

**RASHTRIYA ISPAT NIGAM LIMITED
VISAKHAPATNAM STEEL PLANT
VISAKHAPATNAM**

VSP-6.3 MTPA EXPANSION PROJECT

VSP-6.3/GS-M-04/R1

FOR

**CHILLED WATER PLANT, AIR-CONDITIONING
AND VENTILATION SYSTEMS**

JANUARY 2016



**M. N. DASTUR & COMPANY (P) LTD
CONSULTING ENGINEERS**



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**GENERAL SPECIFICATION
FOR
CHILLED WATER PLANT, AIR CONDITIONING
AND VENTILATION SYSTEMS**

1.0 GENERAL

- 1.1 This specification covers chilled water plant, air conditioning and ventilation systems required for various plant areas.
- 1.2 The chilled water plant shall be of vapour compression type, complete with cooling towers and water circulation system.
- 1.3 The air conditioning systems shall be provided by installing air handling units using the chilled water generated from the chilled water plant. Also depending on the application, package type air-conditioners, split type air conditioners, and window model air conditioners shall be installed to cater to requirement of air conditioning at different premises.
- 1.4 Ventilation systems shall be provided at hydraulic cellars, oil cellars by means of centrifugal fans. The air will be distributed to the cellars through ductwork and grilles. Cable cellars, cable vaults, cable basements, cable tunnels, hydraulic room etc. shall be ventilated by providing tube axial fans.
- 1.5 Air conditioning and ventilation systems shall be provided for conditioning the air to specified limits of temperature and humidity as required and to have adequate air changes in the working premises for human comfort and for equipment cooling.
- 1.6 The design and construction of the air conditioning and ventilation systems shall be suitable in every way for the service intended and oriented towards maximising interchangeability and minimising maintenance. Each system shall be complete in all respects including all accessories essential for proper installation, operation and maintenance irrespective of whether such items are specifically mentioned in the Technical Specification (TS) and General Specification (GS).



1.7 If there is any contradiction between Technical Specification (TS) and, General Specification (GS), the stipulations of Technical Specification will govern.

2.0 STANDARDS AND OTHER REGULATIONS

2.1 The air conditioning and ventilation systems shall be designed to conform to the Standards, Codes and Regulations as applicable and in general shall comply with the requirement of BIS, ASHRAE and TEMA as stated below.

2.2 List of applicable Indian Standards:

Sl.No.	Number	Title
1	IS:277, 1992	Galvanised Steel
2	IS:655, 1963 reaffirmed 1991	Sheet metal ducting work for air conditioning/ventilation
3	IS:659, 1964 reaffirmed 1991	Safety Code for air conditioning
4	IS:2312, 1967 reaffirmed 1991	Propeller type fans
5	IS:3588, 1987 reaffirmed 1991	Electrical axial flow fans
6	IS:4894, 1987 reaffirmed 1991	Centrifugal fans
7	IS:5111, 1993	Testing of refrigerant compressors
8	IS:6595(2)- 1993	Horizontal Centrifugal pump for clear cold water
9	IS:7613, 1975 reaffirmed 1991	Method of testing of panel type air filter for AC
10	IS-10609-1983 reaffirmed 1991	Refrigerants – Number and designation
11	IS-11327-1985 reaffirmed 1991	Requirement for refrigerant condensing unit
12	IS:12065 – 1997	Permissible limits of noise level for rotating electrical machines



Sl.No.	Number	Title
13	IS:12075 – 1987 reaffirmed 1991	Mechanical vibration of rotating electrical machines with shaft heights 56 mm and higher measurement, evaluation and limits of vibration severity
2.3	List of applicable chapters of ASHRAE Handbook :	
2.3.1	ASHRAE Handbook 1997 – Fundamentals : Chapters 1, 3, 6, 18, 19, 20, 25, 28, 32 and 33.	
2.3.2	ASHRAE Handbook 1996 – HVAC Systems and Equipment : Chapters 1, 2, 3, 5, 16, 17, 18, 20, 21, 34, 35, 36, 38, 40, 41 and 43.	
2.3.3	ASHRAE Handbook 1999 – HVAC Applications : Chapters 11, 28 and 46.	
2.3.4	Heat exchangers shall be designed as per TEMA(Eighth edition) Class “C” exchangers.	

