# TAMIL NADU GENERATION AND DISTRIBUTION CORPORATION

## 2X660 MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI

## TECHNICAL SPECIFICATION
## FOR
## VIBRATION ISOLATION SYSTEM
## FOR

## TD BFP (4 NOS) FOUNDATION
## MD BFP (2 NOS) FOUNDATION

**SPECIFICATION NO.: PE-TS-412-614-C001 (Rev 0)**


**BHARAT HEAVY ELECTRICALS LIMITED**
**POWER SECTOR**
**PROJECT ENGINEERING MANAGEMENT**
**NOIDA-201301**

| | TITLE : TECHNICAL SPECIFICATION FOR VIS FOR MILL (14 NOS) FOUNDATION | SPECIFICATION NO. PE-TS-412-614-C001 | |
|---|---|---|---|
| | | SECTION | |
| | | REV. NO. 0 | DATE 07.02.2017 |

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**This Technical Specification consists of two Sections:**

**SECTION I**

- SPECIFIC TECHNICAL REQUIREMENTS.

**SECTION II**

- STANDARD TECHNICAL SPECIFICATION.
- REFERENCE QUALITY PLAN

## COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

01. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

02. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations.'

03. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

04. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

05. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description& quantities as per the specification shall prevail).

06. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.

    The charges for 3rd party inspection (Lloyds, or equivalent) for imported components shall be included in the base price of the equipment by the bidder.

07. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval.

08. GA drawings/ datasheet / QP as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.

09. All sub vendors shall be subject to BHEL/CUSTOMER approval.

10. Any special tools & tackles, if required, shall be in bidder's scope.

# SECTION-I

## SPECIFIC TECHNICAL REQUIREMENTS

## 1.0 SCOPE

### 1.01 SUPPLY OF VIBRATION ISOLATION SYSTEM (VIS):

i) Vibration Isolation System (VIS)
ii) Tools and facilities required for erection and commissioning including seaworthy packing & transportation etc. complete.

### 1.02 SUPERVISION OF ERECTION AND COMMISSIONING OF THE VIS.

Vendor shall deploy experienced manpower for setting the VIS in position and final adjustments after machine installation. Vendor shall also confirm the readiness at site before deploying the manpower for supervision of erection. Vendor shall furnish proposed erection strategy of the entire system and procedure for replacement of VIS and downtime involved.

### 1.03 DESIGN & ENGINEERING FOR THE VIBRATION ISOLATION SYSTEM AND TOP DECK (INCLUDED IN VENDOR'S SCOPE)

Design and engineering shall consist of the following:

i) Selection of Vibration Isolation System (VIS).
ii) Static and dynamic analysis and design of RCC deck slab (supporting arrangement for the equipment supported on VIS)
iii) Calculation of loads on supporting structure along with their points of application and deflection limitations.
iv) Calculation should establish that not more than 10 % of the dynamic loads are transmitted to the substructure supporting VIS and that the foundation system meets the amplitude/frequency requirements.
v) Checking of stiffness for structure supported on VIS.

### 1.04 DOCUMENTATION

Vendor shall furnish following documents:

i) Bill of materials of various elements included in the supply along with detailed specifications of system and various items included in supply and standards local or international standards to which they conform.
ii) General Arrangement (GA) drawing showing location and supporting details of VIS. **(Included in vendor's scope).**
iii) GA and reinforced concrete details drawings for deck slab including bar bending schedule. **(Included in vendor's scope).**
iv) Embedment drawings showing location of all embedment and their details pertaining to RCC deck slab-**(Included in vendor's scope).**
v) Design document. **(Included in vendor's scope).**
vi) Methodology of providing the shuttering and its removal as well as concreting of deck slab, installation of VIS and sequence of above operation.
vii) Installation and maintenance manual indicating equipment, procedures, etc. necessary for installation/maintenance of VIS.
viii) List of power plants where such systems have been successfully installed for such applications.

ix) Performance certificate from the end user/customer for at least two successfully executed contracts for such system.

## 2.0 GENERAL:

2.1 In case of any conflict between section –I and section-II, section-I will prevail over section-II.

2.2 Vibration Isolation system (VIS) shall consist of steel helical springs and viscous damper.

2.3 The isolation efficiency of the foundation system comprising RCC deck and steel helical springs shall be at least 90%.

