TERM OF REFERENCE FOR RESEARCH PROJECT

Title of the Project: Study of chemical, physical and mechanical properties of stainless steel pipe and tubes made of low nickel stainless steel grades

1. Background:

1.1 BIS has formulated the standards IS 17875:2022 and IS 17876:2022 for seamless and welded stainless for general engineering purposes which contains grades of austenitic stainless steel with Nickel more than 3.5 %.

1.2 In India there is large amount of stainless steel pipes manufactured and imported wherein the nickel content is less than 3.5 % and the same is used in non-critical decorative application such as handrails, railings, piping, windows, and gates. This low nickel stainless steel is much cheaper than conventional high nickel stainless steel.

1.3 Nickel in stainless steel mainly acts as an austenite stabilizer and provide the requisite ductility to stainless steel. In low nickel stainless steel, nickel is compensated by addition of Mn, Cu and Nitrogen.

1.4 The chemical composition of low Ni grades viz N1, N2, N3, N5, N6, and N7. have been defined in the standard IS 15997:2012 Low nickel austenitic stainless steel sheet and strip for utensils and kitchen appliances**,** however this specification is for sheet and strip .

1.5 Till date there is no standard for low nickel stainless steel pipes and tubes and in the absence of standard lot of low quality pipes and tubes are manufactured and also imported in India. Although these pipes are primarily used for noncritical applications but few basic properties such as aesthetics, strength, bendability, and corrosion resistance are required in them.

1.6 A need was felt that for formulation of new standard for welded stainless steel tubes for decorative purposes, the properties of the pipes made of low nickel stainless steel needs to be validated and the same is the objective of this R&D project.

1.7 The Indian standards mentioned above can be viewed at https://standardsbis.bsbedge.com.

2. Objective

To collect relevant data and information, from primary and secondary sources, and validate the chemical, physical and mechanical properties of austenitic stainless steel pipe and tubes of grades N1, N2, N3, N6, N5, and N7.

3. Scope:

3.1 Study the available literature like national and international standard such as ASTM, JIS, EN, ISO etc available on the subject, research papers, any study conducted by other organisations, companies' brochure. Identify the grades, their chemical, mechanical., metallurgical and physical properties and any other requirements which can be included in the standard.

3.2 Collect data of the manufacturing base of the product.

3.3 Visit the manufacturers of the product and get the information on the following:

i. Raw material used,
ii. Grades and sizes of pipes manufactured,
iii. Condition of supply (types of heat treatment),
iv. Quality parameters (chemical, physical, metallurgical and mechanical properties) of different grades ,
v. Manufacturing process,
vi. Recommended heat treatment,
vii. In-process quality checks,
viii. Test facilities and test methods,
ix. Tests undertaken,
x. Tests for Corrosion resistance
xi. Routine tests for accepting lots,
xii. Mill test certificates issued,
xiii. Delivery conditions,
xiv. Surface protection,
xv. Weld, meability requirements,
xvi. Sampling plan for accepting a lot,
xvii. Marking, labelling and Packaging requirement &
xviii. Steps taken for addressing sustainability.

3.4 Identify and visit the laboratories.
3.5 Check the quantity of the product imported and exported and countries with which the trade for this product is occurring. Also check if any technical regulations exist for this product in these countries. Take data of the specification as per which the product is being traded.
3.6 Identify users of the product and take data of quantity being used by them, specification used, check for the test certificates received by them and study the chemical and physical properties chemical, physical, metallurgical and mechanical properties mentioned in the TC. Also understand from the user the optional properties required by them for the product.
3.7 Prepare comprehensive project report incorporating the points mentioned above.

4. Research Methodology:

4.1 Study the literature and analyse the findings.
4.2 Visit the manufacturing unit(s) and
a. Observe the manufacturing process,
b. Examine in-process controls,
c. Conduct focussed group discussions with quality/production personnel
d. Collect the data as mentioned in the scope through a questionnaire.
e. Draw samples of the grades and get it tested in BIS approved laboratories
4.3 Visit laboratories and make report on
a. Test equipment required,
b. Test methods used,
c. Testing charges,
d. Testing time required,
e. Sample size.
4.4 Visit importers and exporters and collect data as mentioned in the scope through a questionnaire.
4.5 Visit users of the product and collect data as mentioned in the scope through a questionnaire.
4.6 Analyse the above data and test reports and include the same in the project report.

5. Sampling plan

5.1 Two manufacturers each from large, small and micro scale shall be visited.

5.2 Samples for testing may be drawn from manufacturer, user, importer or market

5.3 Select the grades as per compositions of these grades provided in IS 15997 (for grades N1, N2, N3, N5, N6, N7) and IS 6911 (for grade 304). Grade 304 is 8 % Nickel grade and is being tested to have a comparative study with low nickel grades. Three samples of each grade should be selected in a manner to ensure that each sample of a particular grade selected is of a varying composition of chromium (from minimum to mid-range).

5.3 All pipe samples should be tested for dimensional, chemical composition, tensile tests, flattening tests, bend tests, and salt spray tests as per relevant IS specifications. The sample plan should be in a manner to cover the range of thickness 0.2 mm to 12 mm. Suggested thickness for the sample plan for each grade should be of nearby available thicknesses of 0.2, 0.6, 1.25, 3.0, 6.0, 9.0/12.0 mm having a diameter of popular/common sizes in this thickness range.

In case of constraints in getting samples from manufacturers, alternative means to be discussed with BIS

5.4 Two users of the product shall be visited.

5.5 Two NABL accredited laboratories, preferably one in government sector and one in private sector shall be visited.

6 Deliverables:

6.1 Final project report, in hard copy format as well as in editable soft copy, covering all aspects mentioned in the scope.

6.2 Questionnaire, discussion, visit reports, test reports to be appended with the final project report.

7 Timeline:

The duration of the project is 4 months from the date of award of the project. The proposed indicative timeline stage-wise is given below:

Sr No	Stage	Time from date of award of project (cumulative)
1	Literature review and identification of manufacturing base, testing laboratories, user/user industry, and discussion with BIS for the finalization of sampling plan	1 month
2	Visit to manufacturers, testing laboratories, users and importers and exporters and data collection	3 months
3	Preparation and submission of first draft report to BIS	3.5 months
4	Submission of final project report	4 months

Note : The proposer may submit the draft report to BIS without waiting for test report from independent laboratories if the test is of long duration test (Test duration > 1 month)

8 Support BIS will Provide:

i. National /international standard relevant to the project.

ii. Details of BIS Licensees details of related products

iii. Product manual of related products

iv. Details of BIS and BIS recognized laboratories.

9 Relevant sectional committee and Nodal officer from BIS

Sectional committee :
MTD 19-Steel Tubes, Pipes and Fittings Sectional Committee Sectional Committee
Nodal officer :
Mr Sachin Chaudhary, Scientist C/ Deputy Director – Member Secretary MTD 19 ,
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