TERM OF REFERENCE FOR RESEARCH PROJECT

Title of the Project:

Study of various methods used for determining the thickness of centrifugally cast (Spun) ductile iron pressure pipes for water, and sewage, and suggest the thickness of pipes along with relevant internal and external protection systems, joints and performance test(s) best suited for Indian conditions.

1 Background:

1.1 Ductile Iron is an improved variety of Cast Iron. It is also known as Spheroidal Graphite Iron or Nodular Cast Iron. Centrifugally cast Ductile Iron pipes are one of the most preferred materials for water supply and sewerage applications across the world due to its host of advantages. Pipes made from Ductile Cast Iron provide substantial benefits in terms of pressure-bearing ability, impact resistance, and capacity to sustain external static/ dynamic loading.

1.2 BIS has formulated the standard IS 8329:2000 for centrifugally cast (Spun) ductile iron pressure pipes for water, gas, and sewage. In this standard, which is derived from ISO 2531:1998 version, the thickness of the pipe was defined on the basis of a constant and nominal diameter of the pipe and the same is known as K class pipes.

1.3 The ISO 2531 has since been revised in 2009 and in this version the thickness of the pipe has been revised based on allowable operative pressure and safety factors, known as C class pipes. The calculation based on the safety factor and allowable operating pressure led to a significantly lower thickness of the pipes.

1.4 Both the types of pipes i.e. as per C class and K class are manufactured in India.

1.5 BIS has also received various representations that the thickness requirement mentioned in IS 8329:2000 is overdesigned and needs to be aligned with best international practice keeping in mind the Indian conditions. However, there have been counter arguments from various manufacturers and users that before adopting lower thickness or pressure class of pipes in Indian conditions the various lining, coatings, joint tests, laying standards, soil investigation procedures, corrosion factors, and other attributes followed in International countries should be studied.

1.6 M/s Jal Jeewan Mission of the Ministry of Jal Shakti suggested that the distribution system has different pressures so that thickness may be defined based on allowable operating pressure so that different thicknesses may be used for different operating pressures.

1.7 It was thus felt that a study may be undertaken wherein benefits and drawbacks of K class and C class pipes are studied and the class of pipe best suited for Indian conditions will be suggested. It is also to be noted that many countries like USA or Japan had not adopted the ISO method of determining the thickness. So, all other relevant International DI pipe product

standards are also to be studied before arriving at a decision. Based on this study the decision on revision of standard IS 8329:2000 shall be undertaken.

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

2 Objective:

To suggest the minimum and nominal thickness of ductile iron pipes to be used in India for various applications along with the recommendation of the new classification system of pipes related to working pressure and service conditions and recommendations on joints, linings, coatings, and performance tests for various applications under different operating conditions in terms of characteristics of fluid to be transmitted and soil characteristics.

3 Scope:

3.1 Study the available literature like national and international standards such as ASTM, JIS, EN, ISO, AWWA, IWWA, etc available on the subject, research papers, any study conducted by other organizations, companies' brochure, papers on the basis of calculation of thickness of pipes, data of countries where C and where K class pipes are used

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:

a) Types of Raw material used
b) Varieties/grades manufactured
c) Sizes manufactured
d) Manufacturing process
e) In process quality checks
f) Quality parameters (dimensional, physical and mechanical properties) of different grades
g) Safety requirements and safety factor for pipes.
h) Coating requirements
j) Lining requirements
k) Pressure requirement of the pipe
l) Test facilities and test methods used
m) Tests undertaken
n) Marking and labelling
p) Packaging requirement
q) Measures to address sustainability, waste recycling, reuse, rework

3.4 Identify and visit the laboratories to witness the testing and collect the data of testing as per IS 8329 and ISO 2531.

3.5 Check the quantity of the product imported and exported and the 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 foreign specification as per which the product is being imported or exported.

3.6 Identify the users of the product and take data on the following aspects

a) Quantity of K7 and K9 pipes being used by them;
b) Performance of K7 and K9 in installation and operation and maintenance stage;
c) Extent and nature of soil corrosive study undertaken by user prior to designing the scheme; and
d) Data on verifying the thickness of the pipe against external pressure and surge pressure.

3.7 Take feedback from the various user departments like PHED, Water resources departments (WRD), Industries, major Engineering, Procurement, and Construction (EPC) companies and the Ministry of Jal Shakti and Ministry of Housing and Urban Affairs, CPHEEO, CWC regarding their suggestion for using DI pipes of class K7 and K9 or any other thickness and data of the performance of these pipes used in past.