2.4 Bidder shall quote based on the input drawings as per Table-1 to satisfy the design requirement as per the relevant applicable codes in annexure- A and section - II.

Table-1

| Sl. No | TITLE | DRAWING NO. |
|---|---|---|
| 1 | FOUNDATION ARRANGEMENT FOR BFP & DRIVE TURBINE (SH 1/3) | HY-DG-412-139-0111(R0) |
| 2 | FOUNDATION ARRANGEMENT FOR BFP & DRIVE TURBINE (SH 2/3) | HY-DG-412-139-0111(R0) |
| 3 | FOUNDATION ARRANGEMENT FOR BFP & DRIVE TURBINE (SH 3/3) | HY-DG-412-139-0111(R0) |
| 4 | FOUNDATION ARRANGEMENT OF MD BFP SET (SH 1/2) | HY-DG-1-18000-57719 (R0) |
| 5 | FOUNDATION ARRANGEMENT OF MD BFP SET (SH 2/2) | HY-DG-1-18000-57719 (R0) |

2.7 Bidder shall furnish the information about the entire range of spring units, damper units and spring cum damper units, manufactured by the vendor. The information to be furnished should include the load carrying capacity, stiffness (vertical & horizontal), damping resistance, dimension of spring and damper units as well as quality plan.

2.8 The steel helical springs and viscous damper supplied should be of proven make.

## 3.0 DOCUMENTS TO BE SUBMITTED BY VENDOR

3.1 Document submission schedule after the award of contract shall be as below:

| PACKAGE | BHEL DRG NO | DRG TITLE | Drg Submission schedule |
|---|---|---|---|
| VIS FOR TD/MD BFP FOUNDATION | **Primary Documents** - affecting Manufacturing/ Delivery Directly | | |
| | PE-V0-412-614-C201 | Data sheet of VIS for BFP Foundation | R-0 within Two (02) weeks from LOI/PO & subsequent revisions within 10 days of comments received from BHEL/customer. |
| | PE-V0-412-614-C202 | QAP of VIS for BFP Foundation | |
| | PE-V0-412-614-C203 | Test certificate of VIS for BFP Foundation | |
| | PE-V0-412-614-C204 | Static & dynamic Analysis of VIS for TDBFP Foundation | |
| | PE-V0-412-614-C205 | Static & dynamic Analysis of VIS for MDBFP Foundation | |
| | PE-DG-412-614-C001 | Civil GA drwg of TD BFP Foundation | |
| | PE-DG-412-614-C002 | Civil GA drwg of MD BFP Foundation | |
| | **Secondary Documents** - NOT affecting Manufacturing / Delivery Directly | | |
| | PE-DG-412-614-C003 | RC details of Top Deck of TD BFP Foundation | R-0 within Two (02) weeks of Cat-I(or)II approval on GA drawing |
| | PE-DG-412-614-C004 | RC details of Top Deck of MD BFP Foundation | |

3.2 The documents shall be submitted as mentioned below:

i. Soft copy of all documents/drawings shall be furnished in pdf and AutoCAD format as applicable.
ii. Hard copies shall also be submitted.
iii. Submission of civil drawings/documents shall be as mentioned in the table-2.

Table-2

| | Drawing | Document |
|---|---|---|
| For Approval | Soft copy + 4 nos. hard copies | Soft copy + 4 nos. hard copies |
| For RFC | Soft copy + 7 nos. hard copies | |

## 4.0 SEISMIC LOADING:

The site is located in Zone III as per IS: 1893/Part I -2003 & IS: 1893- Part II- 2005.

Zone factor (Z) shall be 0.16

Importance factor shall be considered as 1.75.

## 5.0 WIND LOADING:

Basic wind speed at project site is 50 m/sec. as per IS: 875-1987 (Part 3).

Probability factor,(k1 risk coefficient), terrain, height and structure size factor, k2 and topography

factor, k3 shall be as per IS:875.

## 6.0 MATERIAL OF CONSTRUCTION

i. Minimum grade of concrete: M35.
ii. Reinforcing bars will be TMT bars of grade Fe500 conforming to IS-1786.