3.0 AIR CONDITIONING AND VENTILATION SYSTEMS

3.1 Heat generated within electrical and non-electrical premises shall be taken out by properly designed air conditioning and ventilation systems to achieve the specified room inside conditions. The air conditioning and ventilation systems shall be designed in consideration to the standards stated above. The areas where controlled and specific room inside conditions are required to be maintained, air-conditioning systems shall be provided at those areas.

3.2 **Information of Plant Site and Design Ambient Condition:**
Information of plant site and design ambient condition as given below shall be considered for design of air conditioning and ventilation systems.

Elevation above mean sea level (Formation level)	..	+ 10.5 m
Barometric pressure	..	760 mm Hg
Ambient temperature		
Absolute maximum	..	45.3°C
Absolute minimum	..	10.5°C
Relative Humidity :		



Absolute maximum	..	100%
Absolute minimum	..	4%
Wind velocity :		
Highest monthly mean wind speed		
For 24 hours	..	15.4 Kmph
Extreme wind velocity	..	131.0 Kmph

DESIGN AMBIENT CONDITION

		Summer	Monsoon	Winter
Dry Bulb Temperature, (OC)	..	38	31	16
Relative Humidity, %	..	70	85	70
Cooling water temperature,(OC)	..	35		

3.3 Design Basis

3.3.1 Unless otherwise specified in Technical Specification the following thermal and relative humidity conditions shall be maintained in various premises of the plant in general.

- a) Control rooms including all electronic AC drive panels, control pulpits, computer rooms, laboratories, office buildings, canteen, first-aid stations etc. shall be air-conditioned to maintain room inside temperature of $(25 \pm 2)^{\circ}\text{C}$ and relative humidity of $(55 \pm 5)\%$. If any other premises is required to be maintained at different temperature and humidity conditions the same shall be maintained as specified in Technical Specification.
- b) Chilled water produced shall be also be provided for process cooling, wherever required.
- c) MCC rooms, switchgear rooms and those rooms accommodating dry-type transformers, capacitor rooms shall be air-conditioned to maintain room inside temperature of $(32 \pm 2)^{\circ}\text{C}$ and maximum relative humidity of 70%.
- d) Dry ventilation systems comprising of filtered air supply and/or controlled exhaust shall be provided at cable basement, cable cellar, cable vault, cable tunnel, transformer rooms, hydraulic rooms, compressor rooms by means of Tube Axial supply and exhaust air fans to restrict the room inside temperature to five (5) degree centigrade above outside ambient temperature. To facilitate standarisation, the capacity of supply air fans shall



preferably be 5000, 10000, 15000, 20000, 30000, 40000 m³/hr. Correspondingly, the capacity of respective exhaust air fans shall be 10% less than the supply air fan capacity. For ventilation of cable tunnel, the tunnel should be isolated in different segments of maximum 150, all be ventilation by means of one (1) No. supply air fan and one (1) No. exhaust air fan, to be installed in ventilation shafts provided at end of each tunnel segment.

- e) Oil cellars and hydraulic cellars shall be provided with dry ventilation system by means of centrifugal fan with ductwork. Exhaust shall be natural through cellar doors, opening on ceiling etc. Inside temperature of the cellars shall be maintained within five (5)°C above outside ambient temperature.
- f) Battery rooms shall have dry ventilation system with tube axial exhaust fans. These fans shall be either belt-driven or bifurated type. The impellers and casing shall have acid-resistant paint. Toilet blocks shall have propeller type exhaust fans.
- g) For spot cooling in non-air conditioned spaces such as offices, change room, rest rooms, time office, pay office, stores-cum-tool-room etc, ceiling or pedestal fans shall be installed. For spot cooling in hot zones in production and ancillary shops, man-coolers shall be provided.

3.4 **Other Design Aspects**

3.4.1 **Air-conditioning systems**

3.4.1.1 Air-conditioning systems shall be designed based on the specified ambient parameters, requirement of room inside dry bulb temperature and relative humidity alongwith associated input data such as internal heat load, occupancy, building orientation with configuration, dehumidified air requirement etc. The temperature and relative humidity requirement of air-conditioned spaces shall be as per technical specification.

