

Government of Rajasthan
PUBLIC HEALTH ENGINEERING DEPARTMENT



QUALITY ASSURANCE & QUALITY CONTROL MANUAL
FOR EXECUTION OF WATER SUPPLY & ASSOCIATED WORKS

July 2021

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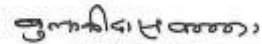


MESSAGE

It is a matter of great pleasure that the Public Health Engineering Department is introducing the Quality Assurance & Quality Control Manual. I hope this manual will prove useful for engineers and employees of the Department.

I am confident, it will help in improving overall quality standards of works to be carried out in the projects/ schemes of the Department.

I would like to appreciate the team of PHED for this initiative to bring this Manual for the first time. I congratulate Public Health Engineering Department officials for their efforts and am confident that they will rise to the occasion and deliver works of high quality for the citizens of Rajasthan.



(Dr. B.D. Kalla)

Minister, PHED, Rajasthan

सुधांश पंत

आई.ए.एस.

Sudhansh Pant
IAS



अतिरिक्त मुख्य सचिव

जन स्वास्थ्य अभियांत्रिकी एवं भू-जल विभाग
राजस्थान सरकार।

Additional Chief Secretary
Public Health Engineering
& Ground Water Department
Government of Rajasthan

FOREWORD

I would like to congratulate the PHED officials, for preparing and bringing out a Quality Assurance & Quality Control Manual. It is always a priority of the Government to maintain utmost quality in the works of water supply schemes and projects.

I am sure that the departmental engineers will certainly benefit from this Manual. I urge all PHED officials not to leave any stone unturned in the process of maintaining high quality standards in the works of the Department. Quality control is going to be very vital in all works being undertaken under Jal Jeevan Mission too.

Sudhansh Pant

Sudhansh Pant 2/7/2021
Additional Chief Secretary,
PHED&GWD, Rajasthan.

PREFACE

This Quality Assurance and Quality Control (QA&QC) Manual has been prepared with the objective of putting in place a comprehensive, consistent and common system to maintain quality standards during implementation of PHED projects/schemes. The Manual covers the overall quality assurance system and the field level quality control procedures for various stages of projects/schemes.

The QA&QC Manual includes tests and inspections for different materials and works. The acceptance/rejection limits have to be assessed in relation to the standards and specifications as incorporated in the schemes/projects/procurement contracts. If there are any differences between the tests and other quality control procedures described in the Manual and those stipulated in the schemes/projects/procurement contracts documents and specifications, the later shall prevail.

I would like to extend my sincere thanks to the Group of engineers, all chief Engineers, QC wing team and all those who rendered their contributions through suggestions.

Obviously Manual of this kind is not a onetime affair. It has to evolve and grow with experience and the new challenges in future. Therefore to keep the relevance of the utility of this document up to date, the users may kindly send their comments/suggestions to the Chief Engineer (Quality Control).



R.C. Mishra
Chief Engineer (Quality Control)
PHED, Rajasthan

PHED, Rajasthan
Quality Assurance & Quality Control Manual
Year 2021

IMPORTANT NOTES FOR USE OF QUALITY MANUAL

1. The QA&QC Manual does not attempt to suggest technical specifications as these are part of relevant Contract document and shall be followed as such.
2. Quality Assurance & Quality Control (QA&QC) Manual provides only guidelines for supervision of construction project/scheme and to ensure quality of material being procured and utilized in the department.
3. QA&QC Manual need to be read & interpreted with relevant IS Codes or relevant International standard/code in case Indian standards are not available. In case of any contradiction, the provisions of relevant IS codes/International Standards/Codes shall prevail.
4. If a particular IS code is revised/amended/upgraded, then different parameters & process provided herein with reference to that IS Code shall be adopted from the revised/amended/upgraded IS code.
5. If requirement of any particular contract document is stringent than mentioned herein, then the requirement as per contract document shall be adopted & implemented.
6. The Users are requested to bring in notice of Quality Control Wing of any error/ discrepancy in the document or any suggestion for improvement of this Manual at following address:

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Quality Control,

Public Health Engineering Department,

2, Jal Bhawan, Jacob Road, Jaipur

Or E-Mail with subject "QAQC Manual: Suggestions" to

E-Mail : ceqc.phed@rajasthan.gov.in

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ABBREVIATIONS

<i>Sl. No</i>	<i>Abbreviation</i>	<i>Description</i>
1.	AC	Asbestos cement
2.	BIS	Bureau of Indian standard
3.	BOQ	Bill of quantities
4.	°C	Degree Celsius temperature
5.	CCDU	Communication and capacity development unit
6.	CI	Cast iron
7.	Cm	Centimeter
8.	Cum	Cubic meter
9.	CWR	Clear water reservoir
10.	Dia	Diameter
11.	EE	Executive Engineer
12.	FC	Fully covered
13.	Fig	Figure
14.	GC	Galvanized corrugated
15.	GI	Galvanized iron
16.	GOR	Government of Rajasthan
17.	Govt.	Government
18.	HDPE	High density poly ethylene
19.	HRD	Human resources development
20.	ISI	Indian Standard Institution
21.	ITP	Inspection test plan
22.	JE	Junior Engineer
23.	Kg	Kilogram
24.	Kl	Kilo Litre
25.	Km	Kilo meter
26.	M	Meter
27.	MC	Manufacturer Certificate
28.	ml	Milliliter

Sl. No	Abbreviation	Description
29.	mm	Millimeter
30.	m ³	Cubic meter
31.	M&E	Monitoring and Evaluation
32.	NC	Not covered
33.	No.	Number
34.	OHSR	Overhead service reservoir
35.	O&M	Operation and Maintenance.
36.	PC	Partially covered
37.	PHED	Public Health Engineering Department
38.	PVC	Poly vinyl chloride
39.	PWD	Public works department
40.	QSC	Quality Surveillance and control
41.	QA/QC	Quality assurance /Quality Control
42.	QAP	Quality assurance plan
43.	QCF	Quality control format
44.	QC-M	Quality control of material
45.	QC-P	Quality control Process
46.	QCW	Quality Control Wing
47.	QS	Quality system
48.	RCC	Reinforced cement concrete
49.	Re / Rs	Rupee / Rupees
50.	SE	Superintending Engineer
51.	T	Tone
52.	TOR	Terms of reference
53.	TMT	Thermo-mechanically treated
54.	TP	Third Party
55.	WQM&S	Water quality monitoring & surveillance
56.	WTP	Water Treatment Plant

CHAPTER 1.

INTRODUCTION

CHAPTER 1. INTRODUCTION

This Quality Assurance & Quality Control Manual is prepared for the use of Public Health Engineering Department, Rajasthan. It is based on Various Quality Assurance practices, PWD specifications, requirement of the tender document for test of materials, Field/laboratory testing and relevant IS codes etc. This will provide a base document outlining policy, procedure, responsibilities, compliance acceptance criteria and documentation for carrying out tasks related to inspection, testing and reporting on various materials, items involved for the satisfactory completion of the work. In all cases however, it is important to understand that the contract documents including the technical specifications are the basis for execution of the construction. Quality Assurance Quality Control (QA/QC) Manual provides a guide line for supervision of construction project and to ensure quality of material being procured and utilized in the department.

A QA/QC Manual establishes a standard guideline for enabling supervisory staff to check different activities of construction in respect of technical specifications. Quality assurance plan serve as a road map to supervisory staff to ensure quality of project/Scheme works/ materials procured in the department.

1.1. BACK GROUND

Government of Rajasthan has undertaken implementation of multi town, multi village water supply projects/water supply schemes involving combination of components e.g. Raw water intake, Pumping stations, Transmission mains, Reservoirs, Water treatment plants, Clear water reservoirs, Transfer and distribution pipe networks, GLR's, ESR's, SCADA etc.

The Projects/schemes are unique in its nature and complexity, characterized by its spread across. In addition to this, department procures a large amount of material for schemes/ O&M of schemes. In view of this complexity, it is essential and important to put in place a comprehensive, consistent, and common system for quality assurance and control during implementation. This document has been prepared with this purpose in mind.

1.2. QUALITY DEFINITION

Quality is the totality of features and characteristics of a product for service that bears on its ability to satisfy the projects/Schemes functional requirements. The quality of output is always agreed upon between the supplier and the client (In project/Scheme works, Contractor and the employer, respectively), and the quality objective is to achieve zero defects with best quality of the project/Scheme works. This is possible only by ensuring quality control at every stage during progress of construction.

Quality is conformity to standards and requirements to achieve excellence. The following are some definitions pertaining to quality and how to achieve it.

- **Quality Assurance (QA):**

The planned and systematic actions and implementations necessary to provide adequate confidence that the work will satisfy quality requirements.

- **Quality control (QC):**

The operational techniques or a system of maintaining standards by reviewing, checking, inspecting and testing.

- **Quality System (QS):**

A set of documented processes, which seek to provide satisfaction that the project/scheme outputs will fulfill all the requirements for which it is being planned. The Quality System should fully incorporate the organization, human resources, materials, equipment, processes, inspections, testing and other parameters of the project/scheme. A key element of QS is the QA/QC Manual.

- **Quality Surveillance:**

This normally covers two aspects.

- At the project/scheme level, a review is required to ensure that the quality practices are implemented and documented to ensure in relation to the quality system.
- At the contract package level, inspection and testing is required to ensure that the works executed meet the required quality standards.

1.3. QA/QC MANUAL

This QA/QC Manual focuses on the implementation activities of the projects/schemes following contract award, primarily on supervision and quality control of construction works. The QA/QC Manual is intended to be used as guide line for supervision of construction activities, primarily by the field staff of the PHED.

It will provide a base outline towards, procedure, responsibilities, compliance acceptance criteria and documentation for carrying out inspection, testing and reporting on various materials, items involved for the satisfactory execution of the project/scheme work. In all cases, somehow, it is most important to understand that the technical specifications as specified in the contract document / agreement are the guidelines for any construction activity.

The QA/QC Manual for the Construction activity does not attempt to suggest technical specifications, since these are stated in the contract documents. Its aim is to ensure that the works are executed as per specifications to achieve best results.

Test results shall be interpreted as applicable for individual package/contract, in accordance with the technical specifications as specified in the conditions of contract.

1.3.1. Key Parameters of Quality Assurance

Quality system involves the various key tools which are generally practiced in the field for Quality Assurance System. The well designed quality assurance system will provide confidence that the project/scheme outputs will fulfill all the requirements for which it is being planned. The quality assurance system should have the following basic parameters.

- Site documents
- Mandatory and optional testing
- Availability of field laboratories
- Manufacturing test certificates
- Departmental team inspections
- Random inspections by QC wing
- Checklist guide for works
- Site inspections
- Post quality testing of finished works
- Post-delivery inspection of materials at divisional stores/ work sites
- Quality certification
- Monthly reporting and review meetings

CHAPTER 2.

ORGANISATION, RESPONSIBILITIES AND AUTHORITIES

CHAPTER 2. ORGANISATION, RESPONSIBILITIES AND AUTHORITIES

This section of the QA/QC Manual describes the organizational arrangements for projects/schemes/material procurement implementation and outlines the responsibilities of each organization.

2.1. PROJECT/SCHEME IMPLEMENTATION ARRANGEMENTS

1. Additional Chief Secretary/Principal Secretary, PHED is administrative Chief of PHED. Department has Chief Engineers, Additional Chief Engineers, Superintending Engineers, Executive Engineers, Assistant Engineers, and Junior Engineers for project/scheme planning, supervision of projects/schemes and O&M of schemes/projects in the state.

Water supply facilities are implemented by the PHED through CE/ACE/SE/EE/AE & JE in the Rural & Urban areas. Department has the primary responsibility for planning and implementing all the project/scheme components in time, within cost estimates and to the quality standards specified in the contract documents within their respective areas.

2. Quality Control Wing has now been created in the department for random quality inspection of different activities of construction during progress of water supply scheme/ project work and random post-delivery inspection of materials at work sites / divisional stores.

3. The details of the individual responsibilities of each wing related to various activities are laid down as below to avoid any misunderstanding. The list of responsibilities as enumerated below may all not appear to be of direct bearing on the quality, do contribute to clarity of responsibility and hence help organize the works better. This is only to facilitate smooth functioning and is not meant in any way to dilute the responsibilities and authority various wings have in their respective jurisdiction.

2.2. RESPONSIBILITIES OF KEY ORGANISATION/AUTHORITY

Table 2.1 identifies the responsibilities of each organization/Authority's to avoid any misunderstanding.

Table: 2.1 Responsibilities of Key Organizations/Authority Levels

Sl. No.	Task	Activities	Unit
1	CONTRACT ADMINISTRATION AND OVERALL SUPERVISION		
1.1	Administration and management of contracts including interpretations of technical specifications.	Management	PHED /Contractor

Sl. No.	Task	Activities	Unit
1.2	Drawings and designs	Submission	Contractor
		Review and Approvals	PHED
1.3	Provide layouts / levels for works. Checking of levels and layouts.	Primary	Contractor
		Secondary	PHED
1.4	Adequacy of the input such as material, labour, equipment with reference to technical requirement.	Primary	Contractor
		Secondary	PHED
1.5	Material register	Documentation	Contractor
		Review	PHED
1.6	Maintain work site in neat, orderly and safe manner.	Primary	Contractor
		Secondary	PHED
1.7	Minimize inconveniences to the public.	Primary	Contractor
		Secondary	PHED
1.9	Continuous on sites supervision during construction and ensuring safety.	Primary	Contractor
		Secondary	PHED
1.10	Monitoring of progress, completion of work within time, find cause of delay, remedial measures	Primary	Contractor
		Secondary	PHED
1.11	Fulfilling all contractual obligation, proper storage of materials, regulations, contract conditions, specifications and instructions.	Primary	Contractor
		Secondary	PHED
1.12	Ensuring that site order book is properly maintained.	Primary	Contractor
		Secondary	PHED
1.13	Test records and results are available for review and assessment.	Primary	Contractor
		Secondary	PHED
1.16	Preparation of drawing of completed works.	Primary	Contractor
		Secondary	PHED
1.17	Developing and implementing efficient O&M procedures and practices for Project/Scheme infrastructure, if applicable.	Primary	Contractor
		Secondary	PHED
2.00	QUALITY ASSURANCE AND INSPECTIONS		
2.1	Provide effective supervision of the works in order to ensure the quality and conformity with the standards and specifications	Primary	Contractor

Sl. No.	Task	Activities	Unit
	prescribed in the contract.	Secondary	PHED
2.2	Inspect all work sites regularly to ensure that the work is being implemented in accordance with the approved standards and that the quality control procedures set forth under the contract are followed.	Primary	Contractor
		Secondary	PHED
2.3	Take samples and test independently testing wherever considered necessary. Ensure that proper records of the tests conducted are maintained.	Primary	Contractor
		Secondary	PHED
2.4	Inspect interim work as required to accept or reject completion stages before permitting the contractor to proceed with further works.	Primary	PHED
		Secondary	Contractor
2.5	Inspect the completed works ensuring that any defects in materials or workmanship are properly identified in a timely manner.	Primary	Contractor
		Secondary	PHED
2.6	Conduct monthly inspections and site coordination meetings for all works to review the overall progress and quality of the works.		PHED
2.7	If any work item or construction material is sub-standard or unacceptable, deduct such work or supply of material from the progress payment or defer payment until the contractor rectifies the deficiencies.		PHED
2.8	Following expiration of the Maintenance Period/defect liability period, inspecting the works, identifying any defects in materials or workmanship, issuing the Maintenance Certificate and releasing the security deposit after satisfactory correction of all defects;		PHED
2.9	Post-delivery inspection of material at divisional stores/ worksites i.e. different type of pipes, submersible pump sets, CID Joints, Rubber rings, any other item used for PHED schemes/projects.		PHED

Contractors are responsible for the execution of the works in conformance with the requirements of the contract documents.

2.3. GENERAL RESPONSIBILITIES OF CONTRACTOR

As applicable for different nature of contracts, Contractors are responsible without prejudice to contracts provisions for providing but not limited to:

- All necessary plant, labour, equipment and construction materials to be used in the works;
- All plant, equipment, materials and labour for temporary and auxiliary works;
- All equipment and components to be installed or incorporated in the works;
- Transportation and storage facilities for all materials and equipment.
- Office and accommodation for staff and labour;
- Sanitation facilities at the site; and
- All necessary staff and equipment for testing and quality control.
- Fulfilling safety requirements at site as per contract
- Meeting contractual obligations regarding labour insurance , labour welfare etc

Contractors are responsible for executing and completing the works in accordance with the specified standards and specifications, within the contractual time allowed, and within the contract price for these works. On water supply SPR contracts, contractors are also responsible for preparing final design & drawing documents and obtaining their approval.

2.4. CONTRACTOR'S QA / QC DUTIES

The contractor's QA/QC duties are summarized in **Table: 2.2**. Apart from these other duties shall be performed as per the contract documents or directed by the Engineer In Charge, it is essential to keep certain documents at site for making a permanent record of each and every item related to the projects/schemes. Such items may include tests conducted at site, test certificates, instructions issued to contractor, record of drawings issued to the contractor, inventory of the material at site. All such site documents play an important role not only in assuring the quality of the work, but also in making the project/scheme management comparatively easier. All these documents with a definite identification number have been listed in Chapter - 3.

Table: 2.2 List of Contractor's QA/QC Duties

Activity/Item	Contractor's QA/QC Duties
Designs/Drawings for contract	• Maintain design / drawing register at site • Keep approved drawings at site with approval letter, which shall be legible and laminated • Use only approved drawings for construction

Activity/Item	Contractor's QA/QC Duties
Test laboratory and equipment, if applicable	- Intimate PHED the details, date of completion with requisite manufacturers' and calibration certificates of equipment. - Maintain the equipment in good condition and calibrate as necessary
Quality Assurance Plan (QAP) for Equipment	- Prepare comprehensive QAP for all the major equipment and other equipment as required by Contract Agreement & get approval from relevant authority. - Each QAP shall carry references of relevant IS/International Codes - Each QAP shall carry references of relevant paragraphs of Contract Agreement - There shall be no overwriting/cutting in the approved QAP
Material receipts Materials testing	- Enter receipts in material register - Materials to be tested only in approved laboratories - Prepare concrete mix proportions as per weight as required by contract and submit test results to PHED for approval. - Take test samples in presence of PHED representative - Perform material tests - Submit test reports to PHED with monthly reports and - Maintain test log - Keep all Equipment & apparatuses in Field Lab calibrated and functional and provide quarterly report on calibration to EIC
Rejected materials	- Entries to be made in material register at site - Tag and record all rejected materials - Intimate PHED in writing the proposed date of removal of material from site and confirm after removal
Material consumption	Enter daily consumption of materials in material register and indicate balance quantity
Construction equipment	- Intimate PHED the details, date of mobilization along with requisite insurance certificate - Maintain equipment in good working condition - Intimate breakdown of construction equipment
Construction	- Intimate PHED in writing when construction is going to commence and what activities are proposed to be undertaken - Intimate PHED in advance when critical works, such as concreting, embankment, paving, pipeline laying and jointing, testing, etc., would be undertaken, along with the test certificates of the materials proposed to be used in these works. No critical activity shall start unless the material is tested. Certificates are verified and approved by the Engineer-in-charge or their representatives. - To provide any other necessary QA/QC requirement.

Activity/Item	Contractor's QA/QC Duties
Daily work progress	To maintain in daily log.
Rejected work items	- Intimate PHED in writing the proposed date of removal from site and confirm after removal. - Rectify defective work and invite PHED for re-inspection.
Inspection of Engineer	- Take instructions in Site Order Book. - Intimate PHED regarding compliance.
Progress scheduling and control	Prepare and maintain project/scheme schedules and undertake work in accordance with approved schedule.
Reporting	Prepare and submit Monthly Progress Reports and other reports as per contractual requirements.
Records	Maintain the following records on Site/Contractor's Office/Laboratory & keep it updated. - Material Register - Site Order Book - Hindrance Register - Approved Construction Drawings - Test Reports - Site Laboratory Record - Permissions Issued by Departments - Copies of Monthly Progress Reports - Non-conforming item record - Any other records such as photographic evidence of tests conducted in lab as specified in the Contract and/or as instructed by the Engineer
Workmanship	All the work executed against the contract shall be of good workmanship.
Disposal of Debris	All the Debris should be disposed of properly after completion of construction work.

2.5. QUALITY CONTROL BY DEPARTMENTAL ENGINEERS DURING INSPECTION

The tenders are on item rate, percentage rate, lump sum etc basis and all the material is procured by the contractor or provided by department, hence to have a proper quality control and to improve the quality of work, the departmental engineers at various level will ensure the key parameters of quality assurance during inspections as per **Table 2.3**.

Table: 2.3 Quality Control by Departmental Engineers during Inspection

Sl. No	Key parameters of Quality Control	SE	EE	AEN/JEN
1	ENSURE UPKEEPING OF SITE DOCUMENTS			
1.1	Site Order book	✓	✓	✓
1.2	Material Register	✓	✓	✓
1.3	Concrete pour Record	-	✓	✓
1.4	Test Record	✓	✓	✓
1.5	Design and Drawing Record	-	✓	✓
1.6	Non-Conforming Item Record	✓	✓	-
1.7	Cube test record	✓	✓	✓
1.8	Hindrance Register	✓	✓	✓
2	WITNESS MANDATORY TESTING			
2.1	Concrete (Slump, Cube test)	-	✓	✓
2.2	Steel bars	-	-	✓
2.3	Hydro testing of pipeline	✓	✓	✓
2.4	Water for construction	-	-	✓
3	AVAILABILITY OF FIELD LAB EQUIPMENTS	<i>As per contract conditions</i>		
4	REVIEW MANUFACTURING CERTIFICATES			
4.1	Cement	-	✓	✓
4.2	Steel for Reinforcement and structural steel	-	✓	✓
4.3	GI Pipe / GI Fittings/ PVC /MS /DI/ HDPE/ GRP and any other pipes	✓	✓	✓
4.4	Flow measuring devices	-	✓	✓
4.5	Control Panel	-	✓	✓
4.6	Lightening arrestor	-	✓	✓
4.7	Level indicator and controllers.	-	-	✓
4.8	Chlorine/ Bleaching	✓	✓	✓
4.9	All types of pipe appurtenances	-	✓	✓
4.10	Pumps and cables	-	✓	✓

Sl. No	Key parameters of Quality Control	SE	EE	AEN/JEN
4.11	Any other item as per agreement	-	-	✓
5	DEPARTMENTAL TEAM INSPECTION (If required)			
5.1	DI, CI, PVC, MS, HDPE/MDPE/GRP, RCC pipes & pipes of any other material and valves	✓	✓	-
5.2	Pumps, Motors & cables	✓	✓	-
5.3	Electric Panels, SCADA, Switchyard, Reservoirs	✓	✓	-
6	FILL-IN CHECK LIST FOR WORKS (If required)			
6.1	Tube well	-	✓	✓
6.2	Laying and jointing of pipeline, Back filling, Hydro testing	-	✓	✓
6.3	Pump & machinery of Tube well	-	✓	✓
6.4	Disinfecting plant		✓	✓
6.5	Pump House	-	✓	✓
6.6	Development of Head works	-	✓	✓
6.7	O.H.S.R / C.W.R/ GLSR/GLR/RWR	-	✓	✓
6.8	Water treatment plant	-	✓	✓
6.9	Control panel for 3 phase pump & motor	-	✓	✓
6.10	Centrifugal pump and motor	-	✓	✓
6.11	Any other item as per contract agreement	-	-	✓

		CE	ACE	SE	EE	AE
7	PERIODICAL SITE INSPECTIONS	✓	✓	✓	✓	✓
8	POST QUALITY INSPECTION OF FINISHED WORKS	-	-	-	✓	✓
9	RANDOM POST DELIVERY INSPECTION OF MATERIALS AT STORES/ WORKSITES	-	-	-	✓	✓
10	QUALITY CERTIFICATION	-	-	-	✓	✓
11	MONTHLY REPORTING AND REVIEW	-	✓	✓	✓	✓

MEETINGS					
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2.6. THIRD PARTY AND CONSTRUCTION SUPERVISION CONSULTANTS

Department may engage a Third-Party Inspection agency or depute departmental agencies for factory/on-site inspection, sampling/testing of material to carry out these tasks on behalf of the department. Similarly, department may also engage Construction Supervision Consultants for supervision of construction work. All agencies such as TPI agencies, Construction Supervision Consultants etc shall be considered as representatives of Engineer-in-charge and shall have authority to perform duties as assigned to them in their respective work orders. Contractor shall provide all assistance & facilities to such agencies as required to be provided to department.

The engineer-in-charge shall inform the contractor at the earliest in writing of such agencies and their duties.

At the minimum, Contractor shall provide all assistance and cooperation to such agencies as follows;

- Contractor shall provide unhindered access to sites, stores, laboratories, tools & equipment, labour to such agencies
- Contractor shall provide access to all related records such as factory inspections, manufacturers certificates, test report, calibration certificates etc to such agencies.
- Contractor shall provide all assistance in inspection, sampling, packing, transportation, testing of samples from sites/stores etc.

2.7. DUTIES & RESPONSIBILITIES OF QUALITY CONTROL WING:

Officers of QC Wing shall carry out the inspection of Divisional stores/ ongoing works randomly. The concept of Random sampling has been adopted to have an external review of quality of works executed. The samples may also be collected as per direction of CE (QC), PHED.

Following are the duties and responsibilities of QC wing:

- Framing guidelines for Quality Control & Quality Assurance in the department, revisions in QA&QC Manual etc.
- Random post-delivery inspection for test check of materials and select samples for testing in approved laboratories.
- Physical inspection of the works under execution for quality and workmanship. Conveying the findings to concerning CE/ACE along with concerned EIC.
- Review of site documentation and contractor compliance.
- Sample verification of test reports and quality certificates.
- Review of issues, constraints and lacunae in quality system implementation.

- In case of post-delivery inspection of material, the concerned competent authority shall be intimated along with findings in writing to take necessary action.
- On receipt of report of rectification done, QC wing can re-check, randomly.

A sample inspection Quality Field inspection report is available at Appendix D.

2.8. ACCOUNTABILITY MATRICES FOR VARIOUS CONSTRUCTION ACTIVITIES

The responsibilities for inspection of works at different levels by departmental officers shall be as per the APPENDIX-F-1: ORDER No. 25588-827 DATED: 30-11-2010 REG.INSPECTOR NORMS OF DEPTT and APPENDIX-F-2: Order No 2439-2563 Dated 16-08-2013 regarding authority providing consent before approval.

Quality assurance is a process control and not the inspection of final construction. The EIC has to ensure that the Quality must be consistent throughout.

CHAPTER 3.

DESIGN CONTROL

CHAPTER 3. DESIGN CONTROL

This section outlines the design preparation and review processes and presents basic design review criteria. The design and drawing preparation responsibilities vary depending on the contract but in general it shall be as follows:

The designs & drawings shall be prepared and submitted by the contractor. The contractor shall submit these design/drawings to EIC. The EIC shall get these designs/drawings thoroughly checked.

Design control requirements are outlined below.

3.1. Design Preparation Process

Designs shall be prepared in accordance with the requirements of the Project, and applicable design standards and criteria, codes, specifications, and methodology. Final designs prepared by contractors shall be based on the preliminary designs concept prepared by department and tender drawings.

For design calculations performed by computer, the EIC shall verify design inputs and check outputs for reasonableness and compliance to requirements. Calculations prepared by hand shall be rechecked. The EIC shall check the prepared designs and documents for completeness, correctness and legibility.

Design documents and calculations shall be reviewed by EIC to ensure that the design method is acceptable and in accordance with the contractual design criteria, codes and standards, that the inputs are correct and the outputs reasonable.

Drawings will generally be prepared by computer aided design methods. As with design calculations, the EIC shall check drawings for completeness, correctness, legibility and conformance to the design calculations, design standards, codes and specifications.

Design documents, calculations and drawings shall be signed and dated by the draftsman (if applicable), the design engineer, and the reviewing representative of EIC And Engineer In charge should sign the same.

3.2. Design checking Review Process

The EIC or his representative, who reviews the design/drawing, shall examine the design documents, and if he has comments, prepare comment sheets and mark up a copy of the documents. If designs need to be reviewed by more than one person or agency, the primary reviewer shall consider the comments of other reviewers, discuss them as needed, and incorporate them into the marked up copy of the document.

Each design document and drawing shall be reviewed for compliance with contract requirements and specifications, applicable standards, codes and criteria. If the reviewer questions the accuracy of calculations or dimensions established by the contractor/designer, he shall ask the Contractor/designer to verify them but shall not change them himself.

THE EIC will provide a certificate for checking, reviewing & recommending or approving the design for approval as per competence.

The authority providing consent before approval shall be as per Letter No 2439-2563 dated 16-08-2013 as provided at Annexure F-2.

3.3. Design Review Checklist

A basic design review checklist is as follows:

- Check document revision number and revision dates (if applicable).
- Check that the contractor/designer has signed each page of the document and designing agency has put up its seal on documents.
- Verify the list of reference drawings and sources of special information and, as necessary, refer to the listed documents.
- Check the general notes for clarity and completeness.
- Review contract plans, specifications, addenda and all approved change orders, and check that the document complies with them.
- Check the accuracy and completeness of a representative set of calculations.
- Consider the aspect of constructability.
- Annotate the drawing, specification, addendum or other document as appropriate.
- Specific items to be checked depend on the type of facility being designed.

CHAPTER 4.

DOCUMENT CONTROL PROCEDURES

CHAPTER 4. DOCUMENT CONTROL PROCEDURES

It is essential to keep certain documents at site for making a permanent record of each and every item related to the project/scheme. Such items may include tests conducted at site, test certificates, instruction issued to contractor, record of drawings issued to the contractor, inventory of the material at site. All such site documents play an important role not only in assuring the quality of the work, but also in making the total management of the project/scheme comparatively easier. All these documents with a unique identification number have been listed in the end of Chapters as Appendix C.

Document control is an art for transmittal, receipt, recording, processing filing and retrieval of documents, and to ensure common format. The most important documents for QA/QC are final design documents, test reports and instructions. Document control procedures, including guidelines for correspondence control, are outlined below.

An important part of the Contractor/Junior Engineer/ Assistant Engineer's work as regards to QA/QC procedures is to keep adequate records. These records enable an appraisal to be made at any time of the progress of work, they form the basis of fixing an accurate assessment in monitoring the contractor's work, they enable all material to be ordered in proper time, they enable the designers to be assured that the assumptions made for design purposes are valid, they assist in the solving of new design problems that may arise during construction, and they form a source of information on the subsequent behavior of the completed works.

4.1. SITE ORDER BOOK

The contractor shall be responsible for a site order book, in triplicate, at the site of work at all time, and this shall be open for inspection by authorized representative of PHED. The site order book has two primary purposes to record day to day instructions given to the contractor and the contractor's compliance with these instructions, and to record the inspections and expectations of work completion stages along with issuing approvals to the contractor to proceed with the next stage of constructions.

As noted above the status of the contractor's compliance with instructions issued is to be summarized in the site order book, Format No. C/QRF-1 of Appendix C and reviewed monthly by the PHED and during the periodic random checks. In cases where the contractor has failed to comply with the instructions the reasons therefore shall be determined and necessary remedial action required to be taken.

The Site Order Book shall be numbered and certified by AE/JE for such numbering at start of book.

4.2. MATERIAL CONTROL

All the materials procured for the construction activities of the scheme as required in the contract agreement shall be entered in the material register by the contractor and shall be open for inspection by all the engineers of PHED.

The report of input materials will be recorded in the Material Register in the form of ledger, using Format No **C/QRF-2** of **Appendix C**. This document shall provide overall information of materials requirement, consumed and balances on that date.

4.3. DAILY PROGRESS REPORT

Daily Progress Report is an essential Document for complete monitoring of the progress of work. It concentrates on extracting the information for the work completed during the day, how many men were engaged on each part of the project/scheme, details of the delays, and other related and pertinent issues. Report shall be maintained by contractor as per format No **C/QRF-3** of **Appendix C**.

4.4. Concrete Pour Record

It is desirable to follow concrete pour card method. This is a method by which the contractor has to maintain record of all concreting work in a card form in accordance with the contractual provisions giving salient features of concrete mix proportions, water cement ratio, test to be carried out such as slump test, cube strength test. It shall be maintained by contractor as per Format No **C/QRF-4** of **Appendix-C**.

4.5. TEST REPORT CONTROL

All the tests and field checks are to be carried out as per the applicable quality control requirements. If tests are to be carried out by the contractor at site lab, he will designate an experienced Laboratory-in-charge who attains proper knowledge about testing of materials (Laboratory-in-charge should preferably be a civil engineer) and should be authorized to sign test reports for him. EIC or his representative shall keep close watch on calibration status of all measuring equipment & apparatuses. The witnessing officer will sign the reports and put his name and designation. The test record shall be maintained by the contractor using the format No **C/QRF-5** of **Appendix C**. The contractor shall maintain all test records properly.

The test reports shall be submitted by the contractor to the EIC in each month.

4.6. DESIGN & DRAWING CONTROL

All the designs and drawings shall be submitted by contractor and approved by PHED. After approval the same be provided to the contractor will be recorded in the Design/Drawing register using Format No **C/QRF-6** of **Appendix C**. Any change in design or drawing from time to time shall also be recorded in it.

At every working site, the contractor shall ensure that all related drawings are available at site and to comply following;

- Only approved drawings shall be used for construction work. There shall be no overwriting on the approved drawings. If there is any overwriting, it must carry initials of approving authority.
- All drawings shall be of discernible & legible.
- All drawings shall be laminated
- All drawing shall accompany with the approval letter.

4.7. NON-CONFORMING ITEM RECORD

Any material found non-conforming (Material deviating from the approved standards) by PHED, the Non-Conformance Report (NCR) about the work will be issued by the EIC, using Format No **C/QRF-7** of **Appendix C**. In case of the defects of works for which notice has been given to the contractor and if he failed to correct the defects in a specified time the Engineer-in-charge will take suitable action against contractor as per provisions of Contract Agreement.

4.8. HINDRANCE REGISTER

During the execution of works, all hindrances in execution of the works shall be recorded in Hindrance register, which shall be maintained as per current PWFAR, and signed by representative of PHED and contractor.

Period of Hindrance of execution of work with detailed reasons of hindrance shall be maintained in the Hindrance register. The Hindrance register shall be issued by the authority executing the agreement and shall be numbered..

This register shall always be available for review for inspecting authorities. The register shall be maintained in Format No **C/QRF-8** of **Appendix-C**.

4.9. OTHER RECORDS

Other records as per item 4.9.1 to 4.9.3 are also required as per site requirement and direction of EIC, which shall be maintained by Contractor/Junior Engineer/Assistant Engineer. This will provide healthy information about the project/scheme as and when required.

4.9.1. Pipe Laying Record

Where long pipelines are laid it is usual to produce a pipe-laying record book which itemizes in sequence the laying of pipe and fitting which has been laid.

Water pipe line should have a detail of type of pipe, size of pipe, type of joint, bedding condition, offset from the permanent nearby permanent objects specials, depth of cover, results of pressure testing, details of appurtenances and ancillary structures should be recorded.

The pipe laying record shall be maintained in format provided at A/TR-20.

4.9.2. Completion Record and Drawings

As built records are very important and consist of pictorial records (the Record Drawings, etc.) of all the work as completed, showing the whereabouts regarding dimensions of all parts as they exist at completion, together with factual descriptions of their origin, operation and their performance under test.

The work on record drawings should continue throughout the contract, a special set of contract drawings being provided on which the Contractor/Junior Engineer/Assistant Engineer marks out all deviations from the original design from time to time, where extensive alterations are encountered, or where preliminary surveys are made, completely new record drawings will have to be made.

Where pipes are laid underground special care must be taken to chart the course of these pipes accurately, marking valve and stopcock positions and hydrants. The only way to get a really permanent record of the positions of such valves, etc., is to measure the distance from buildings and 'tie-in' by two or more measurements. Measuring from frontages, or from kerb lines or road centre's, gives only transitory information, as these reference lines may later be altered in position.

4.9.3. Other Quality Record

The contractor shall maintain all other quality control record and keep it ready for inspection by department's representative as detailed below;

- Factory Inspection Reports
- Manufacturers certificates
- Quarry, Make approval letters
- Approved Quality Assurance Plans (QAPs) of material, equipment, tools etc
- Design Mix Reports
- Geotechnical investigation reports
- Tests reports for samples got tested from external laboratories

4.10. TRACKING OF INSTRUCTIONS

During the process of construction, different agencies are expected to conduct site visits and instruct the contractor to ensure quality and timely construction within the costs to the extent possible. The multiplicity of agencies is a special feature of the

Project/scheme. Hence there may be some ambiguity in the instruction flow if these are not transmitted and recorded properly.

All the instructions to the contractor shall flow through the EIC or its representatives of PHED. The instructions are of the following types:

1. All instructions related to the contract administration including approval of the contract variation orders, time extensions, notices related to rate of progress etc.
2. The instructions regarding quality, testing, monitoring and work scheduling can be issued by the PHED.
3. Instructions issued during site visits or inspections which are normally recorded in the contractor's Site Order Book and
4. Instructions issued during review meetings in the form of minutes, letters, etc.

All instructions noted above are to be recorded by the contractor in the Instruction Log. Instructions also include notices of rejection of work inspected because it was found to be non-conforming to requirements and which has to be redone or rectified.

CHAPTER 5.

CONSTRUCTION QUALITY CONTROL

CHAPTER 5. CONSTRUCTION QUALITY CONTROL

This section provides an overview of construction quality control activities, including testing and site inspection. Materials control requirements are presented in detail here while specific testing and inspection requirements for each category of works are presented in Chapters 6 to 9 of this Manual.

5.1. INTRODUCTION

Construction Quality Control (CQC) is intended to provide a comprehensive, common and consistent framework for quality control across various contract types. CQC comprises two main elements of quality control:

- Testing
- Inspections

Testing control covers the type of tests to be carried out, frequency of testing and stage of testing.

Inspection control covers the timing of inspections, what to be inspected and the inspection procedures. CQC should be affected at five stages:

- Input Materials and Equipment Components
- In-process Activities
- Stage Completion
- Interfacing to other components and/or projects
- Final completion

The contractor is responsible for informing EIC giving sufficient notice time so that they can witness the tests.

5.2. TESTING

Various field tests on materials and works are required to be carried out by the contractor during construction.

5.2.1. Field Laboratory

A well-equipped and properly operating field test laboratory is an important feature of quality assurance plan. The Contractor shall have to establish a well-equipped laboratory for every work order if cost of civil work components (excluding pipe, valves & EMI works cost) in the work order is equal or more than Rs 100.00 lacs. A comprehensive list showing testing equipment / Apparatuses/ Instruments required in site laboratory is presented in **Table 5.1**. All equipment/apparatuses/instruments shall be maintained in field laboratory considering the construction work under the contract. Any other Equipment/

Apparatuses/ Instruments required as per requirement of work and contract, or not required beyond this list may be added or deleted from this list with prior permission of Engineer-in-Charge.

Table: 5.1 List of Equipment/ Apparatuses/ Instruments For Field Laboratory

S.No.	Particulars
1	Cube Testing Machine - Digital - 2000 kN
2	Cube Testing Machine - Hand Operated - 1000 kN
3	Concrete Cube Moulds 15 cm x 15 cm x 15 cm
4	Slump Testing Apparatus
5	Plumb of suitable weight to check Verticality of stagg
6	Vibrating Platform
7	Cement Mortar Cube Moulds 10 cm x 10 cm x 10 cm
8	Elongation Gauge
9	Flakiness Gauge
10	Aggregate Impact Value Test Apparatus
11	Standard Test Sieves (200 mm Dia, Brass) 2.0 mm, 1.17 mm, 425 micron, 212 micron, 90 micron
12	Standard Test Sieves (200 mm Dia, Brass) 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron, 150 micron, 75 micron
13	Standard Test Sieves (450 mm Dia, GI) 45 mm, 25 mm, 20 mm, 16 mm, 12.5 mm, 11.2 mm, 10 mm, 6.3 mm, 4.75 mm
14	PVC Jar Cylinder, 1000 ml
15	PVC Jar Cylinder, 500 ml
16	PVC Jar Cylinder, 100 ml
17	Electric Hot Air Oven
18	Dry Bulk Density Apparatus (Sand pouring cylinder, tray, can etc) complete
19	Core Cutter Apparatus 10 cm dia, 10/15 cm height complete with dolly, Hammer etc
20	Rapid Moisture Testing Apparatus
21	Digital Vernier Caliper - Inside Outside - LC - 0.01 mm
22	Digital Thermometer
23	Measuring Tape 30 meters
24	Digital Screw Gauge
25	First Aid Box
26	Balance 20 kg capacity self indicating type
27	Electronic balance 5 kg capacity - LC - 0.5 gm
28	Pie Gauge
29	Hydrostatic Testing Apparatus
30	Calibrated Pressure Gauge
31	Root Gap Gauge
32	Weld Gauge
33	Digital Tong Tester
34	Portable Temperature measuring Equipment

S.No.	Particulars
35	Illumination measuring equipment
36	Portable Tachometer
37	Ultrasonic gauge for thickness measurement of coating, lining and MS/DI plates

The contractor shall set-up, if required, the site laboratory within 15 days or the period specified in contract agreement after getting letter to proceed/ or as per instructions of Contract Agreement and inform the EIC for conducting inspections. Laboratory equipment shall be properly calibrated, and certificates and its updating as and when required should be kept at the laboratory for review by PHED as necessary. Specialized tests at outside laboratories shall only be undertaken with the prior approval of the PHED.

5.2.2. Tests in Field Laboratory & Test Records

Tests should be performed in accordance with the contract documents. All test samples should be preserved in a sealed container, with proper identification numbers, test log reference, test date, and other applicable information. These samples must be stored at contractor's office/laboratory by the contractor.

The contractor shall maintain proper test record for all tests conducted in field laboratory. Contractor shall submit a copy of all test record to Department on monthly basis.

Sample Formats for different test to be conducted at field lab or at sites are provided at Annexure – A.

5.2.3. Specialized Tests

In addition to tests performed on site, the contractor is responsible for specialized tests which are performed at approved laboratories, and for factory inspections and tests performed by manufacturers or third parties during the manufacturing of various materials and equipment components, as stipulated in the contract documents.

5.3. INSPECTIONS OF SITES

Regular Inspections of sites must be carried out to ensure that the construction activities and construction materials conform to the relevant standards.

5.3.1. Periodical Inspection for Quality

Officers/ Engineer of PHED shall carry out periodic quality inspections during in- process, stage completion, interfacing and final completion, and during all critical activities component wise as per the following examples in **Table 5.2;**

Table: 5.2 List of suggested Activities Component Wise

Sl. No.	Component	Suggested Activities
1	Pipe line	• Completion of excavation Trenches for Pipe laying • Laying and jointing of pipes in correct alignment. • Pressure/leakage Testing of pipeline • Backfilling in layers and watering, Disposal of surplus earth & debris, site cleaning & dressing.
2	OHSR/CWR/GLSR/RWR	• Centering and shuttering for R.C.C. works • Verticality checking by the use of plumb of suitable weight • Placing of reinforcing steel • Concrete mixing, vibrating and pouring • Testing for water tightness • Curing
3	Electro Mechanical	• Installation of electrical and mechanical equipment such as Pump & Machinery and Disinfecting units etc. • Testing, trial runs and commissioning of electro- mechanical equipment and plants
4	Tube Well	• Drilling • Lowering of Assembly • Verticality Test
5	Pump House	• Mortar proportion in Brick masonry • Centering and shuttering for R.C.C. works • Placing of reinforcing steel • Concrete mixing, vibrating and pouring • Curing
6	Water Treatment Plant with units as; i. Intake works and inlet channel ii. Storage cum Sedimentation tank Flash Mixer & Clariflocculators iii. Wash Water Tank iv. Filter beds v. Clear water tank	• Mortar proportion • Centering and shuttering for R.C.C. works • Placing of reinforcing steel • Concrete mixing, pouring and vibrating • Curing • Grading of filter media • LDPE sheets • Water tightness • Hydraulic losses • Efficiency of plant

The PHED shall also inspect the materials certified by manufacturers, materials and equipment components upon delivery to the site. The contractor shall give advance notice to the PHED when critical activities are proposed or major equipment items are to be delivered. On completion of one stage of the construction and before proceeding to the next stage the engineer in charge of PHED shall inspect and certify the quality of the

works completed before granting approval for the next stage of the works to start. The final inspection shall encompass tests on completion and trial runs. The certification of quality will be based on the documents and the periodic site visits.

5.3.2. Random Sampling

The concept of Random sampling has been adopted to have an external review of quality of works executed. The random sampling should be conducted by the QC Wing / PHED Officers following the procedure detailed out in this document.

5.4. CHECKLIST GUIDE FOR WORKS

All the works has to be executed as per specifications given in the agreement. For checking of these works check list are designed and the sample formats are given in **Appendix B**.

5.5. QUALITY CERTIFICATION

PHED officers shall be responsible to certify that the items included in the Contractors interim payment certificate satisfy the required quality of works and are acceptable with regard to the specifications and standards prescribed under the contract before the running bill is passed for payment. A format of this quality certification is included in Appendix-B, as format B/CL-12.

CHAPTER 6.
CONTROL OF MATERIALS AND EQUIPMENT

CHAPTER 6. CONTROL OF MATERIALS AND EQUIPMENT

This section on control of materials and equipment gives an overview of control requirements for construction materials and equipment including field testing, manufacturer's certification, departmental team inspection for materials, efficiency of equipment and calibration of equipment.

6.1. GENERAL

General Control and approval of construction materials and equipment to be incorporated in the works shall be based on the following;

- Brand for cement, Steel & other structure material, quarry & source of sand and aggregate, source of water for construction shall be approved by EIC. In case of any change, same shall again be got approved by EIC.
- Manufacturer's certificates and IS mark for manufactured items indicated in Table 6.3 or as stipulated in the contract;
- Third party inspection, if any, for various items as per contract documents.

6.2. MANDATORY TESTS PERFORMED AT SITE

The material to be tested on site include cement, water, aggregates for concrete, bricks, stone, soil for embankment etc. For aggregates & soil, the contractor shall obtain the approval of source or quarry from the Engineer-in-Charge. The list of material to be tested on site is given in table below;

Table 6.1: List of Material to be tested on site

S.No.	Material	Test Procedure No
1	Cement (to be procured from manufacturer along with test certificates, also to be got tested at site)	TAS-01
2	Sand	TAS-02
3	Water for Construction (can be got tested from approved laboratory)	TAS-03
4	Bricks	TAS-04

S.No.	Material	Test Procedure No
5	Size Stone	TAS-05
6	Coarse Aggregate for concreting	TAS-06
7	Steel (to be procured from manufacturer along with test certificates. Also to be got tested from approved laboratory)	

Table 6.2: Procedures for Testing Materials on Site

CEMENT			TAS-01	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Normal consistency	A/TR-2	One for each source and when called for by the Engineer	On receipt of material at site and before using as directed by the Engineer. Test certificate to be produced to the Engineer before use.
2	Fineness	A/TR-2		
3	Setting time – Initial / final	A/TR-2		
4	Compressive strength - 72 hrs, 168 hrs, 672 hrs.	A/TR-2		
For sulphate resistant cement as per IS-12330 OPC 43/53 shall conform to IS 8112/ 12269 and both 56 and 90 days strength shall be tested.				

SAND			TAS-02	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Sieve analysis	A/TR-3	One test for 15 m ³	On receipt at site and test certificate to be produced to the Engineer before use.
2	Fineness modulus	A/TR-3	One test for 15 m ³	
3	Deleterious constituents	A/TR-3	One test for 15 m ³	
4	Bulking test	A/TR-3	One test per Source	

WATER FOR CONSTRUCTION WORKS			TAS-03	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Alkalinity and acidity as per IS-3025	A/TR-1	Once per source of supply and when called for by the Engineer	Before use of water from that source
2	Solids	A/TR-1		

BRICKS			TAS-04	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Compressive strength	A/TR-4	One test per 50,000 bricks or part thereof	On receipt at site
2	Physical properties	A/TR-4		
3	Water absorption test	A/TR-4		

SIZE STONE			TAS-05	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Water absorption test	A/TR-5	One test per source and when called for	On receipt at site
2	Dimension check	Lab format	As directed by the Engineer	
3	Type of rock	Lab format		

COARSE AGGREGATE FOR CONCRETE			TAS-06	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Aggregate Impact or Los Angeles Abrasion Value as per IS-2386 Part-IV	A/TR-7 A/TR-8	One for each source of supply and when called for by the Engineer	On receipt of material at site
2	Soundness as per IS2386 Part-V	Lab Format		
3	Alkali Aggregate Reactivity as per IS-2386 Part-IV	Lab Format		
4	Flakiness Index	A/TR-9		
5	Gradation by wet sieve analysis	A/TR-6		

COARSE AGGREGATE FOR CONCRETE			TAS-06	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
6	Water Absorption	A/TR-5		
When required, the contractor shall furnish the mix design along with material properties at least 15 days in advance.				

