TENDER DOCUMENT

NIT No.- DLI / C&E / WI-675 / 861

FOR

Tender for ‘Supply of Instrumentation Cables of various sizes’ for the project of “Augmentation of Fuel & Flux crushing Facilities (Package- 064) of Bhilai Steel Plant (SAIL)”.

VOLUME- 2

TECHNICAL PART

ENGINEERING PROJECTS (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)
Core-3, Scope Complex, 7, Institutional Area,
Lodhi Road, New Delhi-110003
TEL NO: 011-24361666   FAX NO. 011- 24363426
## Contents- (Volume-2)

NIT No. DLI/C&E/WI-675/861

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TENDER DOCUMENT

NIT No.- DLI / C&E / WI-675 / 861

Tender for ‘Supply of Instrumentation Cables of various sizes’ for the project of “Augmentation of Fuel & Flux Crushing Facilities (Package - 064) of Bhilai Steel Plant (SAIL)”.

VOLUME- 2A

(GENERAL SPECIFICATIONS)

ENGINEERING PROJECTS (INDIA) LIMITED

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Core-3, Scope Complex, 7, Institutional Area, Lodhi Road, New Delhi-110003
TEL NO: 011-24361666   FAX NO. 011- 24363426
Augmentation of Fuel & Flux Crushing Facilities (PKG-064), BSP-Bhilai

INTRODUCTION:

Bhilai Steel Plant (BSP), SAIL, was conceived in the Second Five Year Plan with a steel production capacity of 1.0 MT per annum. BSP has expanded its production capacity in two phases. First phase expansion to 2.5 MTPA of steel was completed in 1967 and second phase expansion to 4.0 MTPA of steel was completed in 1988. The corporate plan of BSP envisages expansion of its production capacity to 7.0 MTPA of Crude Steel by 2011-12.

The capacity of the present system of receiving, storing and transporting coal for Coke oven will increase in view of the increase in crude steel production to 7.0 MTPA. To meet the additional requirement of coke for new proposed blast furnace no. 8, one new coke oven battery no. 11 has been envisaged. The system of feeding coal to new coal tower and coke sorting plant for the new battery has been envisaged in this specification.

Presently, Blast furnace returns are being transported through C-line belt conveyors to the Junction house 127 of Sinter Plant III (SP-III). These belt conveyors are crossing the proposed Coke Dry & Cooling Plant (CDCP, which shall be executed through other package). Therefore, Dismantling and re-routing of these belt conveyors are envisaged in this package. This package shall also cover the transportation & integration of Proposed BF#8 return fines with re-routed C-line conveyor up-to the existing JH-127 of SP-III.

Further, in order to cater to increased requirement of fuel and flux for the new sinter machine of SP-III, following three facilities have been envisaged under this package:

1. Up gradation/addition of coke crushing and screening facilities.
2. Up gradation/addition of Coke Grinding facilities
3. Up gradation of Flux crushing & screening facilities.

The project, once implemented, shall ensure a smooth operation in transportation of the coking coal to new battery no. 11 and coke & sinter to new blast furnace no. 8, which in turns caters to enhancement of raw material required for the 7.0 MTPY of Crude steel stage.

INTENT OF SPECIFICATION

This tender specification calls for execution of the work covering the design, engineering, manufacture, supply, Supervision of erection, testing, commissioning and demonstration of performance guarantee in a coordinated and integrated manner as per the relevant clauses of the specification.
The tender specification shall be read in conjunction with other tender documents. In case of discrepancy between IPSS and IS/International codes, IPSS shall prevail. This specification is a guideline only and the design & engineering shall be complete in all respect and any equipment or facility not covered in this specification but considered essential for proper installation, operation and maintenance of Augmentation of Fuel & Flux Crushing Facilities shall be deemed to be included in the scope of bidder.

The bidder has satisfied himself, the nature and location of work place, kind of equipment, facilities, services, etc needed during performance of work, general and local conditions as well as all other matters which can, in any way, affect the work covered in this specification. Site & meteorological information of plant i.e. location, climate condition, earthquake factor, connectivity of the site with railways road, ports etc. are furnished, which bidder to consider the same.

The bidder shall be responsible for coordinating the supplies covered in the different parts of this specification from different sources and execute the contract within agreed time schedule. The enclosed specification drawings are deemed to be sufficient for the bidder to assess the nature and quantity of work involved No price increase on account of deviation from specification drawings shall be admissible. Approval of drawings by the BSP/MECON/EPI will not relieve the bidder of his responsibilities for correctness, adequacy of the design & completeness of his work as per the tender.

Inspection and testing of plant/ equipment shall be carried out by BSP/MECON/EPI at the works of contractor during manufacturing and/or on final product to ensure conformity of the same with the acceptable criteria of technical specifications, approved drawings, manufacturing drawings and applicable national/international standards.

Bidder may note that modifications in work within battery limits, which is not specifically mentioned here, but necessary for completeness of the project, safe and trouble free functioning of plant shall also be included in the scope.
GENERAL SPECIFICATION

GENERAL

The following General Specification shall be read in conjunction with General Technical Specification (GTS) of Bhilai Steel Plant, SAIL. If there are any provisions in these General Specification, which are at variance with the provisions of General Technical Specification (GTS) of Bhilai Steel Plant, SAIL, the provisions in these General Specification shall take precedence.

1.0 PROJECT SYNOPSIS

1.1 Site Conditions

1.1.1 Location

Bhilai Steel Plant (BSP), SAIL is located at Bhilai in Durg District of the state of Chhatisgarh in the central region of India. The site lies between 21.15° North latitude and 81.22° East latitude. The nearest convenient railhead is Durg which is about 12km west Bhilai. Bhilai /Durg stations are on the Howarh-Mumbai rail line of SEC Railway of the Indian railways.

The location of Bhilai is as follows:

From New Delhi, the national capital -- 1359 kms
From Kolkata -- 868 kms
From Chennai -- 1269 kms
From Mumbai -- 1100 kms

The distance from State Capital Raipur to Bhilai Steel Plant is 30km. It is well connected by the rail and road network. The nearest national highways are NH 6 & NH 43 crossing through Raipur.

1.1.2 Meteorological Data

In the absence of meteorological data at Bhilai/Durg, the data of the state capital Raipur, 30kms away, are considered. The meteorological details at Raipur are given below:

Ambient Temperature
Absolute maximum : 47.7° C
Absolute minimum : 3.9° C
Highest of mean monthly : 45.2° C

Ambient Air
Ambient air quality : Industrial

Relative Humidity
Maximum : 100%
Minimum : 7%

Climate : Tropical Humid

Rainfall
Harvest rainfall in 24 hours : 370.3mm
Annual Average : 1288.8mm

**Wind**

Predominant wind direction : SW to NE (Oct- Feb) and West to East (Mar- Sep)
Mean wind speed : 6.8 kmph
Maximum mind speed : 45 kmph

**Altitude**

Average altitude of the land is 300 m above MSL. Temperature inside shop premises is generally taken as 5° C above ambient, unless otherwise specified.

### 1.1.3 Infrastructure Facilities Outside the Plant

**Railway**

Bhilai Steel Plant is connected to Indian Railways network via Bhilai/Durg Stations of SEC Railway on the Howrah-Mumbai line. The track gauge of SEC Railways as well as of the plant tracks are standard broad gauge i.e 1676 mm.

**Road**

The plant is well connected to the country by road. National Highways NH6 & NH43 both pass through Raipur.

**Sea Port**

The nearest sea port is Vishakhapatnam approximately 550 km away from the site by rail.

**Air Traffic**

The nearest air port connected to the national network is Mana at Raipur, 30kms away.

### 1.1.4 Infrastructure Facilities inside the Plant

**Railway**

The track gauge for the entire plant corresponds to the Indian Railway standard broad gauge i.e. 1676mm.

**Road**

Main road and side of the Plant shall have roadways of 7.0m and 4.0m width respectively and the temporary roads provided during the construction stage shall be designed to cater the needs of movement of heavy construction vehicles.
2.0 GENERAL TECHNICAL REQUIREMENTS (GTR)

2.1 General Rules and Regulations

All plant units with respect to their location, layout, general arrangement and design of equipment, structural design, etc. shall be safe to the personnel and conform to the relevant statutory requirements issued by Chhattisgarh Government and the Government of India but not limited to the following.

- Chhattisgarh State Factory Rules/Acts
- Indian Electricity Rules/Acts
- Electricity Regulatory Commission Act
- Indian Petroleum Regulations/Acts
- Indian Boiler Regulations/Acts
- Indian Explosives Acts
- Gas Cylinders Rules/Acts
- Carbide of Calcium Rules/Acts
- State and mobile Pressure Vessels Codes (unfired) Rules/Acts
- Fire Protection Manual issued by Tariff Advisory Committee (India)
- Pollution Control Regulations/Acts

Pollution control measures shall be provided considering the latest norms and international standards. These should satisfy the stipulations of Central Pollution Control Board and Department of Environment and the Forest, Government of India.

2.1.1 Standard

Preferred Makes of Equipment & Supplies
To restrict/minimize stock/inventory of spares, the Purchaser considering will limit the makes of equipment & supplies to those listed in the "preferred makes of equipment and supplies" unless otherwise expressly so agreed

Unit of Measurement
All dimensions & weights shall be given in metric system.

Language
All drawings, documents etc. shall be in English language.

2.2 Safety

2.2.1 Safety Regulations
The Vendor shall comply with the, relevant Safety Rules and Regulations but not limited to the following:
- Chhattisgarh State Factory Rules/Acts
- Indian Electricity Rules/Acts
- Electricity Regulatory Commission Act
- Indian Petroleum Regulations/Acts
- Indian Boiler Regulations/Acts
- Indian Explosives Acts
- Gas Cylinders Rules/Acts
- Carbide of Calcium Rules/Acts
- State and mobile Pressure Vessels Codes (Unfired) Rules/Acts
- Fire Protection Manual issued by Tariff Advisory Committee (India)
- Pollution Control Regulations/Acts
Strict attention shall be paid to all statutory regulations and safety rules for prevention of accidents.