3.4.1.2 Unless otherwise specified in technical specification, in general:

- a) Chilled water based central system shall be considered for areas which require high cooling load and where the conditioned premises require stricter control of dry bulb temperature and relative humidity.



- b) Aircooled/water cooled package units may be considered for areas which require light to moderate cooling load and have requirement of rigid control of room inside dry bulb temperature and relative humidity.
- c) In case of fire, the air handling units and package units shall be tripped automatically from signal received by Fire Detectors through fire alarm panel.
- d) Window & aircooled split units shall be considered for offices and areas which require relatively lighter cooling load and where no rigid control of dry bulb temperature and relative humidity within the rooms are required. The compressors of window units shall be of reciprocating type since these units will work under severe plant condition. All units shall be of 1.5 TR capacity without remote unit.
- e) All overhead cranes operating above the heat emitting zones shall be supplied with air tight heat insulated cabins which will be provided with air-conditioners, suitable for high ambient temperature (70°C), high ambient dust content and shall take care of vibration.

However, the selection process shall be based primarily on techno-economic consideration as well as factors like equipment standardisation (with existing equipment), availability of utilities, clients preference, if any etc. and shall be indicated in technical specification.

3.4.2 Ventilation systems

3.4.2.1 In order to maintain proper working environment compatible with human hygienic requirement, the working areas under structural shops shall be generally provided with natural ventilation. The same shall be as indicated in General Specification for Structural steelwork and cladding (VSP-6.3/GS-S-01).

3.4.2.2 Mechanical ventilation systems shall be provided only in the following cases:

- a) At the working areas, where provision of natural ventilation will not ensure maintenance of working atmosphere compatible with human hygienic requirement.
- b) If a particular zone is to be ventilated in a working area.
- c) If for technological requirement, a working area is maintained below certain temperature.



d) In underground working areas without natural draft.

3.4.2.3 Working areas where maintenance of proper working environment compatible with human hygienic requirement can be partially achieved with natural ventilation, provision of both natural and mechanical ventilation shall be made.

3.4.2.4 All ventilation fans of respective areas shall be interlocked with fire detection and alarm system so that in case of fire each fan shall trip automatically through fire alarm panel.

3.4.2.5 General Offices which are not air-conditioned shall be provided with ceiling fans. Number of fans shall be based on 650 to 900 cu m per hour per sq m of floor area.

3.5 Equipment & Selection Criteria

3.5.1 The equipment for Air conditioning and ventilation systems may be any of the following types or combination of the same:

- Central air conditioning by chilled water based system
- Air-conditioning systems with package, split, window type air conditioners
- Fresh filtered air ventilation system with natural exhaust
- Fresh filtered supply and exhaust air ventilation system
- Exhaust air ventilation system

3.6 Central Air-conditioning by Chilled Water Based system

3.6.1 Chilled water based central air-conditioning system shall have chilled water generating plant from where chilled water at desired temperature and pressure will be delivered by supply water piping to air handling units located in the building/areas to be air conditioned. The chilled water shall be taken back to the chilled water plant by return water piping.

Chilled water generation shall be by vapour compression system with reciprocating/screw/centrifugal compressor. The refrigerant used for producing chilled water shall be environment friendly, like R134a or equivalent.

Reciprocating chillers shall be used upto 100 TR cooling capacity. From 100-400 TR cooling capacity, preferably screw chillers



shall be provided. In case cooling capacity is more than 400 TR, the preferable selection shall be of centrifugal chiller.

The system shall be complete with chillers having refrigerant compressors, condensers, chilled water and condenser water pumps, cooling towers, expansion tank, pipework, electrics, instrumentation and control etc. as required.

3.6.2 Air handling units shall have double skin and shall be provided with filters, fans, cooling coil, chilled water piping with flowmeter, valves, strainers, dampers, electrics, instrumentation and control etc. complete as per the requirement. Heater and humidifier shall be provided where rigid control of dry bulb temperature and relative humidity are required. All air handling units shall be installed in separate rooms.

