured that each technical committee develops procedures and codes of practice that conform to ISO 9000 and the Quality Control Group's responsibility is to assist the technical committees. Even if the member organizations do not become ISO 9000 certified, the requirements of this standard are a very good guide for the member organization's quality system. The Quality Control Group agrees with Dr. Abe that some aspects of a technical Committee's recommended procedures may be difficult to carry out. For this reason, the conference as a whole should review and approve the proposed procedures.

Reply to J. Dudziak

The Quality Control Group would like to thank Dr. Dudziak for the interesting presentation of the Quality Assurance System at the Ship Design and Research Center. We think this description is a very good example of how a quality assurance system is set up and implemented. It is also important to note the advantages of a Quality Assurance System as described by Dr. Dudziak.

As to the expectations addressed to the ITTC, the Quality Control Group fully endorses them and expects that the general as well as specialist's committees will note these. Also, the proposal of a workshop devoted to Quality Assurance Systems should be followed up by the future Quality Systems Group of the 22nd ITTC.

Reply to D. Garofallidis

The work done by the National Technical University of Athens is very much appreciated by the Quality Control Group, particularly because it specifically addresses the ITTC conference recommendation related to actual everyday work practice. Therefore this contribution should be of considerable interest to all members of the ITTC.

Because of the general interest in uncertainty analysis, the Quality Control Group suggests that it would be useful for the Quality Systems Group to receive more detailed information on the methods followed and on the preparation procedures for all the aspects considered, especially for the more complicated tests (surface pattern, hull pressure distribution, etc.). This would benefit all the ITTC organizations in their evaluation of the uncertainty associated with their experimental results.

Finally, in figure 1 of the National Technical University of Athens contribution, the considerable spread in the resistance coefficient for the same hull tested in different facilities may be due to more than test uncertainties. It may be due to lack of consistent data corrections to account for the physical differences in the facilities, such as wall and bottom effects and differences in turbulence level and water temperature.

Reply to J. Wichers

The comments as well as the work reported by Dr. Wichers are much appreciated. The Quality Control Group would especially like to support and emphasize the comment that not only test procedures but also the treatment and analysis of the test results should be treated in a consistent and reproducible way.

Reply to Seung-Il Yang

The Quality Control Group has appreciated very much the work done by the Korean Research Institute of Ship and Ocean Engineering. We consider this work to be of considerable interest to all ITTC organizations interested in certification to ISO requirements. In particular, the decision to be certified to ISO 9002 may also be appropriate for many other organizations. Those that will apply for certification will certainly benefit from any details you can provide on your preparations for certification. We are sure that this effort will not only be useful to the Quality Systems Group but also to all organizations engaged in the preparation of their own Quality Manual.

Reply to E. Woo

The Quality Control Group would like to thank Mr. Woo for his support for the work of the ITTC to promote the use of the ISO 9000 Quality Assurance Standards. Mr. Woo suggests additional discussion of the ISO 9001 standard would be helpful. Discussion beyond that included in the Quality Control Group report would be difficult to provide in this reply but it should be noted that there are 20 elements, also known as requirements, for a quality system to satisfy ISO 9001. These requirements address WHAT must be done. However, HOW the requirements are satisfied is the responsibility of each member organization and is the process documentation mentioned by Mr. Woo.

In the Quality Control Group [illegible] reference is made to the four generic product categories Hardware, Software, Processed Materials, and Services, with Services the primary product category of ITTC members. From ISO 8402, the definition of Service is the "Result generated by activities at the interface between the supplier and the customer and by the supplier internal activities to meet the customer needs." However, the "Servicing" referred to by Mr. Woo is one of the 20 ISO 9001 requirements and it relates specifically to tangible products provided to a customer, such as servicing of machinery, servicing of software or, as he describes, the revising of a completed report already provided to a customer. The Quality Control Group appreciates Mr. Woo's discussion and the points that he made.