## 7.0 MATERIAL (DESIGN & SUPPLY)

7.1 Steel helical springs and viscous dampers shall consist of:

i. Steel helical spring units and viscous dampers along with viscous liquid including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads, etc.

ii. Frames for pre-stressing of spring elements.

iii. Suitable hydraulic jack system. required for the erection, alignment etc. of the spring units

iv. Any other items may be required for the pre-stressing, erection, release of pre-stress, alignment and commissioning of the steel helical springs and viscous dampers.

7.2 The sizes of the spring units, damper units, spring cum damper units should be such that groups of such units can be accommodated on column heads in case of elevated foundations and on Pedestals/walls in case of foundations at ground level.

7.3 The steel helical springs and viscous dampers shall be designed for ensuring "fit and forget" guarantee.

## 8.0 MANUFACTURING & TESTING

8.1 Complete manufacturing and testing of the steel helical springs and viscous dampers shall be done at the manufacturing shop of the vendor. For this purpose the vendor shall submit the detailed programme for approval of customer and take up the manufacturing / testing after approval of such programme. The programme (quality plan) shall include:

i. Manufacturing schedule and quality check exercised during manufacturing.
ii. Detail of test to be carried out at the manufacturing shop with its schedule.
iii. Special requirements, if any, regarding concreting of top deck.
iv. Complete step- by- step procedure covering the installation and commissioning of the spring system.
v. Manuals for erection, commissioning, testing and maintenance of the steel helical springs and viscous dampers.
vi. A checklist for confirming the readiness of the civil fronts for erection of steel helical springs and viscous dampers.
vii. Checklist for equipment required at each stage of erection.
viii. Bill of materials (data sheet) of various elements such as spring units, viscous dampers, with their rating, stiffness etc. included in the supply.
ix. Bill of material (data sheet) for frames for pre stressing, hydraulic jack including electric pump, high pressure tubes, hand operated pump etc. with their rating and numbers.
x. Any other details which may be necessary to facilitate design and construction of the foundations / structures.

8.2 The springs shall conform to codes DIN 2089 and DIN 2096. The quality assurance and inspection procedure shall be finalised on the basis of the above codes and the quality plans be drawn accordingly.

## 9.0 ERECTION AND COMMISSIONING AND SUPERVISION

9.1 Complete erection and commissioning of the steel helical springs and viscous dampers including pre-stressing of elements, placing of elements in position, checking clearances on the shuttering of the RCC top deck, releasing of pre-stress in spring elements, making final adjustments and alignments etc. all shall be supervised by a specialist supervisor.

9.2 The scope of work shall be deemed to include all activities, which may not have been explicitly mentioned but are reasonably implied for the successful commissioning of steel helical springs and viscous dampers.

## 10.0 REALIGNMENT OF SPRING SYSTEM

If any realignment of the steel helical springs and viscous dampers is required to be done for aligning the shaft or for any other reasons during the first one year of operation from the date of commissioning of the machine, the same shall be done by the vendor.

## 11.0 TRANSPORTATION

11.1 Steel helical springs and viscous dampers shall be suitably protected, coated, covered, boxed and crated to prevent damage or deterioration during transit and handling.

11.2 The vendor shall be responsible for any loss or damage during transportation, handling.

## 12.0 INSPECTION REQUIREMENTS

12.1 Minimum requirement for quality plan shall be as per quality plan attached in section –II of the specification. Quality plan shall be subject to approval during detail engineering. No price implication shall be admissible to QP approval by BHEL/Customer.

12.2 Inspection for imported item shall be done from third party like Lloyd or equivalent and certificate shall be submitted for review of BHEL.

12.3 In case of new bidder, bidder may need to carry out damping test, stiffness test etc. during customer approval stage before price bid opening. No price implication shall be admissible for these tests.