3.7 Airconditioning systems with Package, Split, Window Model Airconditioners

3.7.1 Package air conditioners shall be plenum or ductable type located in the conditioned space or at a separate room adjacent to it. Package air-conditioners may be aircooled or water cooled type. The air-conditioned spaces where surrounding temperature is hot/dusty shall preferably be provided with water cooled packages units. Cooling tower along with recirculating pumps and piping shall be required to be provided for such water cooled system. Remote spaces to be air-conditioned where water cooling systems is difficult to be available or air-conditioned spaces which are not located at hot zones may be provided with aircooled package air-conditioners. All package air conditioners (indoor units) shall be installed in separate rooms. Outdoor units shall be suitably located outside the conditioned premises.

3.7.2 Air cooled split airconditioners shall have its outdoor units suitably located at terrace or on roof while indoor units, single or multiple, shall be installed at ceiling, floor or wall of the conditioned space as per the requirement. Ductable units shall be considered wherever necessary for uniform distribution of conditioned air.

3.7.3 These units shall contain adequately sized energy efficient compressor, hermetically sealed scroll/reciprocating compressor preferably in multiples of 5.5 TR, evaporators, condensers, refrigerant pipework, filters, fan, electrics, instrumentation and controls etc. as required. Strip heaters & humidifiers may be considered for package air-conditioners where rigid control of dry bulb temperature and relative humidity are required. Refrigerants of chlorofluoro carbon group (R-22) which have toxic effects on environment shall not be used. Systems using environment friendly refrigerants like 407C/410a shall be

R22 not allowed



provided. All refrigerant pipes shall be insulated. Insulation used shall have a maximum thermal conductivity (K) of 0.036 W/m/°C with minimum of 19 mm thickness or equivalent insulation.

3.7.5 The 3rd Ladle Furnace (Twin Ladle furnace) where electrical equipment to be installed, shall be provided with 100% hot-standby arrangement by installing package air conditioner units.

3.7.6 For water cooled package air conditioning system, the cooling tower capacity to be selected considering the total capacity of working and stand-by air conditioner units. There will be 100% stand-by of cooling towers and pumps.

3.8 Fresh filtered air ventilation system with natural exhaust

3.8.1 Hydraulic cellars and oil cellars shall be provided with fresh filtered air ventilation system by means of centrifugal supply air fan. These systems shall include air intake louvre, dry air filter with filter frame, supply air duct with grilles, damper, fire damper, connection piece, etc. Exhaust shall be natural through cellars doors and openings on cellar roof.

3.8.2 Hydraulic room, transformer room shall be provided with fresh filtered air supply by means of tube axial supply air fan and exhaust by gravity louvre. This system shall include dry air filter with filter frame, rain cowl, connection piece etc.

3.9 Fresh filtered air supply and exhaust air system

Cable basement, cable vault, cable cellars, cable tunnels and compressor rooms shall be provided with fresh filtered supply and exhaust air ventilation system by means of tube axial supply and exhaust air fans. These systems shall include dry air filter with filter frame, connection piece, fire damper, rain protection cowl etc. For exhaust air ventilation systems, the exhaust air quantity shall be 90% minimum of supply air quantity to prevent ingress of dust inside the premises.

3.10 Exhaust air ventilation system

Exhaust air ventilation system shall consist of tube axial/propeller type exhaust fan, rain protection cowl, bird protection screen.

4.0 AIR MOVING DEVICES (AMD)



4.1 Standards

4.1.1 The Air Moving Devices (AMD) shall be designed, manufactured, erected, tested and commissioned as per the standards specified and in the Technical Specification. Detailed instructions on such aspects shall be as per the current edition of the relevant codes and standards published by the Bureau of Indian Standards (BIS). In general all AMD's shall conform to the codes/standards of BIS. Where such BIS codes/standards are not available, the AMD's shall be designed and supplied as per other relevant international standards such as ASHRAE Standards.

4.1.2 All AMDs shall conform to the statutory and other Regulations in force such as Indian Factories Act, Environmental Protection Act, Environmental Protection Rules, Indian Electricity Rules, etc.

4.2 Equipment

4.2.1 General Construction of Fans

4.2.1.1 The rotating elements shall be statically and dynamically balanced. Large fans shall operate below first critical speed; others shall have a minimum margin of twenty (20) per cent from first and second critical speeds.

4.2.1.2 All moving and exposed parts, flexible couplings, belts, pulleys, drives etc shall be adequately guarded to prevent accidents to personnel.