Test report formats are included in **Appendix A**. The reports are to be maintained in a bound register, where in 3 copies of report will be prepared, two copies to be submitted with monthly report to PHED and third copy to be retained by contractor.

6.3. MATERIALS AND EQUIPMENTS CERTIFIED BY MANUFACTURER

Acceptance of certain manufactured materials and equipment components, as stipulated in the contract, shall be based on test certificates from the manufacturer conforming to IS and on visual inspection. These items shall bear the IS mark. PHED shall review the manufacturers' certificates for conformance to contract requirements before these items are delivered to the site. Upon their delivery and before their installation or otherwise incorporation in the works PHED shall inspect the condition of these items. Inspection criteria shall be decided by PHED. They may decide to have the material additionally tested in Laboratory. The cost of such tests will be borne by the contractor.

Random post-delivery inspection of materials may be done by QC Wing and sample may be sent to approved laboratories for testing. If there is report of failure, concerning Engineer-in-charge (EIC) along with all concerned officers shall be intimated to take action as per contract agreement and terms & conditions.

The List of material for which the manufacturer's certificates shall be required is as given in **Table 6.3**.

Table: 6.3 List of Material and Equipment Certified by the Manufacturer

Sl. No	Description
1.	Cement
2.	Steel for Reinforcement and structural steel
3.	Pipe such as GI , PVC , MS, CI, HDPE etc. (for building work only)
4.	Manhole covers and Footrest
5.	GI/Fiber glass sheets AC/
6.	Electrical cables/fans and fixtures
7.	Switches/sockets and boards
8.	Lightening arrestor

Sl. No	Description
9.	Water Level indicator and controllers.
10.	All type of specials such as PVC, GI, CI etc. (for building work only)
11.	Sanitary Fittings
12.	Laboratory Equipment
13.	Batteries
14.	All types of valves such as sluice valve, Air valve etc. (for building work only)
15.	Any other item as per contract agreement

6.4. MATERIAL AND EQUIPMENTS INSPECTED BY DEPARTMENTAL TEAM/THIRD PARTY AGENCY AT THE FACTORY

Materials and equipment to be inspected by Departmental Team/Third Party agency vary from package to package, as stipulated in the contract documents. Departmental Team/Third Party inspection would normally take place at the factory during or upon completion of manufacture. Upon delivery and before installation or incorporation in the works, PHED/Third Party shall inspect the physical condition of these items and, if necessary, test them on site. Inspection criteria should be stipulated in the contract document. Refer to **Table 6.4** for a list of materials and equipment suggested for inspection by PHED.

Table 6.4: Material and Equipment Inspected by Departmental Team/Third Party at the Factory

Sl. No	Description
1.	Pipes such as DI, PVC, MS, HDPE, MDPE, RCC, BWSC etc
2.	All types of pipes appurtenances Butterfly Valves, Sluice Valves, Reflux Valves, Air Valves, Control Valves
3.	Pumps, Motors, Cables,
4.	Switchgears, control panels, Starters, Transformers, Cable Trays
5.	Flow Measuring Devices
6.	Cranes & Lifting tackles
7.	Battery Charges, DC Distribution Panel, Bus Duct
8.	Motor Control Centers
9.	Capacitors

Sl. No	Description
10.	All other items required and specified in the contract

6.5. MATERIAL AND EQUIPMENTS TEST INSPECTED BY QUALITY CONTROL WING OF PHED :

The material and equipment can be randomly checked by QC Wing or any other officer designated by department, once it has been reached at the site/store or divisional stores i.e. Post-delivery inspection randomly regarding make, size, no. of samples, location.

6.6. Divisional Stores

The divisional officers are responsible for assuring that quality of all the material received in divisional store/ or sites is as per required standards. All material shall be inspected/ tested by the officers on receipt of material at divisional store or site. Moreover, all material shall be stored in divisional store as per recommendations of relevant Indian Standards.

A committee off Executive Engineer and Divisional Accountant was constituted for quality assurance of material before accepting the same in divisional store issue vide Chief Engineer (U&NRW) Circular No HGIII (3404)/TPI/10-11/24267-301 dated 19-11-2001 and is available at Annexure F-5. The inspection shall carry out all the tests required by Rate Contract/Contract Agreement and record the test measurements in separate sheets and keep this test record safe for any inspection.

To ensure the quality checks, each divisional store shall keep, at minimum, following test equipment:

- Pipe hydraulic test bench
- Submersible pump test bench
- Digital weighing machine
- Measuring Tape
- Digital Screw Gauge
- Digital Vernier Caliper
- Inside & Outside calipers
- Steel Ruler
- Pi scale

It is of utmost importance to document all quality related document to implement quality control & quality assurance system. For this purpose, all divisional stores shall maintain following record;

- All relevant IS Codes

- All relevant Contract agreements/rate Contracts/Work Orders
- Calibration certificates of test equipment in divisional store
- Manufacturers Test Report/certificates of all material received in Divisional store
- All test measurement record for test carried out in divisional store.

CHAPTER 7.
CONTROL OF CIVIL & STRUCTURAL
WORKS AND WATER RETAINING
STRUCTURES

CHAPTER 7. CONTROL OF CIVIL & STRUCTURAL WORKS AND WATER RETAINING STRUCTURES

This section of the QA/QC Manual covers the testing of works and the inspection of workmanship for general civil and structural works. The key elements to be inspected in these works are concreting, stone masonry, brickwork and finishes. The requirements for testing and control of materials for these works are outlined in Chapter 6.

7.1. Construction Sequence and Control Flow Charts

Flow charts indicating the construction sequence and control points for cement concrete and mortar works are shown in Figure 7.1 and 7.2 respectively.

7.2. Preparatory Works required;

It shall be responsibility of contractor to keep all related works/documents ready at site before commencement of construction work as summarized below;

- A. Machinery
 - i. Concrete Mixer
 - ii. Weigh Batcher
 - iii. Vibrators
 - iv. Mechanical lifting arrangement (For OHSRs and other structure with Height more than 6.0 meters)
 - v. Water lifting arrangement for curing
- B. Safety Equipment
 - i. Helmets
 - ii. Gloves
 - iii. Safety Boots
 - iv. Safety Nets (For OHSRs & High rise structures)
 - v. Safety ropes and harnesses
- C. Others
 - i. Field laboratory, if required
 - ii. Slump Apparatus
 - iii. Cube Moulds for Cement Concrete and Cement Mortar

- iv. Water Pit for curing samples

D. Documents

- i. General Arrangement Drawing (legible & laminated) of Structure with Approval Letter
- ii. Structure Design (legible & laminated) of Structure with approval letter
- iii. SBC Report
- iv. Design Mix Report
- v. Manufacturers certificate for Cement & Steel
- vi. Test Certificates of Cement, Water, Coarse Aggregate, Fine aggregate, Steel

For design mix, the field officers are required to follow the instructions issued by a QC Wing Circular No: F()/ACE(QC)/Inspection/18-19/10815-11156 Dated 16-01-2021 (Available at Appendix F-6).

7.3. Testing of Works

The works to be tested on site include excavation, cement concreting, stone masonry, brick masonry, finishes etc. All the materials proposed to be used in these works must have been tested by the contractor and approved by the EIC well in advance of these works.

The contractor shall conduct tests as stipulated. The Representative of Department will witness required number of the entire test conducted. The contractor shall obtain the approval of the Department when a particular stage is completed and before proceeding to the next stage.

The sampling & testing requirement for different works are available in Annexure E.

7.4. Quality Records

All quality related record of any construction site shall be maintained at that site. If laboratory is located at a different location then at-least a copy of all quality related document shall be available at construction site.

- i. Concrete Cube Testing reports
- ii. Concrete Slump Test reports
- iii. Cement Mortar Cubes testing report
- iv. Steel, Cement, Fine Aggregate, Coarse aggregate Test Results, as required.
- v. Brick Test Reports
- vi. Any other such reports/record required by Engineer-in-charge
- vii. All other documents mentioned in Chapter 3 of this manual.

7.5. Inspection Checklists

Inspection checklists for concreting, stone masonry, and brick masonry work and finishes, and building services and finishes are presented in Appendix B.

FIG 7.1 : PROCESS CHART FOR CEMENT CONCRETE CONSTRUCTION WITH TESTING & INSPECTION REQUIREMENTS

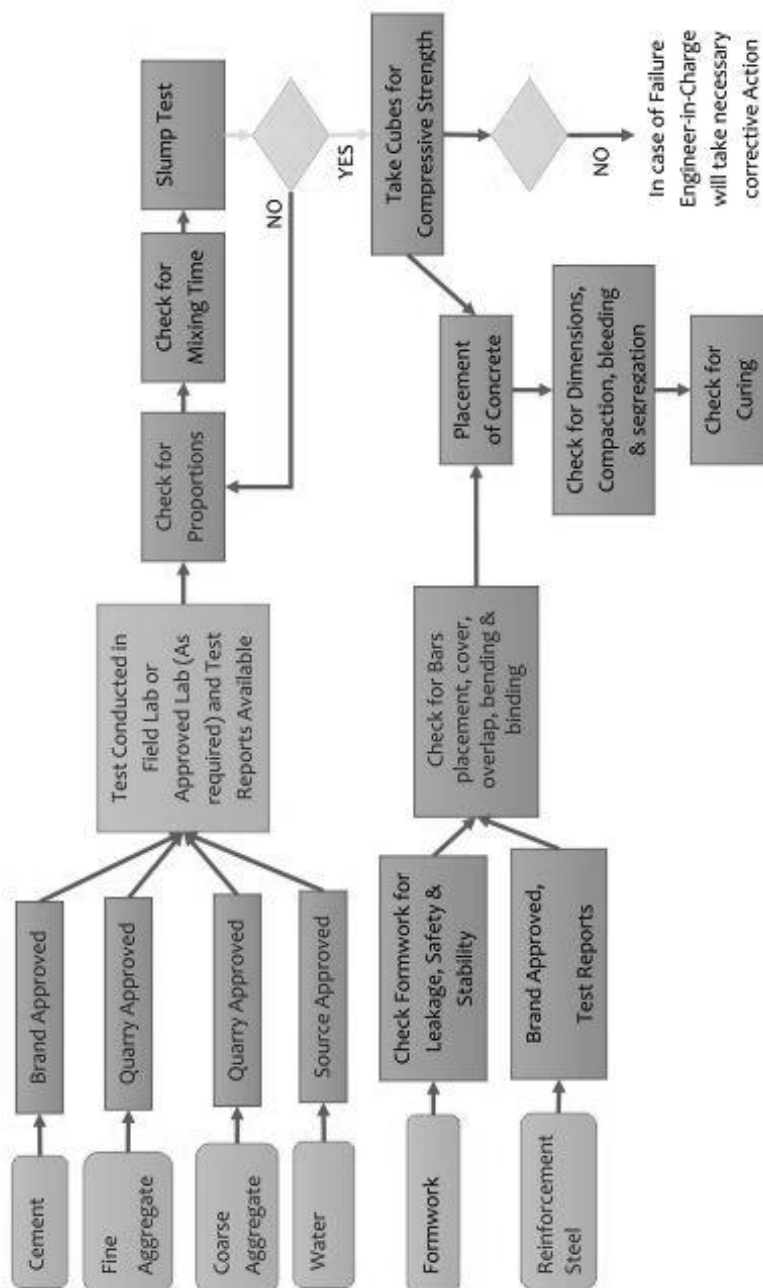
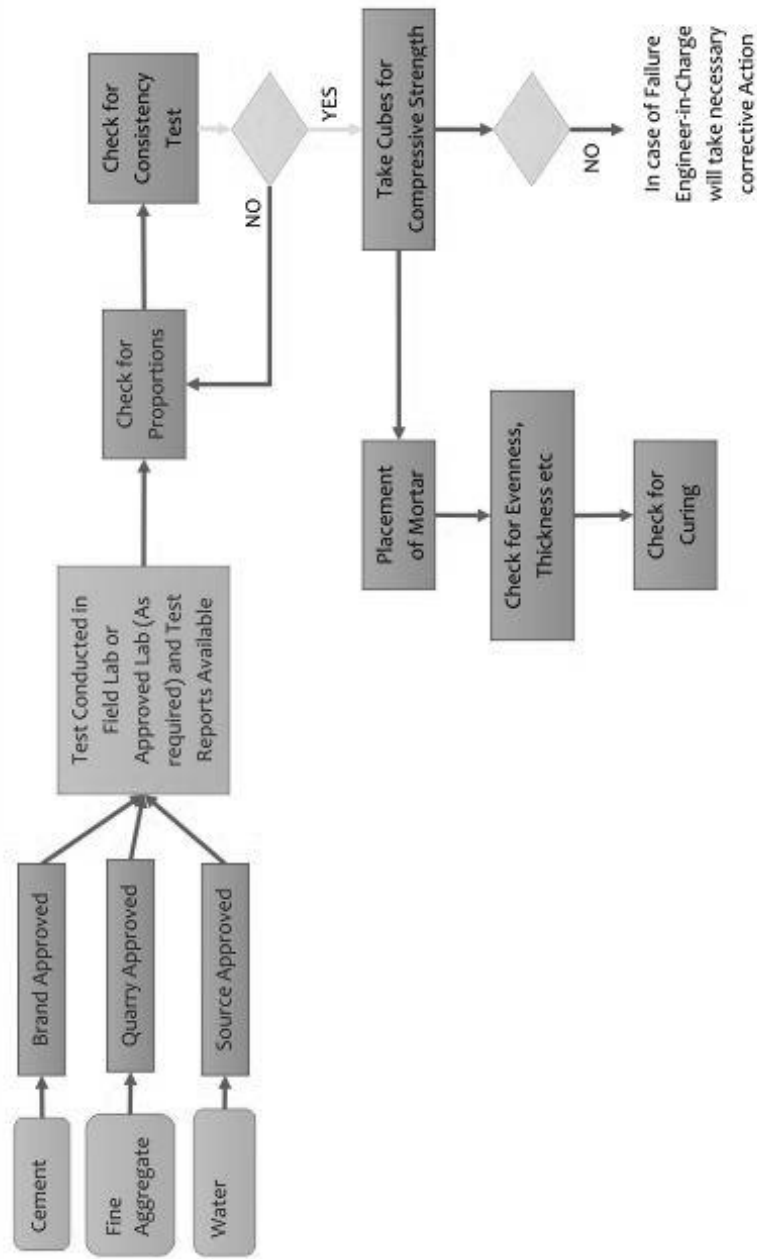


FIG 7.2 : PROCESS CHART FOR CEMENT MORTAR CONSTRUCTION WITH TESTING & INSPECTION REQUIREMENTS



7.6. Testing of Civil & Structural works

The work to be tested on site include excavation, cement concreting, stone and brick masonry. All the materials proposed to be used in these works must have been tested by the contractor and approved by Engineer-in-charge well in advance of these works. The contractor shall submit the concrete pouring report to the Departmental Engineers as & when concreting is done, and shall obtain the approval of the Engineer-in-Charge or his representatives when a particular stage is completed and before proceeding to next stage.

Tests for General civil & structural works are listed in table below. Test procedures are presented in various tables in this chapter. Test report formats are provided in Appendices. The contractor shall conduct tests as stipulated.

Table 7.1: List of Tests for General Civil & Structural Works

S.No.	Process	Material	Test Ref No
1	Embankment formation	Soil/ Earth	MTR-01
2	Excavation/backfilling	Soil/ Earth	MTR-02
3	Concreting	Steel	MTR-03
		Cement	
		Coarse Aggregate	
		Sand	
		Water	
4	Stone Masonry	Size Stone	MTR-04
		Cement	
		Sand	
		Water	
5	Brick Masonry	Bricks	MTR-04
		Cement	
		Sand	
		Water	

Table 7.2: Procedures for Testing General Civil and Structural Works

Embankment Formation			MTR-01	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Moisture content as per IS-2720	A/TR-11	One test for each 250 m ³ of soil	In-process
2	Field density test as per IS-2720	A/TR-11	5-10 density tests for each 1000 m ² compacted area, or as directed by Engineer	
3	Compaction	Daily log	As per required number of passes	While compacting

Excavation/Backfilling			MTR-02	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Layout, slopes of excavation, benching and over-burden	Daily log	As directed by the Engineer	After excavation
2	Sub-soil water, shoring and strutting	Daily log		
3	Bottom levels and compaction	Daily log		
4	Soil classification	Daily log		
5	Backfilling and compaction	Daily log		After backfilling

Concreting			MTR-03	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Compressive strength as per IS-516	A/TR-13	- x One test for 1-5 m³ of concrete - x Two tests for 6-15 m³ of concrete - x Three tests for 16-30 m³ of concrete - x Four tests for 31-50 m³ + one set every 50 m³ of additional concrete work.	Test samples to be taken while pouring. Testing to be done as specified in contract.
2	Slump test per IS-1199	A/TR-14	Random checks throughout concreting as directed by the Engineer	Before pouring concrete
3	Inspection of steel reinforcement placement and bending, and formwork	Daily log	Before pouring concrete	Before pouring concrete
4	Concrete Pour Report	C/QRF-4	When pouring is done	Immediately after pouring

Mortar			MTR-04	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Compressive strength as per IS-2250	A/TR-13	One sample for every 2 m ³ of mortar subject to a minimum of three samples for a day's work	Test samples to be taken while before mortaring. Testing to be done as specified in contract.
2	Consistency as per IS2250	A/TR-15		

7.7. Scaffolding

All scaffolding shall be as per relevant Indian Standards. Engineer-in-Charge or its representatives shall ensure safe & proper scaffolding as per site requirement. It is preferable to use Steel scaffolding in specific conditions.

7.8. CONSTRUCTION OF WATER RETAINING STRUCTURES

In the case of Reinforced Cement Concrete (RCC) water retaining structures, only concrete mix proportions by weight shall be used. The associated quarry and source of sand and aggregate shall be approved by Engineer-in-Charge after satisfactory tests of aggregates. Mechanical mixing with mixtures is mandatory. Mechanical vibrators in sufficient number should be used for compaction of concrete. Hand compaction or manual compaction is not permitted under any circumstances. Adequate mixtures and vibrators, including standby should be available at site well before the start of concrete work.

Shuttering quality should be of good standard, as approved by the Engineer well before the fixing of any shuttering. Shuttering should be fixed in such a manner that no slurry or water seeps through the jointing or box outs. For this plastic tape, Plaster of Paris (POP), putty or other suitable sealants should be used at joints of shuttering.

The concrete should be kept moist throughout 24 hours a day for the specified number of days for adequate curing by flooding with water or by putting moist gunny bags. Adequate separate labour and supervisor should be deployed for curing work, in ensuring that this important component of the work is satisfactorily conducted.

Table: 7.3 List of Tests for Liquid Retaining Structures

Sl. No.	Activity	Material		Test Ref. No.
		Name	Format No.	
1	Concreting	Cement	A/TR-2	QC-LRS-01
		Sand	A/TR-3	
		Water	A/TR-1	
		Coarse Aggregate	A/TR-6 to A/TR-9	
		Steel	Lab Format	
2	Completion of Liquid Retaining Structures (Wet Wells, Storage Reservoirs, Pretreatment Units, RCC Open Channels, etc.)	Stage Completion Test		QC-LRS-02

Table: 7.4 Procedures for Tests for Liquid Retaining Structures

Concreting			QC-LRS-01	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Compressive strength as per IS-516	A/TR-13	- x One test for 1-5 m³ of concrete - x Two tests for 6-15 m³ of concrete - x Three tests for 16-30 m³ of concrete - x Four tests for 31-50 m³ + one set every 50 m³ of additional concrete work.	Test samples to be taken while pouring. Tests to be done as specified in the contract.
2	Slump test per IS-1199	A/TR-14	Random checks throughout concreting period as directed by the Engineer	Before pouring concrete
3	Steel reinforcement placement and bending	Daily log	Before pouring concrete	Before pouring concrete
4	Concrete Pour Report	C/QRF-4	When pouring is done	Immediately after pouring

Completion of Liquid Retaining Structures			QC-LRS-02	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Water tightness for underground structures	A/TR-17	One test per structure	On completion of stage
2	Water tightness for above ground structures	A/TR-18	One test per structure	

The testing of materials to be used in the Works, or of the quality of finished items shall generally be done in field laboratory or in a laboratory approved by the Engineer-in-Charge or his representative. The following tests shall be carried on a routine basis:

- a) Gradation and specific gravity of coarse and fine aggregate to be used for concrete work.

- b) Moisture content in fine and coarse aggregates, bulking of sand of fine aggregate.
- c) Determination of fines and deleterious materials, organic impurities and light weight places in coarse and fine aggregate.
- d) Workability tests on concrete by means of slump cone.
- e) Determination of the crushing strength, absorption and efflorescence of bricks.
- f) Concrete cube crushing strength at 7 days and 28 days.
- g) Determination of flakiness index and crushing value for coarse aggregates.

The above tests (a) to (g) inclusive shall be done on a routine basis as per the provisions of the relevant Indian Standards, or as specified in this Manual. The following additional tests of materials and workmanship shall also be carried out at contractor's cost, if the Engineer-in-Charge or his representative requires:-

- a) Chemical tests of fine and coarse aggregates, to determine the sulphate, chlorides and other deleterious material present in the aggregate.
- b) Testing of cement (Physical and Chemical), as per IS 269:2013 or IS 485, as the case may be.
- c) Tests on steel (Mild and High Tensile (Tor) as per IS 1786 to establish the Ultimate tensile strength, yield stress, percentage elongation and chemical composition.
- d) Tests for suitability of water for concrete work.

CHECK OF REINFORCEMENT AND CONCRETING

All reinforcement shall be got checked recorded prior to pouring of concrete, by a representative of the Engineer-in-Charge. Similarly, the entire concrete pouring work shall be done in the presence of an officer not below the rank of Site Engineer (Degree/Diploma). The contractor shall therefore, give a notice of a minimum three days to the Engineer In Charge or his representatives, such that the work can be checked by him or his representative. No work shall be covered before inspection and approval of Engineer-in-Charge.

7.9. INSPECTION CHECK FOR LIQUID RETAINING STRUCTURES & TESTING CONCRETE STRUCTURES FOR LEAKAGE

The Contractor shall take special care for concrete for liquid retaining structures, underground structures and those others specifically called for to guarantee the finish and water tightness. The Contractor shall make all arrangements for hydro-testing of structure, all arrangements for testing such as temporary bulk heads, pressure gauges, pumps, pipe lines etc.

The Contractor shall also make all temporary arrangements that may have to be made to ensure stability of the structures during construction. Any leakage that may occur during the hydro-test shall be effectively stopped either by cement/epoxy pressure grouting, guniting or such other methods as may be approved by the engineer-in-charge.

Tanks shall be tested for water tightness at full supply level as described in clause 12.1.1 and 12.1.2 of IS:3370 Part I.

Testing Concrete Structures for Leakage

Hydro-static test for water tightness shall be done at full supply level, as may be directed by the Engineer-in-Charge

The tanks shall be filled with water and after the expiry of seven days after the filling, the level of the surface of the water shall be recorded. The level of water shall be recorded again at subsequent intervals of 24 hrs. over a period of seven days. The total drop in surface level over a period for seven days shall be taken as an indication of water tightness of the structure. The actual permissible nature of this drop in the surface level, shall be decided by taking into account whether the structures are open or closed and the corresponding effect it has on evaporation losses and/or on account of rainfall.

For above ground structures, the permissible loss may be adopted as per provisions in the respective contract agreement or as may be directed by Engineer-in-charge.

However, underground tanks whose top is covered may be deemed to be water tight if the total drop in surface level over a period of seven days does not exceed 20 mm.

In the case of structures whose external faces are exposed, such as elevated tanks, the requirements of the test shall be deemed to be satisfied if the external faces show no sign of leakage and remain apparently dry over the period of observation of seven days after allowing a seven day period for absorption after filling.

If the structure does not satisfy the conditions of test, and the daily drop in water level is decreasing, the period of test may be extended for further seven days and if specified limit is then reached, the structure may be considered as satisfactory.

The roofs of liquid retaining structures should be water tight and should be tested on completion by flooding the roof with water to a minimum depth of 25 mm for 24 hours or longer, if so specified. Where it is impracticable, because of roof slopes or otherwise, to contain a 25 mm depth of water, the roof should have continuous water applied by a hose or sprinkler system to provide a sheet of water over the entire area of roof for not less than 6 hours. In either case the roof should be considered satisfactory if no leaks or damp patches show on the soffit. Should the structure not satisfy either of these tests then after completion of the remedial work it should be retested in accordance with relevant clauses of IS:3370=Part I. The roof insulation & covering, if any, should be completed as soon as possible after satisfactory testing.

Each compartment/segment of the structure shall be tested individually and then all together.

For structures such as pipes, tunnels etc. the hydrostatic test shall be carried out by filling with water, after curing as specified, and subjecting to the specified test pressure for specified period. If during this period the loss of water does not exceed the equivalent of the specified rate, the structure shall be considered to have successfully passed the test.

The test report formats for below ground and above ground water retaining structures are available at A/TR-17 and A/TR-18 respectively.

7.10. CONVENTIONAL UNITS OF WATER TREATMENT PLANT

The various units of water treatment plant with their purpose is tabulated in **Table 7.5** below;

Table: 7.5 Units of Water Treatment Plant

Sl. No.	Description	Purpose
1	In take works	For with drawl of water from surface source and to ensure entrance velocity of 0.60-0.90cm/sec.
2	Inlet channel	For conveyance of raw water to sedimentation and storage tank and it should be laid at correct gradient/ alignment.
3	Storage cum Sedimentation	It should be made water tight to reduce losses
4	Flash Mixer & Clariflocculator	The units should be tested for water tightness.
5	Pump House	To house machinery and other equipment and shall be constructed as per standard departmental design.
6	Pumping plants	Centrifugal pumps are installed for pumping raw water to high level Tank and clear water to O H S R.
7	Wash Water Tank	For distribution of back wash water to filter units and should have scour and overflow arrangement. The structure should be tested for water tightness.
8	Slow sand filter/ Rapid sand filter	Provided for filtration of water. The structure is provided with under drainage, filter media, inlet outlet channels as per specifications. The structure should be tested for water tightness.
9	Clear water reservoir	For storage of clear water, and is provided with scour/over flow pipes. Structure should be tested for water tightness.
10	O H S R	Elevated R.C.C. Storage Tank to supply water to consumer at minimum residual pressure.

Sl. No.	Description	Purpose
11	Disinfection	Disinfection of water shall be carried out by Mechanical chlorinator using chlorine Solution

WATER TREATMENT PLANT CHECK LIST

Sr. No	Material/ Equipment	Tests/ Frequency of test	Size of Sample	Authority to conduct test	Witness to test	Location of conducting test- manufacturer's place/ Site/ laboratory	Remark
1	Clarifier						
	Scraper drives	Running test	100%	Manufacturer	PHED	Manufacturers works / site	
	Agitators	Running test	100%	Manufacturer	PHED	Manufacturers works / site	
	Flocculates	Running test	100%	Manufacturer	PHED	Manufacturers works / site	
	Dosing / transfer pumps	Performance test	100%	Manufacturer	PHED	Manufacturers works	
	Plates	Material test certificate	100%	Manufacturer	Record verification	Manufacturers works	
	Sluice gates	Leakage test	100%	Manufacturer	PHED	Manufacturers works	
2	Filter						
	Pumps	Performance test	100%	Manufacturer	PHED	Manufacturers works	
	Air blower	Performance test	100%	Manufacturer	PHED	Manufacturers works	
	Nozzles	Material test certificate	100%	Manufacturer	Record verification	Manufacturers works	
	Sand	Gradation test	100%	Manufacturer	Record verification	Manufacturers works	
	Wash water recirculation pump / plant	Performance test	100%	Manufacturer	PHED	Manufacturers works	
	Clarifier	Running	100%	Manufacturer	PHED	Manufacturers	

Sr. No	Material/ Equipment	Tests/ Frequency of test	Size of Sample	Authority to conduct test	Witness to test	Location of conducting test- manufacturer's place/ Site/ laboratory	Remark
	sludge processing plant	test				works / site	
	Compressor	Performance test	100%	Manufacturer	PHED	Manufacturers works	
	Piping and valves	Material test certificate	100%	Manufacturer	Record verification	Manufacturers works	
3	Raw water/ Clear water / Back wash pumps	Material test certificate	100%	Manufacturer	Record verification	Manufacturers works/ Laboratory	
		Dynamic balancing	100%	Manufacturer	Record verification	Manufacturers works	
		NDT/Surface finish on shaft and impeller	100%	Manufacturer	PHED	Manufacturers works/ Laboratory	
		Hydro test of casing	100%	Manufacturer	Record verification	Manufacturers works	
		Performance test	100%	Manufacturer	PHED	Manufacturers works	BS 5316 Part 2
4	Pressure filters	Material test certificate	100%	Manufacturer	Record verification	Manufacturers works/ Laboratory	
		Welding qualification		Manufacturer	Record verification	Manufacturers works	
		Heat treatment	100%	Manufacturer	Record verification	Manufacturers works	
		Hydro test	100%	Manufacturer	PHED	Manufacturers works	IS 2825

All filter media shall be supplied in polythene bags. Suitable care should be taken to protect the media from spillage or contamination. Storage on site shall only be in an approved area, well drained and free of mud and silt. The filter media shall be carefully placed in the filter

beds and shall not be dropped or dumped or machine handled so as to be detrimental to the floor media, nozzles or sealant etc.

Before filling the supporting layers and the sand of the filter beds the whole under-drains system shall be thoroughly cleaned and tested for equal distribution of water.

It shall be the responsibility of the Contractor to remove any such debris before the commissioning of laying filter floors or laterals and shall continue to remain his responsibility for excluding unwanted materials which could block the filters.

Each filter shall have central and lateral wash water troughs that shall be connected with adequate slope to the wash water outlet to prevent deposits of silt. They shall allow an equal withdrawal of the wash water during backwashing the filter. The filter backwash water shall ultimately be discharged to Recycling (Buffer) Tanks.

7.11. TESTING OF MATERIALS

Test processes are presented in **Table 7.2 & 7.4** under the referenced test numbers. Test report formats are included in Appendix A. List of tests for general structures & liquid retaining structures is given in **Table 7.1 & 7.3**. The contractor shall be responsible for conducting tests as stipulated.

CHAPTER 8.
Control of works of Tube Wells

CHAPTER 8. Control of works of Tube Wells

8.1. TUBE WELL

The construction and testing of tube wells and bore well shall be carried out as per provisions of IS 2800 (part-1) 1991 and IS 2800 (part-2): 1979, and developed in accordance with IS: 11189-1985 amended up to date, and as per provisions of other relevant Indian standards/code application. General requirement to be given attention during execution of the following works are as follows:

- i. Slot size where ever slotted pipes are required and assembly design should be carefully designed by Hydro geologist.
- ii. Development should be done till the well yields the sand free water at the maximum capacity.
- iii. Yield test should be got done in the presence of Engineer-in-charge PHED and Hydro geologist and drawdown should be measured and be given as well completion report.
- iv. The annular space between the bore and the housing pipe be cement grouted up to 5 m below ground level so that the entry of contaminated ground water in to the bore well is stopped.
- v. P- gravel should be packed properly and backwashing should be done as per relevant IS.
- vi. Thickness and quality of MS pipe should be checked by Engineer-In- Charge.
- vii. Casing pipe above GL should be such that water of nearby area during flooding/rains does not get in the bore well
- viii. The pump cable should be securely tied with the riser pipe assembly
- ix. The soak pit shall be constructed as an integral part of TW to take care of waste water, wherever required.
- x. The pump assembly should not be installed against strainer pipes. In rocky strata pump assembly should be installed at suitable depth depending upon available water column.
- xi. Frequent water level monitoring be done along with O&M.
- xii. Tube wells should be tested for plumbness and alignment immediately after the housing pipes are installed and prior to gravel packing.
- xiii. Saline zone should be properly sealed with cement slurry.
- xiv. Sacrificial anode system of cathodic protection should be installed to avoid corrosion of mild steel strainers and casing pipe.
- xv. Acid treatment for rehabilitation of incrustated well screens should be done

- xvi. After construction, the bore well should be properly capped
- xvii. Drawl of water from well should be such that pump set always remains submerged in water and it gives sand free water
- xviii. The pump set should be got properly inspected by before lowering in Tubewell.
- xix. The riser pipes should be properly clamped with the pump assembly to avoid detachment

Handpumps

1. Slot size where ever slotted pipes are required and gravel packing should be carefully designed by Hydro geologist.
2. Bore well should be tested for plumbness and alignment immediately after the housing pipes are installed.
3. Casing pipe above GL should be such that water of nearby area during flooding/rains does not get in the bore well
4. The riser pipes should be lowered up to sufficient depth so that cylinder is always submerged under water.
5. The platform should be constructed as per Department/UNICEF drawing.
6. CWT/Soak Pit be constructed as per departmental guidelines.

8.2. Material

All the material used for construction of tubewell shall be as per relevant Indian Standards / Provisions of relevant Contract agreement. All material shall be got tested & inspected and all test / Inspection / measurement report shall be properly documented.

As per IS:2800 (Part I), the material requirement for different parts of tubewells shall be as follows

S.No.	Name of Part	Typical Material
1	Bail Plug or bottom plug	IS 226
2	Bail Plug Hook	IS:226
3	Casing Pipe	IS:4270 / IS:12818
4	Screens/Slotted Pipes	IS:8110
5	Centraliser	IS:226

S.No.	Name of Part	Typical Material
6	Taper/Reducer	IS:226
7	Housing Pipe	IS:4270
8	Clamp	IS:226
9	Well Cap	IS:226

The summary provision of different IS codes are available at Annexure E-1.

8.3. Construction

The construction of tubewell should be in accordance with provision of IS:2800 (Part I) and the testing of tubewell should follow provisions of IS:2800 (Part II). The gravel for use as pack in tubewell shall comply with IS:4097. The tubewell should be developed as per provisions of IS:11189.

The summary provision of different IS codes are available at Annexure E-1.

8.4. Departmental Guidelines

Filed officers are required to follow the department guidelines, circulars for ensuring quality of works in construction of tubewells, single phase points and handpumps. Chief Engineer (Rural), PHED, Rajasthan has issued guidelines vide its letter No F-107/CE(R)/EE Mon I/Summer 2013/2013-14/59 Dated 24-05-2013 for this effect and is available at Annexure-F-4. The summary of guidelines is as follows;

- Before drilling, ensure potability of water from nearby sources.
- Feasibility report by Hydro-geologist/Jr Hydrogeologist/Drilling wing shall be obtained.
- For departmentally procured material, material shall be thoroughly checked at the time of stock entry.
- For Material to be arranged by Contractor, all material shall be received in divisional store and carry out all testing & inspection requirements. The record entries shall be made in the stock register invariably with Batch Number/Serial Number, make/class of pipe, Weight/m etc.
- During Drilling work, field officers shall check/verify depth of bore wells, length & thickness of casing pipe, depth, gauge, weight of lowering pipes. The Make/Batch numbers of material used shall be verified in field.

The latest & updated guideline issued by Department shall be applicable.

8.5. TEST FOR TUBE WELL

8.5.1. Verticality Test

A simple method of measuring eccentricity in a bore is by use of heavy plumb-ring, 6 mm smaller in diameter than the inside diameter of the well casing. The plumb-ring is suspended by means of a thin strong wire of steel or copper running over a pulley, rigidly fixed to the apex of a tripod. The tripod pulley is at least 3 m above the top of the casing. The tripod is so adjusted that the wire passes through the centre of the top of the well casing. The plumb-ring is lowered in steps of 3 m and the deviations of line from the centre of the casing are observed. The drift at any depth is given by the deviation multiplied by the depth of the line and divided by the height of the pulley above the top of the well casing.

For verticality and alignment, the requirement as laid down in clause 4 of IS: 2800-1979 part – II will be ensured. The reporting will be made in format No. A/TR-7 of **Appendix A**.

Testing of Yield and Drawdown

After the well has been constructed and cleaned out and the depth of the well accurately measured, the yield test shall be carried out.

The test is conducted by installing a test pump in the tube well temporarily and pumping out water. At each rate of discharge, pumping is carried out at least for 30 minutes. If the water level and discharge are found to be fluctuating, development is carried out for some more hours until the discharge become steady and sand content is within tolerable limit. The specific capacities of the well for various pumping rates is computed based on drawdown tests data. Discharge may be measures by any method detailed in 13.7 of IS:5120-1977: Technical requirement of rotodynamic special purpose pumps.

Since the yield is influenced by a number of factors such as geological formation, rainfall, neighboring tube wells etc, the pumping rate shall, in general, not exceed 60% of the yield determined by test.

8.5.2. Water Quality

Water shall be collected after tube well drilling and should be got analysed chemically and bacteriologically to ensure it confirms to departmental standards.

8.6. Taking-over of Tubewell

While taking over the tubewell from drilling/construction agency, EIC should obtain following information from drilling/construction agency;

- Result of Tube well depth and water level measurements;

- Report on the chemical and bacteriological analysis of water;
- Result of development and drawdown test

CHAPTER 9.
CONTROL OF PIPELINE WORKS

CHAPTER 9. CONTROL OF PIPELINE WORKS

This section of the QA/QC Manual covers the testing of works and the inspection of workmanship for pipeline works.

9.1. GENERAL

The pipe-laying appears simple, but it requires too much care while laying, along with close watch to ensure the levels required for quality assurance to attain a satisfactory job. In pipe laying process, generally the whole of the work takes place below the ground surface and the jointing and bedding of pipes must be carried out with precision. Pipes should be laid according to specified grade in straight lengths with least number horizontal and vertical bends.

It should be taken care of that pipes are not to be bedded directly on large stones. Too much precision is necessary for ensuring quality of work, joints and jointing materials should be kept perfectly clean. If the quality of work is not ensured it will prove more costing in terms of future repairs, since the cost of locating and repairing of leaks is very high.

9.2. Preparatory Works required;

It shall be responsibility of contractor to keep all related works/documents ready at site before commencement of pipeline work as summarized below;

- A. Material & Machinery
 - i. Pipes, Joints, Specials, Plugs etc
 - ii. Excavator, if required
 - iii. Mechanical lifting arrangement, if required
 - iv. Road Breaker, if required
 - v. Water, if required
 - vi. Other tools
 - vii. Water Pump, if required
 - viii. Hydraulic testing arrangement
- B. Safety Arrangements & Equipment
 - i. Traffic Diversion Boards
 - ii. Barricading

- iii. Timbering
- iv. Helmets
- v. Gloves
- vi. Safety Boots
- vii. Ropes and Harnesses
- C. Documents
 - i. Plan & L-Section of Pipeline
 - ii. Factory Inspection Reports of Pipes & Specials

9.3. Construction Sequence and Control Flow Charts

Flow charts indicating the construction sequence and control points for materials used in pipeline work and for pipeline works are shown in Figure 9.1, 9.2 and 9.3 respectively.

9.4. Testing of Works

The works to be tested on site include bedding for pipelines, pipeline laying and jointing, and hydrostatic, leakage and water tightness tests after completion. All the materials proposed to be used in these works must have been tested by the Contractor and approved by the Department well in advance of commencing works. The contractor shall obtain the approval of the Department when a particular stage is completed and before proceeding to the next stage.

Table 9.1 List of Tests for Pipeline Works

Sl. No.	Activity	Material	Test Ref. No.
1	Bedding for Pipeline		
1.1	Earth Bedding	Earth/Soil	QC-P-01
1.2	Gravel Bedding	Gravel	
1.3	Concrete Bedding	Cement	QC-P-02
		Sand	
		Water	
		Coarse Aggregate	
		Steel	
2	Completion of Pipeline Laying and Jointing	Stage Completion Test	QC-P-03

Note: 1. MC = manufacturer certified; TPI = third party inspection.

Table 9.2
Procedures for Testing Pipeline Works

Earth Bedding			QC-P-01	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Moisture content as per IS-2720	A/TR-11	One test for each 250 m ³ of soil	In-process
2	Field density test as per IS-2720	A/TR-11	One test for each 100 m ² of compacted area	

Concreting			QC-P-02	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Compressive strength as per IS-516	A/TR-13	- x One test for 1-5 m³ of concrete - x Two tests for 6-15 m³ of concrete - x Three tests for 16-30 m³ of concrete - x Four tests for 31-50 m³ of concrete + one set every 50 m³ of additional concrete work.	Test samples to be taken while pouring. Tests to be done as specified in the contract.
2	Slump test per IS-1199	A/TR-14	Random checks throughout concreting period as directed by the Engineer	Before pouring concrete
3	Steel reinforcement placement and bending	Daily log	Before pouring concrete	Before pouring concrete
4	Concrete Pour Report	C/QRF-4	When pouring is done	Immediately after pouring

Completion of Pipeline Laying and Jointing			QC-P-03	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Hydrostatic test for pressure pipes	A/TR-16	One test for defined stretch	On completion of stage

9.5. Inspection Checklists

An inspection checklist for pipeline works is included in Appendix B.

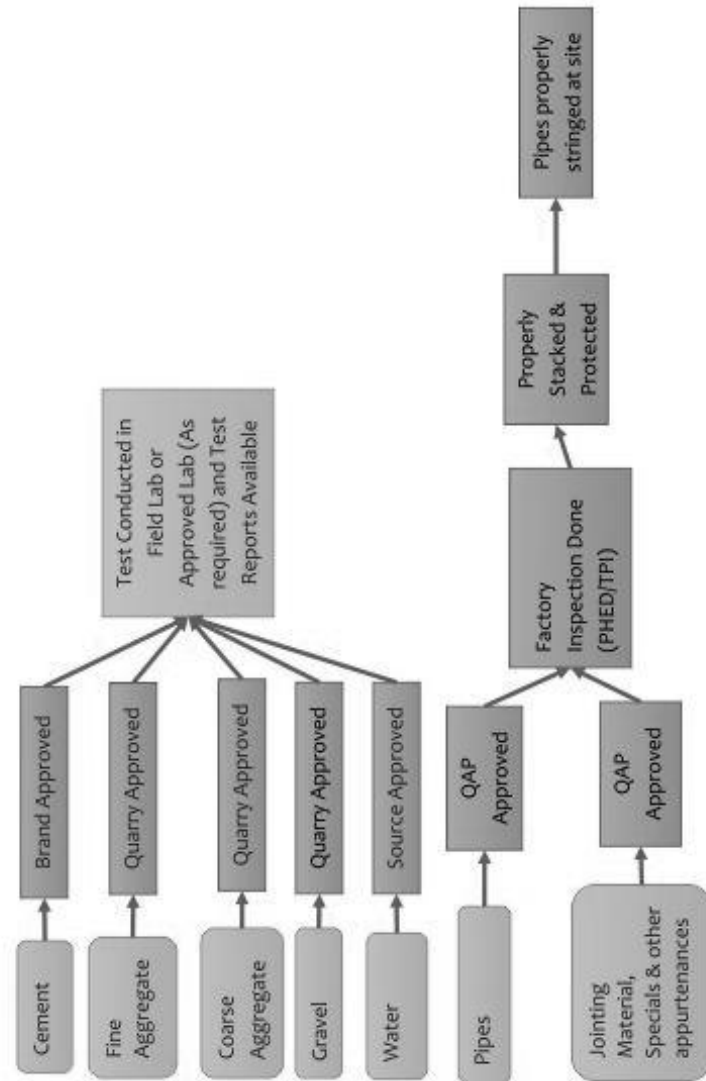
FIG 9.1 : PROCESS CHART FOR PIPELINE MATERIAL FOR TESTING & INSPECTION REQUIREMENTS

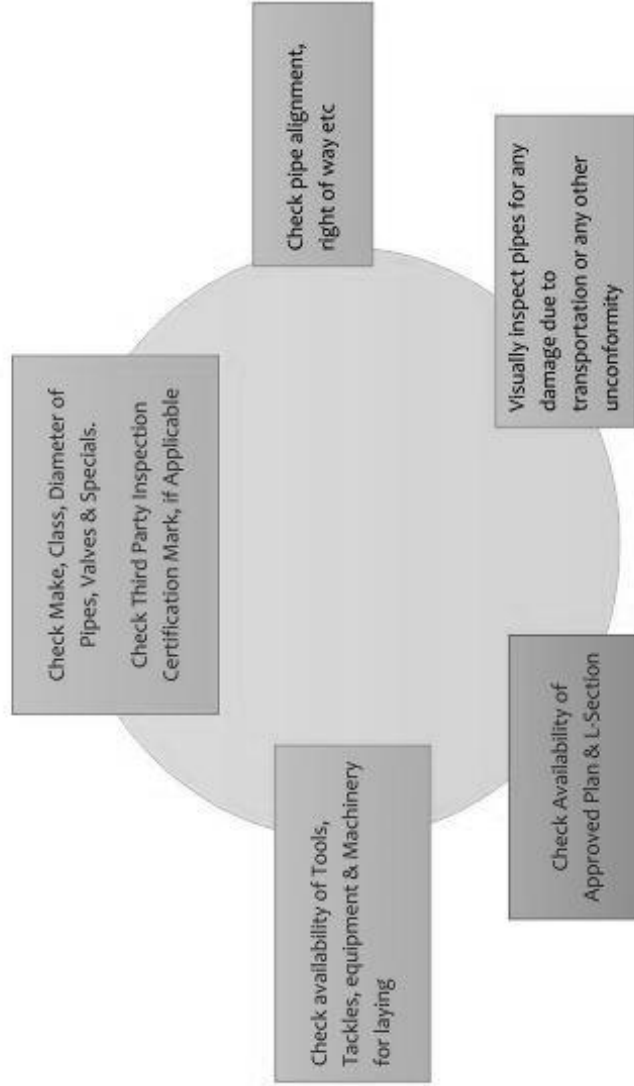
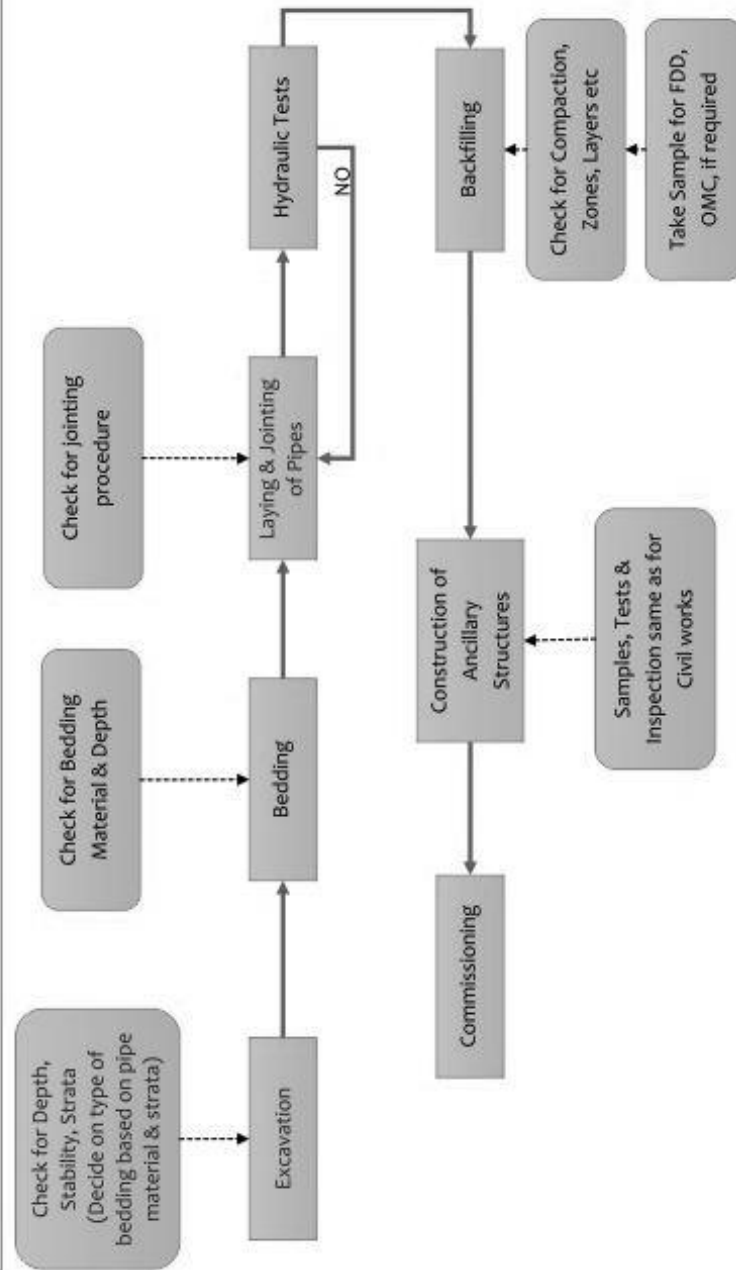
FIG 9.2 : CHECK FOR PREPARATORY WORKS BEFORE LAYING OF PIPELINE

FIG 9.3 : PROCESS CHART FOR TESTING & INSPECTION OF PIPELINE WORKS

9.6. EXCAVATION AND BACKFILLING

The excavation should give enough room at the sides of a pipe for a man to stand down in the trench and move along sideways. Joint holes should be excavated before the pipe is lowered in to position, and must give enough room for the man to reach round to the underside face of the joint. For large-diameter, the joint hole must be large enough for the worker to crouch down beside the pipe and reach the lower face of the joint.