3.8 Compile the data collected from the user departments and EPC companies and analyze these data for comparative study.

3.9 Prepare a comprehensive project report incorporating the points mentioned above and suggest a class of pipes best suited for Indian conditions. Also, suggest suitable pipe thickness for making flanged pipes and restrained joint pipes.

3.10 The various ISO / International Codes that are relevant to DI pipes should be studied and suitably adopted along with the thickness design of DI pipes, for example:

a) Conditions prevailing during the design of thickness as per ISO 10803 or similar standards like AWWA C150/ JIS G 5526, AS/NZS 2280, BS EN 545, BS EN 598, and ISO 7186;
b) Adopted thicknesses are directly related to the protection system, the lining/coating standards under ISO standards systems/other standard systems are to be studied and suitably recommended;
c) Choice of lining/coating system will depend on the surrounding soil atmosphere; soil investigation procedures should be formulated to determine various corrosion factors. Performance test requirements for lining and coating are to be elaborated;
d) Various options for internal lining are to be studied and recommended based on internal fluid characteristics;
e) Various jointing systems and type tests to be studied and suitably incorporated. Use of restrained joint/thrust block and its effect on thickness to be studied; and
f) Changes required in the present IS laying standard, as per ISO 21051 should be identified.

4 Research Methodology:

4.1 Study the literature and analyse the findings.

4.2 Visit the manufacturing unit and

a) Observe the manufacturing process;
b) Examine in-process control measures;
c) Conduct focussed group discussion with quality and production personnel and take feedback on differences in the manufacturing process, testing procedure, and handling procedure of C and K class pipes;
d) Collect the data on details of the pipe manufactured as per K class and C class;
e) Collect the data as mentioned in the scope through a questionnaire; and
f) Draw samples of the pipe grades as per the sampling plan and get it tested in factory/BIS approved laboratories for all requirement specified in the relevant standard viz IS 8329/ISO 2531. Also, any other test felt necessary to establish the suitability of pipes in Indian condition needs to be conducted.

4.3 Visit Engineering, Procurement, and Construction (EPC) companies and take data as mentioned in the scope through a questionnaire.

4.4 Visit to pipe lying site in coordination with PHED, WRD/ EPC, CPHEEO, CWC, to collect data on actual lying along with lining and coating requirements. Feedback on issues faced in handling and laying of K class pipes to be collected.

4.5 Visit laboratories and make report on:

a) test equipment required;
b) test method being used;
c) testing charges; and
d) testing time required.

4.6 Visit the identified importers and exporters and collect data as mentioned in the scope through a questionnaire

4.7 Visit the users of the product including PHED, WRD, Ministry of Jal Shakti, Ministry of Housing and Urban Affairs, CPHEEO, CWC and collect data as mentioned in the scope through a questionnaire.

4.8 Analyse the data and test reports from diverse sources.

5 Sampling plan

a) Two manufacturers from each large, small, and micro-scale shall be visited;
b) Samples may be drawn from manufacturer, user, or market;
c) Four samples from K7 and K9 classification of different nominal diameters and four samples for C classification for the same diameter as K7 & K9 classes;

d) Visit to two pipe-lying sites; and
e) Two laboratories, preferably one in the government sector and one in the private sector shall be visited.

6 Deliverables:

a) Final project report, in hard copy format as well as in soft copy, covering all aspects mentioned in the scope;
b) Questionnaire, discussion, visit reports, and test reports to be appended with the final project report;
c) Recommendation for ductile iron pipes including the scope of linings and coatings;
d) Recommendation for ductile iron fittings including the scope of linings and coatings;
e) Recommendation for design methodology for ductile iron pipes as per the items (c) and (d) above including the type of joints that can be used for ductile iron pipes and their design requirements;
f) Recommendation for the performance test requirements for the DI pipes and fittings; and
g) Recommendation on the classification of pipe based on soil characteristics and lying conditions. Recommendation on performance test requirements for the lining and coatings shall be included in the recommendations to the particular type of lining or coatings as annexure to the pipe and the fitting standard, based on the internal standard requirements.

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:

Sl 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, lying sites, 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.

8 Support BIS will Provide:

a) BIS will provide access to latest available editions of Indian standards and/ or international standards relevant to the project, on request.
b) Details of BIS Licensees;
c) Product manual; and
d) Details of BIS-recognized laboratories.

9 Relevant sectional committee and Nodal officer from BIS Sectional committee:

MTD 6-Pig iron and Cast iron Sectional Committee

Nodal officer:
Shri Sachin Choudhary, Scientist C/Deputy Director – Member Secretary MTD 6,
Email: mtd6@bis.gov.in