## ANNEXURE-A

### Codes and Standards

Latest revision of following codes shall be used for the design of the spring-supported foundations:

| | |
|---|---|
| IS: 456 | Codes practice for plain and reinforced concrete. |
| IS: 2974 | Code of practice for design and construction of machine foundations. |
| IS: 1893 | Criteria for earthquake resistant design of structures. |
| DIN: 4024 | Machine foundations; Flexible supporting structures for machine with rotating masses |
| DIN: 2089 | Helical compression springs out of round wire and rod: calculation & design. |
| DIN: 2096 | Helical compression springs out of round wire and rod: quality requirements for hot formed compression springs. |
| VDI: 2056 | Criteria for assessing mechanical vibrations of machine. |
| VDI: 2060 | Criteria for assessing the state of balance of rotating rigid bodies. |

# SECTION-II

# STANDARD TECHNICAL SPECIFICATION

## 1.0 SCOPE :

This section covers supply, supervision of erection commissioning & design engineering of the vibration isolation system (VIS) suitable for ID/PA/FD Fans/ TDBFP/MDBFP/ TURBOGENERATORS/ MILLS. The vibration isolation system shall be of proven make and should be in successful operation for similar machines.

## 2.0 SUPPLY OF VIBRATION ISOLATION SYSTEM (VIS)

VIS shall be supplied complete along with recommended spares if any. The selection of VIS shall be done by the vendor, in case not done by customer so that the amplitude at bearing locations are within permissible limits as per machine supplier recommendation or ISO 10816 whichever is governing and no dynamic loads are transferred to structure supporting VIS. Minimum 90% isolation shall be achieved and the system shall be capable of withstanding Seismic/Wind forces.

## 3.0 SUPERVISION OF ERECTION AND COMMISSIONING

### 3.01 Manual

Vendor shall supply installation and maintenance manual indicating equipment procedures etc. necessary for installation and replacement of VIS with downtime involved.

### 3.02 Tools and facilities

Vendor shall supply all tools and facilities as required for successful erection and commissioning of VIS. Vendor shall deploy experienced manpower to supervise successful installation of VIS.

## 4.0 DESIGN ENGINEERING OF VIBRATION ISOLATION SYSTEM

### 4.01 Dynamic Analysis

The dynamic analysis shall consist of free vibration analysis and forced vibration analysis. Isolation efficiency of at least 90% shall be obtained. The fundamental natural frequency shall be sufficiently above or below the frequency corresponding to operating speed. Vibration amplitude shall be calculated at all bearing locations and shall satisfy the permissible limits as per ISO 10816 or as specified by the machine supplier. Transient analysis shall be carried out for the short circuit / blade failure condition with an appropriate force function if required by the machine supplier. The forces for which substructure is to be designed shall be furnished.

### 4.02 Static Analysis

The static analysis shall include the

a) Dead weights of machine stationary parts
b) Dead weights of machine rotary parts
c) Loads due to machine power torque
d) Loads due to maximum allowable unbalance
e) Temperature loads
f) Loads due to blade unbalance/short circuit
g) Erection loads
h) Seismic loads
i) Any other loads given by the supplier

Various loads combinations must be investigated to obtain the most severe loads for

foundation design purpose as per relevant IS codes or as per machine supplier recommendation whichever is more critical.

### 4.03 CHECK FOR SHAFT MISALIGNMENT

Foundation deck must be adequately stiff to withstand all operating load combinations without excessively upsetting the rotor shaft alignment. The structural design must carefully be analysed for relative deflection for the members supporting machine shaft to satisfy the limits as given by machine supplier if any.

### 4.04 DESIGN OF RCC DECK SUPPORTED ON VIS

Vendor shall provide General arrangement drawing of deck showing location and supporting detail of VIS, all embedment and their details as per the machine supplier drawing.
RCC design shall be done by working stress method for all machine foundations. Minimum reinforcement shall be governed by IS: 2974 as well IS:456.
All documents/drawings shall be supplied in 25 (twenty five) prints. All calculations shall be supplied in 6 (six) sets. Soft copy of the drawings in Auto Cad shall be supplied along with the soft copy of the documents supplied. All documentation shall be in English language and all RCC/structural design shall be conforming to the relevant Indian Standard Code of practice.

## 5.0 QUALITY PLAN AND TEST CERTIFICATE

Vendor shall furnish the quality plan and Test certificate for the hardware in their scope of supply. The quality plan shall be reviewed by BHEL/Consultant wherein the inspection and hold points shall be indicated. Vendor shall submit test certificate based on approved quality plan. Despatch of material by the vendor shall only take place after the receipt of Material Dispatch Clearance Certificate (MDCC) issued by BHEL/Consultant on the basis of test reports/test certificates submitted by the Vendor after manufacture.