Backfilling must be completed in layers and laid according to specified requirements. Mechanical compaction should be conducted to achieve the required level of compacted density as per the contract document and specification. All large stones liable to damage the coating of the pipe must be removed from contact with the pipe.

Additional excavation is to be completed at localized positions, in accommodating the joints and so ensuring that the full length of the pipe barrel rests directly on the trench bedding.

To ensure firm bedding conditions, the final excavation and dressing of the last 15 cm to trench bed formation level, should be completed manually and not by mechanical excavator.

9.7. LAYING, JOINTING AND SECTIONAL TESTING OF PIPELINES

9.7.1. Sequence of works for ensuring good pipe laying:

1. Submission of L-section and plan for approval of Engineer in Charge prior to commencement of work and after approval take up the work.
2. The contractor should ensure that all required specials, valves and pipes with jointing material duly tested are available before planning for excavation of trenches.
3. The pipes should be received on site only after the above fittings valves and joints has been received and all necessary preparation for laying has been made.
4. The material received should be checked for inspection certification as per contract and damage during transportation. All damaged material should be separated and should be ensured that it is not used.
5. The pipes received should be stored strictly as per directions of the manufacturer or as mentioned elsewhere or standards.
6. Pipe and other materials should be again inspected for any damage before use in the trench
7. The fittings and valves should be installed in sequence with the laying of pipe without leaving any gaps.
8. It is desirable to lay the pipe line from the end from where it can be connected to the water source for regular flushing & sectional testing of laid pipes.
9. The entry of dirt, any foreign material, insects, birds and animals etc. in the pipes should be religiously prevented for which after day's work, the ends of laid water pipe line are properly plugged.
10. Each joint should be carefully checked for its completeness before covering up.
11. There should be commensurate progress in trench excavation, laying and jointing of pipes, fittings, valves etc. and testing of laid pipes in sections so as to complete all pipes laid in quick follow up of completing laying and jointing.

12. Disinfection of laid pipe line should be carried out before commissioning.
 13. Before excavation the trench alignment of pipe line should be approved by the site Engineer of PHED.
 14. The Engineer must ensure that pipe bedding has been done properly and well compacted.
 15. Wherever a socket or collar of pipe or fitting/ special will occur, a grip should be cut at the bottom of the trench or concrete bed to a depth as specified in relevant contract agreement below the bed of the pipe so that the pipe may have a fair bearing on the shaft and does not rest upon its socket. Such grips should be of sufficient size in every respect to admit the hand, all around the socket in order to make the joint and the grip shall be maintained until the joint has been approved by the site Engineer. When welding is to be carried out with the pipes and the specials in the trench, additional excavation of not more than in depth and length as specified in contract agreement should be made at joints in order to facilitate welding.
 16. The trench should be kept clean and dry before lowering the pipes in the trench. If subsoil water is met with during excavation, contractor would provide necessary equipment and laborers for dewatering the trenches.
 17. Utmost care should be taken to see that the width of the trench at the top of the pipe is not more than as specified in the cross section drawing. In case additional width is required, it shall be provided as specified in contract agreement. If rock is met with, it shall be removed as specified in contract agreement and the space resulting shall be refilled with lean cement concrete of adequate depth properly consolidated to give the curved seating. The bottom of the trench shall be properly trimmed to even bedding of the pipe line. Bottom of trenches/ pits shall be saturated with water and well rammed wherever Site Engineer may consider it necessary to do so. In earth and moorum foundation, the curvature of the bottom of the trench should match the curvature of the pipe as far as possible, subtending an angle of 120 degrees at the center of the pipe.
 18. During jointing of pipe special care should be taken so that spigot and socket of adjoining pipes fit snugly into each other. For water distribution network projects, water pipes, fittings and connections must be carefully inspected during placement and verified as to compliance with the plans and specifications.
 19. Testing of water system must be carried out in the presence of the field engineer and the entire testing procedure must be carefully checked including performing leakage testing which must meet standards as included in the specification.
 20. The earth cover should conform to provisions of relevant contract agreement.
 21. Proper safety measures needs to be adopted to avoid any mishap.
 22. For avoiding the collapse of trenches, proper barricading, shoring and bracing should be used.
 23. Back fill the trenches as directed or as per specification.
 24. Hauling away and disposing away excavated materials not necessary or else unsuitable for backfilling purposes as directed by the Site Engineer.
 25. Restoring all property injured or disturbed by the construction activities to the condition as near its original condition as possible.
 26. Restoring the surfaces and repairing all roads, streets, alleys, walk, drives, working spaces and right of ways to a condition as good as prior to excavation.
- The trench excavation of pipe line shall be in accordance with relevant IS.

9.7.2. Anchoring of the pipeline

Thrust blocks shall be provided at each bend, tee, taper, end piece at every change of size, at connection and valves to prevent undue movements of the pipeline under pressure. They shall be constructed as per actual design and approval of Engineer in Charge. Complete or partial failure of a pipe at a bend is almost always due to soil movement behind the block. Thrust blocks for vertical bends are essential, and those on bends down may have to be reinforced. Other thrust blocks, such as those adjacent to river banks, ditches, or depressions in the ground, must be carefully placed, as there is a possibility of collapse of earth at these points. The stipulations of the appropriate IS code must be strictly adhered which are generally followed by the manufacturers/suppliers. Steel and Grade of Concrete shall be as per provisions of Contract Agreement.

Design of thrust block shall be done in accordance to the provision laid down in IS:5330-1984.

9.7.3. Surge control system

Properly designed surge control devices should be provided where ever necessary.

9.7.4. Cover to Pipes

All pipes are normally laid below ground and the amount of cover shall be as per contract agreement above the top of the pipe. However, cover of less than that required in contract agreement is not to be permitted below a public road, or traffic loading would cause damage to pipes. Use of CI/DI/MS pipe is an option for road crossings to mitigate the heavy vehicular traffic.

9.7.5. Testing of Works

The works to be tested on site include bedding for pipelines, pipeline laying and jointing, and hydrostatic leakage and water tightness tested after completion. All the materials proposed to be used in these works must have been tested by the Contractor and approved by the PHED well in advance of commencing works. The contractor shall obtain the approval of the PHED when a particular stage is completed and before proceeding to the next stage.

Test report formats are included in **Appendix A**.

The full requirement, for the testing of pipelines, is given within the provisions of the contractor's contract and specifications. Every section of pipeline laid must be tested before it can be accepted by the supervising engineer. The extent of pipeline to be tested at one time is as per relevant Indian Standards or as per directions of Engineer-in-Charge. .

It is always preferable to test small sections at a time. In some instances the contractor is not allowed to fill back over the joints until a satisfactory test has been taken. Though it is obviously of great benefit to be able to inspect the exterior of joints under pressure, there are definite disadvantages in not backfilling around the joints. In the first place, if the main is being laid in a road it is almost certain that the necessity of restoring the road fully open to traffic will be of overriding importance.

An experienced contractor will try to test the pipeline in as short lengths as possible, with as many joints left exposed to view as is practicable. To do this, the contractor will need some easily fixed stop ends for temporary closure of the end of the pipeline. He must remember, however, to give

time for all thrust blocks on the line to be properly completed and made secure before the test is started.

The test should be carried out at specified pressure and any resulting losses should be within the stipulated permissible levels, as given in the contract document. The pipeline should only be accepted after ensuring losses within the permissible levels, under the full terms of testing.

Hydraulic testing of pipeline shall be carried out as per provisions of relevant IS codes. The hydraulic testing of DI pipe shall also follow the guidelines issued by Chief Engineer (Technical) & TM, RWSSMB, PHED, Jaipur vide its circular CIRCULAR/D&S/2015-16/06 issued vide letter No D&S/CIRCULAR/2015-16/1961-1986 dated 18-03-2016 and is available at Annexure F-3.

9.8. PIPELINE LOG BOOK

It is essential to maintain a pipe log book in which are entered full details of the laying of the pipeline covering each and every pipe, giving frequent levels, details of fittings and connections, and a running total of the Chainage laid, together with sketch plans showing other services encountered and dimensions to locate the position of the pipe from time to time. A format for pipe laying record is available at Annexure A/TR-20.

CHAPTER 10.
Control of Road works

CHAPTER 10. Control of Road works

This section of the QA/QC Manual covers the testing of works and the inspection of workmanship for road works, including earthworks, placement of sub-base and WBM layers, application of prime and tack coats, and placement of bituminous layers. Contractor shall devise the test report format for material required for construction of road works and get it approved by EIC.

10.1. Testing of Works

The works to be tested on site include earthworks, placement of granular sub-base and WBM layers, application of prime and tack coats, and placement of bituminous layers. All the materials proposed to be used in these works must have been tested by the contractor and approved by the EIC well in advance of the works. The contractor shall obtain the approval of the EIC when a particular stage is completed and before proceeding to the next stage. Surface regularity and alignments shall be checked by leveling instrument.

Hot mix designs shall be submitted by the contractor to EIC for review and approval well before the planned start of hot mix operations. The Contractor shall provide such devices as part of his site laboratory, and in sufficient quantity so that all required testing can be carried out as-and-when required. The contractor shall carry out all the tests in the presence of the EIC representative, and shall submit his test reports on a daily basis.

Tests for road works are listed in Table 10.1. Test procedures are presented in Table 10.2, under the referenced test numbers.

10.2. Inspection Checklists

Contractor shall devise the inspection checklists for inspection for construction of road works and get it approved by EIC.

Table 10.1: List of Tests for Road Works

Sl. No.	Process	Material		Test Ref. No.
		Name	Format No.	
1.	Embankment Formation	Soil/Earth	Approved Format	QC-R-01
2.	Excavation			QC-R-02
3.	Granular Sub-base Laying	Granular Subbase	Approved Format	QC-R-03
4.	WBM Laying	WBM	Approved Format	QC-R-04
		Binder	Approved Format	
5.	Prime Coat Application	Bitumen	Approved Format	QC-R-05
6.	Tack Coat Application	Bitumen	Approved Format	QC-R-05
7.	Surface Dressing	Bitumen	Approved Format	QC-R-06
		Metal	Approved Format	
8.	Bituminous Macadam Laying	Bitumen	Approved Format	QC-R-07
		Metal	Approved Format	
9.	DBM Laying	Bitumen	Approved Format	QC-R-08
		Metal	Approved Format	
		Fine Aggregates	Approved Format	
		Filler (Lime)	Approved Format	
10.	Mix Seal Surfacing	Bitumen	Approved Format	QC-R-06
		Metal	Approved Format	
		Fine Aggregates	Approved Format	
11.	Bituminous Concrete Laying	Bitumen	Approved Format	QC-R-08
		Metal	Approved Format	
		Fine Aggregates	Approved Format	
		Filler (Lime)	Approved Format	
12.	On Completion of Laying of BM / DBM / BC	Stage completion test		QC-R-09

Table 10.2: Procedures for Testing Road Works

Embankment Formation			QC-R-01	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Moisture content as per IS-2720	Approved Format	One test for each 250 m ³ of soil	In-process
2	Field density test as per IS-2720	Approved Format	x For earthwork in embankment/cutting 5-10 density tests for each 1000 m ² compacted area x For earthwork in sub grade/GSB and shoulders, 10 density tests for 500 m ² compacted area	
3	Rolling operation	Daily log	As per required number of passes	While rolling

Excavation			QC-R-02	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Layout, slopes of excavation, benching and over-burden	Daily log	As directed by the Engineer	After excavation
2	Sub-soil water, shoring and strutting	Daily log		
3	Bottom levels and compaction	Daily log		
4	Soil classification	Daily log		

Granular Sub-Base Laying			QC-R-03	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Moisture content as per IS-2720	Approved Format	One test for 500m ² of compacted soil (3 observations per test)	In-process

Granular Sub-Base Laying			QC-R-03	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
2	Field density test as per IS-2720	Approved Format	10 observations selected randomly for every 500 m ² of compacted area	
3	Rolling operation	Daily log	Required No. of passes	While rolling

WBM Laying			QC-R-04	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Field Density Test by sand replacement method	Approved Format	As directed by the Engineer	In-process

Prime Coat/Tack Coat Application			QC-R-05	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Temperature Test	Daily log	At regular close intervals	In-process
2	Rate of spreading	Approved Format	Three tests for every 50 m length	

Surface Dressing/Mix Seal Surfacing/ Pre-mix Carpet			QC-R-06	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Rate of spread of mix material	Approved Format	One test for every 500 m ³ of mix with 6 observations	In-process

Bituminous Macadam Laying			QC-R-07	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Temperature Test	Daily log	At regular close intervals	In-process
2	Rate of spread of mix material	Approved Format	2-3 observations at every 10 m interval during paving	

DBM/BC Laying			QC-R-08	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Temperature Test	Daily log	At regular close intervals	In-process
2	Rate of spread of mix material	Approved Format		
3	Stability of Mix/Marshall Stability Test	Approved Format	3 samples for each 400 tons of mix produced subject to a minimum of 2 tests per plant per day.	While hot mixing

On Completion of BM / DBM / BC Layers Stage Completion Test			QC-R-09	
Sl. No.	Type of Test	Test Report Format No.	Frequency of Test	Timing of Test/ Inspection
1	Core test for compacted layer (bitumen content, density and voids)	Approved Format	One test for 250 m ² of compacted area	On completion of stage and before proceeding to next stage
2	Surface regularity and control of alignment	Approved Format	One test for every 300 m of road length	

CHAPTER 11.
CONTROL OF MECHANICAL & ELECTRICAL
WORKS

CHAPTER 11. CONTROL OF MECHANICAL & ELECTRICAL WORKS

This section of the QA/QC Manual gives an overview of the quality control requirements for electromechanical works, such as water treatment and supply systems, pumping systems, and power supply and distribution systems. The requirements for testing and control of input materials and components, including manufacturers' certification, and departmental party inspections, are outlined in Section 5. Materials and components to be incorporated into electromechanical works shall be inspected by PHED as soon as they are delivered, to ensure that they meet the specifications and design requirements, are in agreement with shipping documentation, and are accompanied by manufacturer's certification, third party or departmental inspection certificates, as applicable. Accepted materials and equipment shall be properly stored by the contractor until needed. If manufacturer's installation instructions conflict with design or contract requirements, PHED shall be notified immediately. Installation shall proceed only after the materials and components are approved by PHED.

A series of inspections and tests during installation and completion of electromechanical works shall be performed by the contractor or the equipment manufacturer and witnessed by PHED as follows:

Preparatory Inspections: Prior to installation, the civil and structural works where electromechanical equipment is to be installed shall be inspected to ensure conformance with designs and equipment installation requirements.

Installation inspections and Tests: A system of inspections and tests, as specified in the contract or recommended by the equipment manufacturer, shall be employed throughout movement to position and installation of equipment and systems. Inspections shall be performed by PHED at critical points during installation. The critical points are indicated below in **Table 11.1**;

Table: 11.1 Critical Points for Inspection

Sl. No.	Critical Points	Items
1	Installation of Mechanical Equipment	- Lowering of submersible pump to proper depth - Size of cables - ISI markings as per contract requirement - Efficiency of pump sets
2	Installation of Electrical Equipment	- Proper capacitor in control panel to improve the power factor - Power connection are not loose and properly insulated with use of lugs - Double earthing
3	Disinfection Unit	- Unit of specified capacity. - Unit connected & working properly.

Surveillance shall be provided by PHED throughout the progress of work to ensure that installation is performed in accordance with the contract requirements, approved drawings, acceptable workmanship standards and configuration control requirements.

Control of Quality of material procured in the department shall be made through random Post-delivery inspection test checking.

Installation Verification Inspections: Prior to all mechanical and electrical testing, verification inspection shall be performed to ensure that equipment has been satisfactorily installed.

System Tests: These tests shall be conducted as appropriate to demonstrate that the installed systems are free from damage due to shipment and installation, and that equipment performs in accordance with specifications.

Integrated Tests: After completion of system tests, integrated tests shall be performed to demonstrate that the system performs satisfactorily when connected to its interfacing systems or sub-systems. These tests will be followed up by commissioning tests.

Commissioning Tests: These consist of a tests performed under service operating procedures to demonstrate compatibility of the physical plant with operating procedures.

Final Inspections: Final inspections shall be performed to ensure that the completed work is in accordance with the contract and that all previously identified discrepancies have been resolved satisfactorily.

11.1. PARAMETERS TO BE DECLARED BY THE MANUFACTURER

The pumps supplied by the manufacturer shall be marked with the following parameters and shall be declared by the manufacturer.

- i. Model, size and serial number of the pump;
- ii. Rated speed, total head and discharge at the guaranteed duty point;
- iii. Range of Head;
- iv. Motor range (kW) Prime mover rating;
- v. Rated volume;
- vi. Rated frequency;
- vii. Number of phases;
- viii. Winding connection;
- ix. Maximum current in amperes;
- x. Class of insulation of motor;
- xi. Manufacture's name / trade mark;
- xii. Power input in kW;
- xiii. Classification;
- xiv. Number of stages in case of multistage; and
- xv. Self priming time at 1.5 m or 3 m static suction lift.

11.2. PANELS:

The various functions which the panel has to serve and the corresponding provisions be made in the panel are detailed below.

1. For receiving the supply-Circuit Breaker or switch and fuse units.
2. For Distribution-Bus bar, Switch fuse units, circuit breakers.
3. For Controls-Starters, level controls, if needed: Time –delay relays.
4. As protections-Under voltage relay, over current relay, Hot fault relay, Single phase preventer.
5. For indications and reading-Phase indicating lamps, voltmeters, Ammeters, Frequency meter, power factor meter, temperature scanners, Indications for state of relays, indications for levels and indications for valve positions, if valves are power actuated.

11.3. IMPROVEMENT OF POWER FACTOR

For improvement of power factor, appropriate capacitors should be provided. Capacitors may be located in the control panel or separately.

11.4. PUMP TEST RECORD

The Pump test record shall be maintained as per sheet given here;

Name of Manufacturer:		PUMP TEST RECORD		FULLLOAD	
Pump Type	Pump No	Motor Make	CurrentAmps	Voltage	Volts
Suction mm	Delivery	Motor RatingkW	SpeedRpm	Phase	
Imp. Dia.mm	Material	Motor Frame	Motor Efficiency%	Frequency	Hz
Capacity Measured By		Motor Sl. No.			

Motor Eff. Reference
: Performance curve at Full load, rpm
Nature of test -- Performance test

[illegible]

(i) Head range	(i) Total Head in m	Date	Remarks
(ii) Max. Self Priming time	(ii) Discharge in l/s rev/min	Tested by	
(iii) Max. self priming Static	Pump input kW	Set started at	

General Requirements ----- Satisfactory / Unsatisfactory

11.5. QUALITY CONTROL METHODS

The quality of Electro-Mechanical works shall be ensured through the following control methods:

- Obtaining Manufacturing Certificates.
- Third Party / Departmental Inspection.
- Random inspection by QC wing.
- Check list for pump and machinery works (B/CL-3)
- Check list for Tube well (B/CL-2)
- Check list for control panel for 3 phase Pump and Motor (B/CL-10)
- Check list for centrifugal pump & motor(B/CL-11)

CHAPTER 12.
POST DELIVERY INSPECTION

CHAPTER 12. POST DELIVERY INSPECTION

12.1. Introduction

The Quality control wing will adopt a principle of random sampling in post delivery inspection where in the person authorized to take sample, will identify the random samples from field/Store. The concerned division will arrange to send this sample to approved Test Laboratory.

IT SHALL BE CLEARLY UNDERSTOOD THAT SAMPLING & TESTING BY QC WING IS IN ADDITION TO REGULAR QA&QC PROCEDURES BY FIELD OFFICERS AS REQUIRED UNDER RELATED CONTRACT AGREEMENT. IN CASE A SAMPLE OF MATERIAL COLLECTED BY EIC/REPRESENTATIVE OF EIC/VIGILLANCE/ OR ANY THIRD PARTY AGENCY AUTHORIZED BY DEPARTMENT, IS DECLARED HAVING FAILED TO CONFORM WITH REFERENCE TO SPECIFICATION TAKEN IN CONTRACT, APPROVED QAP AND RELEVANT BIS CLAUSE, IT WILL BE RESPONSIBILITY OF SAMPLE COLLECTING AGENCY AND EIC TO INFORM CE(QC) REGARDING FAILURE OF MATERIAL.

The Test results of these samples shall be compared with the departmental specification and/or Indian Standards. Necessary penalty will be imposed on the Suppliers/Manufacturers/Contractors in case of defective supplies. In case of any dispute, the Supplier/Manufacturer/Contractor may appeal against this decision before an Appellate Authority, decision of which will be final & binding on the Contractor/Supplier/Manufacturer.

The detailed methodology for sampling, testing, dispute resolution in random sampling shall be as follows;

12.2. Officers authorized to take sample

Following officers are authorized to take samples for random sampling;

- Officers posted in Quality Control Wing of Department.
- Officers posted in regional offices of Quality Control Wing of Department (if exists).
- Any other officer, not below the rank of Assistant Engineer authorized by any CE of PHED.

12.2.1. Number of Samples

Officers authorized as per clause 12.2, shall take only one sample (and two counter samples) for one combination of Material/Size/Specification (for example DI Pipe 80 mm diameter K-7) irrespective of quantity available at Site/Store. QC wing may select any item/items for sampling from available items at Site/ Store.

In case the supply is of multiple batches and multiple sizes/specifications from the same source, it is at the sole discretion of inspecting team on the number of sample to be drawn based on its visual inspection, previous experience, past record of supplier/contractor etc.

In cases where samples are to be sent to Test Laboratory for detailed testing, one samples and two counter samples for an item shall be drawn by Officers authorized in the presence of an officer of

division (not below the rank of Assistant Engineer) and representative of the supplier/Contractor, wherever feasible. It will be duty of concerned division to call authorized representative of supplier/contractor during sampling. In case of inspection of divisional stores, requirement of presence of representative of supplier is not mandatory.

The collected sample for an item, so drawn shall be sent to the Approved Test Lab. One of the counter sample shall be given to the authorized representative of supplier/contractor and the another counter sample shall be kept for record with the Division office.

12.2.2. Sampling procedure

The detailed sampling procedure to be adopted while taking samples shall be as follows;

- It shall be ensured that the size of the sample is adequate for testing (and retesting wherever needed) the requirements for which it is desired to be tested.
- The sampling shall be done in presence of officer not below the rank of Assistant Engineer from the concerned division.
- In case of material received in Divisional Stores, the presence of authorized representative of supplier/contractor is not required.
- In case supplier/Contractor is not present during sampling, the concerned division shall intimate the concerned Contractor/Supplier of such sampling ensuring that the Name of Test Lab to which samples are sent is not disclosed to contractor/supplier.
- Samples shall be selected at randomly by Officers authorized on inspection.
- The Inspection Division and/or the contractor/supplier shall arrange cutting, packing of the samples.
- The Samples/Packing of Samples shall be signed by Officers authorized, Officer of concerning division and Authorized representative of Supplier/Contractor (if present).
- The Collected samples shall be handed over to concerned division for its dispatch to relevant laboratory indicating clearly the tests, as identified by Officers authorized. The selection/no. of test/tests by Officers authorized will be random (i.e. not necessarily to go through all the tests, any random tests may be selected by Officers authorized)
- A counter sample of identical size shall be drawn and left with the Inspection division and another counter sample shall be handed over to Supplier/Contractor, if present.
- The Division office shall provide receipt of samples to be sent to test lab and another receipt of counter sample for its custody.
- The Supplier/Contractor shall provide a receipt of receiving counter samples.
- Officers authorized shall also handover a letter to be sent to Test laboratory by division office with their specimen signatures on it matching the signature made on samples. The Test Labs while unpacking the samples shall match the specimen signature of Officers authorized on this letter and signatures on the samples received to ensure that samples are not tempered.

12.2.3. Packing

The samples shall be properly sealed with signatures of Officers authorized, Division officers and authorized representative of Supplier/Contractor (if feasible) so that no substitution or tampering with contents is possible subsequently. The Officers authorized shall suitably instruct the Division/Supplier or contractor to ensure that the sample is packed in a durable packing material to withstand hazards during handling and transportation. Pipes & other bulky material with permanent markings regarding its source need not to be packed as described above.

12.2.4. Labelling

The sample/sample packing shall be labeled to indicate (a) name of the product; (b) the relevant Indian Standard with its year; (c) grade/type/size of the product (d) quantity of sample; (e) Batch No.

12.2.5. Coding

A code number should be given to the sample/label in the following manner:

<u>PHED-QC</u>	<u>PHED Division Name</u>	<u>Sample Details</u>	<u>Site of Sample</u>
<u>Sample Number</u>	<u>Project/Scheme Name</u>		<u>Date of sampling</u>

For example:

<u>PHED-QC</u>	<u>City Dn Kota</u>	<u>DI Pipe K-7 150</u>	<u>Site Store</u>
<u>Sample Number - 1</u>	<u>Reorganisation UWSS</u>	<u>mm</u>	<u>12-03-2018</u>
	<u>Kota</u>		

12.2.6. Dispatching

The Officers authorized shall left the samples with the division office with clear and definite instructions for expeditious dispatch of the sample to the testing laboratory. Division office shall ensure expeditious dispatch of these packed samples to Test Laboratory. The Division shall ensure to send the departmental specifications / Approved QAP of this material to Test Lab and Officers authorized.

12.2.7. Approved Test Laboratories

The Test Labs for testing of material shall be as follows;

- Shri Ram Test House, New Delhi/Police Forensic Laboratory, Jaipur/ Public Health Laboratories/ Government owned/approved Laboratories. (GFAR Chapter I: Stores-III-Rule 5-2-C-ii, Page 10)
- National Test House, Jaipur
- Centre of Industrial Plastic Engineering & Technology, Jaipur
- MNIT Laboratories
- Any other Laboratory approved by Technical Committee, RWSSMB

In special urgent cases, Chief Engineer (QC), PHED, Rajasthan, Jaipur may approve any other laboratory for that specific test and for that specific instance only.

12.2.8. Test Reports

It shall be duty of concerned division office to obtain the test reports of collected samples and send the same to Officers authorized along with departmental specification. Officers authorized shall analyze the test report vis-a-vis the departmental specification or Indian standards (in case of absence of departmental specifications). In case of any ambiguity in departmental specifications, it shall be duty of the concerned Chief Engineer/ Additional Chief Engineer to provide the final interpretation of specification/QAP to Officers authorized.

12.2.9. Payment of Tests

It is the duty of concerned division to get Performa invoice of such testing from the Test Lab and expeditiously make payment to Test Lab.

The testing fee paid shall be borne by the Department/Contractor as per provisions of concerned contract document. In case of rejection however, due to material/equipment found sub-standard on test, the testing fee so paid will be recovered from the supplier/Contractor.

12.2.10. Time Lines

The timeline for different activities for sampling, testing, appeals etc shall be as follows;

Table 12.1 : Timelines for sample testing

S. No.	Particulars	Time Limit	Responsibility
1	Dispatch of Samples to test Laboratory	3 Working Days from Date of Sampling	Concerned Division Office
2	Obtaining Performa Invoice from Test Lab and making payment to Test Lab	10 Working Days from Date of Dispatch of samples to test Labs	Concerned Division Office
3	Intimation to Concerned CE/ ACE, if Samples fail in Test Reports	5 Working Days from Receipt of Test Reports	Officers authorized
4	Intimation of sample failure & proposed action against supplier/contractor/Manufacturer	5 Working Days from Receipt of Test Reports	Concerned Division Office
5	Making Appeal to Appellate Authority against the sample test results giving reasonable justification	7 Working Days from receipt of intimation from division	Supplier/Contractor
6	Disposal of Appeal	30 Working Days from Such Appeal	Appellate Authority
7	Removal & Replacement of Defective material from Site/Division Store	30 Working Days from order to this effect	Supplier/Contractor

In case of any delay in any of the above activities for some uncontrolled reason, the Department/Agency shall intimate such delay providing the reasons of delay to all other concerned.

12.2.11. Testing of Counter samples

For testing of counter samples, the field officers are required to follow the instructions issued by a QC Wing Circular No: F()/ACE(QC)/Inspection/18-19/2153-2487 Dated 26-04-2021 (Available at Appendix F-7).

12.2.11.1 Instance of Failure

In case samples of a material declared having failed after performing tests on the samples collected by Officers authorized as per clause 12.2 or any third party agency authorized by department, it shall be deemed as first instance of failure of that material. These agencies shall follow the sampling procedure as mentioned in clause 12.2.2 and as per CE (Admn.) office Circular No. 2153-2487 Dt. 26.04.2019 and decision of 655th TC Dt. 22.06.2017.

12.2.12. Penal Action for supply of Defective Materials

(i) First Instance of Failure

In case, after performing tests on the samples collected by Officers authorized as per clause 12.2, as per CE (Admn.) office Circular No. 2153-2487 Dt. 26.04.2019 and decision of 655th TC Dt. 22.06.2017 (In case testing of both original sample and counter samples), the material is declared having failed to confirm with reference to the specifications taken in contract, approved QAP and relevant BIS Clauses then this being the first instance of material found failed to pass tests for the concerned supplier/contractor, the penal action proposed shall be as follows;

- The cost of this sample testing shall be recovered from the supplier/contractor.
- The Contractor/Supplier shall have to remove the material from site/divisional store within 30 days from such orders at his own cost.
- The Contractor/Supplier shall have to replace the entire material of failed batch with fresh material, meeting the departmental specifications within the time limit specified above.
- Testing shall be mandatory for such replaced material and testing charges for these replaced materials shall also be recovered from the Supplier/contractor.
- The following penalties shall also be imposed on the contractor for this instance;

• **Table 12.2: Penalties for sample failure**

S.No.	Work Order Cost	Penalty
1	Up to Rs 50.00 Lacs	Rs 10,000.00
2	More than Rs. 50.00 Lacs to Rs 1.00 Crores	Rs 20,000.00
3	More than Rs 1.00 Crore to Rs 10.00 Crore	Rs 40,000.00
4	More than Rs 10.00 Crore to Rs 30.00 Crore	Rs 50,000.00
5	More than Rs 30.00 Crore to Rs 60.00 Crore	Rs 60,000.00
6	More than Rs 60.00 Crore to Rs 100.00 Crore	Rs 80,000.00
7	More Than Rs 100.00 Crores	Rs 100,000.00

(ii) Second Instance of Failure

In case of second instance of failure of material to pass tests with reference to the specifications taken in contract, approved QAP and relevant BIS Clauses, following action should be taken:-

- i. In case second instance of failure of material of same make or manufacturer in same or any other work order/ contract, that make of material or manufacturer shall be banned in this department for procurement and for use in water supply schemes for a suitable time period deemed fit by competent authority, which should not be less than 1 year.
- ii. In case second instance of failure of material by the same contractor/ supplier of any make or material supplied in the same work order/ contract, the contractor/ supplier, shall be debarred for a suitable time period deemed fit by competent authority, which should not be less than 1 year.

The supplier/contractor shall have to remove the material from site/divisional store within 30 days from such orders at his own cost and have to supply and installation of new material within a reasonable time frame as decided by EIC, failing to supply & installation within time may attract another penal action as per contract agreement and RTTP act. With The cost of this sample testing shall be recovered from the supplier/contractor. The delay due to failure of sampling and replacement of material shall be attributed on the part of the contractor/supplier.

The following penalties shall be imposed on the contractor for this instance;

Table 12.3: Penalties for sample failure

S.No.	Work Order Cost	Penalty
1	Up to Rs 50.00 Lacs	Rs 20,000.00
2	More than Rs. 50.00 Lacs to Rs 1.00 Crores	Rs 40,000.00
3	More than Rs 1.00 Crore to Rs 10.00 Crore	Rs 80,000.00
4	More than Rs 10.00 Crore to Rs 30.00 Crore	Rs 100,000.00
5	More than Rs 30.00 Crore to Rs 60.00 Crore	Rs 120,000.00
6	More than Rs 60.00 Crore to Rs 100.00 Crore	Rs 160,000.00
7	More Than Rs 100.00 Crores	Rs 200,000.00

(iii) First instance after debarring

If material found failed to pass tests with reference to the specifications taken in contract, approved QAP and relevant BIS Clauses after debarring once, process of black listing shall be initiated against supplier and/or contractor.

12.2.13. Black Listing

In case the material fails to pass the required test after debarment as above, a process of black listing will be initiated against the Supplier / Contractor by the concerned Chief Engineer/ competent authority.

12.2.14. Appellate Authority

The Contractor/Supplier may appeal before the Appellate committee regarding the issues & disagreement with test results of failed samples.

An Appellate Committee, with the following composition, will hear & decide such appeals:

Table 12.4: composition of Appellate Authority

SN	Designation	Position
i	Chief Engineer (Tech.) & TM RWSSMB	Chairman
ii	Chief Engineer Quality Control	Member Secretary
iii	FA&CAO (RWSSMB)	Member

This committee shall review any appeal before it for any dispute. The above committee will give decision on the issue which is final & binding on the contractor/supplier.

12.2.15. Appeal Procedure

The Contractor/Supplier may appeal before this committee within 10 working days from passing any such orders penalizing him for failure of samples to pass tests. Any appeal beyond this period shall not be entertained. The contractor/supplier should provide adequate justification in support of his appeal. Any appeal not containing any reasonable justification is liable to be rejected.

Form of Appeal

- An appeal shall be in Form along with as many copies as there are respondents in the appeal.
- Every appeal shall be accompanied by an order appealed against, if any, affidavit verifying the facts stated in the appeal and proof of payment of fee.
- Every appeal may be presented to Appellate Authority in person or through registered post or authorized representative.

Fee for filing appeal

- Fee for appeal shall be rupees two thousand five hundred, which shall be non-refundable.
- The fee shall be paid in the form of bank demand draft or banker's cheque of a Scheduled Bank payable to the concerned Division office and original receipt of same shall be produced in the office of Appellate Authority.

Procedure for disposal of appeal

- The Appellate Authority or upon filing of appeal, shall issue notice accompanied by copy of appeal, affidavit and documents, if any, to the respondents and fix date of hearing. On the date fixed for hearing, the Appellate Authority shall,
 - (a) Hear all the parties to appeal present before him; and
 - (b) Peruse or inspect documents, relevant records or copies thereof relating to the matter.
- After hearing the parties, perusal or inspection of documents and relevant records or copies thereof relating to the matter, the Appellate Authority concerned shall pass an order in writing and provide the copy of order to the parties to appeal free of cost.
- The committee may direct for further testing of counter samples to same or any other test lab if deemed necessary. The cost of any such testing shall be recovered from the contractor/supplier.

Memorandum of Appeal in case of Dispute for Material being failed to Pass Quality Tests

Appeal Noof

Before the **Appellate Authority****1. Particulars of appellant:**

- (i) Name of the appellant:
- (ii) Official address, if any:
- (iii) Residential address:

2. Name and address of the respondent(s):

- (i)
- (ii)
- (iii)

3. Number and date of the order appealed against and name and designation of the officer / authority who passed the order (enclose copy), or a statement of a decision, action or omission by which the appellant is aggrieved:**4. If the Appellant proposes to be represented by a representative, the name and postal address of the representative:****5. Number of affidavits and documents enclosed with the appeal:****6. Grounds of appeal:**

.....

(Supported by an affidavit)

7. Prayer:

.....

Place

Date

Appellant's Signature

12.3. TEST REPORT FORMATS

All the essential test report formats for implementation of QA/QC procedures are given in **Appendix- A**, and are listed below;

- Test Certificate for water (where water is brackish)
- Compressive Strength of Concrete
- Concrete Slump Test
- Hydrostatic Test for pressure Pipes
- Leak Test for Under Ground RCC Structures
- Leak Test for Elevated RCC Structures
- Verticality test report

12.4. BRANDS OF MATERIAL AND EQUIPMENTS

The detailed specifications of material and works are not in the preview of QA/QC manual, as these are already available with PHED and the tender/ bids are invited as per these technical specifications.

For quality of goods/equipment, ISI marked or approved brand by Technical committee shall be acceptable for works. However, the obligatory tests for quality assurance shall have to be conducted in both the cases.

CHAPTER 13.
ROLE & RESPONSIBILITIES OF QUALITY
MONITORS (QM)

CHAPTER 13. ROLE & RESPONSIBILITIES OF QUALITY MONITORS (QM)

The Quality Monitors, if appointed, shall be governed by the Approved Guidelines by Department.

CHAPTER 14.
APPENDICES

CHAPTER 14.

APPENDICES

APPENDIX A

TEST REPORT FORMATS

APPENDIX B

CHECKLIST GUIDE FOR WORKS

APPENDIX C

SITE DOCUMENTS

APPENDIX D

QUALITY FIELD INSPECTION REPORT FORMAT

APPENDIX E

SUMMARY REQUIREMENTS FOR SAMPLING TESTING & OTHER REQUIREMENTS FOR WORKS & MATERIALS

APPENDIX F

CIRCULARS & GUIDELINES

APPENDIX-A

TEST REPORT FORMATS

APPENDIX-A: TEST REPORT FORMATS

Sl. No.	Test Report Title	Reference IS	Form No.	Remarks
		Code		
1	Test Report for water for Construction	3025 - 1987	A/TR -1	Mandatory
2	Test Report for Cement		A/TR -2	Mandatory
3	Test Report for Fine Aggregates		A/TR-3	Mandatory
4	Test Report for Bricks		A/TR-4	Mandatory
5	Stone Water Absorption Test		A/TR5	Mandatory
6	Test Report for Coarse Aggregates - Grading		A/TR-6	Mandatory
7	Test Report for Coarse Aggregates – Impact Value		A/TR-7	Mandatory
8	Test Report for Coarse Aggregates – Los angeles Abrasion Test		A/TR-8	Mandatory
9	Test Report for Coarse Aggregates – Flakiness & Elongation Index Test		A/TR-9	Mandatory
10	Soil Moisture Content Test		A/TR -10	Mandatory
11	Soil OMC & MDD Test		A/TR -11	Mandatory
12	Filed Density (Sand Replacement) Test		A/TR -12	Mandatory
13	Compressive Strength of Concrete	456 - 2000 516 - 1959	A/TR -13	Mandatory
14	Concrete Slump Test	1199 -1959	A/TR -14	Mandatory

Sl. No.	Test Report Title	Reference IS Code	Form No.	Remarks
15	Mortar Consistency Test		A/TR -15	Mandatory
16	Hydrostatic Test for pressure Pipes	Manual	A/TR -16	Mandatory
17	WATER TIGHTNESS (under Ground) TEST REPORT	IS:3370 (Part I):2009	A/TR -17	Mandatory
18	WATER TIGHTNESS (Above Ground) TEST REPORT	IS:3370 (Part I):2009	A/TR -18	Mandatory
19	Verticality test report for tubewells	IS:2800 (Part II) -1979	A/TR -19	Mandatory
20	Pipe Laying Report		A/TR -20	Mandatory

FORM A/TR-1 : WATER FOR CONSTRUCTION TESTING REPORT

Form No : A/TR-1							
 Public Health Engineering Department, Rajasthan							
Work Name:							
Division:		Circle:					
Name of Contractor							
W.O./Contract No.		Date:					
WATER FOR CONSTRUCTION TESTING REPORT							
Place:			Structure:				
Source Type:			Source Location:				
Date of Sampling:			Number of Samples:				
S.No.	Parameter	Tested as per IS:	Permissible Limits as per IS:456	Test Results for samples			
				1	2	3	4
1	Color						
2	pH Value	IS 3025 (Part 22 & 23)	≥ 6.0				
3	Organic	IS 3025 (Part 18)	≤ 200 mg/l				
4	Inorganic	IS 3025 (Part 18)	≤ 3000 mg/l				
5	Sulphates (as SO ₃)	IS 3025 (Part 24)	≤ 400 mg/l				
6	Chlorides (As Cl)	IS 3025 (Part 32)					
a	Concrete not embedded with steel		≤ 2000 mg/l				
b	Reinforced Concrete Work		≤ 500 mg/l				
7	Suspended Matter	IS 3025 (Part 17)	≤ 2000 mg/l				
Remarks:							
For Contractor:				For PHED/TPI:			
Signature Name:				Signature Name:			
Position:				Position:			
Date:				Date:			

FORM A/TR-2 : CEMENT TESTING REPORT

Form No : A/TR-2							
Public Health Engineering Department, Rajasthan							
Work Name: _____							
Division: _____			Circle: _____				
Name of Contractor: _____							
W.O./Contract No. _____			Date: _____				
CEMENT TESTING REPORT							
Brand & Type of Cement: _____			Quantity: _____				
Consignment No: _____			Store Register Entry No: _____				
Date of Sampling: _____			Number of Samples: _____				
1 Consistency							
Trail No.	Wt of Cement (gms)	Wt of Water Added (gms)	%age of Water	Reading of Indicator (mm)	Consistency (P)		Remarks
1							
2							
3							
4							
2 Setting Time							
Setting Time	Time recorded when water added		Time recorded at Set		Setting Time	Remark	
Initial Set							
Final Set							
3 Fineness (by dry sieving)							
Wt of Cement Used		Retained on 90 micron IS Sieve		Percentage Retained		Remarks	
4 Compressive Strength (Check for 72, 18 & 672 Hours)							
Room Temp	Date of Casting	Date of Testing	Age of Specimen	Crushing Load (T)	Crushing Strength (Kg/cm ²)	Remark	
Remarks: _____							
For Contractor:				For PHED/TPI:			
Signature Name: _____				Signature Name: _____			
Position: _____				Position: _____			
Date: _____				Date: _____			

FORM A/TR-3 : FINE AGGREGATE TESTING REPORT

Form No. : A/TR-3									
 Public Health Engineering Department, Rajasthan									
Work Name:									
Division:					Circle:				
Name of Contractor									
W.O./Contract No.					Date:				
FINE AGGREGATE TESTING REPORT									
Site Name:					Qty received:				
Date of Receipt:					Source Name:				
Sieve Analysis:									
Sieve Size, mm	Wt of Material Retained, gms	Common weight retained, gms	Percentage Wt Retained, gms	Passing Through %age	Passing Through %age	Grading Limits			Remark
						Zone I	Zone II	Zone III	
10									
4.75									
2.36									
1.18									
600									
300									
150									
Pan									
Dry Bulk Density :					Lab Ref No :		Date:		
Fineness Modulus:									
Deleterious material					Type:		%age by Weight:		
Remarks:									
For Contractor:					For PHED/TPI:				
Signature Name:					Signature Name:				
Position:					Position:				
Date					Date				

FORM A/TR-4 : BRICK TEST REPORT

Form No. : A/TR-4					
Public Health Engineering Department, Rajasthan					
	Work Name: _____				
	Division: _____		Circle: _____		
	Name of Contractor: _____				
	W.O./Contract No. _____		Date: _____		
BRICKS TESTING REPORT					
Site Name: _____			Qty received: _____		
Brand Name: _____			No of Samples: _____		
Dimensions: _____			Class: _____		
Sounding: _____			Color: _____		
Foreign Particle: _____			Obliqueness: _____		
Compressive Strength: _____					
S.No.	Size of Brick L x B x H mm	Crushing Surface Area (sq.mm.)	Crushing Load (kN)	Crushing Strength N/sq.mm.	Remark
Water Absorption Test:					
S.No.	Weight of oven dried Brick, gms	Wt of Wet Brick, gms	Weight of Water Absorbed, gms	%age of Water Absorbed	Remark
Remarks:					
For Contractor:			For PHED/TPI:		
Signature Name:			Signature Name:		
Position:			Position:		
Date			Date		

FORM A/TR-5 : STONE – WATER ABSORPTION TEST REPORT

Form No : A/TR-5					
Public Health Engineering Department, Rajasthan					
	Work Name: _____				
	Division: _____		Circle: _____		
	Name of Contractor _____				
	W.O./Contract No. _____		Date: _____		
STONE: WATER ABSORPTION TESTING REPORT					
Site Name: _____			Qty received: _____		
Quarry Name: _____			No of Samples: _____		
Date of Sampling _____					
Water Absorption Test:					
S.No.	Weight of oven dried Material, gms	Wt of Wet Material, gms	Weight of Water Absorbed, gms	%age of Water Absorbed	Remark
Water Absorption of Stone Samples: _____					
Remarks: _____					
For Contractor:			For PHED/TPI:		
Signature Name: _____			Signature Name: _____		
Position: _____			Position: _____		
Date: _____			Date: _____		

FORM A/TR-6 : COARSE AGGREGATE GRADATION TEST REPORT

		Form No. : A/TR-6					
		Public Health Engineering Department, Rajasthan					
		Work Name:					
		Division:			Circle:		
		Name of Contractor					
W.O./Contract No.			Date:				
COARSE AGGREGATE GRADATION TESTING REPORT							
Site Name:			Qty received:				
Date of Receipt:			Source Name:				
Sieve Analysis:							
Sieve Size, mm	Wt of Material Retained, gms	Common weight retained, gms	Percentage Wt Retained, gms	Passing Through %age	IS Range		Remark
					Graded	Single	
40							
20							
12.5							
10							
4.75							
Pan							
Remarks:							
For Contractor:				For PHED/TPI:			
Signature Name:				Signature Name:			
Position:				Position:			
Date				Date			

FORM A/TR-7 : COARSE AGGREGATE IMPACT VALUE TEST REPORT

		Form No : A/TR-7					
		Public Health Engineering Department, Rajasthan					
		Work Name: _____					
		Division: _____			Circle: _____		
		Name of Contractor: _____					
W.O./Contract No. _____						Date: _____	
COARSE AGGREGATE - IMPACT VALUE TESTING REPORT							
Site Name: _____				Qty received: _____			
Date of Receipt: _____				Source Name: _____			
No	Details	Unit	Trials				
			1	2	3	4	5
1	Wt of dry aggregate passing 12.5 mm and retained on 10 mm sieve + Cylinder measure	Gms					
2	Wt of cylindrical measure	Gms					
3	Wt of dry aggregate taken (1) - (2)	Gms					
4	Wt of crushed aggregate passing 2.36 mm sieve after subjecting the test specimen to 15 blows	Gms					
5	Aggeragate Impact Value = $100 \times (4)/(3)$	%age					
Average Value: _____							
Remarks:							
For Contractor:			For PHED/TPI:				
Signature Name: _____			Signature Name: _____				
Position: _____			Position: _____				
Date: _____			Date: _____				

FORM A/TR-8 : COARSE AGGREGATE LOS ANGELES ABRASION TEST REPORT

Public Health Engineering Department, Rajasthan		Form No : A/TR-8					
	Work Name: _____						
	Division: _____			Circle: _____			
	Name of Contractor: _____						
	W.O./Contract No. _____			Date: _____			
COARSE AGGREGATE - LOS ANGELES ABRASION TESTING REPORT							
Site Name: _____			Qty received: _____				
Date of Receipt: _____			Source Name: _____				
No	Details	Unit	Trials				
			1	2	3	4	5
1	Wt of aggregate of specified gradation	Kg					
2	Weight of passing IS 1.7 mm sieve after specified revolution	Kg					
3	Los Angeles abrasion Value = $100 \times (2)/(1)$	%age					
Average Value: _____							
Remarks:							
For Contractor:			For PHED/TPI:				
Signature Name: _____			Signature Name: _____				
Position: _____			Position: _____				
Date: _____			Date: _____				