The safety posters/regulations for prevention of accidents shall be displayed by the Vendor at appropriate places. Notices and warning signs shall be displayed for all sources of dangers.

The Vendor is not permitted to construct any temporary road crossing on the rail tracks for the sake of their convenience at work site.

When the work is carried out at night or in the obscure day light, adequate arrangements for flood lighting in the working area shall be made by the Vendor at his own cost and got approved by the Purchaser.

All handling/transport and the rigging equipment including lifting tools and tackles shall be checked at regular intervals and kept in good and safe working condition.

A register is to be maintained regarding the results of periodical tests/checks and other particulars in respect of each and every such equipment.

The Vendor must take sufficient care in moving his construction plant and equipment from one place to another, so that those do not cause any damage to the property of the Purchaser or obstruct construction activities of other Vendors.

The Vendor shall depute a full time safety engineer who will exclusively look after all the jobs pertaining to safety at site and keep close liaison with Purchaser/Consultant. He will be responsible for maintaining safe working conditions at site, promoting safety consciousness among the workmen and reporting to concerned authorities in case of accident/dangerous occurrences.

Before execution of work in hazardous area like

- Gas contamination
- Working at height
- Storage of inflammable materials
- Danger of electric shocks
- Explosion risks
- Excavation more than 2m deep, etc.

A protocol should be prepared in association with the agencies of the Purchaser / Consultants.

2.2.2 Safety while Working with Explosives

Explosives shall not be used on the work site by the Vendor without the written permission of the Purchaser and that too only in the manner and to the extent to which it has been prescribed

Explosives shall be stored in special premises approved by Purchaser and at the cost of the Vendor who shall be liable for all damages, loss or injury to any person or property and shall be responsible for complying with all statutory obligations in these respects.
2.2.3 **Safety Appliances**

The Vendor shall provide the safety appliances conforming to the relevant Indian standards to all their workmen and supervisors engaged by them as well as by the sub-contractors.

The Vendor shall ensure that all the workmen and supervisors, are using the safety appliances regularly during work at site.

Any form of compensation in lieu of safety appliances shall not be permitted. Any violation in safety provisions of failure to maintain safe working conditions will lead to serious penalty on the Contractor and finally may lead to termination on the Contract.

The workmen of the Vendor deployed for construction and erection in hazardous areas shall be provided with personnel protective safety appliances of special nature suitable for hazardous working conditions.

2.2.4 **Safety during Construction/Execution**

The Vendor shall be responsible for the safety of his workmen and employees. The Vendor shall ensure that safety practices are followed so as to prevent personal injury to his workmen and also to other persons working/passing by in that area.

The Vendor shall ensure that in case of any accidents, the same are reported without delay to the Purchaser/Statutory Authorities as per Rules. In case of any injury/accident the Vendor shall bear all the expenditure for medical treatment and shall pay the compensation in case of permanent disability or death.

The Vendor shall ensure that all personnel employed do not stray into others areas. Any injury caused due to this shall be the sole responsibility of the Contractor.

The Vendor shall ensure that skilled labours required for specific works have necessary trade certificates and adequate experience of the job. This is likely to be checked by the Purchaser. The concerned operator, mechanics, electricians, fitters, riggers, etc. must be fully conversant with the hazards associated in operation/maintenance of their relevant equipment.

2.2.5 **Safer Working Platforms**

- Vendor shall use strong and secured planks and boards of the right sizes.
- These planks shall be painted at the edges brightly to warn the workers for any misuse (usually zebra paint)
- Vendor shall make sure that scaffolds are erected by the trained scaffolders.
- Supervisors must inspect scaffolds once every week.

2.2.6 **Falling Objects and Debris**

- No loose materials which can fall down should be kept on the working platforms.
- Overhead shelters should be provided to minimize damage from tailing objects.
- Strong nets to be provided to catch these objects or debris.
- Nets must envelop all sides of the building.
2.2.7 **Personal Safety Equipment**

- Workers must wear approved safety helmets and shoes.
- For those working in high places safety belts shall be provided.
- The safety belts must be attached to strong anchorage points.

2.2.8 **Operating Construction Machine**

- Vendors shall make sure that those operating the construction machinery are well trained for their jobs.
- The keys of such machinery shall be kept with the authorized persons.
- The keys shall be removed after use of the machine.

2.2.9 **Safer Electrical Installations**

- Vendor shall use approved types of electrical sockets and plugs.
- Proper insulators for all electrical wiring shall be provided.
- Wiring should not be allowed to lie on the floor or on the ground.

2.2.10 **Safety in Designing of Equipment**

All machinery and equipment must be equipped with safety devices. The safety provisions shall conform to the recognized standards, safety codes and statues.

All safety measures as required to be adopted as per statutory regulations and the safety rules of the plant shall be strictly followed by the Vendor during the execution of the Contract.

2.3 **Drawing and Documents**

2.3.1 **Drawing**

The drafting standards adopted in preparation of drawing shall be such that good clean and legible print of the drawing can be obtained.

For preparation of original drawing guidelines contained in Indian Standard specification IS: 10164-1985 (preparation of engineering drawing and diagrams) shall be followed

<table>
<thead>
<tr>
<th>Size Code</th>
<th>Working Space (mm)</th>
<th>Cut Size (mm)</th>
<th>Uncut (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>811 X 1144</td>
<td>841 X 1189</td>
<td>880X 1230</td>
</tr>
<tr>
<td>A1</td>
<td>564 X 796</td>
<td>594X 841</td>
<td>625 X 880</td>
</tr>
<tr>
<td>A2</td>
<td>390 X 549</td>
<td>420 X 594</td>
<td>450 X 625</td>
</tr>
<tr>
<td>A3</td>
<td>267 X 375</td>
<td>297 X 420</td>
<td>330 X 450</td>
</tr>
<tr>
<td>A4</td>
<td>180 X 252</td>
<td>210 X 297</td>
<td>240 X 330</td>
</tr>
</tbody>
</table>

However, Vendor’s standard drawings are exempted from the above limitations. It is desirable to keep the same size of all drawings for ease of filing, reference and record keeping.

All drawings shall be oriented to match the plant layout drawings and shall have a key plan identifying the plant area to which they apply.
There shall sufficient reference notes and cross-references on the drawings to permit identification of all related drawing and documents, which are required for proper understanding.

When a drawing is revised by the Vendor/ Sub-Contractor, every change made shall be identified on the drawing by placing the revision number in a small triangle so as to be easily recognizable. In addition, a record of revisions along with the co-ordinates showing the location of revisions shall be indicated at the left hand bottom corner of the drawings as per standard practice. In case of revision of drawing, for which different number is allotted, the new drawing shall clearly indicate the number of the drawing which it supersedes.

Approval of drawings from the statutory authorities such as the Indian Boiler Inspectorate, Inspectorate of Explosives, Electrical Inspector, etc. is the responsibility of the Vendor/ Sub-Contractor.

Any additional drawings not specifically mentioned by the EPI/BSP/MECON but are the required for the approval of drawings, shall be submitted by the Vendor/ Sub-Contractor.

The Title block of the drawing shall be enclosed as Annexure I.

2.3.2 Approval of Drawings

Approval of Vendor’s drawings will generally be accorded within four (4) weeks of receipt.

Approval of Vendor’s drawings means that these will be checked for conformity with applicable specifications and general conformity with the engineering requirement for the areas covered in the scope of work. It is understood that approval by the Purchaser’s Consultant does not include checking for drafting and other errors but only reviews of basic concepts and general principles involved.

The Vendor shall be responsible for any discrepancy, errors and omissions in the drawings have been approved by the Purchaser/Consultants or not. The Vendor shall bear all extra cost due to alterations necessitated by reasons of any discrepancies, errors or omissions in the drawings and particulars supplied by the Vendor.

Drawing furnished by the Vendor shall be certified as correct for use and shall bear the signatures of responsible persons of the Vendor.

Approval of Vendor’s drawing shall not relieve the Vendor of his responsibility to comply with the intent of the contract; manufacture/fabrication or procurement prior to approval of drawings shall be at the Vendor’s risk.

The Vendor shall submit drawing to EPI/BSP/MECON for approval by the Purchaser /Consultant as per clause 3.4 to 3.6 of GTR.

If the drawing is “Approved” then one print shall be returned back to the Vendor duly stamped “Approved” by Consultant.

If the drawing is “Not approved” or “Approved as Noted”, then one stamped print with appropriate comments shall be returned back to the Vendor for incorporation of comments and re-submission of revised drawings for approval sets with in 7 days as per clause 3.4 to 3.6 of GTR.
After approval of drawings the Vendor shall submit 12 sets of approved drawings to the EPI. The Vendor shall incorporate the following note on the drawing before “Approved by MECON vide letter no………….dtd…”

The drawing shall become a contract drawing after approval and there after the Vendor shall not deviate from them in any way whatsoever except with the written permission of the EPI/BSP/MECON.

All reference and information category drawings shall be submitted in 12 sets to EPI. These drawings shall be submitted to Purchaser before forwarding the same to erection Vendor at site for constructive/erection activities.

The information category drawings shall not be approved by the Consultant. However, information category drawings shall be stamped “For Information Only” and one set shall be returned back to the Vendor.

In case any discrepancy is observed on these drawing, same shall be informed to the Vendor by marking the comments on the drawings. The Vendor shall resubmit these drawings after incorporating the comments in 12 sets to the EPI.

After receipt of stamped “For Information Only” the Vendor shall submit 10 sets of drawings to the EPI. The Vendor shall incorporate the following note on the tracing before taking additional prints for submission to the EPI.