4.2.1.3 Each fan shall be complete in all respects and include impeller, casing, shaft, bearings, stuffing box, coupling or pulley drive, common base frame, vibration isolators (for centrifugal fans), mounting frame (for propeller fans), pedestal (for mancooler), connection piece, inlet and outlet dampers (as specified), foundation bolts, electric motor, starter, electrical controls, switches and instruments.

4.2.1.4 Sound level of fans shall not exceed 85 dB(A) at one (1) metre distance from the rotating fan parts. This should be limited to 65 dB(A) within conditioned premises.



4.2.1.5 The fan casing shall be of welded/split construction unless otherwise specified. Thickness of casing material shall be appropriate for the duty specified and shall be indicated by the contractor. Inlet screens of wire mesh shall be provided on open inlet fans.

4.3 Special Requirements

4.3.1 Centrifugal fans shall be generally of limit load design, unless otherwise specified.

4.4 Electric Motor, Controls, Cabling and Earthing

4.4.1 All drive motors, starters, controls, cabling and earthing shall conform to the relevant General Specifications for Electrical Equipment and the Technical Specification.

5.0 FRESH AIR FILTER

5.1 Dry air filter: Air filter shall be of 3-ply HDPE with one layer of Aluminium support mesh arranged in pleated form with GI/Al frame of preferable module size 610 x 610 x 50 thk. The pleats shall be suitably supported with Aluminum spacers. The filter shall be housed in a frame with GI intake louver. The efficiency of filters shall be 90% down to 10 micron dust. The face velocity of filters and louvers shall be within 1.5 – 2 m/sec. Fan details are indicated under AMD (Clause 4.0).

6.0 DUCTWORK

6.1 Design Basis

6.1.1 Ducts for conditioned/filtered air supply systems shall be as per the norms recommended by ASHRAE. In general, the supply air velocity shall be about 8-9 m/s in main headers, about 5-6 m/s in branches and about 2-3 m/s at grilles/outlets. Return air velocity shall be about 20 per cent lower compared to supply air velocity.

6.1.2 Neck velocity through supply and return air grilles/diffusers will be 2.5 – 3.5 m/s. The material of construction of diffusers, grilles will be partly coated anodized aluminum & colour of the same will match with the interior decoration i.e. false ceiling. Distance between two consecutive grilles/diffusers will be kept within 2 to 3 m. At each branch supply air duct VCD will be provided in addition to VCD with each supply air grille.

6.1.3 Ductwork for general ventilation systems or for air conditioning systems shall be of rectangular cross-section.



In general, these shall be constructed of galvanised sheet steel conforming to IS:277, Class-VIII. Constructional features shall conform to the latest revision of IS:655. For underground air distribution systems, concrete ductwork may also be used. The ratio of size of duct to the radius of elbow shall be normally not less than 1:1.5.

6.2 Duct Supports

6.2.1 Supports for horizontal and vertical ducts shall be made and positioned so that no weight is taken at connections to equipment and ductwork is not deformed during erection and after installation.

6.2.2 Where ducts are external to buildings, supports shall be fitted to restrain wind thrust. Securing of supports to sides of horizontal ducts shall not be accepted.

6.2.3 It shall be ensured that duct reinforcement, type of supports and spacing of supports shall be enough to hold the weight of the system. Type of supports and their spacing shall be clearly indicated and Purchaser's/Consulting Engineers' approval obtained.

6.3 Insulation

6.3.1 Thermal Insulation

Entire supply air duct and return air duct outside conditioned premises shall be suitably insulated to prevent condensation of moisture from surface of duct. Chilled water pipe lines laid indoor and outdoor shall also be provided with insulation. Insulation shall be as per the General Specification for Thermal Insulation..

6.3.2 Acoustic Insulation

Initial 5 M of supply air duct from the mouth of air handling unit/package air conditioner shall be provided with acoustic insulation. The room for air handling unit/package unit, if installed within administrative building, shall be acoustically insulated, if required.

6.3.3 Underdeck Insulation

The exposed roof of any building shall be provided with underdeck insulation.

All insulation shall conform to General specification no. VSP-6.3/GS-M-06.