FORM A/TR-9 : COARSE AGGREGATE FLAKINESS & ELONGATION TEST REPORT

Form No. : A/TR-9																																																																												
Public Health Engineering Department, Rajasthan																																																																												
	Work Name: _____																																																																											
	Division: _____			Circle: _____																																																																								
	Name of Contractor _____																																																																											
	W.O./Contract No. _____			Date: _____																																																																								
COARSE AGGREGATE - FLAKINESS & ELONGATION INDEX TESTING REPORT																																																																												
Site Name: _____			Qty received: _____																																																																									
Date of Receipt: _____			Source Name: _____																																																																									
<table border="1" style="width: 100%; border-collapse: collapse; font-size: x-small;"> <thead> <tr> <th>Sieve Range (mm)</th> <th>Total Wt of Aggregate (gms)</th> <th>Wt of aggregates passing thickness guage</th> <th>Flakiness Index</th> <th>Wt of non flaky sample</th> <th>Wt of Aggregate passing elongation guage</th> <th>Elongation Index</th> </tr> </thead> <tbody> <tr><td>63 - 50</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>50 - 40</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>40 - 31.5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>31.5 - 25</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>25 - 20</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>20 - 16</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>16 - 12.5</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>12.5 - 10</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>10 - 6.3</td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>							Sieve Range (mm)	Total Wt of Aggregate (gms)	Wt of aggregates passing thickness guage	Flakiness Index	Wt of non flaky sample	Wt of Aggregate passing elongation guage	Elongation Index	63 - 50							50 - 40							40 - 31.5							31.5 - 25							25 - 20							20 - 16							16 - 12.5							12.5 - 10							10 - 6.3						
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10 - 6.3																																																																												
Flakiness Index: _____ Elongation Index: _____ Remarks: _____ 																																																																												
For Contractor: _____			For PHED/TPI: _____																																																																									
Signature Name: _____			Signature Name: _____																																																																									
Position: _____			Position: _____																																																																									
Date: _____			Date: _____																																																																									

FORM A/TR-10 : SOIL MOISTURE CONTENT TEST REPORT

<i>Form No : A/TR-10</i>																																														
	Public Health Engineering Department, Rajasthan																																													
Work Name: _____																																														
Division: _____	Circle: _____																																													
Name of Contractor: _____																																														
W.O./Contract No. _____	Date: _____																																													
SOIL MOISTURE CONTENT TESTING REPORT																																														
Site Name: _____	Samples Collected: _____																																													
Date of Receipt: _____	Samples Tested: _____																																													
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th rowspan="2">No</th> <th rowspan="2">Details</th> <th rowspan="2">Unit</th> <th colspan="5">Test No</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> </tr> <tr> <td>1</td> <td>Wt of Wet soil taken (Sw)</td> <td>Gms</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td>Wt of dry soil in Pan (Sd)</td> <td>Gms</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>3</td> <td>Wt of Water (W=Sw - Sd)</td> <td>Gms</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>4</td> <td>Moisture Content = $100 \times W/Sd$</td> <td>%age</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>		No	Details	Unit	Test No					1	2	3	4	5	1	Wt of Wet soil taken (Sw)	Gms						2	Wt of dry soil in Pan (Sd)	Gms						3	Wt of Water (W=Sw - Sd)	Gms						4	Moisture Content = $100 \times W/Sd$	%age					
No	Details				Unit	Test No																																								
		1	2	3		4	5																																							
1	Wt of Wet soil taken (Sw)	Gms																																												
2	Wt of dry soil in Pan (Sd)	Gms																																												
3	Wt of Water (W=Sw - Sd)	Gms																																												
4	Moisture Content = $100 \times W/Sd$	%age																																												
Remarks: _____																																														
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For Contractor: Signature Name: _____ Position: _____ Date: _____	For PHED/TPI: Signature Name: _____ Position: _____ Date: _____																																													

FORM A/TR-11 : SOIL OMC & MDD TEST REPORT

Form No. A/TR-11							
Public Health Engineering Department, Rajasthan							
	Work Name: _____						
	Division: _____			Circle: _____			
	Name of Contractor: _____			Date: _____			
	W.O./Contract No. _____						
OMC & MDD TESTING REPORT							
Site Name: _____			Samples Collected: _____				
Date of Receipt: _____			Samples Tested: _____				
a) Bulk Density							
No	Details	Unit	Test No				
			1	2	3	4	5
1	Wt of mould + compacted soil (W1)	Gms					
2	Wt of mould (W2)	Gms					
3	Wt of compacted soil (W1-W2)	Gms					
4	Volume of mould (V)	Gms					
5	Bulk Density (W1-W2)/V	Gms/cc					
b) Dry Density							
No	Details	Unit	Test No				
			1	2	3	4	5
1	Wt of cup + wet soil (W3)	Gms					
2	Wt of cup + dry soil (W4)	Gms					
3	Wt of Water W5-W3-W4	Gms					
4	Wt of Cup (W6)	Gms					
5	Wt of dry soil W7 = W4 - W6	Gms					
6	Moisture Content $= W5/W7 \times 100$	%age					
7	Dry Density $(1+W/100)$	Gms/cc					
Maximum Dry Density: _____							
Mean MDD (g/cc) _____							
Mean OMC (%) _____							
Remarks: _____							
For Contractor: _____			For PHED/TPI: _____				
Signature Name: _____			Signature Name: _____				
Position: _____			Position: _____				
Date: _____			Date: _____				

FORM A/TR-12 : SOIL FIELD DENSITY (SAND REPLACEMENT) TEST REPORT

Form No. A/TR-12



Public Health Engineering Department, Rajasthan

Work Name: _____

Division: _____ Circle: _____

Name of Contractor: _____

W.O./Contract No. _____ Date: _____

FIELD DENSITY (SAND REPLACEMENT) TESTING REPORT

Site Name: _____ Samples Collected: _____

Date of Receipt: _____ Samples Tested: _____

a) Determination of Bulk Density of Sand

No	Details	Unit	Test No		
			1	2	3
1	Inside Diameter of calibrating container	cm			
2	Inside Height of calibrating container	cm			
3	Volume of calibrating container	cm ³			
4	Wt of sand + cylinder before pouring	Gms			
5	Wt of sand in cone	Gms			
6	Wt of Sand + cylinder after pouring in calibrating container	Gms			
7	Wt of sand filling with calibrating container	Gms			
8	Bulk Density of sand	Gms/cc			

b) Determination of Bulk Density of Soil in-situ

No	Details	Unit	Test No		
			1	2	3
1	Wt of wet soil from hole	Gms			
2	Wt of Sand + cylinder after pouring into the hole	Gms			
3	Wt of sand in soil	Gms			
4	Volume of hole	Gms			
5	Bulk Density of soil in-situ	Gms/cc			

c) Determination of dry density of soil in-situ

No	Details	Unit	Test No		
			1	2	3
1	Container No				
2	Wt of Container	Gms			
3	Wt of Container + Wet Soil	Gms			
4	Wt of Container + Dry soil	Gms			
5	Wt of Dry Soil	Gms			
6	Wt of Water	Gms			
7	Water Content %	%			
8	Dry Density	Gms/cc			

Remarks: _____

For Contractor: _____

For PHED/TPI: _____

Signature Name: _____

Signature Name: _____

Position: _____

Position: _____

Date: _____

Date: _____

FORM A/TR-13 : CONCRETE CUBE TEST REPORT[illegible]

FORM A/TR-14 : CONCRETE SLUMP TEST REPORT

Form No : A/TR-14				
Public Health Engineering Department, Rajasthan				
	Work Name: _____			
	Division: _____		Circle: _____	
	Name of Contractor: _____			
	W.O./Contract No. _____		Date: _____	
CONCRETE SLUMP TESTING REPORT (AS PER IS:516:1959)				
Place: _____		Structure: _____		
		Casted Member: _____		
Grade of Concrete: _____		Qty of Casted Concrete (Cum): _____		
Pour Card Number: _____		Pour Card Date: _____		
Date of Sampling: _____		Number of Samples: _____		
S.No.	Sample Description	Water Cement Ratio	Slump in mm	Average Slump in mm
Remarks: _____				
For Contractor: Signature Name: _____ Position: _____ Date: _____		For PHED/TPI: Signature Name: _____ Position: _____ Date: _____		

FORM A/TR-15 : MORTAR CONSISTENCY TEST REPORT

<i>Form No : A/TR-15</i>							
	Public Health Engineering Department, Rajasthan						
Work Name:							
Division:	Circle:						
Name of Contractor							
W.O./Contract No.	Date:						
MORTAR CONSISTENCY TESTING REPORT							
Site Name:	Samples Collected:						
Date of Receipt:	Samples Tested:						
No	Details	Unit	Test No				
			1	2	3	4	5
1	Wt of Cement	Kg					
2	Wt of Sand	Kg					
3	Water/Cement Ratio						
4	Wt of Water	Kg					
5	Dial Guage reading before penetration	mm					
5	Dial Guage reading after penetration	mm					
5	Consistency of Mortar	mm					
Average Consistency of Mortar							
Remarks:							
For Contractor:			For PHED/TPI:				
Signature			Signature				
Name:			Name:				
Position:			Position:				
Date			Date				

FORM A/TR-16 : PIPE HYDROSTATIC TEST REPORT[illegible]

FORM A/TR-17 : WATER TIGHTNESS (UG RESERVOIRS) TEST REPORT

<i>Form No : A/TR-17</i>					
Public Health Engineering Department, Rajasthan					
	Work Name: _____				
	Division: _____		Circle: _____		
	Name of Contractor _____				
	W.O./Contract No. _____		Date: _____		
WATER TIGHTNESS (UG RESERVOIRS) TEST REPORT					
Location: _____		Capacity: _____			
Open/Closed _____		Water Column Height: _____			
Date of Filling Water upto Full Supply Level: _____					
A) Container					
After Seven day of Filling upto FSL	Date of Measurement after seven days of filling	Water Level (m)	Water Level Drop (m)	Cumulative Water Level Drop (m)	Remark (Is external surface shows sign of leakage?)
1 Day					
2 day					
3 Day					
4 Day					
5 Day					
6 day					
7 Day					
Allowable drop as per IS3370-1		_____ mm			
Remarks: _____					
B) Roof					
Date & Time of flooding/Start of continuous spray (for sloping roofs) _____					
Depth of Water (if flooding possible) _____					
Date & Time of Observation (24 Hours after flooding) _____					
or 6 hrs of continuous spray (for sloping roofs) _____					
Remarks for leaks or damp patches on soffit: _____					
For Contractor:			For PHED/TPI:		
Signature			Signature		
Name:	_____		Name:	_____	
Position:	_____		Position:	_____	
Date	_____		Date	_____	

FORM A/TR-18 : WATER TIGHTNESS (ABOVE GROUND RESERVOIRS) TEST REPORT

Public Health Engineering Department, Rajasthan					
					
Work Name: _____					
Division: _____		Circle: _____			
Name of Contractor _____					
W.O./Contract No. _____		Date: _____			
WATER TIGHTNESS (Above Ground) TEST REPORT					
Location: _____		Capacity: _____			
Open/Closed _____		Water Column Height: _____			
Date of Filling Water upto Full Supply Level: _____					
A) Container					
After Seven day of Filling upto FSL	Date of Measurement after seven days of filling	Water Level (m)	Water Level Drop (m)	Cumulative Water Level Drop (m)	Remark (Is external surface shows sign of leakage?)
1 Day					
2 day					
3 Day					
4 Day					
5 Day					
6 day					
7 Day					
Allowable drop as Contract _____		mm			
Remarks: _____					
B) Roof					
Date & Time of flooding/Start of continuous spray (for sloping roofs) _____					
Depth of Water (If flooding possible) _____					
Date & Time of Observation (24 Hours after flooding) _____					
or 6 hrs of continuous spray (for sloping roofs) _____					
Remarks for leaks or damp patches on soffit: _____					
For Contractor:			For PHED/TPI:		
Signature			Signature		
Name:			Name:		
Position:			Position:		
Date			Date		

FORM A/TR-19 : TUBEWELL VERTICALITY TEST REPORT[illegible]

[illegible]

APPENDIX – B

CHECKLIST GUIDE FOR WORKS

APPENDIX – B : CHECKLIST GUIDE FOR WORKS

Sl. No	Description of Work	Form No.	Remarks
1	Tube well.	B/CL-1	Mandatory
2	Laying and jointing of pipe line, back filling, and hydro testing.	B/CL-2	Mandatory
3	Pumping machinery & fittings of delivery, pipe in Tube well	B/CL-3	Mandatory
4	Disinfecting plant.	B/CL-4	Mandatory
5	Pump House.	B/CL-5	Mandatory
6	Development of head works.	B/CL-6	Mandatory
7	O.H.S.R	B/CL-7	Mandatory
8	Water treatment plant	B/CL-8	Mandatory
9	Hand Pumps	B/CL-9	Mandatory
10	Control panel for 3 phase pump & motor.	B/CL-10	Mandatory
11	Centrifugal pump, motor & fittings of delivery pipe in pump House	B/CL-11	Mandatory
12	Quality certificate.	B/CL-12	Mandatory

FORM No. B/CL-1 : CHECK LIST FOR TUBEWELL

1. Name of work :
2. Contract Agreement No. :
3. Name of contractor :
4. Location of Tube well :

Sl. No	Description	Yes/No/NA	Remarks
1	Whether tube well site is prone to flooding and free from filled up earth?		
2	Whether any pond is located adjacent to water Works site?		
3	Whether the drilling point of tube well is as per approved lay out plan?		
4	Whether tube well site was investigated hydro geologically & geo-physically to assess the availability of water?		
6	Whether the type of drilling, size of tube well boring are as per contract agreement?		
7	Whether screen slot size and gravel size has been recommended by Hydro geologist?		
8	Whether M.S. Pipes used are of proper thickness, free from rust and with bituminous painted as per approved specification and Departmental inspection conducted?		
9	Whether Stainless steel wire cage strainers are of proper thickness, and as per approved specifications and Departmental inspection conducted?		
10	Whether the tube well assembly has been approved by competent authority.?		
11	Whether lowering of tube well assembly has been done in the presence of AE/ JE in-charge		
12	Whether Cement/clay, seal plug is provided between the annular spaces of boring & lowering assembly to prevent contamination of good quality water bearing strata as per recommendations of the Geologist / Hydrologist?		
13	Whether certificate to the effect that "Certified that the lowering of the pipe assembly and screen/ strainer has been done in our presence and that the quality, sizes and length of pipes and screen/strainer are as per record / entry made and are correctly located and lowered in the bore" has been recorded and is duly signed by AE/JE?		
14	Whether verticality of tube well is checked and recorded?		

15	Whether capacity of Air Compressor (Both CFM and PSI) used is as per specifications given in bid document and is certified by the Engineer-in-charge?		
16	Whether capacity of Submersible pumping set used for development is sufficient w.r.to developed and designed discharge?		
17	Whether tube well development hours are as per contract and log book maintained?		
	a) With compressor		
	b) With submersible pumping set		
18	Whether running hours of air compressor and submersible pumping set are witnessed and certified by authorized officer of PHED?		
19	Whether final performance test done & recorded?		
20	Whether strata chart and assembly chart showing all details of tube well has been submitted by contractor to PHED?		
21	Whether result of water sample tests (Physical/Chemical/ Biological Examination) after development with submersible pumping set are conforming to drinking water standards?		
FOR CONTRACTOR		FOR DEPARTMENT	
Signature	:	Signature	:
Name	:	Name	:
Date	:	Designation	:
		Date	:

FORM No. B/CL-2 : CHECK LIST FOR SUPPLY, LAYING AND JOINTING OF PIPE LINE, BACK FILLING, HYDRO TESTING

1. Name of work :
 2. Contract Agreement No. :
 3. Name of contractor :

Sl. No.	Description	Yes/No/N	Remarks
A. Stage schedule: - Supplying of pipe and valves, excavation, laying, jointing, and fixing of valves.			
1	a) Whether pipes are of proper specifications and as per make as per approved QAP? b) Whether pipes have been tested at manufacturer's premises by PHED Officers/Third Party?		
2	Whether the Sluice Valve/Air Valves etc are as per specification and MOC has been obtained?		
3	Whether the MS/CI/GI/PVC specials are as per specification and MOC has been obtained?		
4	Whether the trenches have been excavated to correct depth as per specifications and dimensions?		
5	Whether the pipe line has been laid true to the alignment with proper bedding made as per specifications?		
6	Whether Jointing material used as per specification?		
7	Whether all the lanes are provided with pipe lines as per approved drawing?		
8	Whether the completion drawing of pipe line prepared and submitted with running bills?		
B. Stage schedule: - Completion, testing and commissioning.			
1	Any bursting of pipeline noticed?		
2	Whether all the leakages observed during testing have been repaired properly?		
3	Whether the trenches were backfilled in layers, and properly watered and consolidated as per specifications?		
4	The filling is carried out to required level and without any settlement?		
5	Field compaction / density test conducted?		
6	Whether the road reinstated properly after laying of pipes?		
7	Whether PHED is satisfied with restoring of roads and streets?		
8	Whether the valve chambers constructed as per drawing and tested for water tightness?		
9	Whether the pipeline system hydraulically tested?		
10	Whether the distribution system properly disinfected before providing connections to consumers?		

FOR CONTRACTOR		FOR DEPARTMENT	
Signature	:	Signature	:
Name	:	Name	:
Date	:	Designation	:
		Date	:

FORM No. B/CL-3 : CHECK LIST FOR PUMPING MACHINERY & FITTINGS OF DELIVERY PIPE IN TUBEWELL

1. Name of work :
2. Contract Agreement No. :
3. Name of contractor :

Sl.	Description	Yes/No/NA	Remarks
1	Whether submersible pump and motor conforming to approved specifications and make as per contract agreement, the MOC obtained and Departmental inspection done?		
2	Whether Sluice valve, reflux valve and Air valve are ISI marked and as per specifications & the MC has been obtained?		
3	Whether the pipes and specials, rubber packing, nut and bolts are as per specifications?		
4	Is there any leakage from fittings?		
5	Is Air Valve/Non Return Valve installed properly?		
6	Whether diameter and length of riser pipe lowered is as per approved specification?		
7	Whether the jointing of riser pipes is done properly to prevent leakage of water?		
8	Whether discharge available from the pump is close to actual discharge of pump? (Actual measurement of discharge by measurement through approved measuring device)		
9	Is motor taking normal current?		
FOR CONTRACTOR		FOR DEPARTMENT	
Signature	:	Signature	:
Name	:	Name	:
Date	:	Designation	:
		Date	:

FORM No. B/CL-4 : CHECK LIST FOR DISINFECTING PLANT

1. Name of work :
2. Contract Agreement No. :
3. Name of contractor :
4. Make, Type & Capacity :

Sl. No.	Description	Yes/No/NA	Remarks
	CHLORINATOR		
1	Whether chlorinator and accessories is as per specification?		
2	Whether MOC has been obtained and PHED inspection conducted?		
3	Whether the chlorinator is installed and working properly?		
4	Whether Testing kit for residual chlorine test available for water sample testing?		
FOR CONTRACTOR		FOR DEPARTMENT	
Signature :		Signature :	
Name :		Name :	
Date :		Designation :	
		Date :	

FORM No. B/CL-5 : CHECK LIST FOR PUMP HOUSE

1. Name of work :
2. Contract Agreement No. :
3. Name of contractor :
4. Location & Other Details :

S.N	Description	Yes/No/NA	Remarks
A Stage : Upto Roof Level			
UPTO PLINTH LEVEL			
1.	Whether Bench Mark pillars are fixed and layout is correct as per approved drawing for excavation of foundation?		
2.	Whether Depth of foundation is correct as per approved drawing?		
3.	Whether Earth bedding condition checked?		
4.	Whether following materials used are as per specifications and Test for materials conducted as per frequency? • Bricks • Fine aggregate • Coarse aggregate • Cement • Steel Reinforcement • Water		
5.	Whether following manufactured materials used are as per specification and Test for materials conducted and MC obtained? • Cement • Steel for reinforcement		
6.	Whether Concrete bedding laid as per specification?		
7.	Whether proper arrangement of curing and curing period maintained as per specification?		
8.	Whether Stone/Brick work in foundation and plinth executed is as per Specifications and necessary test for mix proportion of mortar conducted?		
9.	Whether DPC provided as per specifications?		
UPTO ROOF LEVEL			
10.	Whether Stone/Brick/Concrete work in super structure is as per specifications?. Proper wet bricks are used?. Test for mix proportion of mortar conducted?		
11.	Whether Stone/Brick/Concrete work in super structure is in true plumb and top of all walls are in level?		

12.	Whether Thickness of joints in stonework/brickwork is kept as per specification?		
13.	Whether All horizontal and vertical joints are being filled		
14.	Whether proper curing period maintained as per specification?		
15.	Whether size of doors/windows and other joinery work as per		
16.	Whether proper section of chowkhats have been provided with proper grouting?		
17.	Whether foot rest provided as per drawing and specification?		
B. Stage: - Completion & finishing			
1.	Whether Proper Centering and shuttering has been provided for		
2.	Whether steel Reinforcement laid as per design and drawing?		
3.	Whether R.C.C. Slab is laid of required thickness and in level?		
4.	Whether surface cleaned of all loose mortar and efflorescence before plastering?		
5.	Is the finishing of plaster inside/outside is proper and mix is as per required proportion?		
6.	Whether the floor has been laid in panels, correct thickness and proper sand filling done under floor?		
7.	Whether proper underground conduit for electric cable has been provided for machinery etc?		
8.	Whether electrical fixtures installed are as per approved specifications and quantity?		
9.	Whether top finishing and slope of floor is correct?		
10.	Whether proper roof treatment has been done on roof as per specification?		
11.	Whether proper quality and type of wood has been used with correct thickness of shutters in wooden doors, windows & ventilators as per specification?		
12.	Whether thickness of Glass used in window panes is correct as per specification?		
13.	Have grills, if required, been provided as per standard drawings?		
14.	Whether Quality of White wash/ color wash/ distemper/ cement based paint is as per specification?		
15.	Whether Quality of paint used on wood work/steel work and on other components is as per specification?		
FOR CONTRACTOR		FOR DEPARTMENT	
Signature	:	Signature	:
Name	:	Name	:
Date	:	Designation	:
		Date	:

FORM No. B/CL-6 : CHECK LIST FOR DEVELOPMENT OF HEAD WORKS

1. Name of work :

2. Contract Agreement No. :

3. Name of contractor :

4. Location & Other Details :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether Bench Mark pillars are fixed and layout is correct as per approved drawing for excavation of foundation?		
2	Whether Depth of foundation is correct as per approved drawing?		
3	Whether Earth bedding condition checked?		
4	Whether following materials used are as per specifications and Test for materials conducted as per frequency? • Bricks • Fine aggregate • Coarse aggregate • Cement • Reinforcement • Water		
5	Whether following manufactured materials used are as per specifications and Test for materials conducted and MOC obtained? • Cement • Structural steel		
6	Whether Concrete bedding laid as per specification?		
7	Whether Stone/Brick work in foundation and plinth is as per specifications and necessary test for strength of mortar conducted?		
8	Whether D.P.C. provided as per specifications?		
9	Whether Stone/Brick work in super structure is as per specifications and proper wet bricks are used. Test for mix proportion and strength of mortar		
10	Whether Stone/Brick work in super structure is in true plumb and top of all pillars in level?		
11	Whether Thickness of joints in stone/brick work is kept as per specifications?		
12	Whether All horizontal and vertical joints are being filled correctly?		
13	Whether proper curing period maintained as per specification?		

14	Whether Gate Pillars and corner Pillars have constructed as per drawing?																						
15	Whether barbed wire provided as per IS : 278-2009 and is of proper gauge and fully stretched in correct alignment?																						
16	Whether proper size of iron Gate has been fixed with proper fittings and in alignment as per drawing?																						
17	Whether roads/paths has been constructed according to proper section and camber as per drawing?																						
18	Whether Quality of paint on steel work and on other components is as per specification?																						
19	Whether proper sign board according to specifications has been installed?																						
<table border="0"> <tr> <td colspan="2">FOR CONTRACTOR</td> <td colspan="2">FOR DEPARTMENT</td> </tr> <tr> <td>Signature</td> <td>:</td> <td>Signature</td> <td>:</td> </tr> <tr> <td>Name</td> <td>:</td> <td>Name</td> <td>:</td> </tr> <tr> <td>Date</td> <td>:</td> <td>Designation</td> <td>:</td> </tr> <tr> <td></td> <td></td> <td>Date</td> <td>:</td> </tr> </table>				FOR CONTRACTOR		FOR DEPARTMENT		Signature	:	Signature	:	Name	:	Name	:	Date	:	Designation	:			Date	:
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Name	:	Name	:																				
Date	:	Designation	:																				
		Date	:																				

FORM No. B/CL-7 : CHECK LIST FOR OHSR

1. Name of work :
 2. Contract Agreement No. :
 3. Name of contractor :
 4. Location, Capacity, Type, Staggering etc :

Sl. No.	Description	Yes/No/NA	Remarks
A. Stage:- Foundation and column up-to ring beam			
1.	Is Soil Bearing Capacity has been got checked from approved/reputed institute?		
2	Whether Bench Mark pillars and center pillar were fixed and layout/depth of foundation is correct as per approved drawing?		
3	Earth bedding condition checked for any filled up soil.		
4	Is suitable mechanical arrangement for curing of RCC work (electrical motor/diesel engine operated device) is available at site which is capable of lifting water up to top dome of OHSR.?		
5	Whether following materials used are as per specifications and Test for materials conducted as per frequency? • Fine aggregate • Coarse aggregate • Cement • Steel Reinforcement • Water		
6	Whether following manufactured materials used are as per specifications and Test for materials conducted and MC obtained? • Cement • Steel for reinforcement		
7	Whether all requisite tests have been conducted for the following items as per frequency? • Excavation and bedding • Plain cement concrete • R.C.C. (Slump test, Compressive strength)		
8	Whether PCC laid as per drawing and specifications?		
9	Whether proper steel centering and dent less shuttering is being used?		
10	The reinforcement in the following members provided is as per drawing/design and whether it has been checked by EE/AEN/JE? • Foundation • Columns • Braces • Landings		
11	Whether Concrete Weigh Mixer/ Transit Mixer/Vibrator was used at site and standby arrangement made, if required by contract?		

12	Whether Concrete pour Register with date of casting each bit of Concrete is being maintained?		
13	Whether R.C.C. in the following members laid as per dimensions given in approved drawing with desirable smooth finishing? • Foundation • Columns • Braces		
14	Whether verticality of R.C.C. columns checked before and after pouring of concrete?		
15	Whether proper curing period maintained as per specification?		
16	Whether proper plinth protection constructed?		
17	Whether all scaffolding is of Steel?		
B. Stage: - From ring beam up-to roof slab and completion of stair case.			
1	Whether Bell Mouth Puddle collars, Double Flanged Puddle Collars have been fixed in position and are of proper specifications and approved make?		
2	Is the reinforcement in the following members provided is as per drawing/design and whether it has been checked by EE/AEN/JE? • Bottom Ring beam • Bottom dome and gallery • Tank wall • Top ring beam • Top dome • Staircase and landings		
3	Whether R.C.C. in the following members laid as per dimensions given in approved drawing with desirable smooth finishing? • Bottom Ring beam • Bottom dome and gallery • Tank wall • Top ring beam • Top dome • Staircase and landings		
4	In Stair Case whether G.I. Pipe railing and angle iron pickets is as per drawing and specification?		
5	Whether proper curing period maintained as per specification?		
6	Whether Safety Nets, ropes & harnesses used?		
7	Whether construction joints & water stoppers provided as per approved design & drawing and of proper specifications?		
C. Stage: - Arrangement and erection of C.I D/F pipe and specials, all balance work including plinth protection, automatic water level controller and testing of structure etc.			
1	Whether the CI/ DI/ DF pipes are as per specifications and MOC obtained and pipes have been fixed in true plumb?		
2	Whether inlet and overflow pipes have been properly installed in the tank so as to ensure proper working of OHSR?		

3	Whether following CI/DI valves and specials have been fixed in position		
i.	Duck Foot Bends (IS 13382-1992)		
ii.	Sluice Valves		
iii.	Expansion Joints (IS 1536-1989)		
iv.	M.S. Clamps		
v.	Joining Material (Nut Bolts/Rubber insertion)		
4	Is pipes extended by length, required by contract, beyond Duck Foot Bends?		
5	Is necessary arrangements for overflow pipe eg extension, specials, covering by mesh at end, connecting to supply pipe etc, as required by contract, has been made?		
6	Whether angle posts are painted in two coats after primer?		
7	Whether Roof ventilator is provided with proper cover as per drawing?		
8	Is water level indicator with proper specification has been provided as per drawing. Whether plumb/ indicator is as per size and specifications? Or if, Electronic float system is provided it is as per specification and working properly?		
9	Whether water sealed Manhole Cover of suitable size with proper specifications / Drawing with locking arrangement have been provided?		
10	Whether Lightening Conductor with proper earth electrode and specifications and drawing has been provided?		
11	Whether Ladder of proper MOC from balcony landing to top of the Dome is provided as per drawing and specification?		
12	Whether Ladder of proper MC i.e. Aluminum or any other non corrosive material inside the tank provided as per specifications and drawings and one end fixed to the top dome and other end with the bottom dome?		
13	Whether vertical pipes, clamps, railings, steel ladder and fittings are painted with two coats of paints after applying primer coat?		
14	Whether the OHSR has been tested for water tightness and found no leakage or seepage?		
15	Is overall arrangement of construction as per approved General Arrangement of Structure?		
FOR CONTRACTOR		FOR DEPARTMENT	
Signature	:	Signature	:
Name	:	Name	:
Date	:	Designation	:
		Date	:

FORM No. B/CL-8 : CHECK LIST FOR WATER TREATMENT PLANT

1. Name of work :

2. Contract Agreement No. :

3. Name of contractor :

4. Location, Capacity, Type etc :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether Bench mark Pillars constructed for every units and the foundation, invert, hydraulic and formation levels have been ensured as per drawing?		
2	Whether Drainage Plan/ General Layout of campus approved?		
2	Whether following materials used are as per specifications? Whether Test for materials conducted as per frequency? • Bricks • Fine aggregate • Coarse aggregate • Filter media • Cement • Steel Reinforcement • Water		
3	Whether following manufactured materials used are as per specifications? Whether requisite Tests for materials conducted and Manufacturers Certificate obtained? • Cement • Steel for reinforcement • LDPE sheet • Manhole cover and Footrest • Vent pipes		
4	Whether all requisite tests have been conducted for the following items as per frequency?. • Excavation and bedding • Plain cement concrete • Cement Mortar • R.C.C. (Slump test, Compressive strength)		
5	Whether Inlet chamber has been constructed as per approved drawing?		
6	Whether the Raw Water Reservoir/ sedimentation cum storage tank has been constructed to correct dimensions as per drawing/ specifications and tested for water		

7	Whether the Flash Mixer/ Clari-Flocculator has been constructed to correct dimensions as per drawing/specifications and tested for water tightness?		
8	Whether the Back Wash Water tank has been constructed to correct dimensions as per drawing/specifications and tested for water tightness?		
9	Whether the filter beds has been constructed to correct dimensions as per drawings /specifications and tested for water tightness?		
10	Whether Filter Media is from approved quarry and placed in filter beds to correct position and thickness as per drawing and specification?		
11	Whether the Chlorine Contact Tank has been constructed to correct dimensions as per drawings /specifications and tested for water tightness?		
11	Is the clear water tank has been constructed to correct dimensions as per drawing / specification and tested for water tightness?		
12	Whether the Valves and specials are as per specifications and MOC obtained?		
13	Whether all Mechanical /Electrical /Instrumentation works in Blower Room/ Chemical Building/ Chlorination Building/ Filter Gallery/ Backwash Pump Room as per approved MoC and specifications of Contract?		
FOR CONTRACTOR		FOR DEPARTMENT	
Signature :		Signature :	
Name :		Name :	
Date :		Designation :	
Date			

Note : Check list for components namely OHSR, Pump chamber, Centrifugal pump and motor, Control panel, Development of water works compound and Disinfecting unit shall be required to be filled separately on prescribed format .

FORM No. B/CL-9 : CHECK LIST FOR HANDPUMP

1. Name of work :
2. Contract Agreement No. :
3. Name of contractor :
4. Location & other details :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether HP site is prone to flooding and free from filled up earth?		
2	Whether any village pond is located adjacent to water works site?		
3	Whether the drilling point of Hand pump is as per approved Location?		
4	Whether Handpump site was investigated hydro geologically & geo-physically to assess the availability of water? (applicable to area where there is water scarcity)		
5	Whether the type of drilling, size of hand pump boring are as per contract agreement?		
6	Whether M.S. Pipes used are of proper thickness, free from rust and with bituminous painted as per approved specification, Test certificate obtained?		
7	Whether Riser Pipes (GI pipes) and connecting rods used are as per approved specification, Test certificate obtained?		
8	Whether the Hand pump assembly has been approved by Engineer in charge.		
9	Whether lowering of hand pump assembly has been done in the presence of Some PHED representative?		
10	Whether Cement/clay, seal plug is provided between the annular spaces of boring & lowering assembly to prevent contamination of good quality water bearing strata as per recommendations of the Geologist /		
11	Whether verticality of hand pumps is checked and recorded?		
12	Whether capacity of Air Compressor (Both CFM and PSI) used is as per specifications given in bid document and is certified by the Engineer-in-charge?		
13	Whether hand pump development hours are as per contract and log book maintained?		

14	Whether running hours of air compressor are witnessed and certified by authorized person of PHED?		
15	Whether installation of Hand pump is as per UNICEF/PHED guidelines; Depth of HP bore and length of riser pipe lowered is as per specifications?		
16	Whether Depth of HP bore and length of riser pipe lowered is as per specifications?		
17	Whether strata chart and assembly chart showing all details of handpumps has been submitted by contractor to PHED?		
18	Whether result of water sample tests (Physical/Chemical/Biological Examination) after development are		
FOR CONTRACTOR		FOR DEPARTMENT	
Signature :		Signature :	
Name :		Name :	
Date :		Designation :	
		Date :	

FORM No. B/CL-10 : CHECK LIST FOR CONTROL PANEL FOR 3 PHASE PUMP & MOTOR

1. Name of work :
2. Contract Agreement No. :
3. Name of contractor :
4. Location, Capacity, Type, Make etc. :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether the main switch is of suitable capacity of specified approved make?		
2	Whether the MCB/ MCCB units are of specified make?		
3	Whether the 3 Phase starter is of suitable capacity of specified make?		
4	Whether the required protection relays & other arrangement of specified make is provided and working		
5	Whether the panel box is of approved thickness and has been power painted?		
6	Whether it is suitable for required voltage?		
7	Whether Capacitor is of proper KVAR capacity and of reputed make?		
8	Whether Ampere meter is of suitable range and of specified make?		
9	Whether Volt meter is of suitable range and of specified make?		
10	Whether the ELCB is of reputed make?		
11	Whether three phase Indicators lamps are of approved make?		
12	Whether Fuse bases and HRC fuses are of specified make or equivalent?		
13	Whether selector switch for Ammeter and Voltmeter are of specified make?		
14	CT for Ammeter are of specified make or equivalent?		
15	Contractors relays and timers are of specified make or equivalent?		
16	Switch fuse unit is of specified make or equivalent?		
17	Wires are of specified make or equivalent?		
18	Whether MC has been obtained and inspected by PHED Officers?		
19	Whether the control panel has been fitted properly?		
20	Whether APFC Panel installed as per specification?		
FOR CONTRACTOR		FOR DEPARTMENT	
Signature :		Signature :	
Name :		Name :	
Date :		Designation :	
		Date :	

FORM No. B/CL-11 : CHECK LIST FOR CENTRIFUGAL PUMP, MOTOR & FITTINGS OF DELIVERY PIPE IN PUMP HOUSE

1. Name of work :
2. Contract Agreement No. :
3. Name of contractor :

Sl. No.	Description	Yes/No/NA	Remarks
1	Whether the pumping set is of specified make as per technical specifications, MC obtained and inspection conducted by PHED officers?		
2	Whether the shaft, impeller and bearing are as per technical specifications?		
3	Whether the speed of motor is as per specifications?		
4	Whether the actual discharge of pump is as per specifications?		
5	Whether the alignment of the shaft is correct?		
6	Whether it is suitable for 415 V AC. with variations up to 6		
7	Whether combined efficiency of pump set is as per specifications?		
8	Whether head and discharge are correct as per specifications?		
9	Whether foundation and base plate are as per specifications and foundation bolt are of proper size and length?		
10	Whether the pump set has been power painted?		
11	Whether the suction lift is within the limit as per specifications?		
12	Whether the suction pipe joints are airtight and pump starts without priming?		
13	Whether Sluice valve, reflux valve and Air valve are ISI		
14	Whether the pipes and specials, rubber packing, nut and bolts are as per specifications?		
15	Is there any leakage from fittings? a) Inside the pump house		
16	Is Air Valve/Non Return Valve installed properly?		
17	Is earthing done for machinery and is in order?		
18	Is there any excess vibrations observed on running of pump?		
19	Is there any overheating of bearings?		
20	If the velocity in suction and delivery pipe is within the limit as per contract agreement?		

FOR CONTRACTOR		FOR DEPARTMENT	
Signature	:	Signature	:
Name	:	Name	:
Date	:	Designation	:
		Date	:

FORM No. B/CL-12 : QUALITY CERTIFICATION

1. Name of work :
2. Contract Agreement No. :
3. Name of contractor :
4. Name of Structure/Location :

QUALITY CERTIFICATE

This is to certify that we have inspected the conduct of the works in accordance with established Quality Control procedures and that the items included in this Interim Payment Certificate satisfy the required quality of works and are acceptable with regard to the specifications and standards as prescribed under the Contract. Requisite Test Certificates are attached.

Enclosures

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

Signature/Date:

Date : -----

J.E/A.E.

E.E. [PHED]

Note: This Quality Certificate shall be completed and attached to each Interim Payment before payment is made.

APPENDIX – C
SITE DOCUMENTS

APPENDIX – C : SITE DOCUMENTS

Sl. No.	Name of Document	Responsibility	Remark
C/QRF-1	Site Order book	Contractor	Mandatory
C/QRF-2	Material Register	Contractor	Mandatory
C/QRF-3	Daily Progress Report.	Contractor	Mandatory
C/QRF-4	Concrete pour Record	Contractor	All Concreting Sites
C/QRF-5	Test Record	Contractor	Mandatory
C/QRF- 6	Design and Drawing Record	Contractor	Mandatory
C/QRF- 7	Non-Conforming Item Record	PHED/Contractor	When test results are not O.K. and Quality/Workmanship is poor
C/QRF- 8	Hindrance Register	PHED/Contractor	Mandatory

Form No C/ QRF-1 : SITE ORDER BOOK

Public Health Engineering Department, Rajasthan	
	Work Name: _____
	Division: _____ Circle: _____
	Name of Contractor _____
	W.O./Contract No. _____ Date: _____
Site Order Book	
Inspection Date	_____
Place/Site	_____
Whether Sufficient labor at Site?	_____
Whether Sufficient Material at Site?	_____
Overall Quality of Material?	_____
Overall Quality of Workmanship?	_____
Instruction to Contractor	
Contractor	Inspecting Authority with Designation
Compliance	
Contractor	
Note : *(3 copies per set- one copy each to be sent to EE/SE by the contractor, one copy to be retained at site)	

Form No C/QRF-2: MATERIAL REGISTER

Name of Work :
 Contract Agreement No. :
 Name of Contractor :
 Name of Item :
 Total Quantity Required :
 Source :
 Minimum Size of One Lot :

Sl. No.	Date	Previous Quantity	Invoice/ Bill No	Additional Quantity Procured	Cumulative Quantity	Issued/Consumed	Cumulative Issue	Balance Outstanding Quantity	Present Requirement	Signature of Contractor

*To be maintained item wise in ledger form, to be filled daily by contractor.

Form No C/QRF-3 : DAILY PROGRESS REPORT

Name of Work :

Contract Agreement No. :

Name of Contractor :

Date :

EQUIPMENT AT SITE

Available :

Under Repair :

Sl. No.	Name of Component	Item Executed	Quantity	Location	Labour Engaged				
					Skilled	Non Skilled	Fitter	Mason	Others
1									
2									
3									

Any Special Difficulties/ happening:

Signature :

Name :

Date :

For Contractor

Signature :

Name :

Date :

For Department

Form No C/QRF-4 : CONCRETE POUR RECORD

Public Health Engineering Department, Rajasthan																																																																					
		Work Name:																																																																			
		Division:				Circle:																																																															
		Name of Contractor																																																																			
		W.O./Contract No.				Date:																																																															
Concrete Pour Card																																																																					
Pour Card No																																																																					
Date																																																																					
Supervisor Name:																																																																					
Site Name:																																																																					
Structure Name																																																																					
Structure Component																																																																					
Mix Grade																																																																					
Mix Proportion (Cement:Sand:Aggregate)																																																																					
Cement Used (Make/Grade)																																																																					
Water Cement Ratio																																																																					
Admixtures used such as Plasticiser, Retarder etc.																																																																					
Qty as per Drawing (Cum)																																																																					
Actual Qty (Cum)																																																																					
Method of Pour																																																																					
Date of Pour																																																																					
Time Pour Start																																																																					
Time Pour Finish																																																																					
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Fine Aggregate : Test Report Ref No & Date																																																																					
Compressive Strength and Test Report Ref No & Date																																																																					
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For Contractor:					For PHED/TPI:																																																																
Signature					Signature																																																																
Name:					Name:																																																																
Position:					Position:																																																																
Date					Date																																																																

Form No C/QRF-5 : TEST RECORD

Name of Work :

Contract Agreement No. :

Name of Contractor :

Sl. No.	Description of Sample	Date of Sampling	Size of Sample	Name of Laboratory	Status of Inspection	Status of Manufacturing Certificate	Date & Result of Test	Signature of Contractor	Signature of PHED

Form No C/QRF-6 : DESIGN AND DRAWING RECORD

Name of Work :

Contract Agreement No. :

Name of Contractor :

Sl. No.	Details of Design / Drawing Title/No	Date of Approval of Design / Drawing	Status of Design / Drawing (Original/Revised)	Status of Submission of Soft copy of Design / Drawing	Contractor's Signature	AE/EE Signature

Form No C/QRF-7 : NON CONFORMING ITEM RECORD

- Name of Work :
- Contract Agreement No. :
- Name of Contractor :
- Brief details of item :
- Name and designation of the Authority deciding the non-conformation:
 Name Designation
- Reason for nonconforming :

- Nature of non conforming-Comments :

	Yes	No
i) Whether the item is acceptable with in Specified tolerance limits		
iii) Whether the item requires demolition and re- execution.		

Signature :

Name :

Date :

For Contractor

Signature :

Name :

Date :

For Department

Form No C/QRF-8 : Hindrance Register

HINDRANCE REGISTER
(Refer Note 3 of Item No.23 of Appendix -XIII of PWF&AR Part-II)

- Name of Work:
- Agreement No. & Date:
- Name of Contractor/Firm:
- Contract amount:
- Date of commencement:
- Stipulated date of completion:

S. No.	Details of Hindrance	Date of occurrence of Hindrance	Communication date in writing from contracting firm w.r.t. Hindrance	Date of overcome of Hindrance	Details of corrective measures taken by Engineer(s)*
1	2	3	4	5	6

Total days of hindrance (7=5-3)	Days attributable to contractor (with reasons)	Days not attributable to contractor (with reasons)	Signature of Engineer		
			J.En.	A.E.N.	Ex.En.
7	8	9	10		

APPENDIX – D

QUALITY FIELD INSPECTION REPORT

APPENDIX - D : QUALITY FIELD INSPECTION REPORT

Public Health Engineering Department, Rajasthan			
Quality Control Wing			
QC WING FIELD INSPECTION REPORT			
Division Name		Page	Page 1 of 7
		Inspection Date	
<i>(Sheet to be Filled by Field Officers)</i>			
1. GENERAL			
Name of Division/ Project Inspected		Name of EE	
Name of Block		Name of District	
Name of Section		Name of JE	
Name of Sub Division		Name of AE	
Name of Circle		Name of SE	
Name of Region		Name of ACE	
2. Inspection History			
Inspection of Scheme/Project by ACE with Date & Reference			
Inspection of Scheme/Project by SE with Date & Reference			
Inspection of Scheme/Project by EE with Date & Reference			
Inspection of Scheme/Project by EE(QC) with Date & Reference			
3. Work Details			
Particulars	Work - 1	Work - 2	Work - 3
Name of Work			
Agency			
Work Cost			
Date of Commencement			
Stipulated Date of Completion			
%age Progress			
Note : Detailed List of Works under execution & material available at Site is to be enclosed by Field Officers			
Assistant Engineer PHED, _____		Executive Engineer PHED, _____	

Public Health Engineering Department, Rajasthan					
Quality Control Wing					
QC WING FIELD INSPECTION REPORT					
Division Name		Page		Page 2 of 7	
		Inspection Date			
<i>(For Divisional Stores)</i>					
4. Measuring Instruments at Divisional Store					
SN	Name of Instrument	Availability (Yes/No)	Working Condition (Yes/No)	Calibrated (Yes/No)	Remark
i.	Vernier Caliper				
ii.	Screw Gauge				
iii.	Steel Tape				
iv.	Pt Tape				
v.	Interior/Exterior Calipers				
vi.	Hydrostatic Test Pressure Bench				
vii.	Digital Weighing Balance				
viii.	Any other ...				
ix.					
5. Inspection Reports at Divisional Stores					
SN	Particulars	Yes/No	Remark		
1	Are Inspection reports for material procured in Divisional Store maintained?				
2	Measurement Sheets (i.e. mass, dimension etc) of Inspection maintained or not?				
3	Required Indian Standards available or not?				
AE (QC)		EE(QC)	AE,PHED	EE,PHED	

Public Health Engineering Department, Rajasthan				
Quality Control Wing				
QC WING FIELD INSPECTION REPORT				
Division Name		Page	Page 3 of 7	
		Inspection Date		
<i>(For Project Divisions & Construction Sites)</i>				
6. Quality Documentation				
S. No.	Particulars	Applicability Yes/No	Maintained (Yes/No)	Remarks
1	Whether following documents available at site?			
i	Site Order book			
ii	Material Register			
iii	Daily Progress Report.			
iv	Concrete pour Record			
v	Test Record			
vi	Design and Drawing Record			
vii	Non-Conforming Item Record			
viii	Hindrance Register			
	Any other record			
7. Field Laboratory Equipment				
S. No.	Particulars	Applicability Yes/No	Availability (Yes/No)	Remark
1	Whether Following Field laboratory equipment available at site?			
i.	Compression testing machine			
ii.	Sieve set complete			
iii.	Measuring jars			
iv.	Screw gauge			
v.	Vernier caliper			
vi.	Weight Balance			
vii.	Slump cone			
viii.	Cube mould 3 sets.			
ix.	Hydraulic testing machine			
x.	Any other equipment			

AE (QC)	EE(QC)	AE,PHED	EE,PHED
Public Health Engineering Department, Rajasthan			

Quality Control Wing				
QC WING FIELD INSPECTION REPORT				
Division Name		Page	Page 4 of 7	
		Inspection Date		
8. Field Laboratory Tests				
S. No.	Particulars	Applicability Yes/No	Availability (Yes/No)	Remark
1	Whether following Material being tested at site and lab by contractor?			
i.	Sieve analysis of Coarse aggregate			
ii.	Sieve analysis of Fine aggregate			
iii.	Bricks			
iv.	Cement			
v.	Reinforcing Bar			
vi.	Water			
vii.	Mortar			
viii.	Slump Test			
ix.	Cube test for Concrete			
x.	Pipes for w/s			
xi.	Hydraulic Pressure test of water supply pipelines			
	Any other material			
9. Construction Site Field Equipment				
S. No.	Particulars	Applicability Yes/No	Availability (Yes/No)	Remark
3	Whether following field equipment available at Construction Site?			
i.	Mixture Machine with stand by arrangement.			
ii.	Vibrator with stand by arrangement.			
iii.	Weigh Batcher			
iv.	Lifting pump for curing			
v.	Leveling instrument			
vi.	Hoisting lift			
vii.	Any other equipment			

AE (QC)	EE(QC)	AE,PHED	EE,PHED

Public Health Engineering Department, Rajasthan				
Quality Control Wing				
QC WING FIELD INSPECTION REPORT				
Division Name		Page	Page 5 of 7	
		Inspection Date		
10. Manufacturing Certificates / Third Party Inspection Record				
S. No.	Particulars	Applicability Yes/No	Availability (Yes/No)	Remark
1	Whether manufacturing certificate obtained/ Third Party Inspection conducted for following Items?			
i.	Cement			
ii.	Steel for Reinforcement and structural steel			
iii.	Pipe such as GI , PVC, HDPE ,MS, CI, DI, SW ,RCC etc.			
iv.	Flow measuring devices			
v.	Control Panel			
vi.	Lightening arrestor			
vii.	Water Level indicator and Controller.			
viii.	Disinfection Units			
ix.	Pump and Motor			
x.	All type of specials such as PVC, GI, CI etc.			
xi.	All types of valves such as sluice valve, Air valve etc.			
xii.	Any other item as per agreement			

AE (QC)	EE(QC)	AE,PHED	EE,PHED

Public Health Engineering Department, Rajasthan						
Quality Control Wing						
QC WING FIELD INSPECTION REPORT						
Division Name				Page	Page 6 of 7	
				Inspection Date		
11. Sampling by QC Wing						
S. No.	Name of Item	Collection Site	Qty Sealed	Where Delivered for Testing	Remark	
<i>Note : Enclosed Separate Sheet, if required</i>						
12. Testing by QC Sheet						
S.No.	Name of Item	Location	Type of Test	Test Result	Standard Result	Remark
<i>Note : Enclosed Separate Sheet, if required</i>						
13. Inspection of Civil Works						
S. No.	Work Details	Remarks				
1	ESR at					
2	CWR/GLR at					
3	Pump House at					
4	_____					
AE (QC)		EE(QC)		AE,PHED		EE,PHED
				_____		_____

Public Health Engineering Department, Rajasthan			
Quality Control Wing			
QC WING FIELD INSPECTION REPORT			
Division Name		Page	Page 7 of 7
		Inspection Date	
14. Pipeline Laying			
S.No.	Particulars		Remark
	Location		
	Dia & Type of Pipe		
15. Electro Mechanical Works			
16. Remarks			

AE (QC)	EE(QC)	AE,PHED	EE,PHED

APPENDIX – E

SUMMARY REQUIREMENTS FOR SAMPLING, TESTING & OTHER REQUIREMENTS FOR WORKS & MATERIAL

APPENDIX E-1 : Tubewells & Handpumps

E-1.1 : Steel Tubes for Water Wells (IS 4270)

Process of Manufacture

Steel used for manufacture of tubes and sockets shall be made by basic open hearth electric or basic oxygen process.