## 6.0 ENVIRONMENTAL PROTECTION

VIS shall be suitably protected against environmental damages e.g. abrasion, discolouration, corrosion, oily water etc. to give a prolonged service matching the plant life.

## SECTION-II

## REFERENCE QUALITY PLAN

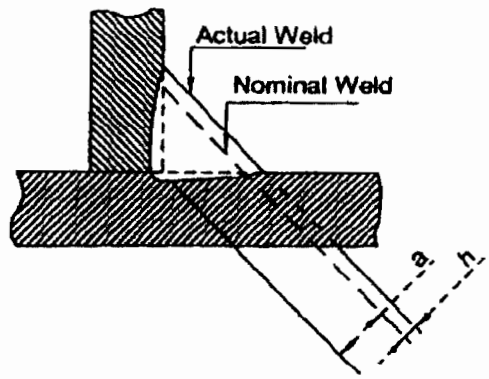
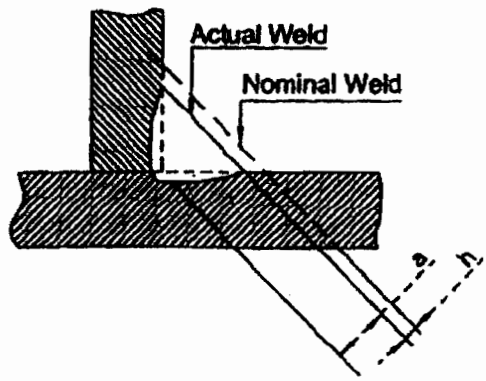
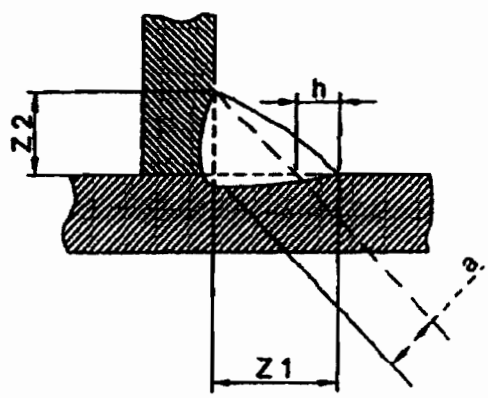
| Manufacturer's logo | Manufacturer's name and Address | **MANUFACTURING QUALITY PLAN (I-QAP)**<br>**ITEM** : Vibration isolation system<br>**Equipment:**<br>**Spring Unit**: Module name as per Vendor | QP No:<br>Rev :<br>Date :<br>Page : | Project:<br>Main supplier: BHEL<br>BHEL P.O NO: |
|---|---|---|---|---|

