Terms of Reference

Research Project
on
Study of marine heat exchangers for use on-board ships

Sectional Committee	**:**	**Marine Engineering and Safety aids Sectional Committee, TED 19**
Division Council	**:**	**Transport Engineering Division Council**
Duration	**:**	**3 Months**

1. TITLE : Study of marine heat exchangers for use on-board ships

2. BACKGROUND :

2.1 Shell and Tube Type Heat Exchanger is the most popular type design with a shell accompanying several tubes and the flow of liquid to be cooled is mainly through tubes, whereas the secondary liquid flows over the tube inside the shell.

2.2 Plate Type Heat Exchanger consists of thin corrugated plates joined parallel together, creating a cavity for fluid flow inside it. Alternate sides of the plate carry two different fluids, between which, heat transfer is carried out.

2.3 Currently, following Indian Standards are available on the subject:

a) IS 11125:1984 General requirements for plate heat exchangers for marine use
b) IS 10746 (Part 1):1983 Specification for shell and tube type marine heat exchangers Part 1 Application standard
c) IS 10746 (Part 2):1983 Specification for shell and tube type marine heat exchangers Part 2 General requirements

2.4 Technical development like improvements in heat exchanger design, such as the use of high-efficiency exchanger geometries, specialized performance optimization techniques and design optimization techniques , enhanced process parameters like type of fluid used, amount of heat being transferred use of newer raw materials used for fabricating heat exchangers have taken place over a period of time

2.5 It is in this context that there is a need for in-depth, incisive study of marine heat exchangers which are currently being used on-board ships'.

3. OBJECTIVE

The objective of research and development project is to collect data, information and evidence from primary and secondary sources in respect of requirements such as improvements in heat exchanger design, high-efficiency exchanger geometries, process parameters like amount of heat transfer, material considerations and other related factors which are currently being applied on heat exchangers used on-board ships'.

4. SCOPE:

4.1 A thorough literature review (includes study of parameters covered in current Indian Standards, tests specified and their test methods) of marine heat exchangers, which include but not limited to:

- Existing international standards if any,
- Regulatory body guidelines/ instructions
- Specified requirements of classification societies,
- Research papers published on the subject,
- Any study conducted by industry body/ association
- Applicable standards for raw materials used
- Any other literature

4.2 Visits to regulatory body, different classification societies, shipyards and ship-owners for discussion on requirements covered under their rules/ regulations/ approval criterion. The regulations which are expected to be enforced in near future are also to be studied. Visits to different stakeholders shall be based on an agreed sampling plan at **5.1**.

4.3 Collection of export and import data and applicability of standards and technical regulations on domestic/ foreign manufacturers of marine heat exchangers.

4.4 Collection and identification of fabrication base (medium scale/ large scale) of heat exchangers in the country and visits to different manufacturers facilities to collect information related to following:

- Factors considered in heat exchanger design
- Raw materials being used and applicable standards on them;
- Process used for manufacturing / fabrication
- In-process quality checks
- Standards being followed
- In-process test facilities
- In house quality checks/ tests on complete product

- Packing, storage and transportation issues;
- Sustainability considerations and waste management
- Focused group discussion on quality issues, challenges being faced and suggestions for improvement with teams involved in design, fabrication and testing;
- The feedback from other manufacturers may be obtained through suitable questionnaire

4.5 Visit to raw materials manufacturers for collection of raw material samples for testing, if required. Discussion on changes in raw material based on process parameters like working fluid, amount of heat transfer should be done.

4.6 Identification of testing laboratories, especially NABL accredited labs, and testing facilities in the country and visit to different laboratories. Discussion should also be done with quality personnel on testing of different parameters, their testing methods and equipment being used for testing.

4.7 Collect data and feedback from different users through circulation of structured questionnaire covering information specified in scope.

4.8 A comprehensive report documenting work done as mentioned above, research findings, data collected and bibliography shall be prepared.

5. SAMPLING PLAN

5.1 Based on the identification of fabrication/ manufacturing and testing base, a sampling plan is required to be agreed upon for visits to different stakeholders and also for collection and testing of samples during the visit.

5.2 In case the manufacturing and testing infrastructure in the country is sufficiently available under large, medium and small scale, the proposer needs to submit a sampling plan to BIS for approval.

6. RESEARCH METHODOLOGY

6.1 Carry out thorough literature review as specified in the scope.

6.2 After the literature review, there will be discussion with BIS to approve the sampling plan so that visits can be undertaken.

6.3 Collect information from stakeholders through discussion and structured questionnaire as specified in the scope.

6.4 Testing of samples, if required, and generation of test results with comparative analysis as specified in the scope.

6.5 Collect data and feedback from different users.

7. DELIVERABLES

An analytical report, in soft and hard copy, covering all aspects mentioned in the scope shall be submitted. Details of visits to regulatory body, classification societies, different manufacturers, laboratories**,** discussions with quality control personnel, questionnaire with exporters/ importers, feedback from users, research findings, data collected, test reports, comparative analysis and bibliography of the literature covered shall be appended to the report.

8. TIMELINE AND METHOD OF PROGRESS REVIEW: A stage wise indicative timeline plan is provided below:

a) Project timeline – 3 months from the date of award of project

b) Primary source covering the review of the literatures – By the end of 20 days

c) Secondary source interaction covering the discussion with regulatory body/ classification societies/ shipyards and existing stipulations, thereof – By the end of 45 days

d) Visits to different manufacturers and laboratories and testing of collected samples – By end of 75 days.

e) Final report covering all the aspects of the ToR – By end of 90 days.

9. SUPPORT BIS WILL PROVIDE:

9.1 BIS will provide access to latest editions of available standards including international standards.

9.2 BIS will provide information regarding the licencees and recognized laboratories available.