Chemical Composition

The tubes shall be manufactured from steel which when analysed shall show neither more than 0.04 percent sulphur nor 0.04 percent phosphorus.

The analysis of steel shall be carried out either by the method specified in IS 228 and its relevant parts or any other established instrumental/chemical method.

Choice of material and the welding process shall be such that no martensite is formed. Alternatively where martensite is likely to be formed during welding, the weld seam shall be suitably heat-treated or processed in such a manner that no untempered martensite remains and its hardness shall be 230 HV maximum.

Mechanical Properties

Tensile Test

The tube/pipe sample when tested in accordance with IS 1608, Yield Strength, Tensile Strength and percentage elongation shall not be less than that specified in table below;

Grade	Yield Strength, min (Mpa)	Tensile Strength, min (Mpa)	% Elongation, min
Fe 410	235	410	15
Fe 450	275	450	13

Flattening Test

The test shall be carried out in accordance with IS 2328. A ring not less than 40 mm long cut from one end of each selected tube shall be flattened cold between parallel flat surfaces without showing either crack or flaw, until the distance between the plates under load condition is not greater than the following

Test	Distance between flat surfaces as percentage of original outside diameter
On Weld	66 percent
On Material	33 Percent

Dimensions

Casting tubes and drive pipes shall have outside diameter, wall thicknesses and weights as specified in Table 2,3,4 and 5 of IS:4270 or may be higher as per mutual agreement between the manufacturer and the purchaser.

Tolerances**Outside diameter**

Permissible tolerances on outside diameter of pipe and socket shall be ± 1 percent but not greater than 3 mm in case of socket.

Thickness

The permissible tolerance on the tube thickness shall be as follows;

Seamless Tube	+ 20% - 12.5%
Welded Tubes	
Upto and including 406.4 mm outside diameter	+ 15% - 12.5%
Over 406.4 mm outside diameter	+ 15% - 10%

Weight

No single tube shall deviate from weights specified in Table 2, 3, 4 & 5 of IS 4270 with a tolerance of + 10 percent and -8 percent.

Length

Unless & otherwise agreed between the supplier and the purchaser, pipes shall be supplied in random lengths of 4 to 7 m. In case of specified lengths, the tolerance shall be as mutually agreed between supplier and the purchaser.

Straightness

Tubes shall not deviate from straightness by more than 1 in 600 of any length.

Hydrostatic Test

Hydrostatic test shall be carried out at a pressure as calculated by the formula subject to maximum test pressure of 7 MPa. The holding time at test pressure shall not be less than 3 second and the pipe shall not show any leakage.

In case of hot finished seamless pipes, testing may be carried out at higher test pressure subject to mutual agreement between the manufacturer and buyer.

Grade	Test Pressure, N/mm ²
Fe 410	280 t/D
Fe 450	350 t/D

Where t – specified thickness of pipe in mm

D – specified outside diameter of pipe in mm

Protective Coating

Unless otherwise specified by the purchaser, the black tubes shall be externally coated with a bituminous solution or any other protective anti-corrosion coating. The bituminous solution shall be of a quantity so as to produce a coating which, when dry, shall be smooth,

tough, tenacious and sufficient hard not to flow on exposure to a temperature of 65°C and shall not be brittle at 0°C. It shall not be such as will impart a taste to the water

Where tubes are required to be galvanized, zinc coating on the tubes shall be in accordance with IS 4736.

Marking

Each pipe shall be marked with the following details by paint stencil.

- Manufacturers Trade Mark
- Nominal Size
- Process of manufacturer
- Grade and
- Length of Tube

Lot sampling criteria for conformity

The sampling & testing of steel tubes for visual, dimensional, alignment and mass requirement shall be in accordance with IS 4711.

The number of tubes to be sampled and tested for mechanical properties are given below by using random number table

Nominal Size	Sample Size
Upto 100 mm	One for every 400 pipes or part thereof
Above 100 mm and upto 300 mm	One for every 200 pipes or part thereof
Above 300 mm	One for every 100 pipes or part thereof
Minimum number of samples per lot	Two

One tube for every 1000 tube in the lot shall be subjected to coating Test. The sample shall pass if the lot is to be accepted under this clause.

All tubes shall be subjected to Hydrostatic Tests. Those tubes failing in the test shall be rejected.

E-1.2 : Gravels for use as pack in Tubewells (IS-4097)

Physical Characteristics

The gravel selected for packing tubewells shall consist of hard quartz (about 96 percent SiO_2) or other suitable material, with an average specific Gravity of not less than 2.5. Not more than 10 percent by weight of the Material shall have a specific gravity of less than 2.25. The gravel shall contain not more than two percent by weight of thin flat or elongated pieces. In the case of such pieces, the larger dimensions shall not be more than 3 times the smallest dimensions. The quartz shall be of sub-rounded to rounded grains with minimum angular features.

The gravel for use as pack shall be free from impurities, such as shale, mica, felspar, clay, sand, dirt, loam, haematite and organic materials.

POROSITY

The porosity of the gravel when laid as a pack shall not be less than 25 percent.

GRAVELSIZES

The gravel conforming to this standard shall be of the following grades:

S.No.	Grade	Pack	Particle Size Range, mm	IS Sieves, mm
1	A	Fine Gravel	Over 2.0 to 3.35	2.0, 3.35
2	B	Fine Gravel	Over 3.35 to 4.75	3.35, 4.75
3	C	Medium Gravel	Over 4.75 to 6.3	4.75, 6.3
4	D	Medium Gravel	Over 6.3 to 8.0	6.3, 8.0
5	E	Coarse Gravel	Over 8.0 to 12.5	8.0, 12.5

For determination of the particle size the corresponding sieves, selected from IS:460, shall be used.

Particle Size Distribution—

The particle size distribution of gravel shall be determined by screening through standard sieves in accordance with IS:460. The percentage distribution of the sizes shall be determined from a graph in which the percentage of material passing through each sieve is plotted against the standard aperture of that sieve. Any size, say D20, will thus indicate that the cumulative weight to fall the grains smaller than this size is 20 percent of the total weight of the test sample.

The uniformity coefficient of the gravel, that is, the ratio of its D20 to D10 sizes shall not exceed 2. A material with uniformity coefficient less than 2 shall be classified as uniform and if greater than 2 it shall be taken as non-uniform.

The limiting sizes given in para above are the minima and maxima, and the stacks containing smaller or bigger sizes as shown by sieve analysis shall be rejected.

HARDNESS

The gravel shall have a hardness of not less than 5 in Moh's scale.

PACK AQUIFER RATIO

The pack aquifer ratio(P/A ratio) is defined as the ratio of 50 percent size (D30) of the gravel pack to the 50 percent size of the aquifer. The size of gravel when used as pack in tubewells shall be Decided in accordance with the size of the aquifer material proposed to be tapped. The gravel size shall be limited as below:

- a) Uniform aquifer with uniform gravel pack.

Pack aquifer ratio—9 to 12.5

- b) Non-uniform aquifer with uniform gravel pack.

Pack aquifer ratio—11 to 15.5

The thickness of gravel pack shall be limited to 13 to 18 cm.

However, artificial gravel pack may not be necessary if the effective size (D10) of the aquifer is greater than 0.3 mm and its uniformity coefficient is greater than 5.

SAMPLING

The method of drawing, reducing and packing the samples as given in clauses 5, 6 and 7 respectively of IS:1811 shall be followed. Each sample shall be not less than ten litres.

The gross sample selected from each sub-lot shall be individually tested for physical characteristics, porosity, particle size distribution and hardness.

Criteria for Conformity The consignment is declared in conformity to the requirements of this standard if the following conditions as applicable are satisfied:

- a) In case the maximum limit for a requirement is specified, the value of the expression $X+0.5 R$ is less than or equal to the value specified.
- b) In case the minimum limit for a requirement is specified the value of expression $X-0.5 R$ is greater than or is equal to the value specified.

NOTE 1 _ The average X is the sum of the test results divided by the number of tests.

NOTE 2 —The range R is the difference between the maximum and minimum of the test results.

E-1.3 : Slotted Pipes (IS-8110)

The well screens and slotted pipes for tubewells shall be as per IS:8110- Well Screens and Slotted Pipes – Specifications.

MARKING

Each pipe shall be marked with the following details:

- a) Nominal size in mm,
- b) Overall length in m,
- c) Manufacturer's trade-mark,
- d) Grade or thickness in mm,
- e) Slot size in mm,
- f) Material

Criteria for conformity

a) Dimensional check — All dimensions shall conform to the drawing or contract and tolerances shall be as given in IS 8110.

"b) Slot opening — The actual values shall be within the tolerance limit applicable as given in IS 8110.

- c) Visual check — No abnormalities shall be found.
- d) Collapse pressure —The collapse shall not take place at collapse pressure lesser than that specified for the respective size as given in IS 8110.
- e) Tensile strength —The failure shall not take place at tensile load lesser than that specified for the respective size as given in IS 8110.
- f) Weld joint strength—The separation of wrapping wire and support rod shall not occur at push load lesser than that specified for the respective size as given in IS 8110

E-1.4 - Tubewell Development

The tubewell shall be developed in accordance with provisions of IS:11189-Methods of Tubewell Development.

E-1.5 : MARK-II DEEP WELL HAND PUMPS --STANDARD (SDWP)

DIMENSIONS AND CONSTRUCTION:

Dimensions and material composition of parts used in connection with the Deepwell hand pumps should be as per IS: 15500:2004 (amended up to date).

GENERAL REQUIREMENTS:

- The material, tolerance, etc. shall be as given in respective figures of IS 15500:2004 (amended up to date).
- The riser pipe holder welded in the water tank shall be as per fig. 4.18F of IS 15500 (part 4).
- The welding shall be done in accordance with IS 9595:1980. Welding for stainless steel components shall conform to IS 2811:1987. Alternatively stainless steel components may be welded by manual arc welding using suitable electrodes conforming to IS 5206:1983. Unless otherwise specified, the minimum specified thickness of the member to be welded shall be the guiding factor for deciding the weld fillet size. It shall normally be not less than the minimum specified thickness of the member to be welded.
- The castings shall conform to Grade FG 200 or higher of IS: 210:1978.
- The bronze castings shall conform to Grade LTB 2 of IS 318:1981.
- The connecting rod shall be as per fig 4.21 of IS: 15500:2004 conforming to bright bar of type 4 conforming to IS 9550 with mechanical properties as follows; Tensile strength =540-790 MPa, Elongation = 12% min. The electro galvanizing shall conform to service grade No. 4 of IS 1573:1986.
- The steel plates/sheets, angle iron and square bars for fabrication of pump shall conform to Grade A of IS 2062:1992.
- The locking of check valve guide with rubber seat retainer shall be done by means of punch locking.
- Plunger rod standard as per fig 4.22 shall be of Stainless Steel & conform to Grade 04 Cr 18 Ni 10 of IS 6603:1972 with following mechanical properties; Tensile strength =1030 MPa, Elongation = 15% min..
- The connecting rods and plunger rod shall be fitted with plastic thread protector at ends before dispatch.
- The machined parts shall not have sharp edged.

ANTI-CORROSIVE TREATMENT:

ELECTRO GALVANIZING:

- i. The following shall be electro galvanized and passivated conforming to service condition No. 4 of IS 1573:1986.

(a) Connecting rod, and

-
- (b) Bearing spacer.
 - (c) Washer
 - ii. All bolts, nuts and washers in the assembly excepting high tensile bolts shall be electro galvanized and passivated conforming to service condition No.2 of IS 1573:1986.

GALVANIZING:

The following assemblies/ parts shall be hot dip galvanized according to IS 4759:1984:-

- (a) Stand
- (b) Water tank
- (c) Head
- (d) cover
- (e) Handle assembly except the inside portion of bearing housing.
- (f) Third Plate

The galvanized assemblies shall be given chromate conversion coating according to 5.9 of IS 2629:1985.

PAINTING:

The exterior surfaces of cast iron components shall be given the following treatment:

- (a) One coat of red oxide primer, conforming to IS 2074:1979.
- (b) Two coats of synthetic enamel paint conforming to IS 2932:1974.

Chain assembly shall be boiled in graphite grease for better anti-corrosion.

TESTING:

VISUAL TESTS:

All the pumps shall be examined for finish and visual defects.

DIMENSIONS AND OTHER TEST:

- i. **SAMPLING:**
Procedure given in IS 2500 (Part 1):1992 shall be followed for sampling inspection. For the characteristics given under 9.3.3 of IS15500, the single sampling plan with general inspection level I and AQL of one percent as given in Tables I & II-A of IS: 2500 (Part 1):1992 shall be followed.
 - ii. The handle shall have reasonably good surface contact with the top and bottom portions of the bracket.
 - iii. The flanges shall be reasonably flat to provide proper matching of the holes to ensure unrestricted insertion of the bolts.
 - iv. After putting the pump on levelled platform, alignment of the rod with respect to the guide bush shall be checked as given below.
-

-
- A rod of length 100 mm and diameter 12 mm shall be fitted to the chain coupling. The handle shall be raised and lowered gently. The rod shall pass through a guide bush with a hole of 13.5 ± 0.5 mm centrally welded with the third plate.
 - The handle shall be checked for lateral play at the end of square section of handle which shall not exceed 2 mm on either side.
 - The clearance between the handle and the bracket shall not be less than 1.5 mm.
- v. The stroke of the pump shall be 125 ± 4 mm.
 - vi. The connecting rods and plunger rod shall be examined for straightness and the formation of the threads. The hexagonal coupler shall also be subjected to similar checks. The hexagonal coupler shall be stress relieved before welding to avoid cracks since these are manufactured from cold drawn bars.
 - vii. The manufacturer shall produce test certificates of raw materials of the components.
 - viii. When pump head assembled in the handle assembly, it shall be possible to insert handle axle by using soft hammer. The fitment of the bearing shall be checked to ensure that outer race of the bearing do not move when mild force is applied on inner racing of the bearing and inner race of the bearing shall rotate freely.
 - ix. The cylinder assembly shall be checked for leakage of water. The cylinder with check valve in place shall be filled with one length of riser pipe. The assembly shall be filled with water and kept in vertical position for 10 minutes. There shall be no leakage of water from the check valve or the caps.
 - x. The check valve and plunger valve shall move freely after assembly.

ROUTINE TESTS:

Two complete pumps including cylinder out of the batch selected shall be subjected to the following tests in addition to the tests given in clause No. 7.6.4.2 above.

- i. The pump assembly and cylinder assembly shall be dismantled and all the components shall be checked in detail for critical dimensions conforming to the drawings. The connecting rods shall also be checked for dimensions.
- ii. The cylinder assembly (other than those selected for dimensional checks) of the pumps shall be placed fully submerged in a barrel of 200 litres water capacity. The pump shall be primed and test shall start only after getting continuous flow of water through the spout. The water shall then be collected in a container for forty continuous strokes to be completed in one minute and the discharge thus measured shall not be less than 15.0 litres.

CRITERIA FOR CONFORMITY:

The lot shall be considered conforming to the requirements of this specification, if the pumps selected according to clause 7.6.4.1 and clause 7.6.4.2 satisfy the following requirements:

-
- (a) The number of pumps not meeting the requirements of a characteristic inspected under clause 7.6.4.2 does not exceed the corresponding acceptance number.
- (b) The pumps selected according to clause 7.6.4.3 meet the requirements as given in clause 7.6.4.3 (i) and clause 7.6.4.3(ii).

MARKING:

The pump head, cylinder and connecting rods shall be marked as under:

- i. The pump head shall have a name plate with the name of the manufacturer and serial number of the pump head assembly and PHED Rajasthan & year of manufacture. In addition, the head flange, the water tank assembly, top flange and the stand assembly flange shall have steel punch impression of manufacturer's identification mark before galvanizing. The impression shall be deep enough so that they shall not be covered under galvanizing.
- ii. The cylinder body shall have manufacturer's identification mark & year of manufacture, marked in raised letters. The serial number and PHED Rajasthan shall be marked on the cylinder by steel punch.
- iii. Each connecting rod shall have steel punch impressions indicating manufacturer's identification mark and PHED Rajasthan & year of manufacture on the 50 mm long hexagonal coupler.
- iv. Each water tank shall be marked with 32 with minimum 10mm letter sizes on the upper side of bottom flange.

E-1.6 : FOR EXTRA DEEP WELL HAND PUMPS (EDWP)

DIMENSIONS AND CONSTRUCTION:

Dimensions and material composition of parts used in connection with the Extra Deepwell handpumps should be as per IS15500:2004 (amended up to date).

GENERAL REQUIREMENTS:

- i. The material, tolerance, etc. shall be as given in respective figures of IS:15500:2004 (amended up to date).
- ii. The riser pipe holder welded in the water tank shall be as per fig 4.18F of IS 15500:2004 (part 4).
- iii. The welding shall be done in accordance with IS 9595:1980. Welding for stainless steel components shall conform to IS 2811:1987. Alternatively stainless steel components may be welded by manual arc welding using suitable electrodes conforming to IS 5206:1983. Unless otherwise specified, the minimum specified thickness of the member to be welded shall be the guiding factor for deciding the weld fillet size. It shall normally be not less than the minimum specified thickness of the member to be welded.
- iv. The castings shall conform to Grade FG 200 or higher grade of IS: 210:1978.
- v. The bronze castings shall conform to Grade LTB 2 of IS 318:1981 with hardness 55 HB, Min. Alternatively Naval Brass conforming to IS 6912 can be used to forge the components..
- vi. The connecting rod shall be as per fig 4.21 of IS: 15500:2004 conforming to bright bar of type 4 conforming to IS 9550 with mechanical properties as follows; Tensile strength =540-790 MPa, Elongation = 12% min. The electro galvanizing shall conform to service grade No. 4 of IS 1573:1986.
- vii. The steel plates/sheets, angle iron and square bars for fabrication of pump shall conform to Grade A of IS 2062:1992.
- viii. For Cylinder setting upto 60m depth. no weights are required. Following weights shall be added at difference intervals:
Above 60m up to 70m 1 Weight
Over 70m upto 80m 2 Weights
Above 80m upto 90mm 3 Weights
(Dimensions of weights as per Fig'4.11' Page of 38 of IS:15500:2004)
- ix. The locking of check valve guide with rubber seat retainer shall be done by means of punch locking.
- x. Plunger rod - EDWP as per fig 4.23 shall be of Stainless Steel & conform to Grade 04 Cr 18 Ni 10 of IS 6603:1972 with following mechanical properties; Tensile strength =1030 MPa, Elongation = 15% min.
- xi. The connecting rods and plunger rod shall be fitted with plastic thread protector at ends before dispatch.

-
- xii. The machined parts shall not have sharp edged.

ANTI-CORROSIVE TREATMENT:**ELECTRO GALVANIZING:**

- i. The following shall be electro galvanized and passivated conforming to service condition No. 4 of IS 1573:1986.
- (a) Connecting rod,
 - (b) Bearing spacer and
 - (c) Washer
- ii. All bolts, nuts and washers in the assembly excepting high tensile bolts shall be electro galvanized and passivated conforming to service condition No.3 of IS 1573:1986.

GALVANIZING:

The following assemblies/Parts shall be hot dip galvanized according to IS 4759:1984:

- (a) Stand
- (b) Water tank
- (c) Head
- (d) Cover
- (e) Handle assembly except the inside portion of bearing housing.
- (f) T Bar
- (g) Counter weight
- (h) Third Plate

The galvanized assemblies shall be given chromate conversion coating Type C as per IS:9839:1981.

PAINTING:

The exterior surfaces of cast iron components shall be given the following treatment:

- (a) One coat of red oxide primer, conforming to IS 2074:1979.
- (b) Two coats of synthetic enamel paint conforming to IS:2932:1974.

Chain assembly shall be boiled in graphite grease for better anti-corrosion.

TESTING:**VISUAL TESTS:**

All the pumps shall be examined for finish and visual defects.

DIMENSIONS AND OTHER TEST:

- i. **SAMPLING:**

Procedure given in IS 2500 (Part 1):1992 shall be followed for sampling inspection. For the characteristics given under 9.3.3 of IS15500, the single sampling plan with general

inspection level I and AQL of one percent as given in Tables I & II-A of IS: 2500 (Part 1):1992 shall be followed.

- ii. The handle shall have reasonably good surface contact with the top and bottom portions of the bracket.
- iii. The flanges shall be reasonably flat to provide proper matching of the holes to ensure unrestricted insertion of the bolts.
- iv. After putting the pump on perfect levelled over the platform, alignment of the rod with respect to the guide bush shall be checked as given below.
 - A rod of length 100 mm and diameter 12 mm shall be fitted to the chain coupling. The handle shall be raised and lowered gently. The rod shall pass through a guide bush with a hole of 13.5 ± 0.5 mm located centrally with respect to the 75 mm diameter opening on the bottom flange.
 - The handle shall be checked for lateral play at the end of square section of handle which shall not exceed 2 mm on either side.
 - The clearance between the handle and the bracket shall not be less than 1.5 mm.
- v. The stroke of the pump shall be 100 ± 4 mm.
- vi. The connecting rods and plunger rod shall be examined for straightness and the formation of the threads. The hexagonal coupler shall also be subjected to similar checks. The hexagonal coupler shall be stress relieved before welding to avoid cracks since these are manufactured from cold drawn bars.
- vii. The manufacturer shall produce test certificates of raw materials of the components.
- viii. When pump head re-assembled with handle assembly, it shall be possible to insert handle axle by using soft hammer. The fitment of the bearing shall be checked to ensure that outer race of the bearing do not move when mild force is applied on inner race of the bearing and inner race of the bearing shall rotate freely.
- ix. The cylinder assembly shall be checked for leakage of water. The cylinder with check valve in place shall be filled with one length of riser pipe. The assembly shall be filled with water and kept in vertical position for 10 minutes. There shall be no leakage of water from the check valve or the caps.
- x. The check valve and plunger valve shall move freely after assembly.

ROUTINE TESTS:

Two complete pumps including cylinder out of the batch selected shall be subjected to the following tests in addition to the tests given in clause No. 7.7.4.2 above.

- i. The pump assembly and cylinder assembly shall be dismantled and all the components shall be checked in detail for critical dimensions conforming to the drawings. The connecting rods shall also be checked for dimensions.
 - ii. The cylinder assembly (other than those selected for dimensional checks) of the pumps shall be placed fully submerged in a barrel of 200 liters water capacity. The pump shall be primed and test shall start only after getting continuous flow of water through the spout. The water shall then be collected in a container for forty
-

continuous strokes to be completed in one minute and the discharge thus measured shall not be less than 12.0 liters.

CRITERIA FOR CONFORMITY:

The lot shall be considered conforming to the requirements of this specification, if the pumps selected according to clause 7.7.4.1 and clause 7.7.4.2 satisfy the following requirements:

- (a) The number of pumps not meeting the requirements of a characteristic inspected under clause 7.7.4.2 does not exceed the corresponding acceptance number as specified in IS:2500(Part-I):1992 and
- The pumps selected according to clause 7.7.4.3 meet the requirements as given in clause 7.7.4.3(i) and clause 7.7.4.3(ii).

MARKING:

The pump head, cylinder and connecting rods shall be marked as under:

- i. The pump head shall have a name plate with the name of the manufacturer and serial number of the pump head assembly and PHED Rajasthan & year of purchase. In addition, the head flange, the water tank assembly, top flange and the stand assembly flange shall have steel punch impression of manufacturer's identification mark before galvanizing. The impression shall be deep enough so that they shall not be covered under galvanizing.
- ii. The cylinder body shall have manufacturer's identification mark and year of manufacture, marked in raised letters. The serial number and PHED Rajasthan shall be marked on the cylinder by steel punch.
- iii. Each connecting rod shall have steel punch impressions indicating manufacturer's identification mark and PHED Rajasthan & year of purchase on the 50 mm long hexagonal coupler.
- iv. Each water tank shall be marked with 32 with minimum 10mm letter sizes on the upper side of bottom flange.

E-1.7 : G.I. PIPES 32mm to 80mm NB, Medium Class (IS 1239-Part-I)**MATERIAL**

- i. General requirements relating to supply of Mild Steel Tubes shall conform to IS 1387:1967. The welded tubes shall be manufactured from hot rolled steel skelp/ strip conforming to IS 10748:1995 (amended upto date).
- ii. The tube shall be Electric Resistance welded (ERW). The height of the internal weld fin shall not be greater than 60% of the specified wall thickness.
- iii. The chemical composition of the steel shall comply with Table 1 of IS 1239 (part 1):2004 in ladle sample analysis. The maximum permissible variations in case of product analysis over the maximum limits specified in table 1 shall be as given in table 2 of IS 1239 (part 1):2004. The analysis shall be carried out as per IS:228.
- iv. The Sockets shall be electric resistance welded and should meet the requirement of IS:1239 (Part-2) 1992 (amended upto date). However socket for 32mm pipe shall be manufactured from seamless pipe & it shall be hot dipped galvanized.

HYDRAULIC PRESSURE TEST:

Hydraulic test shall be carried out at a pressure of 5 Mpa, maintained for at least 3 seconds and shall not show any leakage in the pipes.

DIMENSION AND MASSES:

Dimensions and masses of Steel Tubes shall be as follows:

Nominal Bore (MM)	Out side Diameter		Thickness (MM)	Mass of screwed & socketed type Kg/m	Minimum Outside diameter of socket (MM)	Minimum length of socket (MM)
	Maximum (MM)	Minimum (MM)				
32	42.9	42.0	3.2	3.13	49.0	51.0
40	48.8	47.9	3.2	3.60	56.0	51.0
50	60.8	59.7	3.6	5.10	68.0	60.0
65	76.6	75.3	3.6	6.54	84.0	69.0
80	89.5	88.0	4.0	8.53	98.0	75.0

LENGTH OF PIPE:

The G.I. Pipes of 32mm nominal bore with Socket (as per clause 7.8.1(iv) above) shall be supplied in 3 M. length. For remaining diameters the length shall be as follows:

S. No	Nominal Bore	Length	Remarks
1	50mm	4 to 7 M	With one socket
2	50mm	2.5 to 3.5M	Without socket (for riser pipe of submersible pump in tube well)

S. No	Nominal Bore	Length	Remarks
3	65mm	4 to 7 M	With one socket
4	65mm	2.5 to 3.5M	Without Socket (for riser pipe of submersible pump in tube well)
5	80mm	4 to 7M	With one socket
6	80mm	2.5 to 3.5M	Without socket (for riser pipe of submersible pump in tube well)

The length of tube shall be measured as inclusive of socket on one end with handling tight. Handling tight means that the socket is so tight fitted that it should not fall down during handling or transit.

JOINTS

All screwed tubes shall be supplied with pipe threads confirming to IS:554-1999. Gauging in accordance with IS:8999-1979 shall be considered as an adequate test for conformity of threads of IS:554-1999.

Tubes shall be supplied screwed with taper threads.

Each tube shall be supplied with one socket. Socket shall conform to all requirements of IS 1239 (Part-2): 1992, except clause 6.4.

GALVANIZING

The Zinc coating on the tubes shall be in accordance with IS 4736:1986. The tubes shall be galvanized before screwing.

TOLERANCES

The tolerances shall be permitted as per clause 9 and 11 of IS1239 (Part-1). However tolerance in length of 32mm pipe shall be + 0mm, -25mm.

TESTS

Hydrostatic test for leak tightness as an in-process test at manufacturer's work shall be carried out on each tube. This is a compulsory test.

Other tests on finished tubes shall be carried out as per clause 14 of IS1239 (Part-1).

PROTECTION AND PACKING

The protection and packing shall be done as per provision of relevant IS.

MARKING

- Manufacturer's trade mark.
- Blue colour band.
- BIS certification mark.
- Purchaser's mark as 'PHED RAJASTHAN'
- Inspection mark.

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- f) Random & other length marking.
 - g) Year of supply

SAMPLING & CRITERIA FOR CONFORMITY:

This shall be as per clause 16 of IS 1239 (Part-1).

E-1.8 : M.S.PIPES 100mm to 150mm NB, Medium Class (IS 1239 (part-I))

MATERIAL

- i. General requirements relating to supply of Mild Steel Tubes shall conform to IS 1387:1967. The welded tubes shall be manufactured from hot rolled steel skelp/ strip conforming to IS 10748:1995 (amended upto date).
- ii. The tube shall be Electric Resistance welded (ERW). The height of the internal weld fin shall not be greater than 60% of the specified wall thickness.
- iii. The chemical composition of the steel shall comply with Table 1 of IS 1239 (part 1):2004 in ladle sample analysis. The maximum permissible variations in case of product analysis over the maximum limits specified in table 1 shall be as given in table 2 of IS 1239 (part 1):2004. The analysis shall be carried out as per IS:228.
- iv. The Sockets shall be electric resistance welded and should meet the requirement of IS:1239 (Part-2) 1992 (amended upto date).

HYDRAULIC PRESSURE TEST:

Hydraulic test shall be carried out at a pressure of 5 Mpa, maintained for at least 3 seconds and shall not show any leakage in the pipes.

DIMENSION AND MASSES:

Dimensions and masses of Steel Tubes shall be as follows:

Nominal Bore (MM)	Out side Diameter		Thickness (MM)	Mass of screwed & socketed type Kg/ m	Minimum Outside diameter of socket (MM)	Minimum length of socket (MM)
	Maximum (MM)	Minimum (MM)				
100	115.0	113.1	4.5	12.50	124.0	87.0
125	140.8	138.5	4.8	16.40	151.0	96.0
150	166.5	163.9	4.8	19.50	178.0	96.0

LENGTH OF PIPE:

The Mild Steel Tubes shall be supplied in lengths of 2.5M to 3.5M, 4.0 to 7.0M and 5.0 to 6.5 M. The length of tube shall be measured as inclusive of socket on one end with handling tight. Handling tight means that the socket is so tight fitted that it should not fall down during handling or transit.

JOINTS

All screwed tubes shall be supplied with pipe threads confirming to IS:554-1999. Gauging in accordance with IS:8999-1979 shall be considered as an adequate test for conformity of threads of IS:554-1999.

Tubes shall be supplied screwed with taper threads.

Each tube shall be supplied with one socket. Socket shall conform to all requirements of IS 1239 (Part-2): 1992, except clause 6.4.

TOLERANCES

The tolerances shall be permitted as per clause 9 and 11 of IS1239 (Part-1).

TESTS

Hydrostatic test for leak tightness as an in-process test at manufacturer's work shall be carried out on each tube. This is a compulsory test.

Other tests on finished tubes shall be carried out as per clause 14 of IS1239 (Part-1).

WORKMANSHIP

All pipes shall be cleanly finished and reasonably free from injurious defects. The ends shall be cleanly cut and reasonably square with axis of pipe. The tubes shall be reasonably straight.

PROTECTION AND PACKING

Black tubes not otherwise protected shall be varnished or suitably painted externally throughout the length. For transportation all tubes shall be packed in accordance with IS 4740:1979.

MARKING

- a) Manufacturer's trade mark.
- b) Blue colour band.
- c) BIS certification mark.
- d) Purchaser's mark as 'PHED RAJASTHAN'
- e) Inspection mark.
- f) Random & other length marking.
- g) Year of supply

SAMPLING & CRITERIA FOR CONFORMITY:

This shall be as per clause 16 of IS 1239 (Part-1).

APPENDIX E-2 – Construction Material

E-2.1 : CEMENT and AGGREGATES

Brand for cement, quarry and source of sand and aggregate shall be approved by EIC. In case of any change, same shall be got approved by EIC.

E-2.2 : CONCRETE

Sampling Procedures and Sample Collections

From mixer: At least three approximately equal sample increments totaling 0.02m^3 (20 liters) shall be taken from a batch during its discharge. Each sample increments is to be collected by passing clean & dry receptacle across a stream of concrete. Receptacle should be such as to avoid segregation. G. I. Buckets of 7 to 10 liters capacity will serve the purpose.

From batch: Sample shall be taken while a batch of concrete is being prepared or immediately after it has been discharged on site. Sample shall be collected at not less than five well distributed position, avoiding edge of the mass where segregation may have occurred.

The composite sample obtained by either of the methods mentioned above shall be mixed on a non-absorbent base either with a shovel or trowel to ensure uniformity. These samples can then be used for conducting:

- (a) Slump test,
- (b) Preparation of cube for strength test.

Test of Cement Concrete

Slump Test :

METHOD:

This test is carried out in the field during the course of concreting. The slump test apparatus as per IS: 7320- 1974 is used for determination of slump of fresh concrete. The cone (30x20x10cm) is placed on a flat non-absorbent surface and then filled with concrete mix in four different layers of equal thickness. Each layer is tamped 25 times by the 16 mm dia tamping rod pointed at one end 60 cm length iron rod. The stroke are applied uniformly over the entire area with a force that the rod just penetrates the full depth of the layer compacted. After the filling is completed the conical vessel or mould is removed by raising vertically and the molded concrete is allowed to subside. The subsidence height of the specimen is measured in mm and recorded in terms of slump. The reporting is to be made on format A/TR-3 of **Appendix A**.

STANDARDS

Sl. No.	Placing Conditions	Ref. codes	Degree of Workability	Slump in mm
1	Blinding concrete; Shallow sections; Pavement using pavers	IS: 456 – 2000 IS : 1199 – 1959	Very low	< 25
2	Mass concrete; Lightly reinforced sections in slabs, beams, walls, columns; Floors; Hand placed pavements; Canal lining; Strap footings		Low	25 – 75
3	Heavily reinforced sections in slabs, beams, walls, columns; Slip form work; Pumped concrete		Medium	50 – 100 75 – 100
4	Trench fill;		High	100 – 150
5	In-situ piling Tremie concrete		Very high	> 150

Compressive Test

METHOD: The 150 mm cube moulds as per IS : 10086 -1982 are used for this purpose. Six test specimens shall be taken for each sample to be tested for 7 and 28 days. The mould is filled with concrete mix in 3 layers of equal thickness. Each layer is tamped 25 times by the 16 mm dia tamping rod pointed 60 cm length iron pinning rod.

The test shall be made at the edge of concrete corresponding that to for which the strength specified, Compression tests shall be made immediately upon removal of the concrete test specimens from the curing room i.e. the test specimens shall be loaded in damp condition. The dimensions of the test specimens shall be measured in millimetres accurate to 0.5 mm. The metal bearings plates of the testing machine shall be place in contact with sides of the test specimens.

Cushioning material shall not be used in the machine. In the case of cube, the test specimen shall be placed in the machine in such a manner that the load is applied to the sides of the specimen. An adjustable bearing block shall be used to transmit the load to the test specimen. The size or lower section of the bearing block shall be kept in machine as the head of the testing machine is brought to a bearing on test specimen.

The load shall be applied axially without shock at the rate of approximately 140 kg/ cm² per minute. The total load indicated by the testing machine at failure of the test specimen shall be recorded and the unit compressive strength calculated from the measured dimensions of the test specimen. The type of failure and appearance of the concrete shall be noted. The reporting is to be made on format A/TR-2 of **Appendix A**.

STANDARDS OF CHARACTERISTIC STRENGTH

Group	Grade Designation	Compressive strength on 15 cm cubes for work test in N/mm^2
		Min at 28 days
Ordinary Concrete	M 10	10
	M 15	15
Standard Concrete	M 25	25
	M 30	30
	M 35	35
	M 40	40
High strength Concrete	M 60	60
	M 65	65
	M 70	70

E-2.3 : STEEL

SAMPLING PROCEDURES AND SAMPLE COLLECTIONS

- Take sufficient rods, at random, from each lot to obtain desired number of samples. If more than one rod is needed, they must be taken from different bundles. Using a hacksaw, cut off as many one-metre long pieces as are needed for the test from the sampled rod or rods.
- Tie the cut-off pieces from each lot together with wire and mark properly.
- Every bundle of steel samples must be identified with a proper label and be sent to the laboratory under cover of a sample data from giving:
 - Type of steel
 - Nominal size
 - Cross-section
 - Grade and mould number
 - Test to be done on the samples.

Test of Steel For Reinforcement IS : 1786-2008

METHOD:

The steel should be got tested in authorized laboratories before it is used for work at site. Following tests should be conducted for reinforcement steel,

- Mass per meter & Diameter of Bar
- Yield stress (0.2% Proof stress)
- Ultimate tensile strength
- %age Elongation & Total Elongation
- Bend Test
- Re-bend test
- Chemical composition

Three pieces of 100 cms length in each size should be drawn out of 10 ton lot. After measuring the diameter in mm and weight in kg the strength test and elongation is carried out in Universal testing machine.

STANDARDS

The steel shall be clean and free from loose mill scale, loose rust, mud, oil, grease or any other coating which may reduce or destroy the bond between the concrete and steel. A slight film of rust may not be regarded as harmful but steel shall not be visibly pitted by rust.

Test	Frequency	Ref Codes	Acceptance/Standard for Fe415
Chemical	Once for every source approval Once for every lot	IS1786-2008	
Carbon			0.30 Max %age
Sulphur			0.06 Max %age

Test	Frequency	Ref Codes	Acceptance/Standard for Fe415
Phosphorus			0.06 Max %age
(Sulphur+ Phosphorus)			0.11 Max %age
Physical Tests	Once every 3 months		
Ultimate tensile strength	Once for every source approval	IS : 1608-2005	10% more than the actual 0.2% proof stress but not less 485 N/mm ²
0.2% proof stress	Once for every lot		Min. - 415 MPa
% Elongation			Min.- 14.5 %
Bend Test		IS :1599-1985	To be satisfactory as per Standard IS1786:2008
Re-bend Test		IS :1786-2008	To be satisfactory as per Standard IS1786:2008
Mass per meter run (kg)			6.31 ±3% for 32 mm Dia, 4.830 ±3% for 28 mm dia., 3.85 ± 3% for 25 mm dia., 2.470 ±3% for 20 mm Dia, 1.580 ±5% for 16 mm Dia, 0.888 ±5% for 12 mm Dia, 0.617 ±7% for 10 mm dia, 0.395 ±7% for 8mm dia, 0.222 ±7% for 6mm dia,

E-2.4 : MILD STEEL (STRUCTURAL)**STANDARDS**

Tensile strength of structural steel (As per IS2062:2006)

Sl. No.	Test	Standards
1	Yield strength	250
2	Ultimate strength	400
3	Density	7.8

SAMPLING PROCEDURES AND SAMPLE COLLECTIONS FOR PIPES

- All pipes in a single assignment of the same class, same size and manufactured under essentially similar conditions shall constitute a lot.
- For ascertaining conformity of the lot to the requirements of the standards, sample shall be tested from each lot separately.
- These pipes shall be selected at random from the lot and in order to ensure the randomness of the selection, a random number tables IS: 4905 may be referred to.
- In the absence of random number table, the following procedure may be adopted; Starting from any pipe in the lot, count 1, 2, 3and so on up to r , where r is the integral part of N/n , N being the number of pipes in lot, and n the number of pipes in the sample. Every r^{th} pipe so counted shall be withdrawn so as to constitute the required sample size.

E-2.5 : WATER FOR CONSTRUCTION PURPOSES

Water used for mixing and curing shall be clean and free from injurious amounts of oil, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable water is generally considered satisfactory for mixing concrete.

Sampling of Water

The containers of glass or other inert material like polythene must be carefully cleaned before use. Minimum one liter sample should be collected for lab test.

Method and Standards

Water should be tested as per relevant IS Codes as shown below, and shall conform to IS: 456 -2000 and IS: 10500-2012. The reporting is to be made on format A/TR-1

Test	Frequency	Ref. Codes	Acceptance/Standard
1. Chemical	Once for every source approval		
Analysis	Every Quarterly		
(a) PH value	Chemical tests daily in the site	IRC: 21-2000	a) > 6 or 7.0 to 8.5
(b) Chlorides (as Cl)	Laboratory with testing kits	IS: 3025 (Part 32) - 1987	b) 2000mg/L for concrete not containing embedded steel and 500mg/L for RCC and PSC
(c) Sulphates (as SO ₄)		IS: 3025 (Part 24)	c) 400mg/L
2. Physical	Once for every source approval		
Analysis	Every Quarterly		
(a) Suspended Matter		IS: 3025 (Part 17)	a) 2000 mg/ l max.
(b) Organic Matter		IS: 3025 (Part 18)	b) 200 mg/ l max.
(c) Inorganic Matter		IS: 3025 (Part 18)	c) 3000mg/l max.

APPENDIX E-3: Pipes

E-3.1: UPVC PIPES

The pipe shall conform to the Clause 10 of IS 4985-2000 for its physical and other chemical properties except for the density and Sulphated ash content provisions which shall be as per the stipulations of Contract.

The colour of the pipes shall be light grey. Effect on water intended for human consumption shall be governed by IS: 12235. All plastic and non-plastic material for components of the uPVC piping system e. g. Elastomeric sealing ring, lubricants, when in permanent or in temporary contact with water which is intended for human consumption, shall not adversely affect the quality of the drinking water.

Tests

Type Tests

Tests carried out whenever a change is made in the composition or in the size/ series in order to establish the suitability and the performance capability of the pipes.

Acceptance Tests

Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

All uPVC pipes in the single consignment of the same size and class manufactured under essentially similar conditions on a particular machine shall be considered as a lot for quality control inspection. However, the maximum size of a lot shall not be more than 1000 pipes.

The sampling procedure and scale of sampling for visual inspection and dimensional requirements shall be as per given in Annexure-D of IS: 4985. The pipes shall be tested for lot acceptance.

The following acceptance tests shall be conducted in accordance with IS: 4985 and IS: 12235.

- Visual and dimensional check
 - Reversion test.
 - Vicat Softening test
 - Sulphated Ash Content
 - Density
 - Resistance to external blows at 0 degree temperature.
 - Internal hydrostatic pressure test for pipes and joints
 - Opacity
 - Effect on water
-

Classification of Pipes

The pipes shall be classified by pressure ratings (working pressures) at 27 degree as follows:

Class of pipe	Working pressure(PN)
Class 1	0.25MPa (2.5 kg/cm ²)
Class 2	0.40MPa (4.0 kg/cm ²)
Class 3	0.60MPa (6.0 kg/cm ²)
Class 4	0.80MPa (8.0 kg/cm ²)
Class 5	1.0MPa (10.0 kg/cm ²)
Class 6	1.25MPa (12.5 kg/cm ²)

Composition

The composition shall be based on PVC resin having a K- value of 64 or greater when tested in accordance with IS 4669.

Physical and Chemical Characteristics:
Visual Appearance

The colour of the pipes shall be light grey. Slight variations in the appearance of the colour are permitted.

The internal and external surfaces of the pipes shall be smooth, clean and free from groovings and other defects. Slight shallow longitudinal grooves or irregularities in the pipe shall be permissible provided the wall thickness remains within the permissible limits.

Opacity

The wall of the plain pipe shall not transmit more than 0.2 percent of the visible light falling on it when tested in accordance with IS 12235 (Part 3).

Effect on Water

The pipes shall not have any detrimental effect on the composition of water flowing through them.

Reversion Test

When tested by the immersion method prescribed in IS 12235 (Part 5), a length of pipe 200+/-20mm long shall not alter in length by more than 5%. In the case of socket end pipes, this test shall be carried on the plain portion of the pipe taken at least 100 mm away from the root of the socket.

Vicat Softening Temperature:

When tested by the method prescribed in IS 6307, the Vicat softening temperature of the specimen shall not be less than 80 degree C.

Density

When determined in accordance with IS 13360(Part 3/Sec1), the density of the pipe shall be between 1.40 and 1.46.

Sulphated Ash Content Test

When tested as per Annex B of IS 4985:2000 the sulphated ash content in the pipe shall not exceed 11%.

Mechanical Properties**Hydrostatic Characteristics**

When subjected to internal hydrostatic pressure test in accordance with the procedure given in IS 12235(Part8), the pipe shall not fail during the prescribed test duration. The temperatures and duration of the test shall conform to the requirements given in table below. The test shall be carried out not earlier than 24h after the pipes have been manufactured.

Requirements of pipes for Internal Hydrostatic pressure test

Test	Test Temperature(Min) degree C	Test Duration (Minimum Holding Time) hours	Test Pressure (Min) MPa
Type Test	60	1000	1.16*PN (MPa)
Acceptance Test	27	1	4.19*PN(MPa)

Resistance to External Blows at 0 Degree C

When tested by the method prescribed in Annex C of IS, the pipe shall have a True Impact Rate of not more than 10%. In case of socket – ended pipes, this test shall be carried out on the plain portion of the pipe taken at least 100mm away from the root of the socket.

Sampling and Criteria for Conformity

The sampling procedure and the criteria for conformity shall be as given in Annex D of IS.

Markings

Each pipe shall be clearly marked as indicated below:

- Manufacturers name and trademark
- Outside diameter in mm.
- Class of pipe and pressure rating
- Batch/ Lot No.
- All pipes should be ISI marked.
- Month and year of manufacturing
- Length of pipe

The above information shall be marked in colour as indicated below for different classes of pipes:

Class of pipe	Colour
Class 1	Red
Class 2	Blue
Class 3	Green
Class 4	Brown
Class 5	Yellow
Class 6	Black

E-3.2 : RUBBER RINGS FOR PIPES

For all pipeline materials including iron, steel, stone-ware, asbestos cement, concrete, pitch fibre, plastics and glass reinforced plastics, the rubber rings shall be in accordance with one of the types (Type 1 to Type 6) as per IS 5382:1985. The manufacturer has to however specify the type of sealing ring (namely 1, 2, 3, 4, 5, or 6) that is being offered. The design of the profile of the sealing ring is left to the manufacturer as long as the pipe with sealing ring meets the requirements of the specification.

Type 1 to type 6 correspond to the respective nominal hardness of 40, 50, 60, 70, 80 and 88 IRHD with tolerances as specified in IS:5382:1985.

Requirements**Material**

The rubber shall be free from extractable substances which impart taste, odour or toxicity to water. Substances capable of affecting the organoleptic properties of the water, or toxic materials, such as compounds of mercury, antimony, manganese, lead or copper shall not be included in the composition of rings.

Finish

The rings shall be homogeneous, free from porosity, grit, excessive blooms, blisters or other visible surface imperfections. The fin or flash shall be reduced as much as possible and in any case the thickness of it shall not exceed 0.4mm and the width 0.8mm.

Stretch Test

Stretch gaskets till the circumference is increased by 50 %, then visually inspect for the following:

- Gaskets shall be made of a properly vulcanized virgin rubber compound containing no scrap or reclaim.
- The surface of the gasket shall be smooth, free from pitting cracks, blisters, air marks, and any other imperfection that may affect its behavior in service. The body of the gasket shall be free from porosity and air pockets.

Physical Requirements**Hardness**

When determined in accordance with 'Microtest Method' described in IS:3400 (Part-2)-1980 shall comply with the requirements given in Table-I of IS 5382:1985. For the same ring, hardness values shall be in a maximum range of 41 RHD.

Tensile Strength and Elongation at Break

When determined by the method described in IS:3400 (Part 1)-1977, using Type2 dumb-bell shaped test pieces, the tensile strength and elongation at break shall comply with the requirement given in table 2 of IS 5382:1985. The minimum value vary according to the polymer used.

Compression Set

When determined by the method described in IS: 3400 (Part 10)- 1977 using the small test piece, the compression set shall comply with the requirements given in Table 1.