| Sl. No. 1 | COMPONENT AND OPERATION 2 | CHARACTERISTICS 3 | CLASS 4 | TYPE OF CHECK 5 | QUANTUM OF CHECK 6 | REFERENCE DOCUMENT 7 | ACCEPTANCE NORMS 8 | FORMAT OF RECORD 9 | AGENCY 10 | | | | REMARKS 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | D | M | C | B | |
| 1 | **Materials** | | | | | | | | | | | | |
| 1.1 | For boxes | Chemical/Mechanical | Minor | Verify | One / Heat | IS 2062/DIN EN 10025/ JVHT 02/JVHHT 01B00/SAILMA 350 HI/SAILMA 350 or equivalent | Same as column "7" | Certificate | √ | P | V | V | |
| 1.2 | For Springs | a) Chemical | Major | Verify | One / Lot | 50 Cr V 4 As per DIN 17221 or 51 Cr V 4 As per EN10089 or Equivalent | Same as column "7" | Certificate | √ | P | V | V | |
| | | b) Grain Size | Major | Verify | One / Lot | ASTM E 112 | ASTM 5 or finer | Certificate | √ | P | V | V | |
| | | c) NMI | Major | Verify | One / Lot | IS 4163 | ABCD series T/H-2.0/1.5 | Certificate | √ | P | V | V | |
| | | d) Micro structure | Major | Verify | One / Lot | -- | DIN 17221or equivalent | Certificate | √ | P | V | V | |
| 1.3 | Springs at Manufacturer's end | Hardness | Major | Test | One/Lot | IS 1500 | 415-460 BHN | Certificate | √ | P | V | V | |
| 1.4 | Springs at Manufacturer's end | Decarburization | Major | Test | One / Lot | IS 6396 | Max. depth 0.5% of bar dia - partial | Certificate | √ | P | V | V | |
| 1.5 | Springs at Manufacturer's end | NDE after compression | Major | Test | 100% | IS 3703 | No cracks | Certifcate | √ | P | V | V | |
| 1.6 | Springs ( at vendor end) | Spring Rate | Major | Test | AQL 4.0 | DIN 2096 | Same as column "7" | Lab Register | √ | P | V | V | |
| 1.7 | Adhesive pads (jute),4mm thick, Steel shims | Dimensions (mm) | Minor | Measure / Visual | 5 % | Drawing | DIN 7168 Sg | Internal Record | √ | P | V | V | |
| 1.8 | Viscoliquid | Viscosity/ Penetration speed (mm/sec) | Major | Test | Sample | DIN 53019 or equivalent | Same as column "7" | Certificate | √ | P | V | V | |
| 1.9 | Studs & Nuts | Chemical<br>Dimensions (mm) | Minor<br>Minor | Verify<br>Measure | One / Lot<br>5% | IS 1367 (Grade 6.8 & Class 6)<br>IS 4218 (Tolerance Class 6g & 6H) | Same as column "7"<br>Same as column "7" | Lab Test Report | √ | P | V | V | |
| 2 | In Process Inspection | | | | | | | | | | | | |
| 2.1 | Welding | Visual / Surface exam (mm) | Major | Visual / Measure | 10% on welds | Annexure-1( attached) | Same as column "7" | Certificate | √ | P | V | V | |
| | | NDE | Major | DPT | 10% Random | ASTM / E 165 | Same as column "7" | Certificate | √ | P | V | V | |
| 2.2 | Boxes | Dimensions (mm) | Major | Measure | 10% | Drawing & data sheet | EN ISO 13920 C | Internal record | √ | P | V | V | |
| 3 | Final Inspection | | | | | | | | | | | | |
| 3.1 | Shot Blasting | Picture | Major | Compare | 10% | EN ISO12944-4 | SA – 2 ½ | Certificate | √ | P | V | V | |
| 3.2 | Painting | Thickness (180 microns) | Major | Measure / Visual | 10% | Annexure-2( attached) | Same as column "7") | Certificate | √ | P | V | V | |
| 3.3 | Spring Unit | Dimensions (Except HF&HV) | Minor | Measure | 10% | Drawing / Datasheet | EN ISO 13920 C | Internal Record | √ | P | W | V | |
| 3.4 | Constant of Spring Units (Vertical; Kv) | Load Vs Displacement (kN/mm) | Critical | Test | 10% | DIN 2096 & DIN 2089 | Data Sheet | Certificate | √ | P | W | V | |
| 3.5 | Document Control | Verification of above documents (TC/IR) | Major | Compare | All | MQP | Same as column "7" | Certificate | √ | P | V | V | |
| 3.6 | Packing / Marking | Visual | Major | Visual / Compare | 100% | As per vendor's standard | Same as column "7" | Certificate | √ | P | | | |

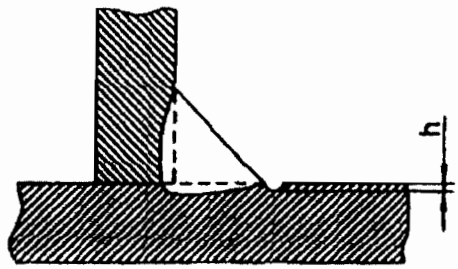
| MANUFACTURER/ SUB-CONTRACTOR CONTRACTOR | LEGEND:<br># RECORDS, IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION<br>M: MANUFACTURER/ SUB-CONTRACTOR C: : MAIN SUPPLIER, B: CUSTOMER<br>INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION | | |
|---|---|---|---|
| SIGNATURE | | REVIEWED BY | NAME & SIGNATURE OF APPROVING AUTHORITY WITH SEAL |