Stamped “For Information Only” by MECON vide their letter no…….. dtd……..

2.3.3 Submission of Drawings, CD Reproducible and Documents

The Vendor shall submit the following drawing/documents to EPI and these will be distributed to BSP/ MECON as detailed below.

<table>
<thead>
<tr>
<th>Drawings</th>
<th>MECON</th>
<th>BSP</th>
<th>EPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Approval category drawings for approval of consultants</td>
<td>8 sets</td>
<td>2 sets</td>
<td>2 sets</td>
</tr>
<tr>
<td>2. Fabrication drawing for approval of consultants</td>
<td>8 sets</td>
<td></td>
<td>4 sets</td>
</tr>
<tr>
<td>3. Drawing after approval along with list of Drawings (for distribution)</td>
<td>10 sets</td>
<td></td>
<td>4 sets</td>
</tr>
<tr>
<td>4. Information category drawings</td>
<td>8 sets</td>
<td>2 sets</td>
<td>2 sets</td>
</tr>
<tr>
<td>5. Information category drawings after stamping “For Information Only” by consultants.</td>
<td>8 sets</td>
<td>2 sets</td>
<td>2 sets</td>
</tr>
<tr>
<td>6. Erection drawings</td>
<td>8 sets</td>
<td>2 sets</td>
<td>4 sets</td>
</tr>
<tr>
<td>7. As built drawings</td>
<td></td>
<td>2 sets</td>
<td>2 sets</td>
</tr>
<tr>
<td>8. Spare parts drawings</td>
<td></td>
<td>2 sets</td>
<td>2 sets</td>
</tr>
<tr>
<td>9. Wearing parts drawings</td>
<td></td>
<td>2 sets</td>
<td>2 sets</td>
</tr>
</tbody>
</table>
**Compact Disc and Reproducibles**

1. As built drawing of approval category 1 sets 1 sets
2. As built drawing of information category 1 sets 1 sets
3. Spare parts drawings 1 sets 1 sets
4. Wearing parts drawings 1 sets 1 sets
5. All manuals 1 sets 1 sets

**Documents**

1. Erection manual 1 set 6 sets 3 sets
2. Operating and maintenance manuals 1 set 6 set 2 sets
3. Storage and reconservation manuals 1 set 6 set 2 sets
4. Safety manuals 1 set 6 set 3 sets
5. List of consumables 1 set 6 set 3 sets
6. List of lubricants and hydraulic 1 set 6 set 3 sets
7. List of special tools and tackles 1 set 6 set 3 sets
8. Test certificates and inspection certificates in bound volume 1 set 6 set 2 sets

Soft copy (AutoCAD format) of drawings / documents shall be submitted by the successful bidder to EPI during engineering activities for approval & onward submission to Client.

### 2.3.4 Progress Report

The Vendor shall submit a detailed PERT Network showing completion time which would indicate starting and completion dates of all activities of engineering, purchasing, procurement of materials, manufacturing, inspection, dispatch, erection, testing, and commissioning, etc. under his scope of work.

The Vendor shall submit the progress report in such details as may be required by the Purchaser so as to enable them to monitor the progress of work.

The Vendor shall submit the progress report every month in the proforma mutually discussed and agreed.

### 2.3.5 Coding Scheme

All drawings/documents/equipment/spare parts/shipments shall have a coded number which shall be finalized with the successful tenderer.

### 2.3.6 Title Block of Drawing

Separate file is attached as soft copy. Hard copy is enclosed as Annexure - A
3. **PERFORMANCE GUARANTEE**

**General**

On completion of erection of the plant units along with utilities and auxiliaries by respective package contractors as per approved drawings / documents as well as detailed drawings, the Contractor shall undertake preliminary Acceptance Test (PAT) i.e. cold test, to prove that the unit has been supplied as per agreement and after erection the unit is fit to be started up and commissioned. The PAT shall be followed by commissioning (hot trials) to demonstrate that the unit is fit for commercial production.

3.1.1 **Preliminary Acceptance Test (PAT)**

01 Cold tests shall be performed on the individual sub-assemblies of the unit and shall be designed to conduct the systematic check of the components and of the functional operation thereof.

02 Cold tests shall comprise idle, no-load tests. Cold tests shall be conducted by the Contractor under his sole responsibility. The Employer will provide skilled operating personnel during the cold test.

03 A detailed programme of cold tests shall be drawn up by the Contractor and shall be subject to the approval of the Employer / consultant. Such programme may be revised and adjusted as may be required by the Employer during the test run.

04 Results of cold tests shall be recorded jointly by the Contractor and the Employer.

05 On completion of preliminary acceptance tests, and liquidation of the defects list, preliminary acceptance certificates shall be issued by the Employer.

3.1.2 **Commissioning (Hot Trials)**

01 After issue of preliminary acceptance certificates, the Contractor shall start-up and commission the unit in an integrated manner under his sole responsibility as per commercial volume of contract.

02 During the start-up and commissioning, the Contractor shall perform the required adaptation, adjustment and hot run the Plant & Equipment to demonstrate its production capacity.

03 The Employer shall, for the purpose of start-up and commissioning, provide operating personnel as may be available with him for normal operation, who shall work under the instructions and guidance of the Contractor.

04 Start-up and commissioning of the unit shall be taken up only when material handling system, electrical power system, inter-plant fluid system and auxiliaries serving the unit as well as the preceding / succeeding plant units are under normal operation and / or feed material is available. The Contractor shall rectify the defects observed during commissioning.

05 The quantities of starting material and facilities necessary for conducting the commissioning shall be mutually determined by the Contractor and Employer.
Commissioning of the unit shall be deemed to be only completed, when the total commercial production of about 10,000 tonnes of material - or - ten(10) days of rated material is transported, for the particular circuit.

Results of start-up tests and commissioning shall be recorded jointly by the Contractor and the Employer.

On completion of commissioning of the unit and its commencement of commercial production as per clause 06.01.02.006, commissioning certificate shall be issued by the Employer within 15 days.

The unit shall be taken over by the Employer when:

a) Commissioning certificate as per clause 06.01.02.008 has been issued by the Employer.

b) The Contractor has submitted all final documents in compliance with the provisions of this specification.

c) The Contractor has supplied all consumables, change parts, special tools and tackles and commissioning spares.

d) The Contractor has met, to the satisfaction of the Employer, all the observation, if any, contained in the Preliminary Acceptance certificate.

Performance Guarantee Tests (PG)

After commissioning of the plant & equipment, the Contractor shall offer the plant for conducting performance guarantee tests as mutually agreed upon between the Employer and Contractor. PG test shall be carried out on full load within six months from commissioning.

The Contractor shall supervise and carry out the operation under their instruction and guidance during performance guarantee tests and shall take full responsibility of the operation. The Employer will make available necessary operating and maintenance personnel as per the agreed manning schedule as well as the raw materials, utilities and services etc, as specified.

The Contractor shall submit the scope, general preconditions, test procedures, guaranteed values and test evaluation methods.

The performance tests for all plant equipment shall be carried out to satisfy all operating parameters as per the relevant clauses of the Technical specification for the equipment under consideration.

Performance Guarantee Test

Performance Guarantee Parameters

(i) Conveyor capacity shall be as per rated capacity given in conveyor data sheets.

(ii) Crusher capacity should not be less than 300 tph.

(iii) The equipment shall operate at rated capacity without undue vibration and undue noise etc. Noise level shall not exceed 85 dB at 1 meter distance.
(iv) Granulometry of the product
   (-) 3 mm size: 81 % minimum
   (-) 0.5 mm size: 35 % maximum

(v) Hammer life in term of throughput: Not less than 0.5 Mill. Tonnes/Set of hammers)

(vi) Life of breaker plates / grate bar: Not less than 2 Mill. Tonnes/set

02 Acceptable Limits & LD

The performance guarantee parameters, PG value and their acceptance limits with Liquidated Damages (LD) shall be as follows:

PERFORMANCE GUARANTEE FOR COAL HANDLING PLANT

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Acceptable</th>
<th>Acceptable with LD</th>
<th>Liquidated Damages</th>
<th>Rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Conveyor capacity</td>
<td>As per rated capacity indicated in data sheet</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Less than rated capacity</td>
</tr>
<tr>
<td>2.</td>
<td>Discharge from Reversible hammer crusher</td>
<td>300 tph</td>
<td>289 to 299 tph</td>
<td>0.25% of Order value for every 1 tph decrease</td>
<td>Less than 289 tph</td>
</tr>
<tr>
<td>3.</td>
<td>Product size (-3 mm) from the Crusher.</td>
<td>-3 mm size upto 81 %</td>
<td>-3 mm size upto 79 %</td>
<td>0.25% of Order value for every 0.5% decrease</td>
<td>0.25% of Order value for every 0.5% increase</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(-) 0.5 mm size up to 35 %</td>
<td>(-) 0.5 mm size more than 35 to up to 38 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Environment Norms</td>
<td>As specified in TS</td>
<td>-</td>
<td>Not achieving norms</td>
<td>Not achieving norms</td>
</tr>
</tbody>
</table>