Accelerated Ageing in Air

When test pieces as described for the hardness test and the stress-strain test are tested after ageing in air at 70 degree C for 7 days, by the oven method described in IS:3400 (Part4) -1978, the changes in hardness, tensile strength and elongation at break after ageing shall comply with the requirements given in Table 1 of IS 5382:1985.

Water Immersion

When determined according to the method given in IS: 3400 (Part6)- 1983 after 7 days immersion in neutral water pH 7 at 70 degree C, the change in volume shall comply with the requirements given in Table 1 of IS 5382:1985.

Cold Resistance

When cooled in a chamber described in Appendix B of IS 5382, the increase in hardness, measured after 7 days at -10 degree C, from the initial hardness, shall comply with the requirements given in Table 1 of IS 5382:1985.

Stress Relaxation in Compression

When determined as described in Appendix B, the stress relaxation in compression shall comply with the requirements of Table 1 of IS 5382:1985.

Water Absorption

Sealing rings shall not absorb more than 10 percent of water when tested according to the method prescribed in Appendix C.

Marking

- Each sealing ring shall be permanently marked with:
- The Manufacturer's name or trade mark.
- The month and year of manufacture
- Diameter of pipe for which the ring is suitable.
- Type of rubber material
- ISI marked.

Sampling

The scale of sampling and criteria for conformity shall be in accordance with Appendix D of IS: 5382:1985.

Storage Conditions After Receipt

To maintain the rings in optimum condition they should be stored in a cool and dark place. The storage temperature should be below 25 degree C and preferably below 15 degree C. At temperatures exceeding 25 degree C, certain forms of deterioration may be accelerated sufficiently to affect the ultimate service life.

E-3.3 : MS PIPE

Manufacturing of MS Pipe

Manufacturing of MS pipes shall be done in conformity with IS: 3589. Manufacturing process shall ensure that;

- Base material i.e. HR coils/Plates shall be of required quality.
- Production equipment is well designed.
- Quality control is comprehensive

Before fabrication of pipes and specials / fittings is commenced, the copies of the mill sheets and the manufacturer's test certificates for plates/ coils and other materials for the fabrication, shall be submitted by the Contractor to the Engineer-in-Charge or his representative for his approval.

Chemical Properties

The supplied steel shall conform to the chemical composition presented in Table-A, unless otherwise modified by Engineer-in-Charge or his representative. The ladle analysis of steel, should be carried out by the method specified in relevant parts of IS 228 (IS 228 – Method of chemical analysis of steel) or any other established instrumental/ method. However, where the method is not given in IS 228 and its relevant parts, a suitable method shall be adopted as agreed between the Engineer-in- Charge or his representative and the contractor. The product analysis shall be carried out on the finished plates. The chemical requirements for steel plates are indicated in Table A .

Table A : Chemical Composition

Steel Grade	Method of Manufacture	Chemical Composition (Ladle Analysis)				
		C, max	Mn, max	P, max	S, max	CE, max
Fe 330	Seamless (S)	0.16	1.2	0.040	0.040	
Fe 330	Welded (ERW)	0.16	1.2	0.040	0.040	
Fe 330	Welded (SAW)	0.16	1.2	0.040	0.040	
Fe 410	Seamless (S)	0.20	1.3	0.040	0.040	0.45
Fe 410	Welded (ERW)	0.20	1.3	0.040	0.040	0.45
Fe 410	Welded (SAW)	0.20	1.3	0.040	0.040	0.45
Fe 450	Seamless (S)	0.25	1.2	0.040	0.040	0.45
Fe 450	Welded (ERW)	0.25	1.2	0.040	0.040	0.45
Fe 450	Welded (SAW)	0.25	1.3	0.040	0.040	0.45

Notes:

- Elements not quoted in this table are not to be intentionally added other than for the purpose of finishing the heat.
- For semi killed quality silicon content shall be 0.08% maximum.
- When the steel is killed by aluminum alone, the total aluminum content shall not be less than 0.02 %. When the steel is killed by silicon alone, the silicon content shall not be less than 0.10 %. When the steel is silicon-aluminum killed, the silicon content shall not be less than 0.03 % and total aluminum content shall not be less than 0.01 %.

- d. Micro-alloying elements may be allowed subject to mutual agreement between the supplier and purchaser. Micro alloying elements like Nb, V or Ti, when used individually or in combination, the total content shall not exceed 0.2 percent.
- e. Nitrogen content of the steel should not exceed 0.012%, which shall be ensured by occasional check analysis.

The permissible variations for product analysis shall be as follows;

Constituent	Variation over specified limit, %, Max
Carbon	0.02
Manganese	0.04
Sulphur	0.005
Phosphorus	0.005

Mechanical Properties and Requirements

As the coil sizes ordered are as per the actual sizes required for the project/scheme, separate test piece of required sizes shall be sent along with each lot.

- (a) **Tensile Tests** – The tensile properties of strip cut longitudinally (excluding the weld) from selected pipe shall show the properties as given in Table Below in respect to specific type of pipes as manufactured. The percentage elongation shall be determined on a gauge length of $5.65\sqrt{S_0}$. If other gauge lengths are used conversion shall be made as in IS3803 (Part I).

The tensile strength, yield strength and percentage elongation of steel shall be determined from standard test pieces cut from pipes/plates. The test shall be carried out on the standard test piece prepared in accordance with test edition of IS 1608 or its international equivalent standard.

- (b) **Flattening or Bend Test for ERW pipes**- The test piece shall be either lengthwise or crosswise from plates. Bend test shall be conducted in accordance with IS 1599 or its international equivalent standard.

The test shall be made on a ring sample not less than 40 mm in length cut from the ends of selected tubes which shall be flattened between parallel plates keeping the weld at 90 degree to the direction of force. No opening shall occur by fracture in the weld until the distance between the plates is less than 75 percent of the original outside diameter of the pipe and no cracks or breaks on the metal elsewhere than in the weld shall occur until the distance between the plates is less than 60% of the original outside diameter.

No bend test is applicable for ERW Pipes.

Steel Grade	Method	Tensile Strength, MPa min	Yield Stress MPa min	Elongation Percent $GL5.65\sqrt{S_0}$ min
Fe 330	ERW, Seamless and SAW	330	195 ¹⁾	20

Fe 410	ERW, Seamless and SAW	410	235 ¹⁾	18
Fe 450	ERW, Seamless and SAW	450	275 ¹⁾	15

1) Yield Stress values are for design purpose only either the upper yield stress ReH, or the 0.5 percent of proof stress (total elongation) ReH 0.5 is to be determined.

(c) Guided Bend Test (for SAW Pipe) – Strip not more than 40 mm wide, cut circumferentially from pipes perpendicular to weld seam with the weld near middle of the sample shall, without fracture, be doubled over a round bar the diameter of which shall be calculated as given in IS:3589. The weld reinforcement shall be removed from the faces.

The specimen shall not fracture completely. Cracks 6.35 mm or less in length at the edge of specimen or 3.18 mm or less in length in the centre of the specimen shall be disregarded. Any crack greater than 3.18 mm in length and regardless of depth located within the weld metal shall be a cause of rejection. Any pop-out greater than 3.18 mm in length (6.35 mm at the edge) and 12.5 percent or less of the specified wall thickness in depth and located in the parent metal, the heat affected zone, or the fusion line shall not be the cause of rejection.

Any test specimen that shows defective preparation or material imperfection unrelated to the intent of the mechanical test whether observed before or after testing, may be disregarded and replaced by another specimen from the same length of the pipe.

On examination of bent specimen, opening out of a specimen, opening out of a slight defect due to incomplete root penetration or lack of root fusion need not be considered a cause of rejection provided the defect has sound metal at the back and on either side of it. In border line cases, further tests shall be made on specimens from the same weld adjacent to the original test specimen.

(d) Hydraulic Pressure Test – Each pipe shall be hydraulically tested at the manufacturers works before the pipe is coated, wrapped and lined.

The hydraulic test pressure shall be pressure calculated as per following formula:

$$P = 2ST/D$$

Where

- P – Hydraulic Test Pressure MPa
- D – Specified outside dia of the pipe in mm
- T – specified thickness of the tube in mm
- S – stress 60% of the specified minimum yield stress in MPa. The maximum test pressure to be limited to 5 MPa wherever applicable.

The Hydraulic test pressure shall be applied for 5 seconds.

(e) Ultrasonic Test - All plates shall be tested by ultrasonic equipment to check for manufacturing defects such as voids, layers etc. The contractor shall supply test certificates to this effect from manufacturer.

Tolerances
Tolerance on Mass

The tolerance on mass per cart load of 10 tonnes or above shall be ± 7.5 percent of the nominal theoretical mass of the tubes.

Mass per meter run of the pipes can be worked out by the formula as under;

$$M = (D - T) \times T \times 0.246615$$

Where,

M – mass of pipe Kg/meter

D – nominal outside diameter of the tube in mm and,

T – nominal thickness of the tube in mm

Tolerance on the outside diameter

Tolerance on outside diameter shall include ovality except for submerged arc welded pipes.

The tolerance on the specified outside diameter of pipe wall shall be as given below;

Outside Dia (for all sizes)	Tolerance
For Seamless Pipes	$\pm 1\%$
For ERW & SAW pipes	$\pm 0.75\%$

Tolerance on thickness

The thickness tolerance shall not apply to the weld area. The maximum height of the weld bead on the internal surface of the pipe shall not exceed 60 percent of nominal wall thickness. The tolerance on the specified wall thickness shall be as follows;

ERW pipes	$\pm 10\%$
SAW and seamless pipes	+ 20% - 12.5%

Tolerance on Ovality

Ovality shall not exceed 1% of specified outside diameter for pipes having diameter to thickness ratio not exceeding 100. Where the diameter to thickness ratio exceed 100, the tolerance on ovality is not specified and should be agreed between the manufacturer and the purchaser.

Tolerance on straightness

Finished pipe shall not deviate from straightness by more than 0.2 percent of the total length.

Fabrication of MS Specials & Fittings

- Welding Inspection Procedures
-

-
- Visual Examination
 - Performa for Welding Profiles Certificate
 - Radiographic procedure

TESTING AT WORK SITE**Field Testing Of Joints**

A minimum of ten percent of the field joints shall be tested radiographically (Samples at random) as per IS: 4853, in case of failure 20% field joints shall be selected. In case of second failure, 100% field joints shall be radiographed.

A minimum five percent of the field joints shall be tested ultrasonic test as per IS: 4260.

The welding of pipes in the field should comply with IS 816-1965 and electrode used should comply with IS 814-1967. Welded joints shall be tested in accordance with procedures laid down in IS 3600-1966 and one test specimen shall be taken from at least one field joint out of 10.

E-3.4 : DI PIPE (DUCTILE IRON PIPE)

Ductile iron, also called nodular iron or spheroidal graphite iron, is characterized by the presence of graphite in nodular or spheroidal form in the resultant casting. It differs from cast iron by greater tensile strength and its significant elongation at break. Ductile Iron offers:

- a) High resistance against breakage due to impact,
- b) High tensile strength, comparable to that of mild steel so that the pipes can be used for higher working pressure
- c) traditional corrosion resistance, comparable to that of cast iron , and
- d) Lighter in mass as compared to cast iron pipes.

The standard nominal diameters DN, of pipes and flanges followed in this standard are as follows:

80,100,125,150,200,250,300,350,400,450,500,600,700,750,800,900,1000,1100,1200,1400, 1600,1800 and 2000mm.

Pipes have been classified as K7, K8, K9, K10, K12 depending on service conditions and manufacturing process.

Fittings conforming to IS 13382:2004 may also be used with ductile iron pipes, when the pressure requirements matches.

Joints

In case of push-on flexible joints, the spigot ends shall be suitably chamfered or rounded off to facilitate smooth entry of pipe in the socket fitted with the rubber gasket.

For high pressure mains where working pressure is greater than 2.4 MPa, suitable flexible joint may be preferred when the joint is restrained against axial movement.

Gaskets

Rubber gaskets used with push-on-joints or mechanical joints shall conform to IS 5382:1985. Rubber gaskets for use with flanged joints shall conform to IS 638.

Sampling

Sampling criteria for various tests, shall be as laid down in IS 11606.

Inspection and Testing :

The pipes will be subjected to following tests for acceptance:

- Visual and dimensional check as per Clause 13 and 15 of IS 8329:2000
- Mechanical Test as per Clause 10 of IS 8329:2000
- Hydrostatic Test as per Clause 11 of IS 8329:2000
- The test reports for the rubber gaskets shall be as per acceptance tests of the IS 5832:1985 and will be in accordance to Clause 3.8 of IS 8329:2000.

The sampling shall be as per the provisions of the IS 8329:2000

Marking

All pipes will be marked as per Clause 18 of IS 8329 and show as below:

- Manufacturer name/ stamp
- Nominal diameter
- Class reference
- Last two digits of the year of manufacture.
- All pipes should be ISI Marked.
- A short white line at the spigot end of each pipe with push-on joint in sizes DN700 and above, to indicate the major axis of the spigot.

Specials for Ductile Iron Pipes*Types of Specials*

DI fittings shall be manufactured and tested in accordance with IS: 9523:2000 or BS: 4772.

Supply

All the DI fittings shall be supplied with one rubber ring for each socket. Flanged fittings shall be supplied with one rubber gasket per flange and the required number of nuts and bolts.

E-3.5 : HDPE PIPES AND SPECIALS

IS 4984:2016 lays down requirements for high density polyethylene pipes from 16mm to 2000 mm nominal diameter of pressure rating from .20 MPa to 2.0 MPa in material grades of PE63, PE80, & PE100 and SDR of 41 to 6 for use for buried water mains and services and for water supply above ground.

Pipes shall be designated according to the grade of material followed by standard dimension ratio, nominal outside diameter and pressure rating (PN) as per clause 6.1 of IS 4984:2016.

Colour

- The colour of the pipe shall be black with blue identification stripes
- Each black pipe with identification stripes shall contain minimum three longitudinal stripes of minimum width of 3 mm in blue colour, circumferentially distributed. These stripes shall be coextruded during pipe manufacturing and shall not preferably be more than 0.2 mm in depth for wall thickness upto 10 mm and 0.5 mm beyond 10 mm. The material of the stripes shall be of the same type as used in the base compound for the pipe.

Testing of Pipe :

HDPE pipes are subjected to following acceptance tests :-

- Visual appearance and dimensions
- Melt Flow Rate (MFR)
- Density
- Reversion Test
- Elongation at Break
- Carbon Black Content
- Carbon Black Dispersion
- Oxidation Induction
- Internal pressure creep rupture test (hydrostatic resistance test) at 80 Degree C for 48 hours
- Internal pressure creep rupture test (hydrostatic resistance test) for joints at 80 Degree C for 48 hours
- The other required tests on HDPE pipes shall be as per the IS 4984 -2016

Visual Appearance

- The internal & external surface of the pipe shall be smooth, clean and free from grooving and other defects. The end of pipe shall be cleanly cut square with the axis of pipe to within the tolerance given in table at Para 7.1 of IS4984:2016.

Length

- The length of straight pipe shall be 5 m to 20 m as agreed between manufacturer and purchaser. Short length of 3 m (minimum) up to maximum of 10 percent of the total supply may be permitted.
-

Coiling

- The pipes shall be coiled such that localized deformation, for example, buckling and kinking is prevented. The minimum internal diameter of the coil shall not be less than 18 dn.

Dimensions

- The mean Outside diameter of pipes and out of roundness (ovality) of the pipes for different nominal diameters shall be in accordance table 3 of IS 4984 -2016.
- The minimum and maximum wall thickness of pipes shall be as given in table 4 of IS 4984:2016.
- Ovality shall be measured at 300mm away from the cut end, using a scale with suitable graduations. For coiled pipes and pipes having SDRs ≥ 21 , re-rounding shall be permissible before the measurement of ovality. The ovality shall be measured during extrusion and prior to coiling.

Marking

- Each straight length of pipe shall be clearly and indelibly marked in white/yellow colors using ink/paint or ink-jet print or hot embossed on white base, at every 1 m throughout the length of pipe/coil with the following information:
 - Manufacturer's name/Trade-mark.
 - Material Designation
 - Pressure Rating
 - Standard Dimension Ratio (SDR)
 - Outside Diameter and
 - Lot number/Batch number containing information of date of manufacture.
 - BIS Certification Marking Each pipe may also be marked with Standard Mark.

E-3.6 : G.I. PIPES

METHOD AND STANDARDS

It shall conform to IS: 1239 (I) -2004 with respect to dimension, weight per meter and Hydraulic test pressure. The Galvanizing of pipes shall also conform to relevant IS: Codes as given below;

Test	Ref Codes	Acceptance/Standard
1. Mass of Zinc Coating	IS: 6745-1972	400 g/m ² minimum total mass of Zinc (inside and outside) per surface area (inside and outside) of the coated surface.
2 Visual Test	IS: 2629-1985	The Zinc coating shall be free from imperfection like flux, ash and dross inclusions, bare patches, black spots, pimples, lumpiness, rums, rust, blister, white deposit etc.

Minimum 1m pipe length for each size should be sent for lab test.

Tests of any other pipes be used in water supply schemes shall conform to relevant IS.

APPENDIX E-4 : ELECTRO MECHANICAL EQUIPMENT**E-4.1 : VERTICAL TURBINE PUMP (MIXED AND AXIAL FLOW), FOR CLEAR COLD WATER****Performance Test**

The expected field performance of the pump may be obtained by testing the bowl assembly in the laboratory and then calculating the required performance.

Laboratory Tests

As far as possible, full load and full speed tests shall be conducted. However, laboratory test at reduced speed and reduced stages shall be according to IS 5120: 1977.

Sampling

The sampling plan as given in IS 10572:1983 shall be followed.

Field Tests

A field test gives an indication of the overall performance of a pump when it is operating under actual field conditions. Field tests are sometimes used as acceptance test. The accuracy with which field test be made depends on the instruments used in the test, the proper installation of the instruments and the skill of the test personnel. It shall be recognized that environmental conditions in a well or the design of a pump shall significantly affect field performance and also affect the apparent results of field test under most conditions, it is recommended that acceptance of the pump shall be based on tests made in laboratory.

Field test shall not be carried out until the pump has worked for at least 24 hours to allow running in time for the bearings. If test is to be carried out at different heads, this shall be done by throttling the delivery valves, in this case delivery valve be placed after the minimum upstream and downstream length as required by flow measuring device. The control valve shall be at least 4 times the diameter away from the discharge head elbow.

Speed

The rotating speed of pump shall be measured by revolution counter or by an accurately calibrated tachometer or by stroboscope counting slip method. *Discharge* The discharge of the pump shall be measured by means of a standard venture tube, nozzle, orifice plate, V-notch/ rectangular weir, pitot tube, traverse or any other recognized method. The method adopted for discharge measurement shall be suitable for the size of pump, its duty, and situation. The pump manufacturer shall, if required give evidence of the proper calibration of the apparatus used.

The pipe preceding and succeeding the fluid measuring device are as important as the calibration of the device itself and shall be taken care.

Net Pump Effective Head

For determining the net pump effective head, following measurement shall be taken and the readings shall be converted to datum reference:

- a) Static water depth with pump in working condition,
- b) Delivery head, and
- c) Velocity head.

Delivery head

Delivery Head shall be measured by means of a calibrated bourdon tube gauge (reading converted to meter of liquid) located at a distance of $2D$ from the discharge elbow of the test pump (D is diameter of delivery pipe) plus the distance from the datum to the centre line of gauge. It is recommended that mercury manometers be used in preference to bourdon type gauges when the head to be measured is 7.5 m or less. For precautions and connections for the gauge refer 13.8.4 of IS 5120:1977.

Velocity head

Velocity head shall be obtained from the actual measurement of the inside diameter of the discharge pipe at the point where the pressure tap is located.

Pump Input

The power input to the pump shall be determined with a vertical dynamometer or a calibrated electric motor. It is generally considered impractical to attempt to measure pump power input by means of transmission dynamometer in field.

Overall Efficiency:

When the specifications calls for an overall efficiency guarantee, the actual job motor shall be used without calibration and efficiency calculated directly.

NOTE: *If it is possible to accommodate pressure tapping in the discharge pipe line with $4D$ straight distance from discharge head outlet flange, head can be measured.

The pump shall be tested for the operating head range. However, the range shall be between + 10 percent and -25 percent of the rated head. Below 30 m, the limit shall be from - 25 percent to +2.5 or ± 3 m whichever is less. The tolerance on discharge shall be ± 25 percent and for the other duty points, tolerance shall be according to IS 9137: 1978. The efficiency of vertical turbine pump shall be guaranteed at the specified point of rating only and shall not be guaranteed to cover the performance of the pump under conditions varying therefrom nor for a sustained performance of any period of time. However, pump discharge may be guaranteed for the range of head between -25 percent and +10 percent of the specified head when the latter is 30 metres or above. Below 30 metres the limits shall be from -25 percent to +25 presents of ± 3 metres whichever is less.

E-4.2 : SUBMERSIBLE PUMPSETS

The technical requirements for submersible pumpsets commonly used in boreholes (borewells or tubewells) for handling clear, cold water.

Pump Test

The testing of the pumps shall be in accordance with IS8034:2002.

Sampling

The sampling shall be as specified in IS 10572:1983.

Laboratory Tests

Testing procedures as given in IS 11346:2002 shall be followed. Measurement of flow shall conform to 3.1 of IS 11346:2002.

Power Measurement

Watt meter of adequate capacity shall be used.

Tests for Electrical Performance**Type Tests**

Submersible motors shall conform to all the requirements of IS 9283:2013. However, in case of pump set, motor need not be tested for full load test [16.1 (g)], performance characteristics [16.1 (h)], momentary overload test [16.1 (m)], vibration test [16.1 (n)] as per IS 9283 and temperature rise test as below:

Temperature Rise Test

Temperature rise test for winding shall be carried out on sample pumpset:

- a) at rated voltage and supply frequency, and
- b) at 85 percent of rated voltage and supply frequency.

Temperature rise test at rated voltage

Run the pumpset at rated voltage and at maximum current in the operating head range for 2 h. Stop the set and measure the winding resistance and water temperature within 30 s. Temperature rise computed by resistance method as per Clause 19.2 of IS 9283:2013 shall not exceed 35°C.

Temperature rise test at reduced voltage

Carry out this test immediately after test at rated voltage. Run the set at maximum current in operating head range at rated voltage. Reduce the voltage to 85 percent of rated voltage in this condition. Run the pumpset for 1 h and measure the winding resistance. Temperature rise so computed shall not exceed 45 °C. Water temperature in both the above tests iii & iv shall not exceed 45°C.

Routine Test

Tests as specified in 16.2 of IS 9283:2013.

Submersible Cable

The cable shall conform to 5.3 of IS 9283:2013. The length of the cable shall be minimum 3 m unless otherwise specified by the customer.

Pump Assembly

Hydrostatic test shall be carried out on pressure boundary part either individually or as a block assembly at a pressure of 1.5 times the maximum discharge pressure for a minimum duration of 2 min. The pump may be equipped with replaceable bearing and wearing ring, wherever provided.

Direction of Rotation

The direction of rotation of pumpsets is designated clockwise or anti-clockwise as observed when looking at the pump stage from the driving end. The direction of rotation shall be clearly and securely marked by incorporating an arrow on the pump set.

Typical Installation

Since the motor and the pump are directly coupled, or closed coupled, the manufacturer shall indicate the minimum size of the borehole in which the submersible pumpset shall be erected and suspended freely. The pumpset shall be installed as per guidelines laid down in IS 14536 or as per the recommendation of the manufacturer. The maximum outside diameter of pumpsets corresponding to nominal diameter of the tubewell is as given below:

Nominal dia of the tubewell	Maximum outside dia of submersible pumpsets
100mm	98mm
150mm	146mm
200mm	196mm
250mm	245mm
300mm	296mm

The pump shall be tested for operating head range. However, it shall not be less than +10 percent and - 25 percent of the rated head. Below 30 m, the limits shall be from + 10 percent to -25 percent or ± 3 m, whichever is less. In the above head range, the motor shall not get overloaded. The criteria for checking non-overloading shall be that maximum current in operating head range shall not exceed the limits specified, in table 1 of IS 8034:2002 for various ratings.

Guarantee of Performance

The pumpsets shall be guaranteed for their performance of the nominal volume rate of flow, nominal head, and overall efficiency.

The pump shall be tested for operating head range. However, it shall not be less than +10 percent and -25 percent of the rated head. Below 30m, the limits shall be from +10percent to -25 percent or ± 3 m, whichever is less. In the above head range, the motor shall not be

get overloaded. The criteria for checking non-overloading shall be that maximum current in operating head range shall not exceed the limits specified in Table 1 of IS8034:2002, for various ratings.

Marking

A name plate of corrosion-resistant material shall be affixed on the pumpset with the following details:

- a) Manufacturer's name or trade-mark, if any;
- b) Model
- c) Serial No.
- d) Number of stages
- e) Bore size, Min
- f) Head, at nominal duty point
- g) Discharge, at nominal duty point
- h) Overall efficiency,
- i) Motor rating(kW)
- j) Rated speed (rpm)
- k) Maximum current (amp)
- l) Rated Voltage (V) with variation
- m) Rated frequency(Hz)
- n) Connection star/ delta
- o) Type of duty (whether continuous or not)
- p) Delivery Size; and
- q) Head range for non- overloading requirements.

E-4.3 : HORIZONTAL CENTRIFUGAL PUMPS

These pumps are installed with suction lift.

Pump Test

The testing of the pumps shall be in accordance with IS 11346:2002.

Sampling

The method of sampling and criteria for conformity for acceptance of lot offered for inspection shall be in accordance with IS 10572:1983.

The tolerance allowed on volume rate of flow, head and efficiency shall be as indicated in IS 11346:2002. Power consumption by the pump shall not exceed the recommended prime mover rating in the specified operating head range.

Marking

Pump shall be marked with the following:

- a) Manufacturer's name or his recognized trade-mark;
- b) Type, size and serial No. of pump;
- c) Speed;
- d) Head, volume rate of flow and efficiency at the specific duty point;
- e) Head range for overloading requirements;
- f) Recommended prime-mover rating; and
- g) Arrow to indicate direction of rotation.

APPENDIX F

CIRCULARS & GUIDELINES

APPENDIX F – CIRCULARS & GUIDELINES
APPENDIX – F-1 : NORMS FOR INSPECTION FOR QUALITY CONTROL
**GOVERNMENT OF RAJASTHAN
PUBLIC HEALTH ENGINEERING DEPARTMENT**

No. F(6 (26) PHED/2010-11/ ACE 10) / Tour-Inspt / dated: 30-11-10.
25588-827

To,

Chief Engineer (Adm.) & Technical Member
RWSSMB, Jaipur

Chief Engineer (SP/HQ/Rural)
PHED Rajasthan, Jaipur

Chief Engineer
PHED Jodhpur

Addl. Chief Engineer
PHED Region Ajmer/Bikaner/Bharatpur/
Kota/Jaipur/Jodhpur/Udaipur/Drilling Jaipur/
Project Ajmer/Project Bharatpur

Superintending Engineer
PHED Circle (all) _____

Executive Engineer
PHED Division (All) _____

Assistant Engineer
PHED Sub Dn. (All) _____

Junior Engineer
PHED Chowki (All) _____

ORDER

In pursuance of the directions issued by State Government, a committee of officers was constituted vide order of the undersigned dated 22.09.2010 for prescribing norms of inspection of works in PHED by the engineers of the department. The committee was directed to give its recommendations in this regard with reference to various categories of works such as O&M works, construction works, quality control etc. The draft recommendations were submitted by committee on 03.11.2010 and have been duly considered by State Government with some additions. On the basis of these recommendations, the

Government hereby determines the norms for inspection of all categories of works by engineers of PHED as per details attached here with.

Annexure I determines the norms for inspection by engineers of the department for works of drilling of bore wells/hand pumps/L&J of pipe line/Sectional Testing/ New Service Connections/Maintenance works in urban and rural water supply schemes/projects.

Annexure II determines the norms for inspection and supervision of works by engineers of the department having working in water supply project divisions.

Annexure III determines the norms for inspection and supervision of works by engineers of the department working in regular maintenance divisions.

Annexure IV determines the norms for inspection and supervision of works by engineers of the department for operation & maintenance of Urban/Rural water supply schemes.

Annexure V contains list of selective items for checking.

The assessment of the performance of the engineers of the department in the annual performance appraisal forms shall be based on the achievement of the norms as determined by these orders. All engineers of the department are hereby directed to adhere to the norms as determined herein. It is also reiterated that during such tours and inspections, the engineers concerned shall record their notes in the inspection registers/logbooks maintained at each site for which directions have already been issued separately vide order dated 03.03.2009.

Encl:- as above

29/11
(RAM LUBHAYA)
Principal Secretary to Government
PHED, Rajasthan, Jaipur

Norms of Inspection for Quality control in PHED

Annexure 1

Norms of checking / inspection by Engineers of PHED Dept., for drilling of Bore wells/ Hand pumps/L&J of Pipeline/ Sectional testing / new service connection / maintenance works etc.

S.no.	Name of work	Post	Norms of checking & inspection
A (a)	For drilling of Bore wells/ Single Phase/ Hand pumps (checking to be done in terms of no. of tube wells)	Junior Engineer	100%
		Asst. Engineer	30% and all final Bills
		Executive Engineer	10% of Final Bill (Minimum 1 in a contract)
		Superintending Engineer	3% (minimum 1) of the contract
(b)	Depth of drilling & casing pipe	Asst. Engineer	100 %
(c)	Yield of well including sand contents	Asst. Engineer	100 %
(d)	Thickness of pipe	Asst. Engineer	100 %
(e)	Slotting of pipe	Asst. Engineer	100 %
		Executive Engineer	25 %
B	For quality of Material such as pipes, pump sets, cables, panels etc. under rate contract of HP/TW/SP. (Note: Pump set quality and size of cable to be checked by EE)	Junior Engineer	100%
		Asst. Engineer	50%
		Executive Engineer	20%
		Superintending Engineer	5%
C (a)	Laying and Jointing of Pipeline of all types	Junior Engineer	100%
		Asst. Engineer	50%
		Executive Engineer	10%
		Superintending Engineer	3%
(b)	Depth of pipeline (Note: Strata of soil to be checked by EE)	Asst. Engineer	At every 500 mtr.
		Executive Engineer	At every 1000 mtr.
D	Sectional testing of pipeline	Junior Engineer	100%
		Asst. Engineer	30%
		TA to EE on behalf of EE	20%
		Superintending Engineer	3%

S.no.	Name of work	Post	Norms of checking & inspection
E (a)	Procurement of pipes, valves, pumps , motors , panels etc requiring third party inspection	Junior Engineer (Store/site)	100% (In terms of quantity)
		Asst. Engineer (Store/site)	(a)50 % (In terms of quality) (b) 100 % (In terms of quantity)
		Executive Engineer (Store/site) With Divisional Accountant	(a)100 % (Size of material received in stores) (b) 20 % (in term of Quality)
		Superintending Engineer	10 % in a year
		Addl. Chief Engineer	3 % in a year
		(b)	Bench testing of pump sets
		Executive Engineer	10 %
F	For new service connections	Junior Engineer	100%
		Asst. Engineer	30%
		Executive Engineer	10%
Inspection of Maintenance Works			
G	Holding charge of maintenance schemes only (in rural areas)	Junior Engineer	Min. 1 inspection of every scheme in a month
		Asst. Engineer	Min. 1 inspection of every scheme once in 2 months
		Executive Engineer	Min. 1 inspection of every scheme once in 6 months
		Superintending Engineer	25% inspection of total schemes in a year
		Addl. Chief Engineer	5% inspection of total schemes in a year or minimum 10 schemes of every circle under jurisdiction in a year

S.no.	Name of work	Post	Norms of checking & inspection
H	Holding charge of maintenance schemes only (in Urban areas)	Junior Engineer	Daily inspection of every scheme
		Asst. Engineer	Min. 1 inspection of every scheme in a week
		Executive Engineer	Min. 1 inspection of every scheme once in a month
		Superintending Engineer	Min. 1 inspection of every scheme once in 6 month
		Addl. Chief Engineer	Min. 1 inspection of every scheme once in a year
I	a) Pressure measuring in all tail end habitations in Jurisdiction b) Taking water samples for quality checking from area prone to water contamination c) Reporting status of sanitation to E.E. daily and see whether open defecation/ dumping of garbage near the water sources or pipeline could pollute water and to take preventive steps in co-ordination with municipal authorities. d) Calculate TW discharge and power consumption daily and take corrective steps to bring it to design level e) Inspect water chlorination f) Inspect all lines, pump houses and CWR daily g) Identify illegal connections, boosters and out of order meters regularly in his area and take corrective steps. h) Weekly inspection of filtration plant and ensure preventive O&M and repairs as and when required.	Junior Engineer(Urban)	Daily inspection
		Assistant Engineer (Urban)	25 % inspection of works as mentioned above in his Jurisdiction
		Executive Engineer (Urban)	5 % inspection of works as mentioned above in his Jurisdiction

Annexure II**Norms of checking / inspection by engineers of PHED Dept. working in Project divisions**

S.no.	Name of work	Post	Norms of checking & inspection
A	For construction works or works under execution (For works costing less than Rs. 50 Lacs)	Junior Engineer	Min. 15 inspections in a month on different days
		Asst. Engineer	Min. 10 inspections in a month on different days
		Executive Engineer	Min. 3 inspections in a month on different days
B	For construction works or works under execution (For works costing Rs. 50-100 Lacs)	Junior Engineer	Min. 17 inspections in a month on different days
		Asst. Engineer	Min. 12 inspections in a month on different days
		Executive Engineer	Min. 6 inspections in a month on different days
		Superintending Engineer	Min. 3 inspections in a month on different days
		Addl. Chief Engineer	Min. 1 inspection in a month on different days
C	For construction works or works under execution (For works costing more than Rs. 100 Lacs)	Junior Engineer	Min. 20 inspections in a month on different days
		Asst. Engineer	Min. 15 inspections in a month on different days
		Executive Engineer	Min. 10 inspections in a month on different days
		Superintending Engineer	Min. 7 inspections in a month on different days
		Addl. Chief Engineer	Min. 3 inspections in a month on different days

S.no.	Name of work	Post	Norms of checking & inspection
	Civil works (with RCC)		
D (a)	Concreting works (during Concreting)	Junior Engineer	100 % in his presence
		Assistant engineer	10 % in his presence
(b)	Cubes are to be checked from PWD laboratory/ contractor's lab	Junior Engineer	100 %
		Assistant Engineer	10 %
(c)	In terms of visual checking including shape, size, finishing, formwork etc.	Executive Engineer	10 % & final bill
E	Checking of Reinforcement		
(a)	Quality of steel including testing from authorized laboratory	Assistant Engineer	100 %
(b)	Placement of reinforcement and quantity		
(b-i)	For works costing less than & upto Rs. 10.00 Lacs in rural areas	Junior Engineer	100 %
(b-ii)	For works costing more than Rs. 10.00 Lacs	Assistant Engineer	100 %
(c)	Quality and dimensions of shuttering and scaffolding	Assistant Engineer	100 %

Annexure III**Norms of checking / inspection by engineers of PHED Dept. working in regular maintenance divisions**

S.no.	Name of work	Post	Norms of checking & inspection
Checking of new works			
<u>Civil works (without RCC)</u>			
A	Civil works costing less than Rs. 2.00 Lacs	Junior Engineer	Minimum 5 inspections in a month or 100 %
		Asst. Engineer	Minimum 1 inspection in a month or 30 %
B	Civil works costing more than Rs. 2.00 Lacs but upto Rs.10.00 Lacs	Junior Engineer	Minimum 7 inspections in a month or 100 %
		Asst. Engineer	Minimum 3 inspections in a month or 20 %
C	Civil works costing more than Rs. 10.00 Lacs but upto Rs.50.00 Lacs	Junior Engineer	Minimum 10 inspections in a month or 100 %
		Asst. Engineer	Minimum 5 inspections in a month or 20 % and final bill
		Executive Engineer	Minimum 1 inspection in a month or 5 % and final bill
D	Civil works costing Rs.50.00 Lacs or more	Junior Engineer	Minimum 15 inspections in a month or 100 %
		Asst. Engineer	Minimum 8 inspections in a month or 30 % and final bill
		Executive Engineer	Minimum 3 inspections in a month or 10 % and final bill
		Superintending Engineer	Min. 1 inspection in a month or 5 %
<u>Civil works (with RCC)</u>			
E (a)	Concreting works (during Concreting)	Junior Engineer	100 % in his presence
		Assistant engineer	10 % in his presence

S.no.	Name of work	Post	Norms of checking & inspection
(b)	Cubes are to be checked from PWD laboratory/ contractor's lab	Junior Engineer	100 %
		Assistant Engineer	10 %
(c)	In terms of visual checking including shape, size, finishing, formwork etc.	Executive Engineer	10 % & final bill
F	Checking of Reinforcement		
(a)	Quality of steel including testing from authorized laboratory	Assistant Engineer	100 %
(b)	Placement of reinforcement and quantity		
(b-i)	For works costing less than & upto Rs. 10.00 Lacs in rural areas	Junior Engineer	100 %
(b-ii)	For works costing more than Rs. 10.00 Lacs	Assistant Engineer	100 %
(c)	Quality and dimensions of shuttering and scaffolding	Assistant Engineer	100 %

Note: Measurement book will be filled by Junior Engineer himself positively.

Annexure IV**Norms of checking / inspection by engineers of PHED Dept. for O & M Works**

S.no.	Name of work	Post	Norms of checking & inspection
A	Checking of filters (under O&M schemes)		
(a)	Rapid Gravity Filter Plants	Asst. Engineer	100% twice in a year
		Executive Engineer	100% once in a year
		Superintending Engineer	20% once in a year (subject to min. 2 in a year)
		Addl. Chief Engineer	10% once in a year (subject to min. 2 in a year)
		Chemist district	100% once in a year
		Chief Chemist	Min. 4 units in a year
(b)	Slow Sand Filter Plants	Asst. Engineer	100% once in a year
		Executive Engineer	20% once in a year
		Superintending Engineer	5% once in a year
		Addl. Chief Engineer	2% once in a year
		Chemist district	10% once in a year
		Chief Chemist	Min. 10 units in a year
B	Water Quality checking under O&M schemes (Lab reports and its results)	Asst. Engineer	100% once in a month
		Executive Engineer	20% once in a month
		Superintending Engineer	5% once in a year
C	Electrical/Pumping installation in Pumping stations of O&M schemes	Asst. Engineer	100% once in a year
		Executive Engineer	20% once in a year
		Superintending Engineer	5% once in a year

Annexure V**List of Selective items**

1. All works below ground level and hidden such as foundation concrete, foundation masonry, casing/ strainer pipes of tube wells and DCB's for Hand pumps & power pumps, depth of tube well for HP's and Power pumps, depth of water table with respect to items paid for saturated soil.
2. Fabricated steel work.
3. Reinforcement in RCC works.
4. Laying and jointing of pipelines, specials etc.
5. All electrical fitting and pump installation works.
6. RCC works.
7. For earth work including compaction etc.
8. Installation of hand pumps, power pumps and machinery.
9. Other masonry works.

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APPENDIX F-2 : AUTHORITY PROVIDING CONSENT BEFORE APPROVAL

Government of Rajasthan
Public Health Engineering Department

No: 2439-2563 Date: 16/8/13

OFFICE ORDER

A large number of Major Water Supply projects are under execution in the State and, of late, there is a growing need for improvement in management & supervision practices of these projects.

In order to streamline the process of various approvals, to improve quality control, to ensure better coordination among project offices and for timely implementation of Major Water Supply Projects, the Engineer-in-Charge shall take consent before issuing approval as detailed below;

S. No.	Activity	Criteria	Authority providing consent before approval
1	Approval of Work Plan & Implementation Schedule	All	CE(Concerned)
2	Approval of General Arrangement & Layout Plans		
i	Pumping Station	HT Installation	Concerned ACE, Project
		LT Installation	Concerned SE, Project
ii	Electric Substations	HT Installation	Concerned ACE, Project
		LT Installation	Concerned SE, Project
iii	Water Treatment Plant	All	Concerned ACE, Project
3	Approval of Vendor/Make		
i	Pipes & Valves		Concerned ACE, Project
ii	Electro Mechanical Equipment		
	Transformer/Pump/Motor/Panels/Switchgear/VFD/Starter/Cable	HT Installation	Concerned ACE, Project
	All Equipment other than above for HT Installations	HT Installation	Concerned SE, Project
	All Equipment	LT Installation	Concerned SE, Project
iii	SCADA & Instrumentation		
	SCADA Architecture & Software	All	Concerned ACE, Project
	SCADA - Hardware, PLC/RTU & Instrumentation	All	Concerned SE, Project

1

S. No.	Activity	Criteria	Authority providing consent before approval
iv	Surge Analysis & Protection devices	All	Concerned ACE, Project
4	Approval of Drawing, Design & QAP		
I	Hydraulics		
	Water Treatment Plant Sizing & Hydraulics	All	Concerned ACE, Project
	System Hydraulics	All	Concerned ACE, Project
II	Structures design intake	All	Concerned ACE, Project
	Structures designs All Other Civil Structures	All	Concerned SE, Project
III	Electro Mechanical Devices	HT Installation	Concerned ACE, Project
	Electro Mechanical Devices	LT Installation	Concerned SE, Project

Further, the norms for Inspection & Testing shall be as follows:

i	Pipes (Each Material Type), Pumps & Motors, MS Pipe Fabrication	One inspection for each category for each A&F sanctioned project	Concerned ACE, Project
ii	Pipes (Each Material Type), Pumps & Motors, MS Pipe Fabrication, Valves, VFD, Switchgears, Panels	One inspection for each category for each work order	Concerned SE, Project
iii	All Inspections	20% of all inspections under his jurisdiction	Concerned Executive Engineer, Project

The requirements contained in this order should not violate in any way the provision for the related activities in PWFAR, GFAR or any other prevailing Government Rules and provisions of Contract agreement of the related works. Such provisions shall prevail. The time limit for various approvals by authority as specified in contract document shall be adhered to and getting consent for approval under these orders should be within that specified time limit.

All the officers are directed to submit the approval/inspection reports to Chief Engineer (Concerned) in reference to this order. These orders shall come in force immediately from the date of issue of this order.


Principal Secretary to Government
PHED, Rajasthan, Jaipur

No: 2439-2563 Date 16/8/13

Copy to following for information & compliance

1. TM & CE(Adm)/CE(HQ)/CE(R), PHED, Jaipur
2. Chief Engineer (SP), PHED, Jaipur/ Project, Jodhpur
3. All Addition Chief Engineer (Project), Region _____, PHED, _____
4. All Superintending Engineer (Project), Region _____, PHED, _____
5. All Executive Engineer (Project), Region _____, PHED, _____


Principal Secretary to Government
PHED, Rajasthan, Jaipur

APPENDIX F-3 : SECTIONAL TESTING OF DI PIPES – D&S CIRCULAR



Office of the Chief Engineer (Technical) & TM
RWSSMB, Public Health Engineering Department
JalBhawan, 2- Civil Lines, Jaipur, Rajasthan

Ph. 0141- 2222342

E-mail- rj_tm@nic.in

No. D&S/CIRCULAR/2015-16/ 136/- 1386

Date: 18-3-2016

CIRCULAR/D&S/2015-16/06

Subj:- Guidelines for field sectional testing of DI pipelines.

For test pressure to be applied during sectional testing of DI pipelines, following was decided in 635th meeting of Technical Committee held on 01.03.2016.

S.No.	Type of pipe	Field test pressure	Remarks
1.	DI K-7	1.5 times the maximum sustained operating pressure (or maximum pipeline static pressure) or 12Kg/cm ² , whichever is higher.	Time of test shall be 6 Hrs.
2.	DI K-9	1.5 times the maximum sustained operating pressure (or maximum pipeline static pressure) or 18Kg/cm ² , whichever is higher.	Time of test shall be 6 Hrs.

Following guidelines shall be adopted for field sectional testing of laid DI pipelines:-

- Sectional field testing of pipelines should be done only after constructing thrust blocks at bends as well as at dead ends of the pipeline. In case of permanent dead end, thrust block should be constructed before testing and at temporary dead end, temporary anchor should be provided to take complete thrust.
- The length of pipeline to be tested may initially be kept as 500 mtr. which can be increased in subsequent tests by Engineer in charge.
- During filling of pipeline with water, air should be released from air vent pipes and care should be taken to close air vents only when complete air has been removed from the pipeline and smooth flow of water starts.
- In case of pipeline with internal cement mortar lining the water is to be kept filled in the pipeline for 48 hours before sectional testing.
- Efforts should be made to install the pressure gauge of 150mm dial diameter and of appropriate ratings at the lowest point of the pipeline and if it is not possible than an allowance should be made for the difference in static head between the lowest point and point of

measurement to ensure that the maximum pressure is not exceeded at the lowest point.

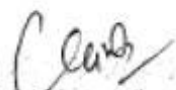
- (f) The water for this purpose shall be reasonably clear and free of solids and suspended matters, water should be filled in pipeline from the point in the pipeline section having lowest RL.
- (g) The testing conditions for the pipeline shall be as per the test pressures mentioned above and conditions laid out in IS: 12288:1987 (Amended up to date) and CPHEEO manual on water supply and treatment.
- (h) The test pressure shall be gradually raised at the rate of $1\text{Kg/cm}^2/\text{min.}$, while inspecting the thrust blocks and the temporary anchoring.
- (i) Start the test by maintaining the test pressure at the desired level. If a drop occurs in the test pressure make it the same by adding more water, record the water added and the pressure in intervals of 15 minutes at the beginning and 30 minutes at the end of test period.
- (j) Rebuilding of pressure up to the testing pressure shall be done after every fall of 10% from the testing pressure.
- (k) Quantity of water added during the test of 6 hours should not exceed 0.1 litre per mm of pipe diameter per KM of pipeline per day for each 30 mtr. head of pressure applied. Allowable leakage during testing for various size of pipelines for test pressure of 12 Kg/cm^2 and 18 Kg/cm^2 is shown in table below and for any other test pressure quantity of leakage can be calculated on average basis.

Allowable leakage during testing of pipe @ 0.1 litre per mm of pipe dia per KM of pipe line per day for 30 metre head of pressure. (As per CPHEEO manual cl. 5.4.4.2)

S. No.	Dia. of pipe in mm	Test duration in hour	Allowable leakage in litre during test duration and field test pressure in metre head per KM of pipeline	
			12 Kg/cm ²	18 kg/cm ²
1	100	6	10.00	15.00
2	125	6	12.50	18.75
3	150	6	15.00	22.50
4	200	6	20.00	30.00
5	250	6	25.00	37.50
6	300	6	30.00	45.00
7	350	6	35.00	52.50
8	400	6	40.00	60.00
9	450	6	45.00	67.50
10	500	6	50.00	75.00
11	600	6	60.00	90.00
12	700	6	70.00	105.00
13	800	6	80.00	120.00
14	900	6	90.00	135.00
15	1000	6	100.00	150.00

- (l) If leakage is greater than the specified the defective pipe(s) or joint(s) shall be repaired/replaced until the leakage is within the specified allowance.
- (m) Water used for testing should not be carelessly disposed off on land which would ultimately find its way to trenches.
- (n) One register for testing pipeline should be maintained and all tests including failures tests should be recorded.
- (o) Water required for pipeline testing is to be arranged by the contractor himself at his own cost.

The circular is issued to incorporate the above provisions for sectional testing of DI pipelines in all future tender of the department and it shall come in force with immediate effect.


 (C. S. Chhatwani)
Chief Engineer (Technical) & TM
RWSSMB, PHED, Rajasthan, Jaipur

No. D&S/CIRCULAR/2015-16/ 1361-1386

Date: 18-3-2016

Copy to following:

1. PS to Hon'ble Minister, PHED, Govt. of Rajasthan, Jaipur.
2. PS to Pr. Secretary, PHED, Govt. of Rajasthan, Jaipur.
3. Chief Engineer (Rural)/(HQ)/(SP)/(Adm.) PHED Jaipur.
4. Chief Engineer (P) Jodhpur/ (PMU),RRWS&FMP PHED Nagaur.
5. Secretary, RWSSMB, PHED Jaipur.
6. Addl. Chief Engineer, PHED, (All) for information, necessary action and to circulate copy of the circular to all SEs, EEs, AEs & JEs within their jurisdiction for compliance.