6.4 Dampers



6.4.1 Dampers shall be provided at inlet/outlet of each centrifugal fan. Dampers of big fans shall be provided with operating lever and position indicators showing percentage of opening. All diffusers/grilles connected at supply air duct of air-conditioning and ventilation systems shall be provided with volume control dampers. Self-acting dampers to ensure required pressurisation inside premises and fire dampers shall be provided as required. Electrically actuated dampers may be provided at the centrifugal fans, if necessary.

6.4.2 Fire Dampers: Fire dampers shall be of fusible link type and shall be installed in accordance with relevant codes of the National Fire Protection Association (NFPA) of USA or equivalent. Fire dampers shall be provided where ducts penetrate walls or floors forming fire barriers. The fire rating of each damper shall be 1 & 1/2 hours. The fusible link shall melt at a temperature of 65-740C.

6.5 Flexible Connection

Flexible connections shall be fitted at inlet and outlet of centrifugal fan units to prevent transmission of vibration. These connections shall be leak proof and made of impregnated canvas, 3 mm thk. The length of these connections shall not be less than 250 mm, unless otherwise specified.

6.6 Other Accessories

6.6.1 These include diffusers, grilles, louvres etc. Material of construction of diffuser/grilles shall be powder coated GI/Anodised Aluminum and colour of the same shall match with the interior decoration.

The selection of each diffuser and grille shall be based on manufacturer's performance data for air delivery, air throws, terminal velocity and pressure drop characteristics. Each shall be selected to maintain low noise level in accordance to IS:3483 or equivalent. These shall be provided with volume and directional control devices.

Airhandling units and package airconditioners shall have provision for measurement of temperature and air quantity at equipment outlet.

7.0 ASSEMBLY, ERECTION, TESTING AND COMMISSIONING



7.1 All components of air-conditioning and ventilation systems shall be inspected for completeness and correctness of supply as per contract stipulations before assembly and erection.

7.2 Assembly and erection shall generally be carried out as per manufacturer's guidelines and under his supervision. The stipulations in the contract as regards erection of equipment, tools, safety, procedures etc shall also be followed. Systems shall be tested and commissioned as per the guidelines and procedures given in the contract or agreed to during engineering.

8.0 PAINTING

Painting of air conditioning and ventilation systems shall conform to the General Specification for Painting (VSP-6.3/GS-P-01).

9.0 INSPECTION AND TESTING

9.1 Manufacturers Premises

9.1.1 All equipment and items for airconditioning and ventilation systems shall be inspected and tested at the manufacturer's works by the Purchaser/Consulting Engineer as per General Specification for Inspection and testing requirement for plant and equipment at manufacturer's premises (VSP-6.3/GS-IN-01).

9.2 Site Test

9.2.1 All components of each airconditioning and ventilation system shall be inspected for completeness and correctness of supply and erection as per General Conditions of Contract and as specified in relevant clauses of the technical specification for the systems and equipment.

9.2.2 Performance test of equipment/system shall be carried out as per Purchaser's/Consulting Engineers' standard practice for asserting the correctness of flow rate, pressure drop, temperature, humidity, power consumption, as per the requirement of condition of contract.

10.0 DRAWINGS AND DOCUMENTS

Technical information in the form of drawings and documents shall be furnished in accordance with General Conditions of Contract and as specified in the relevant clauses of Technical Specification.