PERFORMANCE GUARANTEE FOR COKE SORTING PLANT

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Acceptable</th>
<th>Acceptable with LD</th>
<th>Liquidated Damages</th>
<th>Rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Conveying capacity</td>
<td>As per rated capacity</td>
<td>Nil</td>
<td>Not applicable</td>
<td>Less than acceptable limits</td>
</tr>
<tr>
<td>2.</td>
<td>80mm grizzly screen</td>
<td>Total misplacement ≤15%</td>
<td>1 to 15%</td>
<td>0.125% of order value for every 3%</td>
<td>More than acceptable limits</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Description</td>
<td>Acceptable with LD</td>
<td>Acceptable with LD</td>
<td>Liquidated Damages</td>
<td>Rejected</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------</td>
<td>--------------------</td>
<td>--------------------</td>
<td>--------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>More than acceptable limits</td>
</tr>
<tr>
<td>3.</td>
<td>Coke crusher</td>
<td>+80% &lt;5%</td>
<td>1 to 5%</td>
<td>0.25% of order value for every 1% increase</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>30mm vibrating screen</td>
<td>Total misplacement ≤15%</td>
<td>1 to 15%</td>
<td>0.125% of order value for every 3% increase</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>60mm Grizzly screen</td>
<td>Total misplacement ≤15%</td>
<td>1 to 15%</td>
<td>0.125% of order value for every 3% increase</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Dust Suppression</td>
<td>Up to 5mg/Nm³</td>
<td>1mg/m³ to 5mg/Nm³</td>
<td>0.3% of order value for every 1mg/Nm³ increase</td>
<td></td>
</tr>
</tbody>
</table>

**PERFORMANCE GUARANTEE FOR AUGMENTATION OF FUEL & FLUX PREPARATION FOR SP III & FINES CONVEYORS**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Acceptable with LD</th>
<th>Acceptable with LD</th>
<th>Liquidated Damages</th>
<th>Rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Flux crushing at output of closed circuit</td>
<td>(-) 5mm 100%</td>
<td>(-) 3mm 95%</td>
<td>Nil</td>
<td>Not applicable</td>
</tr>
<tr>
<td>2.0</td>
<td>Fuel (Coke) crushing</td>
<td>(-) 5mm 100%</td>
<td>(-) 3mm 90%</td>
<td>(-) 1mm &lt; 50%</td>
<td>(-) 0.5mm &lt; 30%</td>
</tr>
<tr>
<td>3.0</td>
<td>Conveying capacity</td>
<td>As per rated capacity</td>
<td>-</td>
<td>Not applicable</td>
<td>Less than rated capacity</td>
</tr>
</tbody>
</table>

However, total liquidated damage on all account shall be limited to 7.5% of contract value.

The performance guarantee test shall be performed for each sub section continuously for 7 days. Continuity of operation however, be limited by availability of raw materials for unloading and stacking and availability of storing capacity on...
delivering end. Wherever equipment in the sub section is of stand by nature, each such equipment shall operate for at least 10 hours on load in the period.

The performance guarantee test shall also be performed for the complete system for 5 days on round the clock basis.

In case the test is disrupted due to equipment or facilities supplied by others, the performance is to be repeated for two more times after rectification of fault of the equipment or facilities supplied by others. Repair / Rectification of fault shall be done by others. If the test is disrupted even after that, the performance test shall be on the basis of total hours of uninterrupted operation of the system, 200 hours for sub section and 100 hours for total system. However, there should not be any failure of the equipment supplied by Contractor between starts and finish of this time counting. If the operation stops due to failure of any item supplied by contractor, the operating hours prior to such failure will not be counted.

In case some equipment can not be tested within the period of testing because of failure of equipment or facility provided by others, the same will be accepted on the basis of load test result for the limited period or no – load test result where load test could not be performed at all.

The contractor shall prepare and submit a draft performance test procedure for each equipment and system within 12 months of order. The final performance test procedure will be prepared jointly by the Employer / consulting engineers and the contractor based on the draft performance test prepared by the contractor and various requirement indicated in the contract specification and the order.
4.0 GENERAL SPECIFICATION ON QUALITY SYSTEM, INSPECTION & TEST OF PLANT & EQUIPMENT AT MANUFACTURER’S PREMISES

4.1 General

Inspection & testing of plant & equipment shall be carried out by BSP/MECON/EPI at the works of successful tenderer during manufacturing and/or on final product to ensure conformity of the same with the acceptable criteria of technical specifications, approved drawings, manufacturing drawings applicable national / international standards.

4.2 Quality System Requirements

The successful tenderer must recognise the importance of quality and follow defined quality programme in all stages of manufacturing and quality control activities of the product. Vendor / Contractor must define and implement the tasks and control that will provide needed assurance, in case manufacturing of product is sub-contracted either partly or fully and/ or for the procured from vendors which are duly approved by the project authority.

BSP/MECON/EPI reserve the right to verify the quality programme of tenderer & its vendors/sub- vendors to assure the effectiveness of the programme to meet the intended and specified quality of the product.

4.3 Quality Assurance Plan (QAP)

4.3.1 The successful tenderer shall furnish Quality Assurance Plan (QAP) for respective equipment after completion of detailed engineering and finalization of billing schedule / equipment identification number for Consultant’s approval at least one month prior to start of manufacturing.

4.3.2 QAP shall be prepared & furnished by Vendor / Contractor for structural & mechanical equipment, electrical equipment and refractory materials etc., QAPs must be submitted in four (4) sets duly signed and stamped by tenderer for BSP/MECON/EPI approval.

4.3.3 The successful tenderer shall indicate procurement source and furnish to BSP/MECON/EPI, during the submission of QAP, copies of P.O., Sub-P.O., T.S., approved GA drawings/ data sheets & detailed manufacturing drawings, as backup reference materials for scrutiny & final approved by BSP/MECON/EPI. The submission & subsequent approval of QAPs shall be ensured to be restricted to one round only.

4.3.4 Inspection and test requirements shall be decided with due consideration of factors like safety, duty cycle, operating conditions, equipment life, environmental conditions, place of installation and statutory regulations, as applicable, for a particular equipment. Any, additional type or special tests or routine tests if found necessary to establish the intended quality after detailed engineering then the same shall have to be incorporated in the QAP without any commercial implication.

4.3.5 Detailed QAP shall be prepared by the successful tenderer in consultation with their Sub-contractors / Manufacturers to avoid any complicacy later.

4.4 Calibration of Measuring Equipment
4.4.1 All the measuring equipment used for inspection & testing shall be calibrated and appropriate accuracy class of measuring equipment shall be used. Calibration standards used for calibration of measuring equipment shall be traceable to national standards of National Physical Laboratory (NPL), New Delhi with unbroken chains of comparison.

4.4.2 Valid calibration certificate for all measuring equipment used during inspection and testing at manufacturer’s works, with traceability to national standards of NPL/NABL accredited laboratories shall be furnished prior to undertaking inspection by BSP/MECON/EPI.

Calibration certificate shall also indicate reference no. of calibration standards calibrated by NPL/NABL accredited laboratories and copies of such calibration certificates of calibration standards shall be included in the compiled dossiers of inspection/test results.

4.5 Test Certificates and Documents

4.5.1 For each of the items being manufactured as per approved QAP, following test certificates and documents, as applicable for each of the equipment, in requisite copies including original, duly endorsed by the Manufacturer/successful tenderer with appropriate linkage to project, purchase order and acceptance criteria etc shall be submitted to Consultant/Purchaser.


ii) WPS, PQR & WPQ documents as per applicable code.

iii) Details of stage wise inspection & rectification records for fabricated items, castings, forgings and machined articles.

iv) Control dimension chart with records of alignment, squareness etc.

v) Manufacturer’s material and performance/ relevant test certificates for all bought-out items.

vi) Details of heart-treatment and stress relieving charts as per specification.

vii) Non-Destructive Test reports as per respective code.

viii) Static/dynamic balancing certificate for rotating components/machines.

ix) Hardness test certificate.

x) Pressure/Leakage Test Certificates.

xi) Performance Test Certificates for all characteristics.

xii) Routine / type / calibration / acceptance / special test (Type Tests etc) certificates for electrical items.

xiii) Surface preparation and painting certificates.
xiv) Certificates from competent authority for the items coming under statutory regulations.

4.5.2 Where physical and chemical test certificates of material are not available, the successful tenderer/Sub-contractor shall arrange to have specimens and test samples of the materials, tested in his own laboratory at his cost and submit the copies of test results in requisite numbers to BSP/MECON/EPI for review. Number of test samples against each heat/cast/lot or batch of materials, as applicable shall be as per relevant Indian or International Standards.

4.5.3 Where facilities for testing do not exist in the successful tenderer/Sub-contractor’s laboratories or in case of any dispute, samples and test pieces shall be drawn by the successful tenderer/Sub-contractor in presence of BSP/MECON/EPI and sealed sample shall be sent to any Govt. approved /NABL accredited laboratory for necessary tests at former’s own cost.

4.5.4 The BSP/MECON/EPI shall have the right to be present and witness all tests being carried out by the successful tenderer/Sub-contractor at their own laboratory or approved laboratories. Also, the Inspection Agency shall reserve the right to call for confirmatory test on samples, at his discretion.

4.6 **Internal Inspection by Successful Tenderer/Manufacturer**

4.6.1 Inspection and tests shall be carried out by Contractor/ Manufacturer in accordance with approved drawing, T.S., P.O., and approved QAP. They shall maintain records of each inspection and test carried out and signed documents shall be submitted to Purchaser/ Consultant for verification.

4.6.2 The successful tenderer shall carry out their internal inspection & obtain clearance from statutory bodies e.g. IBR, CCE, TAC, Weights & Measures, safety, IE rules etc. prior to offering any equipment for BSP/MECON/EPI’s inspection in accordance with approved QAP.

4.6.3 The successful tenderer/ Manufacturers shall identify all the inspected equipment/component/raw materials & shall maintain the record of status of inspection viz. inspected & found acceptable, require rectification/rework, rejected etc.

4.6.4 The successful tenderer shall establish and maintain procedures to ensure that the product that does not confirm to specified requirements is prevented from inadvertent use or installation. The description of non-conformity that has been accepted subsequently by BSP/MECON/EPI by concession and/ or of repairs, shall be recorded.

Repairs and reworked product shall be offered for re-inspection to BSP/MECON/EPI along with records of corrective action taken.