 (D.M.Jain)
Additional Chief Engineer(Tech.)
RWSSMB, PHED, Rajasthan, Jaipur

APPENDIX F-4 : QUALITY CONTROL FOR CONSTRUCTION OF TUBEWELLS / SINGLE POINT / HANDPUMPS

 **OFFICE OF CHIEF ENGINEER (RURAL), PHED**
2, CIVIL LINES, JAL BHAWAN, RAJASTHAN, JAIPUR
 Phone: 0141-2222183, Fax: 141-2223197, e-mail: raj_ce@nic.in

No. F-107/CE(R)/EE Mon-1/Summer-2013/ 2013-14/ 59 Date: 24.5.2013

Addl. Chief Engineer
 PHED, Region _____ (All)

Superintending Engineer
 PHED, Circle _____ (All)

Executive Engineer
 PHED, Division _____ (All)

SUB: Checking quality of works for drilling & commissioning of tube wells, Single Phase and hand pumps.
REF: i. Circular issued by Pr Secretary, PHED vide letter NO CE(R) / 2005-06/ 1164-79 dated 26.04.2005 & 251-263 dated 27.02.2006.
 ii. Circular issued by CE (R) vide letter No. CE(R)/ EE SR/ PRI_HP/ PHED/ 2013-14/ 266-406 dated 04.04.2013.

As per Budget Announcement 2013, works of 20000 HPs including about 5000 SPTW are being taken up to mitigate the problem of drinking water in the State. In order to ensure quality of these works being taken up at large scale, it has become all the more essential that field officers of PHED exercise utmost vigilance in checking up quality of the these works. It would be prime duty of EE/ SE to keep strict quality control while executing the work of HP/SP. They should make frequent inspection and carryout test checks as prescribed in circulars under reference (i) (copy enclosed) and ensuring strict compliance to other directions, as well, given vide referred circulars including the guidelines, reiterated below:

1. The work of Tube Wells/ Hand Pump should not be taken up in water quality affected habitations. It shall always be ensured to have latest chemical analysis report of the nearby tube well/open well/hand pump for potability of water before sanctioning/ taking up the works.
2. Similarly, feasibility report by hydro geologist/ Jr. hydro geologist of GWD/drilling region with clear recommendations about the type of strata, depth of bore hole for drilling and exact pin-pointing should be obtained to ensure sustainability of the bore well.
3. In cases, where material is procured departmentally, all the materials procured should be checked at the time of stock entry in stores itself as per tests prescribed in rate contracts of CE(HQ).
4. In cases, where material is being/ to be arranged by the contractor, all materials should first be received in divisional store and issued to field only after proper checking & inspection. EE will solely be responsible for quality of the material received and being dispatched to site. The record entries should also be made in the stock register invariably with batch number/ serial number, make/ class of pipe, thickness, weight/m etc.

5. During drilling of works, field officers should check/ verify the depth of bore wells, length & thickness of casing pipes, depth, gauge, weight of lowering pipes and ensure that same material as issued from divisional stores is used by the contractor. The make/ batch numbers of GI / MS Pipes be entered/ verified in log book during inspection by departmental officers.
6. As far as possible, the contractor should be refrained from working at night hours.
7. As per enlistment rules, contractors enlisted in Class AA, A, B, C & D are required to employ technical staff (Civil graduate Engineer for work over Rs. 100 Lac and Civil Diploma holder for works between Rs. 15 Lacs to 100 Lacs) and the contractors in Class AA, A and B should have permanent Engineering Organization. The departmental field officers should, therefore, verify the works of the contractor only after contractor's own Engineer has checked and verified the same.
8. The video-recording of works of drilling & commissioning of TW/ SPTW/ HPs by the contractors can also be insisted by the department, if required so as to ensure the number of pipes being lowered, make of pipes, ISI mark, make & serial number of submersible pump sets etc.
9. The norms for conducting test checks should be followed strictly as issued by Principal Secretary PHED (copy enclosed).

The above directions/ guidelines should also be circulated to all officers under your jurisdiction for treating these as **most important** and ensuring regular monitoring & strict compliance at every level of field engineers.

Encl: As above


Chief Engineer (Rural)
PHED Rajasthan, Jaipur

No. F-107/CE(R)/EE Mon-I/Summer-2013/2013-14/59

Date: 24/5/2013

Copy to following for information/ necessary action-

1. P.S. to Hon'ble Minister, PHED Rajasthan
2. P.S. to Pr. Secretary, PHED, Rajasthan
3. Chief Engineer (Adm) & TM/ (Hq)/SP Jaipur/(P) Jodhpur PHED, Rajasthan
4. FA&CAO RWSSMB / FA (HQ) , PHED , Jaipur.
5. Chief Engineer, Ground Water Department, Jodhpur
6. Addl. Chief Engineer, Drilling Region, PHED, Jaipur
7. Addl. Chief Engineer (Rural) / (Urban), PHED, Rajasthan, Jaipur.
8. Chief Chemist, PHED, Rajasthan, Jaipur.
9. SE & TA to CE (R)/SE, DIPM/SE Rural/ Secretary Board, Jaipur.
10. SE MM PHED, Jaipur
11. Sr. Hydro geologist/ Hydro geologist PHED/ GWD for compliance and also to issue feasibility report timely taking all the due care for success of the borewell.


Chief Engineer (Rural)
PHED Rajasthan, Jaipur

Appendix F-5 – Formation of Committee for quality assurance in Divisional Store

OFFICE OF CHIEF ENGINEER (HQ), MATERIAL MANAGEMENT CELL
PUBLIC HEALTH ENGINEERING DEPARTMENT RAJASTHAN, JAIPUR

No.: H/G III (3404) /TPW 10-11/2427-3X1

Dated: 17.11.2010

CIRCULAR

SUBJECT: Guidelines for assurance of quality of materials received in divisional store.

In 605th meeting of Finance Committee held on 12.11.2010, the tenders received for 3rd Party Inspection of Materials (Pre-dispatch) were filed and it was decided to develop a system for assurance of quality of materials before accepting the same in divisional stores. It was also decided to make responsible the Committee of SE and DA for inspection of received materials as well as for drawing of samples for testing by approved lab / institution.

In compliance of above decision of Finance Committee, pre-dispatch inspection of materials, except for the items for which quoted rates include pre-dispatch inspection e.g. hand pump set and hand pump spares, shall not be applicable for all future supply orders and materials shall be inspected / tested by the department on receipt of materials at divisional stores. However, testing of materials at works shall be conducted by the manufacturer as per provisions / specifications of rate contract / supply order and only tested & passed materials shall be dispatched to divisional stores.

A Committee of Executive Engineer (EE) and Divisional Accountant (DA) is hereby constituted for quality assurance of materials before accepting the same in divisional store. This Committee shall inspect / test the received material to ensure its quality / specifications as per provision of rate contract / supply order. This Committee shall also draw sample for getting tested the materials from approve labs / institutions, in case testing of materials is not possible at their level. Concerned ACEs shall identify the test labs / institutions in their jurisdiction / nearby area, where testing can be got done by the Divisional Officers.

Compliance of above guidelines is to be made strictly by all the field officers for all future supply orders.


Chief Engineer (HQ)
PHED Rajasthan, Jaipur

Appendix F-6 – QC Wing Circular regarding design mix for concreting



OFFICE OF CHIEF ENGINEER (Admn.),
Public Health Engineering Department,
2, Civil Lines, Jacob Road, Jaipur

Email: aceqcadmn.phed@rajasthan.gov.in

Tel: 0141-2222241, Fax: 0141-2222585

No. F() / ACE(QC) / Inspection/18-19/ 10815-11156 Date: 16-01-2019

CIRCULAR

During various inspections by the teams of quality control it is observed that the approved design mix for carrying out the work of civil structure, particularly storage reservoirs, does not mention the source of ingredient material of concrete mixture. It is also observed that the grades of concrete selected for components, which remains in contact with water, of water storage tanks are different in different zones of department despite having same environmental exposure conditions. The making, marking and curing of compression test samples in the field are also not in accordance with the provision of IS 516.

In order to achieve effective quality control on concrete works following instructions are issued for compliance without prejudice to the various other provisions of Indian standard, rate contract, quality assurance plan etc.:-

- Only those design mix shall be approved which clearly states the source of material i.e. the make, type and trade mark of cement, the quarry of aggregates etc. In case of any change in source and the quality of material the design mix shall again be got approved.
- The mix calculation and other relevant computations for concrete mix proportioning in accordance with IS 10262 should also be sought before approval of design mix
- Approved Mix design done earlier but not prior to one year may be consider adequate for later work provided there is no change in source and the quality of material
- The provision of concrete grade, especially in the case of water retaining structure must be kept considering the environmental exposure condition of structure in accordance with provisions of IS 456.
- The preparation and compaction of test specimen of concrete cubes must be in accordance with provisions of IS 516 and IS 1199
- The sample cube of concrete for compression testing must be clearly marked for later identification for grade of concrete, date of casting, component part of structure etc.
- Test results of the sample shall be the average of the strength of three specimens. The individual variation should not be more than $\pm 15\%$ of

the average. If more, the test results of samples shall be considered as invalid.

- The record of all Compressive strength tests must be maintained regularly in proper formats and these tests require witness of departmental representative.
- The test results must fulfil the acceptance criterion mentioned in clause 16 of IS 456 for compressive strength and flexure strength
- Water used for mixing and curing shall be clean and free from injurious amount of oils, acids, alkalis, salts, sugar, organic material or other substances that may be deleterious to concrete or steel. Potable water may be considered satisfactory for mixing concrete.
- All testing equipments must be properly and timely calibrated.

It is enjoined upon all the officers to comply with above given instruction and ensure quality control of all civil works to the best extent possible

Anil Kumar Shrivastava
 (Anil Kumar Shrivastava)
 Chief Engineer (Admn.)
 PHED, Jaipur
 Dt 16-01-19

S.No- 10815-11156

Copy to the following for information and necessary action:-

1. Chief engineer (Tech.) & Technical Member, RWSSMB, Jaipur with the request to issue necessary direction at his level regarding suitability of grade of concrete to be used for construction of Water retaining structure having water disinfected by chlorination
2. Chief Engineer (Urban& NRW)/Rural/Special Project/PMU RRWS&FMP Nagaur/Project Jodhpur ✓
3. Additional Chief Engineer PHED Region _____ (ALL)
4. Superintending Engineer PHED Circle _____ (ALL)
5. Executive Engineer PHED Division _____ (ALL)

H. K. Sharma
 ✓ Addl. Chief Engineer
 Quality Control
 PHED, Jaipur

Appendix F-7 – QC Wing circular regarding testing of counter samples



OFFICE OF CHIEF ENGINEER (Admn.),
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CIRCULAR

During scrutiny of test reports of identified sample by the teams of quality control, it is observed that in some cases the test reports of failed sample have not been furnished to the quality control wing and only the test reports of two counter samples, which subsequently passed from the laboratory, were submitted to quality control wing.

This process not only hinders the monitoring of identified sample but also lacks the transparency in monitoring of quality control checks. Moreover, in submission of counter samples, the thrust on identification of counter samples is not being ensured which may result in complications while finalizing the acceptance or rejection of material.

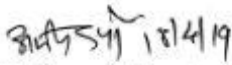
In order to achieve effective and transparent quality control and ascertaining the quality of material following instructions are issued for compliance without prejudice to the various other provisions of Indian standard, rate contract, quality assurance plan etc.:-

- Whenever the sample, identified by the team of quality control fails, while testing in the prescribed laboratory, the Engineer-In-Charge/Project Manager shall immediately inform the contractor to replace the entire supply of that batch/lot. A copy of test report shall immediately be furnished to quality control wing of department along with all relevant document i.e. Approved QAP, Technical specification of contract agreement.
- The counter sample of pipe would be submitted to the same laboratory strictly in accordance with the direction issued by Technical Committee in its 655th meeting held on 22-06-2017, only if the contractor protests the test reports and desires counter sample be tested for ensuring the quality of material.
- While submitting the counter sample, the details of failed test report of identified sample shall be categorically mentioned in the request letter and a copy of earlier sample test request letter, having contained specimen signature of quality control officer, shall necessarily be enclosed with the request letter. A copy of such request letter shall

necessarily be endorsed to Project manager/Engineer-In-Charge and quality control wing as well.

- The counter sample shall preferable be submitted to the same laboratory which carried out test on identified sample.
- The counter sample shall be thoroughly examined before submission to the laboratory for all identification marks including signature of officers of quality control team and others. A photo of sample should also be printed on request letter.
- In case of failure of counter samples Engineer-In-Charge/Project manager shall ensure that punitive action is initiated immediately against the defaulter contractor and concern Additional Chief Engineer/Chief engineer (project) shall inform the quality control wing accordingly.
- The test reports of counter samples, in every case, shall immediately be furnished to the quality control wing by concerned Additional Chief Engineer along with his specific recommendation in prescribed format along with all relevant documents.

It is enjoined upon all the officers to comply with above given instruction and ensure quality control of all material being procured or utilized in procurement and civil works to the best extent possible.


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S.No:- 2153-2487

Dt 26-04-19

Copy to the following for information and necessary action:-

1. Chief Engineer (Tech.) & Technical Member, RWSSMB, Jaipur
2. Chief Engineer (Urban & NRW)/Rural/Special Project/PMU RRWS&FMP Nagaur/Project Jodhpur
3. Additional Chief Engineer PHED Region _____ (ALL)
4. Superintending Engineer PHED Circle _____ (ALL)
5. Executive Engineer PHED Division _____ (ALL)


Addl. Chief Engineer
Quality Control
PHED, Jaipur

APPENDIX G

**REFERENCE LIST OF INDIAN AND
INTERNATIONAL CODE**

APPENDIX G : REFERENCE LIST OF INDIAN AND INTERNATIONAL CODE

Group	Source	Code Number	Title
Construction Planning and Storage of Materials	IS	4082	Recommendation on stacking and storage of construction materials at site (first revision)
Construction Planning and Storage of Materials	IS	7969	Safety code for handling and storage of building materials
EARTHWORK	IS	883	Design of structural timber in building - Code of practice (third revision)
EARTHWORK	IS	1498	Classification and identification of soils for general engineering purposes (first revision) (Amendments 2) (Reaffirmed)
EARTHWORK	IS	2682 - 1984	Chlordane emulsifiable concentrates (second revision) (Amendment 1) (Reaffirmed 1994)
EARTHWORK	IS	3764: 1992	Excavation work - Code of safety (first revision)
EARTHWORK	IS	4081	Safety code for blasting and related drilling operations
EARTHWORK	IS	6313 (Part 2)	Code of practice for anti-termite measures in buildings: Part 2 Preconstructional chemical treatment measures (Reaffirmed)
FOUNDATIONS	IS	269	33 grade ordinary Portland cement.
FOUNDATIONS	IS	432 (Part 1)	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part 1 Mild steel and medium tensile steel bars (third revision)
FOUNDATIONS	IS	455	Portland slag cement
FOUNDATIONS	IS	456	Code of practice for plain and reinforced concrete (Reaffirmed 2000)
FOUNDATIONS	IS	1080 : 1986	Code of practice for design and construction of shallow foundations on soils (other than raft, ring and shell)
FOUNDATIONS	IS	1489 (Part 1)	Portland pozzolana cement: Part 1 Fly ash based
FOUNDATIONS	IS	1489 (Part 2)	Portland pozzolana cement: Part 2 Calcined clay based
FOUNDATIONS	IS	1786	High strength deformed steel bars and wires for concrete reinforcement
FOUNDATIONS	IS	1904	Code of practice for design and construction of foundations in soils: General requirements
FOUNDATIONS	IS	2062	Steel for general structural purposes
FOUNDATIONS	IS	2950 (Part 1)	Code of practice for design and construction of raft foundations: Part 1 Design
FOUNDATIONS	IS	2974 (Part 1)	Code of practice for design and construction of machine foundations: Part 1 Foundations for reciprocating type machines
FOUNDATIONS	IS	2974 (Part 2)	Code of practice for design and construction of machine foundations: Part 2 Foundations for impact type machines (hammer foundations)

Group	Source	Code Number	Title
FOUNDATIONS	IS	2974 (Part 3)	Design and construction of machine foundations - Code of practice: Part 3 Foundations for rotary type machines (medium and high frequency)
FOUNDATIONS	IS	2974 (Part 4)	Code of practice for design and construction of machine foundations: Part 4 Foundations for rotary type machines of low frequency
FOUNDATIONS	IS	2974 (Part 5)	Code of practice for design and construction of machine foundations: Part 5 Foundation for impact machines other than hammers (forging and stamping press, pig breakers, drop crusher and jolter)
FOUNDATIONS	IS	3629	Specification for structural timber in building (first revision) (Reaffirmed 1991)
FOUNDATIONS	IS	4091 : 1979	Code of practice for design and construction of foundations for transmission line towers and poles (first revision) (Reaffirmed 1987)
FOUNDATIONS	IS	6403	Code of practice for determination of bearing capacity of shallow foundations.
FOUNDATIONS	IS	6909	Specification for supersulphated cement
FOUNDATIONS	IS	8009 (Part 1)	Code of practice for calculation of settlement of foundations: Part 1 Shallow foundations subject to symmetrical static vertical loads
FOUNDATIONS	IS	8009 (Part 2)	Code of practice for calculation of settlement of foundations: Part 2 Deep foundations subjected to symmetrical static vertical loading.
FOUNDATIONS	IS	4138	Safety code for working in compressed air.
FOUNDATIONS	IS	8041	Rapid hardening Portland cement
FOUNDATIONS	IS	9456: 1980	Code of practice for design and construction of conical and hyperbolic paraboloidal types of shell foundations.
FOUNDATIONS	IS	19556	Code of practice for design and construction of diaphragm walls.
FOUNDATIONS	IS	11089	Code of practice for design and construction of ring foundation
FOUNDATIONS	IS	12269	53 grade ordinary Portland cement.
FOUNDATIONS	IS	13094	Guidelines for selection of ground improvement techniques for foundation in weak soils.
FOUNDATIONS	IS	13301	Guidelines for vibration isolation for machine foundations
FOUNDATIONS	SP	SP 36 (Part 2) :1988	Compendium of Indian Standards on soil engineering : Part 2 Field testing
Mortar	IS	269	33 grade ordinary Portland cement
Mortar	IS	383	Coarse and fine aggregates from natural sources for concrete
Mortar	IS	455	Portland slag cement
Mortar	IS	456	Code of practice for plain and reinforced concrete

Group	Source	Code Number	Title
Mortar	IS	1344	Calcined clay pozzolana
Mortar	IS	1489 (Part 1)	Portland pozzolana cement: Part 1 Fly ash based
Mortar	IS	1489 (Part 2)	Portland pozzolana cement: Part 2 Calcined clay based
Mortar	IS	2116	Stand for masonry mortars
Mortar	IS	2250	Code of practice for preparation and use of masonry mortars
Mortar	IS	2720 (Parts 1 to 41)	Methods of test for soils
Mortar	IS	3812	Fly ash for use as pozzolana and admixture
Mortar	IS	6452	Specification for high alumina cement for structural use
Mortar	IS	6909	Specification for supersulphated cement
Mortar	IS	8041	Rapid hardening Portland cement
Mortar	IS	8043	Hydrophobic Portland cement
Mortar	IS	8112	43 grade ordinary Portland cement
Mortar	IS	12269	53 grade ordinary Portland cement
Mortar	IS	12600	Low heat Portland cement
Mortar	SP	SP 20 (S & T) :	Handbook on masonry design and construction
Mortar	SP	SP 21 (S & T)	Summaries of Indian Standards for building materials
Brickwork	IS	269	33 grade ordinary Portland cement
Brickwork	IS	383	Coarse and fine aggregates from natural sources for concrete
Brickwork	IS	455	Portland slag cement
Brickwork	IS	456	Code of practice for plain and reinforced concrete
Brickwork	IS	1489 (Part 1)	Portland pozzolana cement: Part 1 Fly ash based
Brickwork	IS	1489 (Part 2)	Portland pozzolana cement: Part 2 Calcined clay based
Brickwork	IS	2645	Integral cement waterproofing compounds
Brickwork	IS	3812	Fly ash for use as pozzolana and admixture
Brickwork	IS	5454	Methods of sampling of clay building bricks
Brickwork	IS	6452	Specification for high alumina cement for structural use
Brickwork	IS	4014 Part 1 & 2	Code of practice for steel tubular scaffolding
Brickwork	IS	6909	Specification for supersulphated cement
Brickwork	IS	8041	Rapid hardening Portland cement
Brickwork	IS	8042	White Portland cement
Brickwork	IS	8043	Hydrophobic Portland cement
Brickwork	IS	8112	43 grade ordinary Portland cement
Brickwork	IS	9103	Admixture for concrete
Brickwork	IS	12269	53 grade ordinary Portland cement
Brickwork	IS	12600	Low heat Portland cement
Brickwork	SP	SP 20 (S & T)	Handbook on masonry design and construction

Group	Source	Code Number	Title
Brickwork	SP	SP 21 (S & T)	Summaries of Indian Standards for building materials
Brickwork	IS	1077	Common burnt clay building bricks
Brickwork	IS	2212	Code of practice for brick work
Brickwork	IS	3696 (Part 1)	Safety code of scaffolds and ladders: Part 1 Scaffolds
Brickwork	IS	4014 (Part 2)	Code of practice for steel tabular scaffolding: Part 2 Safety regulations for scaffolding
Brickwork	SP	SP 25 (S & T)	Handbook on caused and prevention of cracks in building
Stonework	IS	1123	Method of identification of natural building stones
Stonework	IS	1127	Recommendations for dimensions and workmanship of natural building stones for masonry work
Stonework	IS	1128	Limestone (slab and tiles)
Stonework	IS	1129	Recommendation for dressing of natural building stones
Stonework	IS	1130	Marble (blocks, slabs and tiles)
Stonework	IS	1597 (Part 1)	Code of practice for construction of stone masonry: Part 1 Rubble stone masonry
Stonework	IS	1597 (Part 2)	Code of practice for construction of stone masonry: Part 2 Ashlar masonry
Stonework	IS	1905	Code of practice for structural use of un-reinforced masonry
Stonework	IS	2250	Code of practice for preparation and use of masonry mortars
Stonework	IS	3316	Specification for structural granite
Stonework	IS	3622	Specification for sandstone (slab and tiles)
Stonework	IS	3696 (Part 1)	Safety code of scaffolds and ladders: Part 1 Scaffolds
Stonework	IS	4101 (Part 1)	Code of practice for external facing and veneers: Part 1 Stone facing
Stonework	IS	12440	Pre-cast concrete stone masonry blocks
Stonework	SP	SP 20 (S & T)	Handbook on masonry design and construction
Stonework	SP	SP 21 (S & T)	Summary of Indian Standards for building materials
Plain And Reinforced Concrete	IS	269	33 grade ordinary Portland cement
Plain And Reinforced Concrete	IS	383	Coarse and fine aggregates from natural resources for concrete
Plain And Reinforced Concrete	IS	432 (Part 1 & 2)	Mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement: Part 1 Mild steel and medium tensile steel bars. Part 2 Hard drawn steel wire
Plain And Reinforced Concrete	IS	455	Portland slag cement
Plain And Reinforced Concrete	IS	456	Code of practice for plain and reinforced concrete

Group	Source	Code Number	Title
Plain And Reinforced Concrete	IS	516	Method of test for strength of concrete
Plain And Reinforced Concrete	IS	712	Building limes
Plain And Reinforced Concrete	IS	875 (Part 1)	Code of practice for design loads (other than earthquake) for buildings and structures: Part 1 Dead loads -Unit weights of building material and stored materials
Plain And Reinforced Concrete	IS	875 (Part 2)	Code of practice for design loads (other than earthquake) for buildings and structures: Part 2 Imposed loads
Plain And Reinforced Concrete	IS	875 (Part 3)	Code of practice for design loads (other than earthquake) for buildings and structures: Part 3 Wind loads
Plain And Reinforced Concrete	IS	875 (Part 4)	Code of practice for design loads (other than earthquake) for buildings and structures: Part 4 Snow loads
Plain And Reinforced Concrete	IS	875 (Part 5)	Code of practice for design loads (other than earthquake) for buildings and structures: Part 5 Special loads and load combinations
Plain And Reinforced Concrete	IS	650	Standard sand for testing of cement
Plain And Reinforced Concrete	IS	3085	Method of test for permeability of cement mortar & concrete
Plain And Reinforced Concrete	IS	9284	Method of test for abrasion resistance of concrete
Plain And Reinforced Concrete	IS	5816	Method of test for splitting tensile strength of concrete cylinders
Plain And Reinforced Concrete	IS	8142	Method of test for determining setting time of concrete by penetration resistance
Plain And Reinforced Concrete	IS	12600	Low heat Portland cement masonry cement
Plain And Reinforced Concrete	IS	3466	Masonry cement
Plain And Reinforced Concrete	IS	3558	Code of practice immersion Vibrator for consolidating concrete
Plain And Reinforced Concrete	IS	8042	White Portland cement
Plain And Reinforced Concrete	IS	13620	Fusion bonded epoxy coated reinforcing bars
Plain And Reinforced Concrete	IS	1343	Code of practice for Prestressed concrete
Plain And Reinforced Concrete	IS	883	Design of structural timber in building - Code of practice
Plain And Reinforced Concrete	IS	1199	Methods of sampling and analysis of concrete
Plain And Reinforced Concrete	IS	1344	Calcined clay pozzolana

Group	Source	Code Number	Title
Plain And Reinforced Concrete	IS	1489 (Part 1)	Portland pozzolana cement: Part 1 Fly ash based
Plain And Reinforced Concrete	IS	1489 (Part 2)	Portland pozzolana cement: Part 2 Calcined clay based
Plain And Reinforced Concrete	IS	1566	Hard-drawn steel wire fabric for concrete reinforcement
Plain And Reinforced Concrete	IS	1786	High strength deformed steel bars and wires for concrete reinforcement
Plain And Reinforced Concrete	IS	1791	Batch type concrete mixers
Plain And Reinforced Concrete	IS	1946	Code of practice for use of fixing devices in walls, ceilings and floors of solid construction
Plain And Reinforced Concrete	IS	2062	Steel and general structural purposes
Plain And Reinforced Concrete	IS	2386 (Part 1)	Methods of test for aggregates for concrete: Part 1 Particle size and shape
Plain And Reinforced Concrete	IS	2386 (Part 2)	Methods of test for aggregates for concrete: Part 2 Estimation of deleterious materials and organic impurities
Plain And Reinforced Concrete	IS	2386 (Part 3)	Methods of test for aggregates for concrete: Part 3 Specific gravity, density, voids, absorption and bulking
Plain And Reinforced Concrete	IS	2386 (Part 4)	Methods of test for aggregates for concrete: Part 4 Mechanical properties
Plain And Reinforced Concrete	IS	2386 (Part 5)	Methods of test for aggregates for concrete: Part 5 Soundness
Plain And Reinforced Concrete	IS	2386 (Part 6)	Methods of test for aggregates for concrete: Part 6 Measuring mortar making properties of fine aggregates
Plain And Reinforced Concrete	IS	2386 (Part 7)	Methods of test for aggregates for concrete: Part 7 Alkali aggregate reactivity
Plain And Reinforced Concrete	IS	2386 (Part 8)	Methods of test for aggregates for concrete: Part 8 Petrographic examination
Plain And Reinforced Concrete	IS	2502	Code of practice for bending and fixing of bars for concrete reinforcement
Plain And Reinforced Concrete	IS	2505	Concrete vibrators - Immersion type - General requirements
Plain And Reinforced Concrete	IS	2506	General requirements for screed board concrete vibrators
Plain And Reinforced Concrete	IS	2514	Concrete vibrating tables
Plain And Reinforced Concrete	IS	2751	Recommended practice for welding of mild steel plain and deformed bars for reinforced construction
Plain And Reinforced Concrete	IS	3025	Methods of sampling and test (physical and chemical) for water used in industry
Plain And Reinforced Concrete	IS	3036	Laying lime concrete for a waterproofed roof finish - Code of practice

Group	Source	Code Number	Title
Plain And Reinforced Concrete	IS	3812	Fly ash for use as pozzolana and admixture
Plain And Reinforced Concrete	IS	4031 (Part 1)	Methods of physical tests for hydraulic cement: Part 1 Determination of fineness by dry sieving
Plain And Reinforced Concrete	IS	4098	Lime-pozzolana mixture (first revision)
Plain And Reinforced Concrete	IS	4656	Form vibrators for concrete
Plain And Reinforced Concrete	IS	4925	Concrete batching and mixing plant
Plain And Reinforced Concrete	IS	4926	Ready mixed concrete
Plain And Reinforced Concrete	IS	4990	Plywood for concrete shuttering work
Plain And Reinforced Concrete	IS	6452	Specification for high alumina cement for structural use
Plain And Reinforced Concrete	IS	6909	Specification for supersulphated cement
Plain And Reinforced Concrete	IS	7861 (Part 1)	Code of practice for extreme weather concreting: Part 1 Recommended practice for hot weather concreting
Plain And Reinforced Concrete	IS	7861 (Part 2)	Code of practice for extreme weather concreting: Part 2 Recommended practice for cold weather concreting
Plain And Reinforced Concrete	IS	8041	Rapid hardening Portland cement
Plain And Reinforced Concrete	IS	8043	Hydrophobic Portland cement
Plain And Reinforced Concrete	IS	8112	43 grade ordinary Portland cement
Plain And Reinforced Concrete	IS	9012	Recommended practice for Concreting
Plain And Reinforced Concrete	IS	9013	Method of making, curing and determining compressive strength of accelerated cured concrete test specimens
Plain And Reinforced Concrete	IS	9103	Admixtures for concrete
Plain And Reinforced Concrete	IS	10262	Recommended guidelines for concrete mix design
Plain And Reinforced Concrete	IS	12269	53 Grade ordinary Portland Cement
Plain And Reinforced Concrete	IS	13330	Sulphate resisting Portland Cement
Plain And Reinforced Concrete	IS	12600	Low heat Portland cement
Plain And Reinforced Concrete	IS	13311(Part 1)	Non-destructive testing of concrete - Methods of test: Part 1 Ultrasonic pulse velocity

Group	Source	Code Number	Title
Plain And Reinforced Concrete	IS	13311 (Part 2)	Non-destructive testing of concrete - Methods of test: Part 2 Rebound hammer
Plain And Reinforced Concrete	SP	SP 23 (S & T)	Handbook on concrete mixes (based on Indian Standards)
Plain And Reinforced Concrete	SP	SP 24 (S & T)	Explanatory handbook on Indian Standard Code for plain and reinforced concrete
Plain And Reinforced Concrete	SP	SP 33 (S & T)	Handbook on timber engineering
Plain And Reinforced Concrete	SP	SP 34 (S & T)	Handbook on concrete reinforcement and detailing
Anti-Termite Measures	IS	6313 (Part 1)	Code of practice for anti-termite measures in buildings: Part 1 Constructional measures
Anti-Termite Measures	IS	6313 (Part 2)	Code of practice for anti-termite measures in buildings: Part 2 Pre-constructional chemical treatment measures (first revision)(Amendments 3)
Door and Windows (Wood And Metal)	IS	208	Door handles
Door and Windows (Wood And Metal)	IS	303	Plywood for general purposes
Door and Windows (Wood And Metal)	IS	399	Classification of commercial timbers and their zonal distribution
Door and Windows (Wood And Metal)	IS	401	Code of practice for preservation of timber
Door and Windows (Wood And Metal)	IS	419	Putty, for use on window frames
Door and Windows (Wood And Metal)	IS	1003 (Part 1)	Timber panelled and glazed shutters: Part 1 Door shutters
Door and Windows (Wood And Metal)	IS	1003 (Part 2)	Timber panelled and glazed shutters: Part 2 Window and ventilator shutters
Door and Windows (Wood And Metal)	IS	1038	Steel doors, windows and ventilators
Door and Windows (Wood And Metal)	IS	1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators
Door and Windows (Wood And Metal)	IS	1328	Veneered decorative plywood
Door and Windows (Wood And Metal)	IS	1658	Fibre hardboards
Door and Windows (Wood And Metal)	IS	1659	Block boards
Door and Windows (Wood And Metal)	IS	2191 (Part 1)	Wooden flush door shutters (cellular and hollow core type): Part 1 Plywood face panels
Door and Windows (Wood And Metal)	IS	2191 (Part 2)	Wooden flush door shutters (cellular and hollow core type): Part 2 Particle board and hard board face panels
Door and Windows (Wood And Metal)	IS	2202 (Part 1)	Wooden flush door shutters (solid core type): Part 1 Plywood face panels

Group	Source	Code Number	Title
Door and Windows (Wood And Metal)	IS	2202 (Part 2)	Wooden flush door shutters (solid core type); Part 2 Particle board and hard board face panels
Door and Windows (Wood And Metal)	IS	2553 (Part 1)	Safety glass: Part 1 General purpose
Door and Windows (Wood And Metal)	IS	2835	Flat transparent sheet glass
Door and Windows (Wood And Metal)	IS	3087	Wood particle boards (medium density) for general purposes
Door and Windows (Wood And Metal)	IS	3097	Veneered particle boards
Door and Windows (Wood And Metal)	IS	3129	Low density particle boards
Door and Windows (Wood And Metal)	IS	3348	Specification for Fibre insulation boards
Door and Windows (Wood And Metal)	IS	3478	Specification for high density wood particle boards
Door and Windows (Wood And Metal)	IS	3548	Code of practice for glazing in building
Door and Windows (Wood And Metal)	IS	10521	Collapsible gates
Door and Windows (Wood And Metal)	IS	6248	Metal rolling shutters & grills
Door and Windows (Wood And Metal)	IS	10451	Steel sliding shutters
Door and Windows (Wood And Metal)	IS	1361	Steel windows for industrial buildings, ventilation blinds for windows
Door and Windows (Wood And Metal)	IS	4021	Timber door, window and ventilator frames
Door and Windows (Wood And Metal)	IS	1826	Venation blinds for windows
Door and Windows (Wood And Metal)	IS	1948	Aluminum doors, windows and ventilators
Door and Windows (Wood And Metal)	IS	4020 (Parts 1-16)	Door shutters, method of test
Door and Windows (Wood And Metal)	IS	4351	Specification for steel door frames
Door and Windows (Wood And Metal)	IS	4913	Code of practice for selection, installation and maintenance of timber doors and windows
Door and Windows (Wood And Metal)	IS	4962	Specification for wooden side sliding doors
Door and Windows (Wood And Metal)	IS	5187	Flush bolts
Door and Windows (Wood And Metal)	IS	5437	Figured, rolled and wired glass
Door and Windows (Wood And Metal)	IS	5509	Fire retardant plywood

Group	Source	Code Number	Title
Door and Windows (Wood And Metal)	IS	5539	Specification for preservative treated plywood
Door and Windows (Wood And Metal)	IS	6198	Legged, braced and battened timber door shutters
Door and Windows (Wood And Metal)	IS	6248	Specification for metal rolling shutters and rolling grills
Door and Windows (Wood And Metal)	IS	6534	Guiding principles of grading and inspection of timber
Door and Windows (Wood And Metal)	IS	6701	Tungsten filament miscellaneous electric lamps
Door and Windows (Wood And Metal)	IS	7316	Decorative plywood using plurality of veneers for decorative faces
Door and Windows (Wood And Metal)	IS	7452	Hot-rolled steel sections for doors, windows and ventilators
Door and Windows (Wood And Metal)	IS	10439	Code of practice for patent glazing
Door and Windows (Wood And Metal)	IS	10451	Steel sliding shutters
Door and Windows (Wood And Metal)	IS	10521	Collapsible gates
Door and Windows (Wood And Metal)	IS	10701	Structural plywood
Door and Windows (Wood And Metal)	IS	11433 (Part 1)	One part grade polysulphide base joints sealant: Part 1 General requirements
Door and Windows (Wood And Metal)	IS	11433(Part 2)	One part grade polysulphide base joints sealant: Part 2 Methods of test
Door and Windows (Wood And Metal)	IS	12896	Classification of Indian timbers for door and window shutters and frames
Door and Windows (Wood And Metal)	SP	SP 21 (S & T)	Summarise of Indian Standards for building materials
Door and Windows (Wood And Metal)	SP	SP 33 (S & T)	Handbook on timber engineering
Floors and Floor Coverings	IS	77	Linseed oil, boiled for paints
Floors and Floor Coverings	IS	269	33 grade ordinary Portland cement
Floors and Floor Coverings	IS	303	Plywood for general purposes
Floors and Floor Coverings	IS	383	Coarse and fine aggregates from natural sources for concrete
Floors and Floor Coverings	IS	401	Code of practice for preservation of timber
Floors and Floor Coverings	IS	455	Portland stag cement
Floors and Floor Coverings	IS	456	Code of practice for plain and reinforced concrete
Floors and Floor Coverings	IS	533	Gum spirit of turpentine (oil of turpentine)
Floors and Floor Coverings	IS	651	Salt glazed stoneware pipes and fittings
Floors and Floor Coverings	IS	653	Linoleum sheets and tiles
Floors and Floor Coverings	IS	657	Materials for use in the manufacture of magnesium oxychloride flooring compositions
Floors and Floor Coverings	IS	658	Code of practice for magnesium oxychloride composition floors

Group	Source	Code Number	Title
Floors and Floor Coverings	IS	712	Building limes
Floors and Floor Coverings	IS	723	Steel countersunk head wire nails
Floors and Floor Coverings	IS	809	Rubber flooring materials for general purposes
Floors and Floor Coverings	IS	1077	Common burnt clay building bricks
Floors and Floor Coverings	IS	1195	Bitumen mastic for flooring
Floors and Floor Coverings	IS	1196	Code of practice for laying bitumen mastic flooring
Floors and Floor Coverings	IS	1197	Code of practice for laying of rubber floors
Floors and Floor Coverings	IS	1198	Code of practice for laying, fixing and maintenance of linoleum floor
Floors and Floor Coverings	IS	1237	Cement concrete flooring tiles
Floors and Floor Coverings	IS	1322	Bitumen felts for waterproofing and damp-proofing
Floors and Floor Coverings	IS	1443	Code of practice for laying and finishing of cement concrete flooring tiles
Floors and Floor Coverings	IS	1489 (Part 1)	Portland pozzolana cement: Part 1 Fly ash based
Floors and Floor Coverings	IS	1489 (Part 2)	Portland pozzolana cement: Part 2 Calcined clay based
Floors and Floor Coverings	IS	1580	Bituminous compounds for water proofing and caulking purposes
Floors and Floor Coverings	IS	1609	Code of practice for laying damp-proofing treatment using bitumen felts
Floors and Floor Coverings	IS	1661	Code of practice for application of cement and cement-lime plaster finishes
Floors and Floor Coverings	IS	2114	Code of practice for laying in-situ terrazzo floor finish
Floors and Floor Coverings	IS	2116	Sand for masonry mortars
Floors and Floor Coverings	IS	2180	Heavy duty burnt clay building bricks
Floors and Floor Coverings	IS	2386 (Part 4)	Methods of test for aggregates for concrete: Part 4 Mechanical properties
Floors and Floor Coverings	IS	2571	Code of practice for laying in-situ cement concrete flooring
Floors and Floor Coverings	IS	3384	Specification for bitumen primer for use in waterproofing and damp proofing
Floors and Floor Coverings	IS	3414	Code of practice for design and installation of joints in buildings
Floors and Floor Coverings	IS	3461	Specification for PVC - asbestos floor tiles
Floors and Floor Coverings	IS	3462	Specification for unbacked flexible PVC flooring
Floors and Floor Coverings	IS	3502	Steel Chequered plates
Floors and Floor Coverings	IS	3583	Specification of burnt clay paving bricks
Floors and Floor Coverings	IS	3622	Specification for sandstone (slabs and tiles)
Floors and Floor Coverings	IS	3629	Specification for structural timber in building
Floors and Floor Coverings	IS	3670	Code of practice for construction of timber floors
Floors and Floor Coverings	IS	4441	Code of practice for use of silicate type chemical resistant mortars

Group	Source	Code Number	Title
Floors and Floor Coverings	IS	4442	Code of practice for use of sulphur type chemical resistant mortars
Floors and Floor Coverings	IS	4443	Code of practice for use of resin type chemical resistant mortars
Floors and Floor Coverings	IS	4456 (Part 1)	Methods of test for chemical resistant mortars - Part 1 Silicate type and resin type
Floors and Floor Coverings	IS	4456 (Part 2)	Methods of test for chemical resistant mortars - Part 2 Sulphur type
Floors and Floor Coverings	IS	4457	Ceramic unglazed vitreous acid resisting tile
Floors and Floor Coverings	IS	4631	Code of practice for laying of epoxy resin floor toppings
Floors and Floor Coverings	IS	4832 (Part 1)	Specification for chemical resistant mortars: Part 1 Silicate type
Floors and Floor Coverings	IS	4832 (Part 2)	Specification for chemical resistant mortars: Part 2 Resin type
Floors and Floor Coverings	IS	4832 (Part 3)	Specification for chemical resistant mortars: Part 3 Sulphur type
Floors and Floor Coverings	IS	4860	Acid resistant bricks
Floors and Floor Coverings	IS	4971	Recommendations for selection of industrial floor finishes
Floors and Floor Coverings	IS	5318	Code of practice for laying of flexible PVC sheet and tile flooring
Floors and Floor Coverings	IS	5389	Code of practice for laying of hardwood parquet and wood block floors
Floors and Floor Coverings	IS	5491	Code of practice for laying of in-situ granolithic concrete flooring topping
Floors and Floor Coverings	IS	5760	Compressed argon
Floors and Floor Coverings	IS	5766	Code of practice for laying of burnt clays brick flooring
Floors and Floor Coverings	IS	6909	Specification for supersulphated cement
Floors and Floor Coverings	IS	7193	Glass fibre base coal tar pitch and bitumen felts
Floors and Floor Coverings	IS	8042	White Portland cement
Floors and Floor Coverings	IS	8374	Bitumen mastic, anti-static and electrically conducting grade
Floors and Floor Coverings	IS	9077	Code of practice for corrosion protection of steel reinforcement in RB and RCC construction
Floors and Floor Coverings	IS	9197	Epoxy resin, hardness and epoxy resin compositions for floor toppings
Floors and Floor Coverings	IS	9472	Code of practice for laying mosaic parquet flooring
Floors and Floor Coverings	IS	10440	Code of practice for construction of RB and RBC floors and roofs
Wall and Ceiling Finishes and Coverings and Walling	IS	269	33 grade ordinary Portland cement
Wall and Ceiling Finishes and Coverings and Walling	IS	303	Plywood for general purposes

Group	Source	Code Number	Title
Wall and Ceiling Finishes and Coverings and Walling	IS	383	Coarse and fine aggregates from natural sources for concrete
Wall and Ceiling Finishes and Coverings and Walling	IS	451	Technical supply conditions for wood screws
Wall and Ceiling Finishes and Coverings and Walling	IS	455	Portland slag cement
Wall and Ceiling Finishes and Coverings and Walling	IS	459	Corrugated and semi-corrugated asbestos cement sheets
Wall and Ceiling Finishes and Coverings and Walling	IS	710	Marine plywood
Wall and Ceiling Finishes and Coverings and Walling	IS	712	Building limes
Wall and Ceiling Finishes and Coverings and Walling	IS	723	Steel countersunk head wire nails
Wall and Ceiling Finishes and Coverings and Walling	IS	733	Wrought aluminium and aluminum alloy bars, rods and sections for general engineering purposes
Wall and Ceiling Finishes and Coverings and Walling	IS	737	Wrought aluminium and aluminum alloy sheet and strip for general engineering purposes
Wall and Ceiling Finishes and Coverings and Walling	IS	777	Glazed earthenware wall tiles
Wall and Ceiling Finishes and Coverings and Walling	IS	883	Design of structural timber in building - Code of Practice
Wall and Ceiling Finishes and Coverings and Walling	IS	1130	Marble (blocks, slabs and tiles)
Wall and Ceiling Finishes and Coverings and Walling	IS	1237	Cement concrete flooring tiles
Wall and Ceiling Finishes and Coverings and Walling	IS	1328	Veneered decorative plywood
Wall and Ceiling Finishes and Coverings and Walling	IS	1344	Calcined clay pozzolana
Wall and Ceiling Finishes and Coverings and Walling	IS	1414	Code of practice for fixing wall covering

Group	Source	Code Number	Title
Wall and Ceiling Finishes and Coverings and Walling	IS	1489 (Part 1)	Portland pozzolana cement: Part 1 Fly ash based
Wall and Ceiling Finishes and Coverings and Walling	IS	1489 (Part 2)	Portland pozzolana cement: Part 2 Calcined clay based
Wall and Ceiling Finishes and Coverings and Walling	IS	1542	Sand of plaster
Wall and Ceiling Finishes and Coverings and Walling	IS	1635	Code of practice for field slaking of building lime and preparation of putty
Wall and Ceiling Finishes and Coverings and Walling	IS	1658	Fibre hardboards
Wall and Ceiling Finishes and Coverings and Walling	IS	1659	Block boards
Wall and Ceiling Finishes and Coverings and Walling	IS	1661	Code of practice for application of cement and cement-lime plaster finishes
Wall and Ceiling Finishes and Coverings and Walling	IS	1946	Code of practice for use of fixing devices in walls, ceilings and floors of solid construction
Wall and Ceiling Finishes and Coverings and Walling	IS	2095	Gypsum plaster boards
Wall and Ceiling Finishes and Coverings and Walling	IS	2098	Asbestos cement building boards
Wall and Ceiling Finishes and Coverings and Walling	IS	2114	Code of practice for laying in-situ terrazzo floor finish
Wall and Ceiling Finishes and Coverings and Walling	IS	2116	Sand for masonry mortar
Wall and Ceiling Finishes and Coverings and Walling	IS	2185 (Part 1)	Concrete masonry units : Part 1 Hollow and solid concrete blocks
Wall and Ceiling Finishes and Coverings and Walling	IS	2185 (Part 2)	Concrete masonry units : Part 2 Hollow and solid light weight concrete blocks
Wall and Ceiling Finishes and Coverings and Walling	IS	2185 (Part 3)	Concrete masonry units : Part 3 Autoclaved cellular aerated concrete blocks
Wall and Ceiling Finishes and Coverings and Walling	IS	2402	Code of practice for external rendered finishes

Group	Source	Code Number	Title
Wall and Ceiling Finishes and Coverings and Walling	IS	2441	Code of practice for fixing ceiling covering
Wall and Ceiling Finishes and Coverings and Walling	IS	2547 (Part 1)	Gypsum building plaster : Part 1 Excluding premixed lightweight plaster
Wall and Ceiling Finishes and Coverings and Walling	IS	2547 (Part 2)	Gypsum building plaster : Part 2 Premixed lightweight plaster
Wall and Ceiling Finishes and Coverings and Walling	IS	2691	Burnt clay facing bricks
Wall and Ceiling Finishes and Coverings and Walling	IS	2818	Indian hessian : Part 1 General
Wall and Ceiling Finishes and Coverings and Walling	IS	2849	Specification for non-load bearing gypsum partition blocks
Wall and Ceiling Finishes and Coverings and Walling	IS	3087	Wood particle boards (medium density) for general purposes
Wall and Ceiling Finishes and Coverings and Walling	IS	3097	Veneered particle boards
Wall and Ceiling Finishes and Coverings and Walling	IS	3129	Low density particle boards
Wall and Ceiling Finishes and Coverings and Walling	IS	3348	Specification for fibre insulation boards
Wall and Ceiling Finishes and Coverings and Walling	IS	3466	Specification for masonry cement
Wall and Ceiling Finishes and Coverings and Walling	IS	3478	Specification for high density wood particle boards
Wall and Ceiling Finishes and Coverings and Walling	IS	3629	Specification for structural timber in building
Wall and Ceiling Finishes and Coverings and Walling	IS	3630	Code of practice for construction of non-load bearing gypsum block partitions
Wall and Ceiling Finishes and Coverings and Walling	IS	3677	Unbonded rock and slag wool for thermal insulation
Wall and Ceiling Finishes and Coverings and Walling	IS	3812	Fly ash for use as pozzolana and admixture

Group	Source	Code Number	Title
Wall and Ceiling Finishes and Coverings and Walling	IS	4101 (Part 1)	Code of practice for external facing and veneers: Part 1 Stone facing
Wall and Ceiling Finishes and Coverings and Walling	IS	4101 (Part 2)	Code of practice for external facing and veneers: Part 2 Cement Concrete facing
Wall and Ceiling Finishes and Coverings and Walling	IS	4101 (Part 3)	Code of practice for external facing and veneers: Part 3 Wall tiling and mosaics
Wall and Ceiling Finishes and Coverings and Walling	IS	4407	Code of practice for reed walling
Wall and Ceiling Finishes and Coverings and Walling	IS	4671	Expanded polystyrene for thermal insulation purposes
Wall and Ceiling Finishes and Coverings and Walling	IS	5390	Code of practice for construction of timber ceiling
Wall and Ceiling Finishes and Coverings and Walling	IS	5509	Fire retardant plywood
Wall and Ceiling Finishes and Coverings and Walling	IS	6730	Felt nails
Wall and Ceiling Finishes and Coverings and Walling	IS	6738	Panel pins and lost head nails
Wall and Ceiling Finishes and Coverings and Walling	IS	6760	Slotted countersunk head wood screws
Wall and Ceiling Finishes and Coverings and Walling	IS	7316	Decorative plywood using plurality of veneers for decorative faces
Wall and Ceiling Finishes and Coverings and Walling	IS	8041	Rapid hardening Portland cement
Wall and Ceiling Finishes and Coverings and Walling	IS	12727	Code of practice for no fines cast in-situ cement concrete
Roofs and Roofing	IS	158	Ready mixed paint, brushing, bituminous, black lead-free, acid alkali and heat resisting
Roofs and Roofing	IS	217	Cutback bitumen
Roofs and Roofing	IS	269	33 grade ordinary Portland cement
Roofs and Roofing	IS	277	Galvanized steel sheet (plain and corrugated)
Roofs and Roofing	IS	280	Mild Steel wire for general engineering
Roofs and Roofing	IS	383	Coarse and fine aggregates from natural sources for concrete