**RASHTRIYA ISPAT NIGAM LIMITED
VISAKHAPATNAM STEEL PLANT
VISAKHAPATNAM**

VSP-6.3 MTPA EXPANSION PROJECT

VSP-6.3/GS-M-05/R1

GENERAL SPECIFICATION

FOR

AIR POLLUTION CONTROL SYSTEM

JANUARY 2016



**M. N. DASTUR & COMPANY (P) LTD
CONSULTING ENGINEERS**



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ANNEX-1

LIST OF STANDARDS AND CODES OF PRACTICES

Sl.No.	Standard	Description
1.	IS:4894-1987 (1 st Revision Reaffirmed 1991)	Centrifugal Fan
2.	IS:2062-1992	Steel for General Structural purpose
3.	IS:5182 (Part-5) 1975 (Reaffirmed)	High Volume Sampling
4.	ISO-1940	Rotating parts dynamic balance
5.	IS:3144-1992	Mineral wool thermal insulation material, method of test (Second Rev)
6.	IS:3233-1967	Graphical symbols for process measurement and control function
7.	IS:3734-1983 (Reaffirmed 1991)	Dimensions for worm gearing
8.	IS:3757-1985	Specification for high strength structural bolts
9.	IS:4671-1984 (Reaffirmed 1990)	Expanded polystyrene for thermal insulation purpose
10.	IS:5798-1070 (Reaffirmed 1990)	Specification for mercury barometers
11.	IS:6157-1981 (Reaffirmed 1991)	Valve inspection and test
12.	IS:6454-1972 (Reaffirmed 1991)	Specification for self aligning roller bearings
13.	IS:6456-1972 (Reaffirmed 1991)	Specification for single row radial ball bearings

**ANNEX-1** (cont'd)

Sl.No.	Standard	Description
14.	IS:6834(1)-1973 (Reaffirmed 1991)	Specification for conveyor chains, wheels and attachments, Part-1- Chains
15.	IS:6834(2)-1976 (Reaffirmed 1991)	Specification for conveyor chains, wheels and attachments, Part-2 Chain wheel
16.	IS:6834(3)-1976 (Reaffirmed 1991)	Specification for conveyor chains, wheels and attachments, Part-3 Attachments
17.	IS:7155(1)-1986 (Part-1,2,3)	Code of recommended practices for conveyor safety
18.	IS:11255	Methods for measurement of emission
19.	IS:7504-1974 (Reaffirmed 1991)	Method of inspection of spur and helical gears
20.	IS:7613-1975 (Reaffirmed 1991)	Method of testing panel type air filters for air conditioning and ventilation purpose
21.	IS:7938-1976 (Reaffirmed 1991)	Specification for air receivers for compressed air installation
22.	IS:9549-1980 (Reaffirmed 1992)	Dimensions for split pin holes, wire holes and head slots for bolts
23.	IS:9625-1980 (Reaffirmed 1990)	Location of bypass and drain connection for valves
24.	IS:10431-1994	Measurement of air flow of compressors and exhausts by nozzles
25.	IS:10720-1999 (Reaffirmed 1993)	Technical drawings for structural metal work
26.	IS:10852-1984 (Reaffirmed 1989)	Guidelines for storage and transportation of sponge iron/direct reduction iron (DR)

**ANNEX-1** (cont'd)

Sl.No.	Standard	Description
27.	IS:11507-1985 (Reaffirmed 1990)	Specification for synchronous belt drive pulley
28.	IS:11727-1985 (Reaffirmed 1990)	Measurement and evaluation of vibration severity in site of large rotating machine with speed range from 10 to 200 Rev./sec.
29.	IS:11724-1985 (Reaffirmed 1990)	Basis for specifying rules in evaluating mechanical vibration of machine in operating range 10 to 200 rev/sec.
30.	IS:9516-1980 (Reaffirmed 1987)	Specification for heat resisting steels
31.	IS:822-1980 (Reaffirmed 1991)	Code of procedure for inspection of welds
32.	IS:2494(1)-1974 (Reaffirmed)	Specification of V-belts for industrial purpose
33	IS:12065-1997	Permissible limits of noise level for rotating electrical machines
34	IS:12075-1987 (Reaffirmed 1991)	Mechanical vibration of rotating electrical machines with shaft heights 56mm and higher measurement, evaluation and limits of vibration severity.
35.	IS:10711-2001 (Reaffirmed 1993)	Size of drawing sheets
36.	EJMA 1980	Standards of the expansion joint Manufacturers Association, Inc.
37.	IS:325-1978	Three Phase induction motors (Fourth revision)
38.	IS:900-1992	Code of practice for installation and maintenance of induction motors
39.	IS:1231-1974	Dimensions of three phase floor mounted induction motors (third revision)