4.7 **Manufacturing and inspection schedule**

All Vendors / contractors shall submit the schedule for manufacturing and inspection indication equipment / components, sub-assembly/ assembly. Date of approval of drawings / data sheets. Address of manufacturer with contact person and scheduled date of inspection. Such reports shall be submitted to respective Consultant Inspecting Offices with a copy to Inspection Co-ordinating Office once in a month. These monthly reports shall state the planning for next three months.
Submission of first reports must commence one month prior to commencement of manufacturing activities of the product.

4.8 **Method of Undertaking Inspection & Testing by Consultant / Purchaser**

4.8.1 Inspection call shall be given only on readiness of the equipment/assembly/sub-assembly & after approval of all relevant drawings and QAP. In case equipment/assembly/sub-assembly offered for inspection are found not ready, all the cost of visit of Consultant’s engineer shall have to be borne by the successful tenderer.

If the equipment/assembly/sub-assembly after inspection found not acceptable, require rework and involve Consultant’s re-inspection, all the cost of such re-inspections shall also have to be borne by the successful tenderer.

4.8.2 Inspection call shall be floated to BSP/MECON/EPI, in the approved duly filled in, with ten days clear margin, enclosing all documents like test Certificates, Internal Inspection Reports, P.O., Sub-P.O., T.S., Approved QAP, approved GA drawings/data sheets and manufacturing drawings. Inspection calls without above documents shall be treated as invalid and shall be ignored. The hard copy of such documents must also accompany a CD (comprising computer readable files) containing the identical documents.

4.8.3 The successful tenderer shall offer substantial quantities for economical inspection consistent with the size of order.

4.8.4 On receipt of the Inspection call, pertaining to particular package / equipment/item, QA & Inspection group of MECON, Ranchi (Overall co-ordinating office for Inspection activities) shall organize inspection visit or will issue Inspection assignment to other Consultant’s office (based on nearness to the vendor’s manufacturing works / relevant job expertise). For further inspection pertaining to the same package / equipment / item, successful tenderer may forward the subsequent inspection calls to the respective Consultant’s offices (as identified per initial assignment), with a copy to QA & Inspection Section, Ranchi.

4.9 **Obligations of Successful Tenderer**

4.9.1 The successful tenderer shall provide all facilities and ensure full and free access of the Inspection Engineer of BSP/MECON/EPI to their own or their Sub-Contractor’s premises at any time, during contract period, to facilitate him to carry out inspection & testing of the product during or after or after manufacture of the same.

4.9.2 The successful tenderer shall delegate a Representative / Co-ordinator to deal with BSP/MECON/EPI on all inspection matters. Representative of successful tenderer shall be present during all inspection at Sub-Contractor’s works.

4.9.3 The successful tenderer shall comply with instructions of BSP/MECON/EPI fully and with promptitude.

4.9.4 The successful tenderer/Sub-Contractor shall provide all instruments, tools, necessary testing & other inspection facilities to BSP/MECON/EPI free of cost for carrying out inspection.
4.9.5 The cost of testing welds by ultrasonic, radiographic and dye penetration tests etc. in the fabrication workshop shall be borne by the successful tenderer. These tests need to be witnessed by ASNT/ISNT Level-II qualified NDT personals.

4.9.6 The successful tenderer shall ensure that the equipment/ assembly/ component of the plant and equipment required to be inspected, are not dismantled or dispatched before inspection.

4.9.7 The successful tenderer shall not offer equipment for inspection in painted condition unless otherwise agreed in writing by BSP/MECON/EPI.

4.9.8 The successful tenderer shall not offer equipment and materials once rejected by the BSP/MECON/EPI, are not re-used in the manufacture of the plant and equipment. Where parts rejected during inspection have been rectified as per agreed procedures laid down in advance, such parts shall be segregated for separate inspection and approval, before being used in the work.

4.10 Stamping and Issue of Inspection Documents

4.10.1 Inspection Memo:- For rejected items/ items, which do not conform to Technical Specification in one or more quality characteristics requiring rectification / rework, Inspection Memo shall be issued indicating therein the details of observation & remarks. All the non-conformities with respect to specification of the product shall be indicated in the Inspection Memo for further quality control by successful tenderer.

4.10.2 Inspection Certificate:- On satisfactory completion of final inspection & testing. All accepted plant & equipment shall be stamped suitably and Inspection Certificate shall be issued by the Consultant for the accepted items.

4.11 General Clause

4.11.1 Inspection & tests carried out by Consultant/Purchaser shall no absolve the responsibility of the successful tenderer/ Manufacturer to provide acceptable product as per the terms of contract nor shall it preclude subsequent rejection.

4.11.2 Purchaser/ Consultant reserve the right to inspect any product at any stage of manufacturing beyond pre-identified stages & hold points of approved QAP.

4.12 Format

Performa for inspection of all equipment shall be as per EPI / EPI’s clients requirement.
5.0 PAINTING

5.1 General

5.1.1 This specification covers the materials, tools, facilities and quality requirement for surface preparation and painting of steel structures, equipment, piping, ducts, chutes, wood work etc.

5.1.2 This is only a general guideline of the painting scheme to be followed by the Tenderer. However, in case a specific painting procedure is stipulated in any tendering specification, then this general guideline shall be superseded. Any special case which may arise from time to time shall be dealt with individually on the merit of each case.

5.1.3 The term “painting” referred herein covers rust preventive, fungus/insects preventive and decorative coating along with surface protection of the following area but not limited to the areas indicated below.
   i) Structural steel works
   ii) Mechanical equipment
   iii) Electrical equipment
   iv) Instrumentation and control equipment.
   v) Pipe work
   vi) Oxygen plant, etc.

5.1.4 Surfaces made of asbestos, aluminum, brass, bronze, galvanized steel, stainless steel, cast iron and other corrosion resistant alloys and rubber/synthetic polymer/fiber reinforcement plastic and buried pipe work are not required to be painted unless specified except for aesthetic purposes or for identification bands, wherever relevant.

5.1.5 The complete paint system for any item includes the following basic activities:
   i) Proper surface preparation
   ii) Application of primer coats
   iii) Application of intermediate coats
   iv) Application of finished coats

All the above coats shall be of quality paint products and of approved make. The scope of work shall also include supply of all paint materials as per specification described herein.

5.1.6 If the contractor desires to adopt alternative paint system for any specific item for an improvement or equivalent to the system specified here-in or as per recommendations of paint manufacturer, may do so subject to purchaser's approval in advance.

5.2 Surface Preparation

5.2.1 Surface preparation required for paint application, shall be such as to clean the surface thoroughly of any material which will be conducive to premature failure of the paint substrates.

5.2.2 All surfaces shall be cleaned of loose substances, and foreign materials, such as dirt, rust, scale, oil, grease, welding flux, etc. in order that the prime coat is rigidly anchored to the virgin metal surface. The surface preparation shall confirm to
pictorial representation of surface quality grade of Swedish Standards Institution SIS – 055900 or equivalent standards such as SSPC – VIS – 1.67 or DIN 55928 (Part 4) or BS 4232 or IS 1477 – 1971 (Part I).

5.2.3 The acceptable surface preparation quality /grade are described under each paint system. The procedures include solvent cleaning, hard tool cleaning, power tool cleaning, blast cleaning, wood surface cleaning, flame cleaning and pickling. The will ensure surface quality as required by the specific primer paint. For ready reference surface preparation quality grade to be adopted in respect of SIS 055900 and DIN 55928 (Part – 4) is given in Annexure -01.

5.2.3.1 Solvent Cleaning

The surface shall be cleaned by wiping, immersion, spraying or vapour contacting of a suitable solvent or washing with an emulsion or alkaline solution to remove oil, grease, dirt, old paint, etc. Solvent cleaning shall not remove rust, scales, mill scales or weld flux. Therefore, before application of paint, solvent cleaning shall be followed by other cleaning procedures as stated in subsequent clauses.

5.2.3.2 Hand Tool Cleaning

The surface shall be cleaned manually by vigorous wire brushing as per grade St -2 quality of Swedish Standard Institution SIS 055900 and DIN 555928. This method effectively removes loosely adherent materials, but would not affect residues of rust or mill scales that are intact and firmly adherent. Finally the surface is to be cleaned with a vacuum cleaner or with clean compressed air or with clean brush. After preparation the surface shall have a faint metallic shine. The appearance shall correspond to the prints designated St-2.

5.2.3.3 Power Tool Cleaning

The surface shall be cleaned by electric or pneumatic tools, such as brushes, sanding machines, disc abrasive grinder, rotary disc scaler etc, to St -3 quality. The tools shall be used carefully to prevent excessive roughening of surface and formation of ridges and burrs. This method will remove loosely adherent materials but would not affect residues of rust or mill scales that are firmly adherent and intact.

5.2.3.4 Blast Cleaning

The surface shall be cleaned by impingement of abrasive materials, such as graded sand at high velocity created by clean and dry compressed air blast as per the grade according to Swedish Standard Institution SIS 055900. This method will remove loosely adherent materials as well as adherent scales and mill scales. Prior to application of blast, heavy deposit of oil and grease are removed by solvent cleaning excessive surface scales are removed by hand tools or power tool cleaning. The extent of removal of adherent scales is varied, depending on the application and are defined by the surface quality grades Sa 1, Sa 2, Sa 2.5 and Sa 3 in the order of increasing cleanliness. The blast cleaning is not recommended for sheet metal work.

5.2.3.5 Flame Cleaning

The surface is cleaned by rapid heating by means of oxyacetylene flame to loosen the adherent scales, followed immediately by wire brushing. This method will remove loosely adherent materials as well as most of the adherent scales and mill
scales. In order to minimize or prevent distortion flame cutting shall not be used on members having thickness of 6 mm and lower.

5.2.3.6 **Pickling**

In this method the surface is cleaned of mill scales, rust or rust scales by chemical reaction or electrolysis or both.