# ANNEXURE - 1
# WELDING

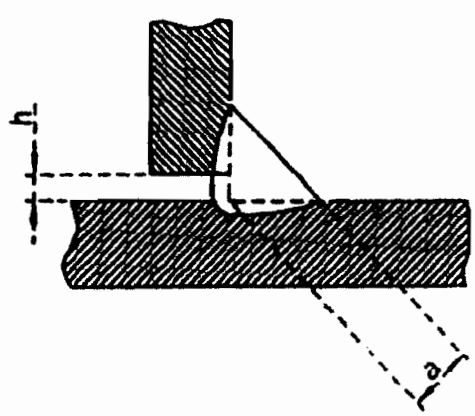
WELDING DETAILS

| Sl No | Imperfection Designation | Outside status | Limits for Imperfection with reference to quality level: DIN EN 25817 / D |
|---|---|---|---|
| 1. | Excessive convexity |  | $h \leq 1mm + 0.25\ b$ ; max. 5mm |
| 2. | Fillet weld having a throat thickness smaller than the nominal value |  | Short imperfections: $h \leq 0.3$ mm + 0.1.a ; max. 2mm<br>Long imperfections: Not Permitted |
| | | A fillet weld with an apparent throat thickness smaller than that prescribed should not be regarded as being imperfect if the actual throat thickness with a compensating greater depth of penetration complies with the nominal value. | |
| 3. | Excessive asymmetry of fillet weld |  | $h \leq 2mm + 0.2\ a$ |
| | | It is assumed that the asymmetric fillet weld has not been expresly prescribed. | |

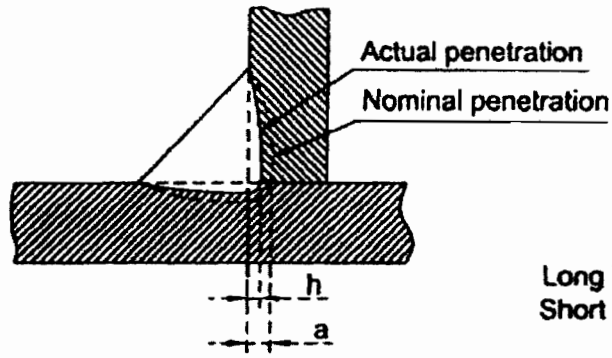
WELDING DETAILS

| Sl No | Imperfection Designation | Outside status | Limits for Imperfection with reference to quality level: DIN EN 25817 / D |
|---|---|---|---|
| 4. | Undercut |  | |
| | | Smooth transition is required | h ≤ 1.5mm |
| 5. | Gas pores and porosity | The following conditions and limits for imperfections shall be fulfilled | |
| | | a) Maximum dimension of the summation of the projected or surface crack area of the imperfection. | 4% |
| | | b) Maximum dimension of a single pore for<br>-butt welds<br>-fillet welds | <br>d ≤ 0.5 s<br>d ≤ 0.5 a |
| | | c) Maximum dimension for a single pore | 5 mm |
| 6. | Localised (clustered) porosity | The total pore area within the cluster should be summed and calculated as a percentage of the greater of the two areas; an envelop surrounding all the pores or a circle with a diameter corresponding to the weld width. | |
| | | The permitted porous area should be local. The possibility of masking other imperfections should be taken into consideration. | |
| | | The following conditions and limits for imperfections shall be fulfilled: | |
| | | a) Maximum dimension of the summation of the projected or suface crack area of the imperfection | 16% |
| | | b) Maximum dimension of a single pore for<br>-butt weld<br>-fillet weld | <br>d ≤ 0.5 s<br>d ≤ 0.5 a |
| | | c) Maximum dimension for localised clustered porosity. | 4mm |