**ANNEX-1** (cont'd)

Sl.No.	Standard	Description
40.	IS:2223-1983	Dimensions of flange mounted AC induction motors (first revision)
41.	IS:2705(1-4)-1992	Current transformers Part-1 General Requirements . (Second revision) Part-2 Measuring Current . Transformers (second rev) Part-3 Protective Current . Transformers (second rev) Part-4 Protective Current . Transformers for special purpose applications
42.	IS:12075-1986	Mechanical Vibrations of Rotating electrical machines with shaft heights 56 mm and higher measurement, evaluation and limits of vibration severity
43.	IEC-131-1-1992	Programmable Controllers, Part 1 : General Information
44.	IEC-1131-2-1992	Programmable Controllers, part-2 : Equipment requirements and tests
45.	IS:3043-1987	Code of Practice for Earthing
46.	IS:3156(1-4)-1992	Voltage Transformer Part-1 General Requirements . (Second revision) part-2 Protective Voltage . Transformers (second rev) Part-3 Protective Voltage . Transformers (second rev) Part-4 Capacitor Voltage . Transformers (second rev)
47.	IS:4691-1985	Degree of protection provided by enclosures for rotating electric machinery (first revision)
48.	IS:4722-2001	Rotating electrical machines (first rev)
49.	IS:5578-1985	Guide for marking of insulated conductors (first revision)
50.	IS:6362-1995	Designation of methods of cooling of rotating electrical machines

**ANNEX-1** (cont'd)

<u>Sl.No.</u>	<u>Standard</u>	<u>Description</u>
51.	IS:13703(1-2)-1993	Specification for Low Voltage Fuses for Voltages not exceeding 1000 V AC or 1500 V DC Part-1 General Requirements Part-2 Fuses for use by authorised persons Section-1 Supplementary Requirements
52.	IS:694-1990	PVC insulated cables for working voltage upto and including 1100 V
53.	IS:1255-1983	Code of Practice for installation and maintenance of power cables upto and including 33 kV
54.	IS:1534-(Part-1) 1977	Ballasts for fluorescent lamps for switch start circuits.
55.	IS:1569-1976	Capacitors for use in tubular florescent, high pressure mercury and low pressure sodium vapour discharge lamp circuits.
56.	IS:1777-1978	Industrial luminate with metal reflectors.
57.	IS:2215-1984	Starters for fluorescent lamps
58.	IS:2418-1977	Tubular fluorescent lamps for general lighting service
59.	IS:2705-1992 (Part-1) (Second Rev)	Current transformers – Specification General requirements
60.	IS:2705-1992 (Part-2) (Second Rev)	Current transformers – Specification measuring current transformers

**ANNEX-1** (cont'd)

<u>Sl.No</u>	<u>Standard</u>	<u>Description</u>
61.	IS:2705-1992 (Part-3) (Second Rev)	Current transformers – Specification Protective current transformers
62.	IS:3324-1982	Holders for starters for tubular fluorescent lamps
63.	IS:3480-1966	Flexible steel conduits for electrical wiring
64.	IS:4160-1967	Interlocking switch socket outlets
65.	IS:6616-1982	Ballasts for high pressure mercury vapour lamps
66.	IS:9974-1981	High pressure sodium vapour lamps
67.	IS:10118(Part-1-4) 1982	Code of practice for selection, installation and maintenance of switchgear and controlgear.
68.	IS:13947(Part-1) 1993	Low voltage switchgear and control gear Part-1: General Rules
69.	IS:13947(Part-2) 1993	Low voltage switchgear and controlgear Part-2: Circuit breakers (Amendment-1-1993)
70.	IS:13947(Part-3) 1993	Low voltage switchgear and controlgear Part-3: Switches, Disconnectors, Switch disconnectors and fuse combination units.
71.	IS:13947(Part-4) Sec.1 – 1993	Low voltage switchgear and controlgear Part-4: Contactors and Motor Starters

**ANNEX-1** (cont'd)

<u>Sl.No.</u>	<u>Standard</u>	<u>Description</u>
72.	IS:13947(Part-5) Sec.1 – 1993	Low voltage switchgear and controlgear Part-5: Control circuit devices and switching elements
73.	IE Rules with amendments upto 1995 – 1956	Indian Electricity Rules
74.	ANSI Std. No.C37.20.2	IEEE Standard for metal clad and station type cubicle switch-gear (Reaffirmed 1992)
75.	IEC-298 – 1990	AC Metal enclosed switch-gear & control for rated voltage above 1 KV upto and including 52 KV. Amendement No.1 (1994)