5.3 **Paint Application**

5.3.1 **Paints**

5.3.1.1 Paint shall be applied in accordance with paint manufacturer’s recommendations. The work shall generally follow IS 1477 – 1971 (Part II) for jobs carried out in India and SSPC-PA-1 or DIN 55928 of equivalent for jobs carried out outside India.

5.3.1.2 General compatibility between primer and finishing paints shall be established by the paint manufacturer supplying the paints.

5.3.1.3 In the event of conflict between this general procedure on painting and the paint manufacturer’s specification, the same shall be immediately brought to the notice of the Purchaser. Generally in cases of such conflicts, Manufacturer’s specifications / recommendations shall prevail.

5.3.1.4 Before buying the paint in bulk, it is recommended to obtain sample of paint and establish “Control Area of Painting”. On Control Area, surface preparation and painting shall be carried out.

5.3.1.5 If required, samples of paint shall be tested in laboratories to establish quality of paint with respect to:

   (i) Viscosity  
   (ii) Adhesion/Bond of paint in steel surfaces.  
   (iii) Adhesion/Simulated salt spray test.  
   (iv) Chemical analysis (percentage of solids by weight).  
   (v) Normal wear resistance as encountered during handling & erection.  
   (vi) Resistance against exposure to acid fumes, etc.

5.3.1.6 Whole quantity of paint for a particular system of paint shall be obtained from the same manufacturer.

5.3.1.7 The main Contractor shall be responsible for supply of paints and this responsibility shall not be passed on to the sub-contractor.

5.3.1.8 The painting material as delivered to the Contractor, must be in the manufacturer’s original container bearing thereon manufacturer’s name brand and description. Paint/Painting material in containers without labels or with illegible labels shall be rejected, removed from the area and shall not be used.

5.3.1.9 Thinners wherever used shall be those recommended by the paint manufacturers and shall be obtained in containers with manufacturer's name and brand name of thinner legibly printed, failing which the thinner is liable to be rejected and shall not be used.
5.3.1.10 All paint containers shall be clearly labeled to show the paint identification, date of manufacture, batch number, special instruction, shelf life etc. The container shall be opened only at the time of use.

5.3.1.11 All paints shall be stored in accordance with the requirements of laid down procedure by the paint manufacturer.

5.3.1.12 All ingredients in a paint container shall be thoroughly mixed to break-up lumps and disperse pigments before use and during application to maintain homogeneity.

5.3.1.13 The proposed make, quality and shade of the paint shall have the approval of the client.

5.3.1.14 The colour code of the finishing paint to be followed shall be intimated to the successful Tenderer after finalisation of order. The undercoat shall have different tint to distinguish the same from the finishing coat.

5.3.1.15 The Contractor shall furnish paint manufacturer’s test report or technical data sheet pertaining to the paint selected. The data sheet shall indicate among other things the relevant standards, if any, composition in weight percent of pigments, vehicles, additives, drying time, viscosity, spreading rate, flash point, method of application, quality of surface preparation required, corrosion resistance properties and colour shades available.

5.3.1.16 For details of paint materials refer Annexure -02.

5.3.2 General

5.3.2.1 Each coat of paint shall be continuous, free of pores and of even film thickness without thin spots.

5.3.2.2 Each coat of paint shall be sufficiently dry before application of next coat.

5.3.2.3 Paint shall be applied at manufacturer’s recommended rates. The number of coats shall be such that the minimum dry film thickness specified is achieved. The dry film thickness of painted surfaces shall be checked with ELCOMETER of measuring gauges to ensure application of specified DFT.

5.3.2.4 Zinc rich primer paints which have been exposed several months before finishing coat is applied shall be washed down thoroughly to remove soluble zinc salt deposits.

5.3.2.5 The machine finished surfaces shall be coated with white lead and tallow before shipment or before being put out into the open air.

5.3.2.6 Areas which become inaccessible after assemble shall be painted before assembly (after obtaining painting clearance from the inspecting authority) after requisite surface cleaning as specified.

5.3.2.7 Paint shall not be applied when the ambient temperature is 5 deg C and below or 45 deg C and above. Also paint shall not be applied in rain, wind, fog or at relative humidity of 80% and above unless the manufacturer’s recommendations permit. Applications of paint shall be only be spraying or brushing as per IS 486 – 1983 and IS 487 -1985.
5.3.2.8 Primer paint shall be applied not later than 2-3 hours after preparation of surface, unless specified otherwise.

5.3.2.9 Edges, corners, crevices, depressions, joints and welds shall receive special attention to ensure that they receive painting coats of the required thickness.

5.3.2.10 Surfaces which cannot be painted but require protection shall be given a coat of rust inhibitive grease according to IS 958 – 1975 or solvent deposited compound according to IS 1153 – 1975 or IS 1674 – 1960.

5.3.2.11 Surfaces in contact during shop assembly shall not be painted. Surfaces which will be inaccessible after assembly shall receive minimum two coats of specified primer.

5.3.2.12 Surfaces to be in contact with wood, brick or other masonry shall be given one shop-coat of the specified primer.

5.3.3 Site/Field Painting

5.3.3.1 Wherever shop primer painting is scratched, abraded or damaged, the surface shall be thoroughly cleaned using emery paper and power driven wire brush wherever warranted, and touched up with corresponding primer. Touching up paint shall be matched and blended to eliminate conspicuous marks.

5.3.3.2 If more than 50% of the painted surface of an item requires repair, the entire item shall be mechanically cleaned and new primer coats shall be applied followed by intermediate and finishing coats as per painting specification.

5.3.3.3 All field welded areas on shop painted items shall be mechanically cleaned (including the weld area proper, adjacent areas contaminated by weld spatter or fumes and areas where existing primer paint is burnt). Subsequently, new primer and finishing coats of paint shall be applied as per painting specification.

5.3.3.4 The first coat of finish paint at site shall be applied preferable within three months of the shop paint.

5.3.4 Structural

5.3.4.1 All fabricated steel structure, fabricated steel pipes, etc. shall have a minimum of two coats of primer paint before dispatch to site.

5.3.4.2 Parts of steel structures embedded in concrete shall be given a protective coat of Portland cement slurry immediately after fabrication and after surfaces of this part is thoroughly cleaned from grease, rust mill scales, etc. No paint shall be applied on this part.

5.3.4.3 All structures shall receive appropriate number of primer and finishing coats in order to achieve overall DFT as per design drawings/specification.

5.3.5 Hot Surfaces

5.3.5.1 Total DFT for heat resistant paints should not exceed 100 – 120 microns, otherwise flaking occurs (as per paint manufacturer’s recommendations).

5.3.5.2 Heat resistant paints should be applied by brush.

5.3.5.3 Primer coat should not be applied on the surfaces having temperature condition more that 120 deg C.
5.4 **Painting Schemes**

For a complete painting scheme of any item being printed, all types of paints are to be procured from the same manufacturer as approved by the purchaser.

5.4.1 **Legend**

- **SP** - Surface preparation quality as per SIS standard
- **2P1** - Two (2) coats of Primer paint type P1
- **1I1** - One (1) coats of Intermediate paint type I1
- **2F1** - Two (2) coats of Finish paint type F1
- **DFT** - Dry Film Thickness in microns developed
- **CRT** - Clean and Retouch

Type of paint products like P1 to P9, I1 to 14 and F1 to F10 have been specified under Annexure-02.

5.4.2 The painting scheme to be followed for various structure/equipment exposed to different condition is briefly given in Annexure-03 for guidance to the tenderer.

5.4.3 The colour code for different applications are indicated in Annexure-04. Wherever colour codes are not specified, the same is to be mutually agreed between the Purchaser and Contractor.

5.5 **Guarantee**

5.5.1 The Contractor shall guarantee that the physical and chemical properties of the paint materials conform with the specification of paint products.

5.5.2 The Contractor shall submit internal test reports from paint manufacturers regarding the quality of paint whenever asked by the BSP/MECON/EPI.

5.5.3 Guarantee period shall commence from the date of completion of finishing coat of paint. The guarantee period will be indicated depending on the type of surface preparation and system of painting. To fulfill this obligations the Contractor may obtain from the painting manufacturer, guarantee for the performance of paint/painted surfaces.
### Surface Preparation Grade

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Surface Preparation</th>
<th>Swedish Std SIS 055900</th>
<th>DIN Std. Din 55928 (Part 4)</th>
</tr>
</thead>
</table>
| 1      | Blast cleaning to white metal  
Removal of all visible rusts, mill-scales, paint and foreign matters.             | Sa 3                   | Sa 3                        |
| 2      | Blast cleaning to near white metal:  
95% of any section of surface area is free from all rusts, mill-scales and visible residues. | Sa 2.5                 | Sa 2.5                      |
| 3      | Blast cleaning to commercial quality:  
At least 2/3 of any section of the surface area is free from all rusts, mill-scales and visible residues. | Sa 2                   | Sa 2                        |
| 4      | Brush-off blast cleaning:  
Removal of all loose mill-scales, rust and foreign matters etc.                       | Sa 1                   | Sa 1                        |
| 5      | Power tool cleaning:  
Very thorough scrapping and wire brushing to remove loose mill-scale, rust and foreign matters to have pronounced metallic shine. | St 3                   | St 3                        |
| 6      | Hand tool cleaning:  
Removal by hand brushing of loose mill-scale, loose rust and foreign matters.         | St 2                   | St 2                        |
PAINT MATERIALS

01. **PRIMER PAINTS (P)**

Primer paint products shall be applied only on dry and clean surfaces.

01.01 **Primer Paint – P1 (Phenolic – Alkyd Based)**

A single pack air drying phenolic modified alkyd composition with zinc phosphate as a primer paint conforming generally to IS : 2074.

- **Air drying time**
  - About 60 minutes (touch dry)
  - Overnight (hard dry)

- **Dry film thickness (DFT)/ Coat**
  - 40 microns (min)

- **Temperature resistance**
  - Upto 100°C dry heat

01.02 **Primer Paint – P2 ( Chlororubber Based)**

A single pack air drying high build chlorinated rubber based zinc phosphate primer.