Group	Source	Code Number	Title
Roofs and Roofing	IS	432 (Part 1)	Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement: Part 1 Mild steel and medium tensile steel bars
Roofs and Roofing	IS	451	Technical supply conditions for wood screws
Roofs and Roofing	IS	455	Portland slag cement
Roofs and Roofing	IS	456	Code of practice for plain and reinforced concrete
Roofs and Roofing	IS	459	Corrugated and semi-corrugated asbestos cement sheets
Roofs and Roofing	IS	723	Steel countersunk head wire nails
Roofs and Roofing	IS	725	Copper wire nails
Roofs and Roofing	IS	730	Hook bolts for corrugated sheet roofing
Roofs and Roofing	IS	805	Code of practice for use of steel in gravity water tanks
Roofs and Roofing	IS	808	Dimensions for hot-rolled steel beam, column channel and angle sections
Roofs and Roofing	IS	883	Design of structural timber in building - Code of Practice
Roofs and Roofing	IS	1077	Common burnt clay building bricks
Roofs and Roofing	IS	1120	Coach screws
Roofs and Roofing	IS	1199	Methods of sampling and analysis of concrete
Roofs and Roofing	IS	1254	Corrugated aluminium sheet
Roofs and Roofing	IS	1322	Bitumen felts for waterproofing and damp-proofing
Roofs and Roofing	IS	1343	Code of practice for Prestressed concrete
Roofs and Roofing	IS	1344	Calcined clay pozzolana
Roofs and Roofing	IS	1489 (Part 1)	Portland pozzolana cement: Part 1 Fly ash based
Roofs and Roofing	IS	1489 (Part 2)	Portland pozzolana cement: Part 2 Calcined clay based
Roofs and Roofing	IS	2098	Asbestos cement building boards
Roofs and Roofing	IS	2119	Code of practice for construction of brick-cum-concrete composite (Madras terrace) floor or roof
Roofs and Roofing	IS	2204	Code of practice for construction of reinforced concrete shell roof
Roofs and Roofing	IS	2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage
Roofs and Roofing	IS	2690 (Part 1)	Burnt clay flat terracing tiles: Part 1 Machine made
Roofs and Roofing	IS	2690 (Part 2)	Burnt clay flat terracing tiles: Part 2 Hand made
Roofs and Roofing	IS	3007 (Part 1)	Code of practice for laying of asbestos cement sheets: Part 1 Corrugated sheets
Roofs and Roofing	IS	3007 (Part 2)	Code of practice for laying of asbestos cement sheets: Part 2 Semicorrugated sheets
Roofs and Roofing	IS	3629	Specification for structural timber in building

Group	Source	Code Number	Title
Roofs and Roofing	IS	6061 (Part 1)	Code of practice for construction of floor and roof with joints and filler blocks : Part 1 with hollow concrete filler blocks
Roofs and Roofing	IS	6061 (Part 2)	Code of practice for construction of floor and roof with joints and filler blocks : Part 2 with hollow clay filler blocks
Roofs and Roofing	IS	6061 (Part 3)	Code of practice for construction of floor and roof with joints and filler blocks : Part 3 Precast hollow clay blocks joints and hollow clay filler blocks
Roofs and Roofing	IS	6061 (Part 4)	Code of practice for construction of floor and roof with joints and filler blocks : Part 4 With precast hollow clay blocks slab panels
Roofs and Roofing	IS	6332	Code of practice for construction of floor and roofs using precast doubly curved shell units
Roofs and Roofing	IS	8869	Washers for corrugated sheet roofing
Roofs and Roofing	IS	12093	Code of practice for laying and fixing of sloped roof coverings using plain and corrugated galvanized steel sheet (ISO 6589-1983)
Roofs and Roofing	IS	12506	Code of practice for improved thatching of roof with rot and fire retardant treatment
Damp - Proofing and Waterproofing	IS	73	Paving bitumen
Damp - Proofing and Waterproofing	IS	269	33 grade ordinary Portland cement
Damp - Proofing and Waterproofing	IS	383	Coarse and fine aggregates from natural sources for concrete
Damp - Proofing and Waterproofing	IS	702	Industrial bitumen
Damp - Proofing and Waterproofing	IS	1195	Bitumen mastic for flooring
Damp - Proofing and Waterproofing	IS	1203	Determination of penetration
Damp - Proofing and Waterproofing	IS	1322	Bitumen felts for waterproofing and damp-proofing
Damp - Proofing and Waterproofing	IS	1346	Code of practice for waterproofing of roofs with bitumen felts
Damp - Proofing and Waterproofing	IS	1580	Bituminous compounds for water proofing and caulking purposes
Damp - Proofing and Waterproofing	IS	1609	Code of practice for laying damp-proofing treatment using bitumen felts
Damp - Proofing and Waterproofing	IS	1635	Code of practice for field slaking of building lime and preparation of putty
Damp - Proofing and Waterproofing	IS	1834	Hot applied sealing compound for joint in concrete
Damp - Proofing and Waterproofing	IS	2116	Sand for masonry mortars
Damp - Proofing and Waterproofing	IS	2508	Low density polyethylene films

Group	Source	Code Number	Title
Damp - Proofing and Waterproofing	IS	2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage
Damp - Proofing and Waterproofing	IS	2541	Code of practice for preparation and use of lime concrete
Damp - Proofing and Waterproofing	IS	2645	Integral cement water proofing compounds
Damp - Proofing and Waterproofing	IS	2690 (Part 1)	Burnt clay flat terracing tiles: Part 1 Machine made
Damp - Proofing and Waterproofing	IS	2690 (Part 2)	Burnt clay flat terracing tiles: Part 2 Hand made
Damp - Proofing and Waterproofing	IS	3036:1992	Laying lime concrete for a waterproofed roof finish
Damp - Proofing and Waterproofing	IS	3037	Bitumen mastic for use in waterproofing of roofs
Damp - Proofing and Waterproofing	IS	3067	Code of practice for general design details and preparatory work for damp-proofing and waterproofing of buildings
Damp - Proofing and Waterproofing	IS	3370 (Part 1)	Code of practice for concrete structures for the storage of liquids: Part 1 General Requirements
Damp - Proofing and Waterproofing	IS	3384	Specification for bitumen primer for use in waterproofing and damp proofing
Damp - Proofing and Waterproofing	IS	4098	Lime-pozzolana mixture
Damp - Proofing and Waterproofing	IS	4365	Code of practice for application of bitumen mastic for water proofing of roofs
Damp - Proofing and Waterproofing	IS	5871	Bitumen mastic for tanking and damp-proofing
Damp - Proofing and Waterproofing	IS	6494	Code of practice for waterproofing of underground water reservoirs and swimming pools
Damp - Proofing and Waterproofing	IS	7193	Glass fibre base coaltar pitch and bitumen felts
Damp - Proofing and Waterproofing	IS	7198	Code of practice for damp-proofing using bitumen mastic
Damp - Proofing and Waterproofing	IS	7290	Recommendations for use of polyethylene film for waterproofing of roofs
Damp - Proofing and Waterproofing	IS	9759	Guidelines for dewatering during construction
Damp - Proofing and Waterproofing	IS	9918	Code of practice for application of silicone based water repellent
Damp - Proofing and Waterproofing	IS	12027	Silicone-based water repellents
Damp - Proofing and Waterproofing	IS	12054	Code of practice for application of silicone based water repellent
Damp - Proofing and Waterproofing	IS	13182	Waterproofing and damp-proofing of wet areas in building Recommendations

Group	Source	Code Number	Title
Joints in Buildings (Control of Cracks In Buildings)	IS	1834	Hot applied sealing compound for joint in concrete
Joints in Buildings (Control of Cracks In Buildings)	IS	1838 (Part 1)	Performed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type): Part 1 Bitumen impregnated fibre
Joints in Buildings (Control of Cracks In Buildings)	IS	1838 (Part 2)	Performed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type): Part 2 CNSL Aldehyde resin and coconut pith
Joints in Buildings (Control of Cracks In Buildings)	IS	3414	Code of practice for design and installation of joints in buildings
Joints in Buildings (Control of Cracks In Buildings)	IS	10958	General check list of functions of joints in buildings
Joints in Buildings (Control of Cracks In Buildings)	IS	11433 (Part 1)	One part grade polysulphide based joint sealant: Part 1 General Requirements
Joints in Buildings (Control of Cracks In Buildings)	IS	11817	Classification of joints in buildings for accommodation of dimensional deviations during construction
Joints in Buildings (Control of Cracks In Buildings)	IS	11818	Method of test for laboratory determination of air permeability of joints in buildings
Joints in Buildings (Control of Cracks In Buildings)	IS	12118 (Part 1)	Two parts polysulphide based sealant: Part 1 General requirements
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	44	Iron oxide pigments for paints
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	55	Ultramarine blue for paints
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	109	Ready mixed paint, brushing, priming, plaster, to Indian Standard Colour No. 361 and 631 White and off white
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	133	Enamel, interior: (a) undercoating, (b) finishing
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	158	Ready mixed paint, brushing, bituminous, black lead-free, acid alkali and heat resisting

Group	Source	Code Number	Title
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	168	Ready mixed paint, air drying, for general purpose
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	427	Distemper, dry, colour as required
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	428	Distemper, oil emulsion, colour as required
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	702	Industrial bitumen
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	712	Building limes
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	2395 (Part 1)	Code of practice for painting concrete masonry and plaster surfaces : Part 1 Operation and workmanship
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	2395 (Part 2)	Code of practice for painting concrete masonry and plaster surfaces : Part 2 Schedule
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	2547 (Part 1)	Gypsum building plaster: Part 1 Excluding premixed lightweight plaster
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	2547 (Part 2)	Gypsum building plaster: Part 2 Premixed lightweight plaster

Group	Source	Code Number	Title
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	2932	Enamel, synthetic, exterior (a) undertaking (b) finishing
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	2933	Enamel, exterior (a) undertaking (b) finishing
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	3140	Code of practice for painting asbestos cement building products
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	3384	Specification for bitumen primer for use in waterproofing and damp proofing
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	5410	Cement paint
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	5411 (Part 1)	Plastic emulsion paint: Part 1 for interior use
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	5411(Part 2)	Plastic emulsion paint: Part 2 for exterior use
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	6278	Code of practice for whitewashing and colour washing
White Washing, Colour Washing and Painting of Masonry, Concrete and Plaster Surfaces (Calcareous Surfaces)	IS	9862	Ready mixed paint, brushing, bituminous, black lead-free, acid alkali, water and chlorine resisting
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	102	Ready mixed paint, brushing, red lead, non settling, painting

Group	Source	Code Number	Title
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	110	Ready mixed paint, brushing, Grey filler, for enamels for use over primers
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	117	Ready mixed paint, brushing, finishing exterior, semi-gloss for general purposes to Indian Standard Colours No. 101 to 104, 169,174,216, 217, 219, 275, 278, 280,281, 283, 352 to 354, 358 to 365, 384 to 388, 397, 410, 442 to 444
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	124 (Part 3)	Ready mixed paint, brushing, finishing exterior, semi-gloss for general purposes: Part 3 (superseding IS 119)
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	127	Ready mixed paint, brushing, finishing exterior, semi-gloss for general purposes white
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	128	Ready mixed paint, brushing, finishing exterior, semi-gloss for general purposes black
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	133	Enamel, interior: (a) undercoating, (b) finishing
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	137	Ready mixed paint, brushing, matt or eggshell flat, finishing, interior to Indian Standard colour as required
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	144	Ready mixed paint, brushing, petrol resisting, air-drying, for interior painting of tanks and container, red oxide (colour unspecified)
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	158	Ready mixed paint, brushing, bituminous, black lead-free, acid alkali and heat resisting
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	198	Varnish gold size
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	207	Gate and shutter hooks and eyes
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	337	Varnish, finishing interior
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	348	French polish
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	401	Code of practice for preservation of timber
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	423	Plastic wood for joiners filter

Group	Source	Code Number	Title
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	524	Varnish, finishing, exterior, synthetic, air drying
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	525	Varnish, finishing, exterior and general purposes
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	1477 (Part 1)	Code of practice for painting of ferrous metals in buildings: Part 1 Pretreatment
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	1477 (Part 2)	Code of practice for painting of ferrous metals in buildings: Part 2 Painting
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	2338 (Part 1)	Code of practice for finishing of wood and wood based materials: Part 1 Operations and workmanship
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	2338 (Part 2)	Code of practice for finishing of wood and wood based materials: Part 2 Schedules
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	2339	Aluminium paint for general purposes, in dual container
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	2554 (Part 1&2)	Code of practice for painting of non ferrous metals in buildings
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	2524 (Part 1)	Code of Practice for painting of non-ferrous metals in buildings; Part 1 Pretreatment
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	2524 (Part 1)	Code of Practice for painting of non-ferrous metals in buildings; Part 2 Painting
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	2932	Enamel, synthetic, exterior (a) undertaking (b) finishing
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	2933	Enamel, exterior (a) undertaking (b) finishing
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	3531	Glossary of terms relating to corrosion of metals
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	3536	Ready mixed paint, brushing, wood primer, pink

Group	Source	Code Number	Title
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	3537	Ready mixed paint, finishing interior, for general purposes, to Indian Standard Colours No. 101, 216, 217, 219, 275, 281, 352, 353, 358 to 361, 363, 364, 388, 410, 442, 444, 628, 631, 632, 634, 693, 697, white and black
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	3539	Ready mixed paint, undercoating for use under oil finishes to Indian Standard Colours, as required
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	3585	Ready mixed paint, aluminium, brushing priming water resistant, for woodwork
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	4597	Code of Practice for finishing of wood and wood based products with nitrocellulose and cold catalysed materials
Painting, Varnishing and Allied Finishes (Wood And Metals)	IS	6005	Code of practice for phosphating of iron and steel
Water Supply	IS	1172	Code of basic requirements of water supply, drainage and sanitation
Water Supply	IS	1239 (Part 1)	Mild steel tubes, tubular and other wrought steel fittings: Part 1 Mild steel tubes
Water Supply	IS	1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage
Water Supply	IS	1537	Vertically cast iron pressure pipes for water, gas and sewage
Water Supply	IS	1592	Asbestos cement pressure pipes
Water Supply	IS	3114	Code of practice for laying of cast iron pipes
Water Supply	IS	5822	Code of practice for welded steel pipes for water supply
Water Supply	IS	1626 (Part 1)	Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings: Part 1 (Pipe and pipe fittings)
Water Supply	IS	2064	Selection, installation and maintenance of sanitary appliances - Code of practice
Water Supply	IS	2065	Code of practice for water supply in buildings
Water Supply	IS	2692	Ferrules for water services
Water Supply	IS	3076	Low density polyethylene pipes of potable water supplies; sewage and industrial effluents
Water Supply	IS	4984	Specification for high density polyethylene pipes for potable water supplies; sewage and industrial effluents
Water Supply	IS	4985	Specification for unplasticised PVC pipes for potable water supplied
Water Supply	IS	7558	Code of practice for domestic hot water installations
Water Supply	IS	7634 (Part 2)	Code of practice for plastics pipe work for potable water supplies : Part 2 Laying and jointing polyethylene (PE) pipes

Group	Source	Code Number	Title
Water Supply	IS	7634 (Part 3)	Code of practice for plastics pipe work for potable water supplies : Part 3 Laying and jointing of UPVC pipes
Water Supply	IS	12183 (Part 1)	Code of practice for plumbing in multi-storeyed buildings: Part 1 Water supply
Water Supply	IS	1916	Steel cylinder pipes with lining and coating
Water Supply	IS	4127	Code of practice for laying of salt glazed stoneware pipes
Water Supply	IS	12709	Glass fibre reinforced plastic pipes, joints and rings for potable water supply
Water Supply	IS	3597	Concrete pipes-methods of test
Water Supply	IS	7319	Perforated concrete pipes
Water Supply	NBC	NBC	National Building Code of India
Water Supply	SP	SP 35 (S & T)	Handbook of water supply and drainage with special emphasis on plumbing
Building Drainage	IS	277	Galvanized steel sheet (plain and corrugated)
Building Drainage	IS	458	Precast concrete pipes (with and without reinforcement)
Building Drainage	IS	651	Salt glazed stoneware pipes and fittings
Building Drainage	IS	782	Caulking lead
Building Drainage	IS	783	Code of Practice for laying of concrete pipes
Building Drainage	IS	1230	Cast iron rainwater pipes and fittings
Building Drainage	IS	1536	Centrifugally cast (spun) iron pressure pipes for water, gas and sewage
Building Drainage	IS	1537	Vertically cast iron pressure pipes for water, gas and sewage
Building Drainage	IS	1592	Asbestos cement pressure pipes
Building Drainage	IS	1626 (Part 1)	Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings: Part 1 (Pipe and pipe fittings)
Building Drainage	IS	1726	Cast iron manhole covers and frames
Building Drainage	IS	1742	Code of Practice for building drainage
Building Drainage	IS	3006	Specification for chemically resistant glazed stoneware pipes and fittings
Building Drainage	IS	4111 (Parts 1 to 5)	Code of Practice for ancillary structures in sewerage system
Building Drainage	IS	4733	Methods of sampling and test for sewage effluents
Building Drainage	IS	4984	Specification for high density polyethylene pipes for potable water supplies; sewage and industrial effluents
Building Drainage	IS	4985	Specification for unplasticised PVC pipes for potable water supplied
Building Drainage	IS	5329	Code of Practice for sanitary pipe work above ground for buildings
Building Drainage	IS	5455	Cast iron steps for manholes
Building Drainage	IS	12592 (Parts 1 & 2)	Precast manhole covers & frames
Building Drainage	IS	4350	Concrete porous pipes for Under drainage

Group	Source	Code Number	Title
Building Drainage	IS	2470 (Parts 1 & 2)	Code of Practice for installation of septic tank
Building Drainage	IS	784	Prestressed concrete pipes
Special Construction Procedures Earthquake Effects, Etc.	IS	1893	Criteria for earthquake resistant design of structures
Special Construction Procedures Earthquake Effects, Etc.	IS	4326	Earthquake resistant design and construction of buildings- Code of practice
Special Construction Procedures Earthquake Effects, Etc.	IS	13920	Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice
Special Construction Procedures Earthquake Effects, Etc.	IS	13935	Repair and seismic strengthening of buildings - Guidelines
Special Construction Procedures Earthquake Effects, Etc.	IS	4991	Criteria for blast resistant design of structures for explosions above ground
Special Construction Procedures Earthquake Effects, Etc.	IS	6922	Criteria for safety and design of structures subject to underground blasts
Special Construction Procedures Earthquake Effects, Etc.	IS	2190	Selection, installation and maintenance of first-aid fire extinguishers - Code of practice
Special Construction Procedures Earthquake Effects, Etc.	IS	3696 (Part 2)	Safety code of scaffolds and ladders: Part 2 Ladders
Special Construction Procedures Earthquake Effects, Etc.	IS	4912	Safety requirements for floor and wall openings, railings and toe boards
General	IS	10005	S.I. units and recommendations for use of their multiples and of certain other units
General	IS	6060	Code of practice for day lighting of factory buildings
General	IS	3103	Code of practice for industrial ventilation
General	IS	3483	Code of practice for noise reduction in industrial buildings
General	IS	2440	Guide for day lighting of buildings
General	IS	1200 (1 to 28)	Method of measurement of Building and Civil Eng. Works
General	IS	7973	Code of practice for architectural and building working drawings
General	IS	962	Code of practice for architectural and building drawings
General	IS	13415	Code of safety for protective barrier in and around buildings
General	IS	4801	Safety code for blasting and related drilling operations
General	IS	8969	Safety code for erection of concrete framed structures

Group	Source	Code Number	Title
Pump	IS	1520	Horizontal centrifugal pumps for clear cold fresh water
Pump	IS	5120	Technical requirement rotodynamic special purpose pumps
Pump	IS	5639	Pumps handling chemicals and corrosive liquids
Pump	IS	5659	Pumps for process water
Pump	IS	1710	Vertical Turbine Pumps for clear, cold, fresh water
Pump	IS	11732	Mechanical Balancing
Pump	IS	5120	Performance test of pumps
Pump	ISO	ISO 5199	Standards of the Hydraulic Institute of USA.
Pump	IS	9137	Code for acceptance tests for Centrifugal, Mixed flow and Axial pumps Class-C
Pump	ISO	ISO 2373	Balancing of impeller
Pump	IS	13537	Technical specification for centrifugal pumps - Class 2
MS Pipe	AWWA	AWWA M11	Steel pipe design and installation
MS Pipe	AWWA	AWWA C651	Standard for disinfecting water mains.
MS Pipe	BS	BS 2633	Class I arc-welding of ferritic steel pipework for carrying fluids.
MS Pipe	BS	BS 2971	Class II arc-welding of carbon steel pipework for carrying fluids.
MS Pipe	BS	BS 4129	Welding primers and welding through sealants, adhesives and waxes for resistance welding of sheet steel.
MS Pipe	BS	BS 4147	Bitumen-based hot-applied coating materials for protecting iron and steel, including suitable primers where required.
MS Pipe	BS	BS 4190	ISO metric black hexagon bolts screws and nuts.
MS Pipe	BS	BS 4320	Metal washers for general engineering purposes. Metric series.
MS Pipe	BS	BS 4515	Welding of steel pipelines on land and offshore.
MS Pipe	BS	BS 6956: Part 5	Jointing materials and compounds: Jointing compounds for use with water, low pressure saturated steam, 1st family gases (excluding coal gas) and 2nd family gases.
MS Pipe	BS	BS 8010: Part 1	Pipelines on land: general.
MS Pipe	BS	BS EN 681-1&2	Elastomeric seals for joints in pipework and pipelines.

Group	Source	Code Number	Title
MS Pipe	BS	BS EN 681-1	Vulcanized rubber
MS Pipe	BS	BS EN 1092	Circular flanges for pipes, valves and fittings (PN designated); steel, cast iron and copper alloy flanges.
MS Pipe	BS	BS EN ISO 10216	Corrosion-resistant stainless steel fasteners.
MS Pipe	BS	BS EN 1514-1	Dimensions of non-metallic flat gaskets
MS Pipe	BS	BS EN 10224	Non-alloy steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption.
MS Pipe	BS	BS EN 10217-1:2002	Welded steel tubes for pressure purposes. Non-alloy steel tubes with specified room temperature properties.
MS Pipe		PD 5500	Unfired fusion-welded pressure vessels.
MS Pipe		CP 2010: Part 2	Design and construction of steel pipeline on land.
MS Pipe	ASTM	ASTM E 94	Guide for Radio Graphic Testing.
MS Pipe	ASTM	ASTM E 165	Test method for Liquid Penetrant Examination.
MS Pipe	ASTM	ASTM A751	Standard test methods, practices and terminology for chemical analysis of steel products.
MS Pipe	API	API 5L	Line pipe.
MS Pipe	API	API 1104	Welding of pipelines and related facilities.
MS Pipe	AWS	AWS A 5-17	Specification for bare mild steel electrodes and fluxes for submerged arc welding.
MS Pipe	IS	IS 638: 1979	Specifications for sheet rubber jointing and rubber insertion jointing
MS Pipe	IS	IS 814: 1991	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel
MS Pipe	IS	IS 816	Code of practice for use of metal arc welding for general construction in mild steel.
MS Pipe	IS	IS 817	Code of Practice for training and testing of metal arc welder
MS Pipe	IS	IS 1182	Recommended practice for Radiographic examination of fusion weld Butt joints in steel plant.
MS Pipe	IS	IS 1916 : 1982	Cement lining of steel pipes
MS Pipe	IS	IS 2062	Steel for general structural purposes grade Fe 410
MS Pipe	IS	IS 2598	Safety Code for industrial radiographic practice.

Group	Source	Code Number	Title
MS Pipe	IS	IS 2720: Part 7 1980	Method of test of soils (Compaction test for backfilling, consolidations)
MS Pipe	IS	IS 3589	Steel pipes for water gas and sewage (168.3 to 2032 mm outside diameter) – Specification.
MS Pipe	IS	IS 3600: Part 1	Welding jointing testing
MS Pipe	IS	IS 3613	Acceptance tests for wire flux combinations for submerged arc welding.
MS Pipe	IS	IS 3658	Code of practice for liquid penetration flaw detection.
MS Pipe	IS	IS 4081: 1986	Safety code for blasting and related drilling operation laying welded steel pipelines
MS Pipe	IS	IS 4353	Submerged arc welding of mild steel and low alloy steels recommendations.
MS Pipe	IS	IS 4533	Submerged Arc welding of mild steel and low alloy steels
MS Pipe	IS	IS 4620: 1986	Recommended practice for ultrasonic method test
MS Pipe	IS	IS 4711 : 1974	Method of sampling of steel pipes
MS Pipe	IS	IS 4736 : 1986	Hot dip zinc coating in mild steel tubes
MS Pipe	IS	IS 4853: 1982	Recommended practice for radiographic inspection of fusion and welded butt joints
MS Pipe	IS	IS 5504 :1997	Specifications for spirally welded pipes, IS 5822: 1994 Code of practice for laying of electrically welded steel pipes for water supply
MS Pipe	IS	IS 6392 : 1971	Specifications for steel pipes flanges.
MS Pipe	IS	IS 10221	Code of practice for coating and Wrapping of underground Mild Steel pipes
MS Pipe	IS	IS 11906: 1986	Recommendations for cement mortar lining of cast iron, mild steel and ductile iron pipes.
Coating	AWWA	AWWA C602-76	Standard for Cement Mortar Lining of Water Pipelines - 4 in. and larger - In Place.
Coating	IS	IS - 3696	Safety code for scaffolds and ladders (Part I & II)
Coating		ASTM - C40	Test for Organic Impurities in Sands for Concrete.
Coating	IS	IS-1916	Steel cylinder pipes with concrete lining and coating –specification.
Coating	IS	IS 3589	Steel pipes for water and sewage

Group	Source	Code Number	Title
Coating	IS	IS 11906	Recommendation for cement mortar lining for CI/MS/DI pipe
RWR Canal	IS	7894	Stability Analysis for Earth Dams
RWR Canal	IS	9429	Drainage system for Earth and Rockfill dams
RWR Canal	IS	3873	Lining of canals with Cement concrete block
RWR Canal	IS	10635	Free Board requirements in embankment dams
RWR Canal	IS	10889	HDPE films
RWR Canal	IS	9698	Lining for canals with High Density polyethylene film
RWR Canal	IS	5620	Structural design criteria for low head slide gates
RWR Canal	IS	456	Plain and reinforced concrete.
RWR Canal	IS	3370	Concrete structures for the storage of liquids
RWR Canal	IS	6494	Water proofing of underground water reservoirs and swimming pools.
RWR Canal	IS	875	Design loads
RWR Canal	IS	269	Specification for ordinary and low heat portland cement
RWR Canal	IS	8041	Specification for Rapid hardening portland cement
RWR Canal	IS	12330	Sulphate resisting portland cement
RWR Canal	IS	383	Specification for coarse and fine aggregate from natural sources for concrete
RWR Canal	IS	432	Specification for Mild Steel & Medium Tensile bars and hard drawn steel wire for concrete reinforcement: Mild steel & Medium tensile steel bars
RWR Canal	IS	456	Code of Practice for Plain and Reinforced Concrete
RWR Canal	IS	516	Methods of Tests of strength of Concrete
CWR	IS	3764	Safety code for excavation works
CWR	IS	3720	Methods of tests for soils
CWR	IS	1988	SBC
CWR	IS	280	Mild steel wire for general engineering purposes
CWR	IS	269	Portland cement
CWR	IS	383	Coarse and fine aggregate
CWR	IS	432	Medium tension steel bars and hard drawn steel wire
CWR	IS	456	Code of practice for plain and reinforced concrete
CWR	IS	516	Methods of testing for strength of concrete
CWR	IS	1199	Method of sampling and analysis of concrete
CWR	IS	1566	Fabric reinforcement
CWR	IS	1786	Cold twisted steel bars for concrete reinforcement

Group	Source	Code Number	Title
CWR	IS	3370	Code of practice for concrete structures for the storage of liquids
CWR	IS	7861	Recommended practice for hot weather concreting (Part-I)
CWR	IS	4082	Recommendation on stacking and storage of construction material on site.
CWR	IS	875	Code of practice for structural safety of buildings, loading standards
CWR	IS	1911	Dead loads
CWR	IS	1893	Criteria for earthquake resistant design and structures
CWR	IS	2950	Design of raft
CWR	IS	1200	Method of measurements
Electric Works	IS	732	Code of practice for electrical wiring installations (System voltage not extending 650 volts)
Electric Works	IS	900	Code of practice for installation and maintenance of Induction Motors
Electric Works	IS	1271	Classification of insulating materials for electrical machinery and apparatus in relation to their thermal stability in service
Electric Works	IS	1646	Code of practice for fire safety of buildings (general) Electrical Installations.
Electric Works	IS	1866	Code of practice for maintenance of insulating oil.
Electric Works	IS	1882	Code of practice for outdoor installation of public address systems.
Electric Works	IS	1886	Code of practice for installation and maintenance of Transformers.
Electric Works	IS	1913	General and safety requirements of electric lighting fittings
Electric Works	IS	2032	Graphical symbols used in electric technology.
Electric Works	IS	2165	Guide for insulation coordination.
Electric Works	IS	2274	Code of practice for electrical wiring installations (System voltage exceeding 658 volts)
Electric Works	IS	2309	Code of practice for the protection of buildings and Allied structures against lightning.
Electric Works	IS	3034	Code of practice for fire safety of industrial buildings – Electrical generating and distributing stations

Group	Source	Code Number	Title
Electric Works	IS	3043	Code of practice for earthing
Electric Works	IS	3072	Code of practice for installation and maintenance of switchgear (System voltage not exceeding 1000 volts)
Electric Works	IS	3106	Code of practice for selection, installation and maintenance of fuses (voltage not exceeding 650 volts)
Electric Works	IS	3638	Application guide for gas-operated relays.
Electric Works	IS	3646	Code of practice for interior illumination.
Electric Works	IS	3716	Application guide for insulation coordination – Equipment located in hazardous situations.
Electric Works	IS	3842	Application guide for electrical relays for AC system.
Electric Works	IS	4004	Application guide for non-linear resisted type lightning arrestors for AC system.
Electric Works	IS	4146	Application guide for voltage transformers.
Electric Works	IS	4201	Application guide for current transformers.
Electric Works	IS	5571	Guide for selection of electrical equipment in hazardous area.
Electric Works	IS	5572	Classification of hazardous areas for electrical installations.
Electric Works	IS	5780	Intrinsically safe electrical apparatus and circuits.
Electric Works	IS	5908	Method of measurement of electrical installations in buildings.
Electric Works	IS	375	Marking and arrangement for switchgear bus-bars, main connections and auxiliary winding.
Electric Works	IS	694	PVC insulated cables (for voltages up to 100v) with copper conductors.
Electric Works	IS	1248	Direct acting electrical indicating instruments
Electric Works	IS	2147	Degrees of protection provided for enclosures for low voltage switchgear and control gear
Electric Works	IS	2208	HRC cartridge fuse links up to 650 V.
Electric Works	IS	2705	Current transformers
Electric Works	IS	3156	Voltage transformers.

Group	Source	Code Number	Title
Electric Works	IS	3202	Code of practice for climate proofing of electrical equipment.
Electric Works	IS	3231	Electrical relays of power system protection
Electric Works	IS	4047	Heavy duty air break switches and composite units of airbreak switches and fuses for voltages not exceeding 1000 volts.
Electric Works	IS	4237	General requirements for switchgear and control gear for voltages not exceeding 1000V.
Electric Works	IS	5987	Code of practice for selection of switches (voltage not exceeding 1000V)
Electric Works	IS	335	Insulating oil for transformers and switchgear.
Electric Works	IS	2516	Alternating current circuit breakers – Requirements and tests for voltage ranges 1000 to 11000 volts.
Electric Works	IS	3427	Metal enclosed switchgear and control gear for voltages above 1000 V but not exceeding 11000 V.
Electric Works	IS	722	AC electricity meters.
Electric Works	IS	1951	PVC sleeving for electrical purposes.
Electric Works	IS	2516	AC circuit breakers – requirements and tests for voltages not exceeding 1000V.
Electric Works	IS	2419	Dimensions of electrical indicating instruments.
Electric Works	BS	BS-4752	Circuit breakers of rated voltage up to and including 1000 volts and 1200 volts dc.
Electric Works	BS	BS-6231	PVC insulated cables for switchgear wiring.
Electric Works	IEC	IEC-157	Low voltage distribution switchgear circuit breakers.
Electric Works	IS	1554	PVC insulated (heavy duty) electric cables for working voltages up to and including 1100 volts.
Electric Works	IS	1822	AC motor starters of voltage not exceeding 1000 volts.
Electric Works	IS	2959	AC contactors of voltage not exceeding 1000 V.
Electric Works	IS	391	Mains transformers for electronic equipment.
Electric Works	IS	335	Insulating oil for transformers and switchgear.
Electric Works	IS	2026	Power transformers.
Electric Works	IS	2099	High voltage porcelain bushings
Electric Works	IS	3070	Lightning arrestors for AC systems.

Group	Source	Code Number	Title
Electric Works	IS	3637	Gas operated relays.
Electric Works	IS	3639	Fittings and accessories for power transformers
Electric Works	IS	325	Three phase induction motors.
Electric Works	IS	4691	Degrees of protection provided by enclosures for rotating electrical machinery
Electric Works	IS	4722	Rotating electrical machines
Electric Works	IS	1652	Stationery cells and batteries, lead-acid type (with plants positive plates).
Electric Works	IS	440	Stationery batteries
Electric Works	IS	1554	PVC insulated (heavy duty) electric cables for working voltages up to and including 1100 volts and for upto 33 KV.
Electric Works	IS	1753	Aluminum conductors for insulated cables.
Electric Works	IS	3961	Recommended current ratings for cables.
Electric Works	IS	3975	Mild steel wires, strips and tapes for armouring cables.
Electric Works	IS	5819	Recommended short-circuit ratings of high voltage cables.
Electric Works	IS	5831	PVC insulation and sheaths of electric cables
Electric Works	IS	7132	Guide for testing synchronous machines
Electric Works	IS	5422	Turbine type generators
Electric Works	IS	7306	Methods for determining synchronous machine quantities from tests.
Electric Works	IEC	IEC 60028 Ed. - 2.0 b: 1925	International standard of resistance for copper
Electric Works	IEC	IEC 60034-1 Ed.11.0 b:2004	Rotating electrical machines – Part 1 : Rating and performance
Electric Works	IEC	IEC 60034-11 IEC 60034-12 - Ed.2.0 b: 2002	Rotating electrical machines – Part 12 : Starting performance of single-speed three-phase cage induction motors.
Electric Works	IEC	IEC 60034-14 - Ed.3.0 b:2003	Rotating electrical machines – Part 14 : Mechanical vibration of certain machines with shaft heights 56 mm Higher – Measurement, evaluation and limits of vibration severity.
Electric Works	IEC	IEC 60034-15 - Ed.2.0 b : 1995	Rotating electrical machines – Part 15 : Impulse voltage withstand levels of rotating a.c. machines with formwound

Group	Source	Code Number	Title
			stator coils.
Electric Works	IEC	IEC 60034-16-1 -Ed.1.0 b:1991	Rotating electrical machines – Part 16 : Excitation systems for synchronous machines –Chapter 1 : Definitions.
Electric Works	IEC	IEC 60034-18-1 Ed.1.0 b : 1992	Rotation electrical machines – Part 18 : Functional evaluation of insulation systems – Section 1 :General guidelines & Section 21 : Test procedures
Electric Works	IEC	IEC 60034-18-31 Ed 1.0 b : 1992	Rotating electrical machines – Part 18 : Functional evaluation of insulation systems – Section 31 : Test procedures for form-wound windings – Thermal evaluation and classification of insulation systems used in machines up to and including 50 MVA and 15 kV
Electric Works	IEC	IEC 60034-2 Ed.3.0 b : 1972	Rotating electrical machines Part 2 : Methods for determining I losses and efficiency of rotating electrical machinery from tests
Electric Works	IEC	IEC 60034-2A Ed. 1.0 b : 1974	Rotating electrical machines – Part 2 : Methods for determining Losses and efficiency of rotating electrical machinery form tests (excluding machines for traction vehicles) – First supplement : Measurement of losses by the calorimetric method.
Electric Works	IEC	IEC 60034-3 Ed. 5.0 b : 2005	Rotating electrical machines – Part 3 : Specific requirements for cylindrical rotor synchronous machines
Electric Works	IEC	IEC 60034-4 Ed.2.0 b : 1985	Rotating electrical machines – Part 4 : Methods for determining synchronous machine quantities from tests.
Electric Works	IEC	IEC 60034-5 Ed 4.0 b : 2000	Rotating electrical machines – Part 5 : Degrees of protection provided by the integral design of rotating electrical machines (IP code) – Classification
Electric Works	IEC	IEC 60034-6 Ed.2.0 b : 1991	Rotating electrical machines – Part 6 : Methods of cooling (IC code).

Group	Source	Code Number	Title
Electric Works	IEC	IEC 60076-1 Ed.2.1 b : 2000	Power transformers – Part 1 : General
Electric Works	IEC	IEC 60076-11 Ed.1.0 b : 2004	Power transformers – Part 11 : Dry-type transformers
Electric Works	IEC	IEC 60076-2 Ed.2.0 b: 1993	Power transformers – Part 2 : Temperature rise
Electric Works	IEC	IEC 60076-8 Ed.1.0 b:1997	Power transformers – Part 8 : Application guide
Electric Works	IEC	IEC 60079-0 Ed.4.0 b:2004	Electrical apparatus for explosive gas atmospheres – Part 0 : General requirements
Electric Works	IEC	IEC 60079-10 Ed.4.0 b:2004	Electrical apparatus for explosive gas atmospheres – Part 10 Classification of hazardous areas
Electric Works	IEC	IEC 60086-1 Ed.9.0 en:2000	Primary batteries – Part 1: General
Electric Works	IEC	IEC GUIDE III	Selection of Rotating Machinery
Electric Works	IEC	IEC/TS 60034-16	Power Transformer – General, Selection, Testing etc.
Electric Works	IEC	IEC- 62026	Low Voltage Switchgear
Electric Works	IEC	IEC-62040	Uninterrupted Power Supplies
Electric Works	IEC	IEC-60502	Power Cables Upto 30 kV-General Requirement, Selection
Electric Works	IEC	IEC-60287	Power Cables – Testing
Electric Works	IEC	IEC-60255	Requirements For Protective Relays
Electric Works	CBIP	CBIP Publication No 275	CBIP Manual on Transformers
Electric Works	IS	2026	Power Transformers
Electric Works	IS	335	Insulating oils for transformers and switchgears
Electric Works	IS	2099	Bushings for alternating voltages above 1000 V
Electric Works	IS	3347	Creepage distance (mm)
Electric Works	IS	3347	Outdoor Bushings
Electric Works	IS	7421	Specification for low voltage bushings
Electric Works	IS	4257	Dimensions for clamping arrangements for bushings
Electric Works	IS	5434	Specification for Al Wire rods
Electric Works	IS	9335	Specification for Insulating Kraft Paper
Electric Works	IS	1576	Specification for Insulating Press Board
Electric Works	IS	10028	Code of practice for installation and maintenance of transformers
Electric Works	IS	6600	Guide for loading of oil immersed transformers
Electric Works	IS	6162	Paper covered Aluminum conductor

Group	Source	Code Number	Title
Electric Works	IS	6160	Rectangular Electrical conductor for electrical machine
Electric Works	IS	5561	Electrical Power connector
Electric Works	IS	104	Ready mixed paint, brushing zinc chromate, priming
Electric Works	IS	12444	Specification for Copper wire rod
Electric Works	IS	649	Testing for steel sheets and strips and magnetic circuits
Instrumentation & Control	IEC	IEC 60381-1:1982	Analogue signals for process control systems. Specification for direct current signals.
Instrumentation & Control	IEC	IEC 60947-4-1:2000	Specification for low-voltage switchgear and controlgear. Contactors and motor-starters. Electromechanical contactors and motor-starters.
Instrumentation & Control	IEC	IEC 60947-4-2:1999	Specification for low-voltage switchgear and controlgear. Contactors and motor-starters. A.C. semiconductor motor controllers and starters.
Instrumentation & Control	IEC	IEC 60947-4-3:1999	Specification for low-voltage switchgear and controlgear. Contactors and motor-starters. Contactors and motorstarters. AC semiconductor controllers and contactors for non-motor loads.
Instrumentation & Control	IEC	IEC 60770-1:1999	Transmitters for use in industrial-process control systems. Methods for performance evaluation.
Instrumentation & Control	BS	BS ISO 1217:1996	Displacement compressors. Acceptance tests.
Instrumentation & Control	ISO	ISO 2112:1990	Specification for aminoplastic moulding materials.
Instrumentation & Control	ISO	ISO 6817:1997	Measurement of conductive liquid flow in closed conduits. Method using electromagnetic flowmeters.
Instrumentation & Control	BS	BS EN 837-1:1998	Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing.
Instrumentation & Control	BS	BS EN 1057:1996	Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications.

Group	Source	Code Number	Title
Instrumentation & Control	BS	BS EN 1092-1:2002	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges.
Instrumentation & Control	BS	BS EN 1563:1997	Founding. Spheroidal graphite cast iron.
Instrumentation & Control	BS	BS EN 60529:1992	Specification for degrees of protection provided by enclosures (IP code).
Instrumentation & Control	BS	BS EN 60534-1:1993	Industrial-process control valves. Industrial-process control valves. Control valve terminology and general considerations.
Instrumentation & Control	BS	BS EN 60546-1:1993	Controllers with analogue signals for use in industrialprocess control systems. Controllers with analogue signals for use in industrial-process control systems.
Instrumentation & Control	BS	BS EN 60584-2:1993	Thermocouples. Tolerances
Instrumentation & Control	BS	BS EN 60654:1998	Operating conditions for industrial-process measurement and control equipment. All relevant parts.
Instrumentation & Control	BS	BS EN 60751:1996	Industrial platinum resistance thermometer sensors
Instrumentation & Control	BS	BS EN 60873:1993	Methods of evaluating the performance of electrical and pneumatic analogue chart recorders for use in industrialprocess control systems.
Instrumentation & Control	BS	BS EN 61000-6:2001	Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments.
Instrumentation & Control	BS	BS 89:1990	Direct acting indicating analogue electrical measuring instruments and their accessories. All parts.
Instrumentation & Control	BS	BS 90:1975	Specification for direct-acting electrical recording instruments and their accessories.
Instrumentation & Control	BS	BS 476	Fire tests on building materials and structures. All parts.
Instrumentation & Control	BS	BS 1042-1.4:1992	Measurement of fluid flow in closed conduits. Pressure differential devices. Guide to the use of devices specified in Sections 1.1 and 1.2.

Group	Source	Code Number	Title
Instrumentation & Control	BS	BS 1041-2.1:1985	Code for temperature measurement. Expansion thermometers. Guide to selection and use of liquid-in-glass thermometers.
Instrumentation & Control	BS	BS 1041-2.2:1989	Code for temperature measurement. Expansion thermometers. Guide to selection and use of dial-type expansion thermometers.
Instrumentation & Control	BS	BS 1041-3:1989	Temperature measurement. Guide to selection and use of industrial resistance thermometers
Instrumentation & Control	BS	BS 1041-4:1992	Temperature measurement. Guide to the selection and use of thermocouples.
Instrumentation & Control	BS	BS 1042-1.4:1992	Measurement of fluid flow in closed conduits. Pressure differential devices. Guide to the use of devices specified in Sections 1.1 and 1.2.
Instrumentation & Control	BS	BS 1123-1:1987	Safety valves, gauges and fusible plugs for compressed air or inert gas installations. Code of practice for installation.
Instrumentation & Control	BS	BS 1203:2001	Hot-setting phenolic and aminoplastic wood adhesives. Classification and test method.
Instrumentation & Control	BS	BS 1553-1:1977	Specification for graphical symbols for general engineering. Piping systems and plant.
Instrumentation & Control	BS	BS 1571-2:1975	Specification for testing of positive displacement compressors and exhausters. Methods for simplified acceptance testing for air compressors and exhausters.
Instrumentation & Control	BS	BS 1646-1:1979	Symbolic representation for process measurement control functions and instrumentation. Basic requirements.
Instrumentation & Control	BS	BS 1646-2:1983	Symbolic representation for process measurement control functions and instrumentation. Specification for additional basic requirements

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Instrumentation & Control	BS	BS 1646-3:1984	Symbolic representation for process measurement control functions and instrumentation. Specification for detailed symbols for instrument interconnection diagrams.
Instrumentation & Control	BS	BS 1646-4:1984	Symbolic representation for process measurement control functions and instrumentation. Specification for basic symbols for process computer, interface and shared display/control functions.
Instrumentation & Control	BS	BS 1794:1952	Specification for chart ranges for temperature recording instruments.
Instrumentation & Control	BS	BS 2765:1969	Specification for dimensions of temperature detecting elements and corresponding pockets.
Instrumentation & Control	BS	BS 3680	Measurement of liquid flow in open channels. All relevant parts.
Instrumentation & Control	BS	BS 3693:1992	Recommendations for design of scales and indexes on analogue indicating instruments.
Instrumentation & Control	BS	BS 4675-2:1978	Mechanical vibration in rotating machinery. Requirements for instruments for measuring vibration severity.
Instrumentation & Control	BS	BS 4999-142:1987	General requirements for rotating electrical machines. Specification for mechanical performance: vibration.
Instrumentation & Control	BS	BS 5169:1992	Specification for fusion welded steel air receivers.
Instrumentation & Control	BS	BS 5728-3:1997	Measurement of flow of cold potable water in closed conduits. Methods for determining principal characteristics of single mechanical water meters (including test equipment) .
Instrumentation & Control	BS	BS 6004:2000	Electric cables. PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring.
Instrumentation & Control	BS	BS 6739:1986	Code of practice for instrumentation in process control systems: installation design and practice.

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Instrumentation & Control	BS	BS 7671:2001	Requirements for electrical installations. IEE Wiring Regulations. Sixteenth edition.
Instrumentation Society of American Standards and recommended practices		S 5.1	Instrumentation symbols and identification
Instrumentation Society of American Standards and recommended practices		S 5.4	Instrument loop diagrams
Instrumentation Society of American Standards and recommended practices		S 7.3	Quality standard for instrument air
Instrumentation Society of American Standards and recommended practices		RP 16.1	Terminology, dimensions and safety practices for indicating variable 2, 3 area meters
Instrumentation Society of American Standards and recommended practices		RP 16.4	Nomenclature and terminology for extension-type variable-area meters (rotameters)
Instrumentation Society of American Standards and recommended practices		RP 16.5	Installation, operation, maintenance instructions for glass tube variable area meters (rotameters)
Instrumentation Society of American Standards and recommended practices		RP 16.6	Methods and equipment for calibration of variable area meters (rotameters)
Instrumentation Society of American Standards and recommended practices		RP 18.1	Specifications and guides for the use of general purpose annunciators
Instrumentation Society of American Standards and recommended practices		S 26	Dynamic response testing of process control instrumentation
Instrumentation Society of American Standards and recommended practices		RP 31.1	Specification, installation and calibration of turbine flowmeters
Instrumentation Society of American Standards and recommended practices		S 37.1	Electrical transducer nomenclature and terminology
Instrumentation Society of American Standards and recommended practices		S 37.3	Specifications and tests for strain gauge pressure transducers
Instrumentation Society of American Standards and recommended practices		S 50.1	Compatibility of analog signals for electronic industrial process instruments
Instrumentation Society of American Standards and recommended practices		S 51.1	Process instrumentation terminology

Group	Source	Code Number	Title
Instrumentation Society of American Standards and recommended practices		RP 60.08	Electrical Guide for Control Centres



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