- **Percent chlororubber**
  - 20 to 22 (% Chlorine above 65% in Chlororubber)

- **Air drying time**
  - About 15 minutes (touch dry)
  - Overnight (hard dry)

- **DFT/ Coat**
  - 50 microns (min)

- **Temperature resistance**
  - Up to 65°C dry heat

01.03 **Primer Paint – P3 (PVC Copolymer Alkyd Based)**

Polyvinyl chloride (PVC) - Alkyd zinc phosphate – red oxide Based primer

- **Ratio**
  - PVC copolymer + alkyd reisn (1.1)

- **Pigments**
  - Zinc phosphate & Fillers

- **Air drying time**
  - 24 hours

- **DFT/Coat**
  - 80 microns

- **Temperature**
  - Upto 80°C dry heat

01.04 **Primer Paint – P4 (Epoxy Based)**

A two pack air drying Epoxy polyamide resin based red oxide – zinc phosphate primer.

- **Epoxy content (% wt.)**
  - 15 to 18

- **Air drying time**
  - About 30 minutes (touch dry)
01.05 **Primer Paint – P5 (Epoxy Based)**
A two pack air drying Epoxy polyamide with zinc dust of at least 92% zinc dust on the dry film.

- Epoxy content (% wt.) - 8 to 10
- Air drying time - Less than 10 minutes (touch dry) Less than 2 hours (hard dry)
- DFT/Coat - 30 microns (min)
- Temperature resistance - Upto 120°C dry heat

01.06 **Primer Paint – P6 (Poly – Vinyl Butyral Resin Based)**
A two pack air drying polyvinyl butyral resin based wash primer with rust inhibitive pigments.

- Air drying time - 5 to 7 minutes (touch dry) 2 hours (hard dry)
- DFT/Coat - 8 microns
- Temperature resistance - Upto 65°C dry heat

01.07 **Primer Paint – P7 (Ethyl Zinc Silicate, EZS Based)**
A two pack heavy duty zinc dust rich silicate primer which protects the surface with just a single coat.

- Total solids (3 wt) - 84 +/- 2
- Density (g / cc) - 3.07 +/- 0.05
- Air drying time - To top coat 16 hours
- DFT / Coat - 60 microns
- Temperature resistance - Upto 450 deg C dry heat

01.08 **Primer Paint – P8 (high Build Coal Tar Epoxy)**
A two pack cold cured H. B. epoxy coal tar coating –no primer is required.

- Mixing ratio - Base: Hardener (4:1 by vol.)
- Air drying time - 48 hours (hard dry) Full cure 7 days
- DFT / Coat - 100 microns

01.09 **Wood Varnish – P9**
Treated oil based primer pigmented with suitable pigments:

Air drying time - 16 hours for application of top coat.
Coverage - 10 to 14 sq. m/litre

02. INTERMEDIATE PAINTS (I)

These paints shall be applied over primer coats as an intermediate layer to provide weather proof seal of primer coats.

02.01 Intermediate Paint-II (Phenolic alkyd based)

A single pack high build phenolic based paint with micaceous iron oxide (M 10).

Air Drying Time - 4 to 6 hours (touch dry)
2 days (hard dry)
DFT / Coat - 75 microns (min)
Temperature resistance - Upto 100 deg C dry heat
Compatible with - Primer P1

02.02 Intermediate Paint -12 (Chlororubber based)

A single pack air drying high build chloro based paint with MIO.

Air Drying Time - 15 minutes (touch dry)
- 24 hours (hard dry)
DFT/Coat - 70 microns (min)
Temperature resistance - Upto 65 deg C dry heat
Compatible with - Primer P2, P3 & P4

02.03 Intermediate Paint -13 (PVC – Alkyd Based)

PVC Coploymer - Resin 1 : 1
Pigments - Micaceous iron oxide (MIO)
DFT/Coat - 80 microns
Temperature resistance - Upto 80 deg C dry heat
Compatible with - Primer P2 & P3

02.04 Intermediate Paint -14

A two pack air drying high build epoxy resin based paint with MIO.

Air drying time - 6 to 8 hours (touch dry)
- 7 days (full cure)
DFT / Coat - 100 microns
Temperature - Up to 180°C dry heat
Compatible with - Primer P4 & P5

03. FINISH PAINTS (F)

Finish paint costs shall be applied over primer coats and intermediate coats after proper cleaning and touch up of primed surface.

03.01 Finish Paint – F1
A single pack air drying high gloss phenolic alkyd modified synthetic enamel paint suitably pigmented.

Air drying time
- 3 to 4 hours (touch dry)
- 24 hours (hard dry)

DFT/Coat
- 25 microns (min)

Temperature
- Upto 100°C dry heat

Compatible with
- Primer P1
- Intermediate I1

Colour
- Generally all shades

03.02 **Finish Paint – F2**

A single pack air drying polyurethane enamel of high gloss and hard finish suitably pigmented.

Air drying time
- 2 to 2 ½ hours (touch dry)
- 6 hours (hard dry)

DFT/Coat
- 30 microns (min)

Temperature resistance
- Upto 100°C dry heat

Compatible with
- Primer P1 & P8 and Intermediate I1

Colour
- Generally all shades

03.03 **Finish Paint – F3**

A two pack air drying bituminous aluminum paint.

Air drying time
- 1 to 2 hours (touch dry)
- 21 hours (hard dry)

DFT/Coat
- 25 microns (min)

Temperature resistance
- Upto 100°C dry heat

Compatible with
- Primer P1 and Intermediate I1

Colour
- Bright metallic

03.04 **Finish Paint – F4**

A ready mixed oil–alkyd based synthetic enamel paint of high gloss and hard wearing properties.

Air drying time
- 6 to 8 hours

Coverage
- 14 to 16 Sq. m/litre

Temperature resistance
- Upto 60°C dry heat

Compatible with
- P8
03.05 **Finish Paint – F5**

A single pack air drying plasticized chlororubber paint suitably pigmented.

- **Air drying time**
  - 30 minutes (touch dry)
  - 24 hours (hard dry)

- **DFT/Coat**
  - 35 microns (min)

- **Temperature resistance**
  - Primer 65°C dry heat

- **Compatible with**
  - Primer P2 & P3,
  - Intermediate I2 & I3

- **Colour**
  - Nearly all shades except few.

03.06 **Finish Paint – F6**

A PVC - Copolymer alkyd based enamel.

- **Density**
  - 1.17 ± 0.05

- **Total solids (1 wt)**
  - 55 ± 2

- **DFT/Coat**
  - 40 microns

- **Compatible with**
  - P2 and P3

03.07 **Finish Paint – F7**

A two pack air drying epoxy polyamide enamel suitably pigmented.

- **Air drying time**
  - 2 to 3 hours (touch dry)
  - 7 days (full cure)

- **DFT/Coat**
  - 40 microns (min)

- **Temperature resistance**
  - Up to 130°C dry heat

- **Compatible with**
  - Primer P4 & P5,
  - Intermediate 14

- **Colour**
  - Generally all shades.

03.08 **Finish Paint – F8**

A single pack synthetic rubber based aluminum paint.

- **Air drying time**
  - 2 hours (touch dry)
  - 24 hours (hard dry)

- **DFT/Coat**
  - 25 microns (min)
<table>
<thead>
<tr>
<th>Property</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature resistance</td>
<td>Upto 200(^\circ)C dry heat</td>
</tr>
<tr>
<td>Compatible with</td>
<td>No Primer paint except primer P6 is applicable in case of non-ferrous</td>
</tr>
<tr>
<td></td>
<td>substrate.</td>
</tr>
<tr>
<td>Colour</td>
<td>Smooth aluminium.</td>
</tr>
</tbody>
</table>
# PAINTING SCHEME

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description</th>
<th>Painting Scheme</th>
<th>Total DFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td><strong>Steel Structures (Temp. not exceeding 80°C)</strong></td>
<td></td>
<td>(Refer Note-1)</td>
</tr>
<tr>
<td>1.1</td>
<td>Technological steel structures for plant and equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indoor</td>
<td>SP – Sa 2.5</td>
<td>CRT 2F1 130</td>
</tr>
<tr>
<td></td>
<td>Outdoor</td>
<td>SP – Sa 2.5</td>
<td>CRT 2F1 205</td>
</tr>
<tr>
<td>1.2</td>
<td>Fabricated steel structures at site for rung ladders, cat-ladders, gates, rolling shutters, etc. (Springs/rubbing surfaces excluded)</td>
<td>SP – St-2 and / Or St-3 2P1</td>
<td>CRT 2F1 130</td>
</tr>
<tr>
<td></td>
<td>- Indoor / Outdoor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.3</td>
<td>Walkways, stairs, platforms etc. which are of wearing surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Indoor</td>
<td>SP – St-2 and / Or St-3 2P1</td>
<td>CRT 2F1 130</td>
</tr>
<tr>
<td></td>
<td>- Outdoor</td>
<td>SP-St2 and / Or St -3 2P1 1/1</td>
<td>CRT 2F1 205</td>
</tr>
<tr>
<td>1.4</td>
<td>Steel doors and windows</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Indoor / outdoor</td>
<td>SP- St-2 and / Or St-3 2P1 1/1</td>
<td>CRT 2F2 215</td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Description</td>
<td>Painting Scheme</td>
<td>Total DFT</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>-----------------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>At Shop</td>
<td>At Site</td>
</tr>
<tr>
<td>2.0 MECHANICAL EQUIPMENT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Mechanical equipment (Temp. not exceeding 80°C)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1. 1 Static equipment like storage tanks, vessels, bins, bunkers, heat exchangers, coolers, Cyclones, scrubbers, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Indoor</td>
<td>SP –Sa 2.5 2P2/2P3</td>
<td>CRT 2F5/2F6</td>
<td>170/240</td>
</tr>
<tr>
<td>- Outdoor</td>
<td>SP –Sa 2.5 2P2/2P3+1/2 / 1/3</td>
<td>CRT 2F5/2F6+1/2 / 1/3</td>
<td>240/320</td>
</tr>
<tr>
<td>2.1. 2 Rotary/moving equipment and machineries like crushers, mills, vibratory screens, bin activators, blowers, fan, air/gas compressors, pumps, gear boxes, machine housings etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Indoor</td>
<td>SP –Sa 2.5 2P3/2P4</td>
<td>CRT 2F6/2F7</td>
<td>240/140</td>
</tr>
<tr>
<td>- Outdoor</td>
<td>SP –Sa 2.5 2P3+1/3 / 1/4</td>
<td>CRT 2F6/2F7</td>
<td>320/340</td>
</tr>
<tr>
<td>3.0 Pipe / Duct work (Over ground)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Non – insulated (temperature up to 80°C)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Indoor</td>
<td>SP –St2 and or St3 2P1</td>
<td>CRT 2F1</td>
<td>130</td>
</tr>
<tr>
<td>- Outdoor</td>
<td>SP –St2 and/ or St3 2P1 + 111</td>
<td>CRT 2F1</td>
<td>205</td>
</tr>
<tr>
<td>3.2 Insulated (hot)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Indoor / Outdoor</td>
<td>SP – St2 and/ or St3 1P1</td>
<td>Remove paint and insulate</td>
<td></td>
</tr>
</tbody>
</table>
### 4.0 **Oxygen Plant**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Surface Preparation</th>
<th>Coating</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Outdoor steel structures</td>
<td>SP – St2 and/or St3 2P1 + 1I1</td>
<td>CRT 2F3</td>
<td>205</td>
<td></td>
</tr>
<tr>
<td>4.2 Rotary equipment like air compressors</td>
<td>Sa 2.5 2P4</td>
<td>CRT 2F7</td>
<td>140</td>
<td></td>
</tr>
</tbody>
</table>

### 5.0 **Others**

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Surface Preparation</th>
<th>Coating</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Standard mobile equipment like chassis of trucks, dumpers, crawler cranes, bulldozers, Railway rakes, chassis of slag cars, ladle cars, etc.</td>
<td>As per manufacturer’s standards</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2 Laboratory equipment like ovens, screens, magnetic stirrers, samplers, etc.</td>
<td>Stove enameling</td>
<td>CRT</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td>5.3 Steel structures partly immersed in water</td>
<td>SP – Sa 2.5 2P8</td>
<td>CRT</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:-**

1. Painting scheme of all fabricated steel structures, fabricated pipe work, building structures, conveyor galleries, pipe trestles etc. is indicated in the Technical Specification of steel structures.

2. **Primer Paint**
   Primer coat shall be suitable for intended temperature applications as per manufacturer’s recommendation. The primer selection shall be generally in line with the specification laid down in Annexure -02.

3. **Finish Paint**
   In case of Aluminium cladding final painting will not be required.
ANNEXURE - 04

COLOUR CODE

The colour codes are mentioned for all the items including pipe work. Shades of finish coat of paint applied over respective item indicated below are tentative and subject to alteration as per Purchaser’s request or due to compatible paint system adopted. The service for which colour code/bands are not specified are to be mutually agreed for by the Purchaser & the Contractor.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Items Painted</th>
<th>Colour</th>
<th>Colour No. of IS:5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><strong>Structures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Building frames including bracings, side girts, louvers etc.</td>
<td>Aircraft grey</td>
<td>693</td>
</tr>
<tr>
<td></td>
<td>Crane girders</td>
<td>Azure blue</td>
<td>104</td>
</tr>
<tr>
<td></td>
<td>Crane stops</td>
<td>Post office red</td>
<td>538</td>
</tr>
<tr>
<td></td>
<td>Gutters</td>
<td>Black bituminous</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Fire escape platforms ladders, etc.</td>
<td>Signal red</td>
<td>537</td>
</tr>
<tr>
<td></td>
<td>General hand railing, top runners</td>
<td>Lemon yellow</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>Rung ladders</td>
<td>Lemon yellow</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>All members blocking passages for movement</td>
<td>Lemon yellow</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td>Trestles, towers and pipe bridges</td>
<td>Dark admiraltry grey</td>
<td>632</td>
</tr>
<tr>
<td></td>
<td>Conveyor gallery structures</td>
<td>Aircraft grey</td>
<td>693</td>
</tr>
<tr>
<td></td>
<td>Steel chimneys</td>
<td>Aluminium</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td><strong>Equipment and Machinery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>General indoor equipment</td>
<td>Light grey</td>
<td>631</td>
</tr>
<tr>
<td></td>
<td>General outdoor equipment</td>
<td>Dark admiraltry</td>
<td>632</td>
</tr>
<tr>
<td></td>
<td>Crane bridges, trolleys, hooks etc. and other mobile equipment</td>
<td>Base : Lemon yellow</td>
<td>355</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stripes : Black (100 mm wide)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Furnaces</td>
<td>Aluminium</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tanks</td>
<td>Base : Same as for general equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fire-fighting equipment</td>
<td>Signal red</td>
<td>537</td>
</tr>
</tbody>
</table>

3. Pipe work

Colours shall be as given below. The base colour shall be applied throughout entire length except on surfaces of materials such as asbestos, aluminium, brass, bronze, galvanized steel, stainless steel and other corrosion resistant alloys and rubber / synthetic polymers. In such cases identification colour bands of at least 500mm width shall be provided near each branch, valve and at distances not exceeding 10m either as local colour coatings or coloured adhesive type of suitable material or label attached to the pipe work. Additional identification bands superimposed over the base colour shall be provided near each branch, valve and at distance not exceeding 10m. The bands shall be at least 25mm wide except in case of double bands where the first band shall be about 100mm wide. Direction of flow shall be clearly marked on the pipelines at intervals not exceeding 10m and all branches and change of directions.
<table>
<thead>
<tr>
<th>Service</th>
<th>Colour</th>
<th>Colour No. of IS:5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea or river water (untreated)</td>
<td>Base – Sea green</td>
<td>217</td>
</tr>
<tr>
<td></td>
<td>Band - White</td>
<td></td>
</tr>
<tr>
<td>Cooling water</td>
<td>Base – Sea green</td>
<td>217</td>
</tr>
<tr>
<td></td>
<td>Band - White</td>
<td>166</td>
</tr>
<tr>
<td>Boiler feed water</td>
<td>Base – Sea green</td>
<td>217</td>
</tr>
<tr>
<td>Condensate</td>
<td>Base – Sea green</td>
<td>217</td>
</tr>
<tr>
<td></td>
<td>Band – Light brown</td>
<td>410</td>
</tr>
<tr>
<td>Drinking water</td>
<td>Base – Sea green</td>
<td>217</td>
</tr>
<tr>
<td></td>
<td>First band - French blue</td>
<td>166</td>
</tr>
<tr>
<td></td>
<td>Second band – Signal red</td>
<td>537</td>
</tr>
<tr>
<td>Industrial water</td>
<td>Base – Sea green</td>
<td>217</td>
</tr>
<tr>
<td></td>
<td>Band – Light orange</td>
<td>557</td>
</tr>
<tr>
<td>Compressed air</td>
<td>Base – Sky blue</td>
<td>101</td>
</tr>
<tr>
<td>Instrument air</td>
<td>Base – Sky blue</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td>Band – Light brown</td>
<td>410</td>
</tr>
<tr>
<td>Drainage</td>
<td>Base – Black</td>
<td></td>
</tr>
<tr>
<td>Fuel oil</td>
<td>Base – Light brown</td>
<td>410</td>
</tr>
<tr>
<td></td>
<td>Band – Signal red</td>
<td>537</td>
</tr>
<tr>
<td>Coke oven/BF gas/other fuel</td>
<td>Base – Canary yellow</td>
<td>309</td>
</tr>
<tr>
<td></td>
<td>Band – Signal red</td>
<td>537</td>
</tr>
<tr>
<td>Argon</td>
<td>Base – Canary yellow</td>
<td>309</td>
</tr>
<tr>
<td></td>
<td>Band – French blue</td>
<td>166</td>
</tr>
<tr>
<td>Acetylene</td>
<td>Base – Canary yellow</td>
<td>309</td>
</tr>
<tr>
<td></td>
<td>Band – Dark violet</td>
<td>796</td>
</tr>
<tr>
<td>LP Gas (LPG)</td>
<td>Base – Canary yellow</td>
<td>309</td>
</tr>
<tr>
<td></td>
<td>First band – Signal read</td>
<td>537</td>
</tr>
<tr>
<td></td>
<td>Second band – Traffic green</td>
<td>267</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Base – Canary yellow</td>
<td>309</td>
</tr>
<tr>
<td></td>
<td>Band – Black</td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td>Base – Canary yellow</td>
<td>309</td>
</tr>
<tr>
<td></td>
<td>Band – White</td>
<td></td>
</tr>
<tr>
<td>Non-acidic slurries</td>
<td>Base – Sea green</td>
<td>217</td>
</tr>
<tr>
<td></td>
<td>Band – White</td>
<td></td>
</tr>
<tr>
<td>Fire-fighting system</td>
<td>Base – Signal red</td>
<td>537</td>
</tr>
<tr>
<td>Rain water down pipes</td>
<td>Base – Sea green</td>
<td>217</td>
</tr>
<tr>
<td></td>
<td>Band – Sky blue</td>
<td>101</td>
</tr>
<tr>
<td>Duct work</td>
<td>Base – Aluminium</td>
<td></td>
</tr>
</tbody>
</table>

Note: For these services, hazard marking as per fig. 4C of IS:2379 shall also be provided.