## WELDING DETAILS

| Sl No | Imperfection Designation | Outside status | Limits for Imperfection with reference to quality level: DIN EN 25817 / D |
|---|---|---|---|
| 7. | Elongated cavities, worm holes | Long imperfections for<br>-butt welds<br>-fillet welds<br>In any case, maximum dimension for elongated cavities, worm holes | <br>$h \leq 0.5\ s$<br>$h \leq 0.5\ a$<br><br>2mm |
| | | Short imperfections for<br>-butt welds<br>-fillet welds<br>In any case, maximum dimension for elongated cavities, worm holes | <br>$h \leq 0.5\ s$<br>$h \leq 0.5\ a$<br><br>4mm or Not Larger Than Thicknes (NLTT) |
| 8. | Solid inclutions (other than copper) | Long imperfections for<br>-butt welds<br>-fillet welds<br>In any case, maximum dimension for elongated cavities, worm holes | <br>$h \leq 0.5\ s$<br>$h \leq 0.5\ a$<br><br>2mm |
| | | Short imperfections for<br>-butt welds<br>-fillet welds<br>In any case, maximum dimension for elongated cavities, worm holes | <br>$h \leq 0.5\ s$<br>$h \leq 0.5\ a$<br><br>4mm or Not Larger Than Thicknes (NLTT) |
| 9. | Lack of fusion (Incomplete fusion) | | Permitted, but only intermittently and not breaking the surfaces |
| 10. | Bad fit-up, fillet weld |  <br>An excessive or insufficient gap between the parts to be joined. Gaps exceeding the appropriate limit may in cases be compensated for by a corrsponding increase in the throat. | $h \leq 1mm + 0.3\ a$ max. 4mm |

WELDING DETAILS

| Sl No | Imperfection Designation | Outside status | Limits for Imperfection with reference to quality level: DIN EN 25817 / D |
|---|---|---|---|
| 11. | Incomplete penetration |  | Long inperfections: Not permitted<br>Short imperfections: h ≤ 0.2 s, max. 2mm |
| 12. | Cracks | All types of cracks | Not Permitted |
| 13. | Crater cracks | | Permitted |
| 14. | Spatters | Fused welding splashes are material trickless (drops) fused to the basic material or welding seam. | Permssible |
| 15. | Stray flash or arc strike | Ignition points are local fuses caused by the electric arc on the surface of the basic material or welding seam. | Permssible |

Abbreviations

a nominal fillet weld throat thickness (fillet thickness), in mm
b width of weld reinforcement, in mm
d pore diameter in mm
h size (height or width) of imperfection, in mm
l length of imperfction, in mm
s nominal butt weld thickness or, in the case of partial penetration, the prescribed depth of penetration, in mm
t tube-wall- or plate thickness, in mm
z leg length of fillet welds (in case of isoscele-right angle triangular section z = a . / 2) in mm

# ANNEXURE-2

# CORROSION PROTECTION PAINTING

## REQUIREMENTS

### 1. Painting of steel parts

All steel parts must be coated immediately after short blasting according to EN-ISO 12944-4. Surface must be free of fat.

a. Material:
   M/s Southfield paints –RAL 6011 Green or equivalent
   M/s Toyo paints – RAL 1000 Black or equivalent
   M/s Akzo Nobal Coatings India Pvt. Ltd. – RAL 1004 Yellow colour or equivalent

b. Execution:
   Painting is performed as given below:
   Layer thickness:
   -Standard:
   One layer coating thickness of minimum 100 microns.
   -Long term protection:
   Two layers coating to total thickness of minimum 180 microns.

c. Mixing of paint compounds:
   The compounds (mother paint, accelerator, thinner) must be mixed according to instructions of the paint manufacture. The mixing procedure has to be adjusted to the ambient climatic situation.

d. Coating:
   Coating is performed with spray gun. Baking temperature 80 °C. furnace exposing time 45 minutes.

e. Coating thickness control:
   Measurements to be taken at 5 random points. Acceptable thickness is 10% below specified thickness.

### 2. Springs

All the springs must be powder coated by "Electrostatic powder coating spray process" (EPS).

a. Preparation:
   Springs must be oil free
b. Execution:
   Electrostatic spray coating with an epoxy polyester powder. Baking temperature 190 °C +10 °C. furnace exposing time of 40 minutes.
   Colour: Black.
c. Coating thickness:
   Coating thickness must be minimum of 70 microns.

**Note.**

1. The colour of paint is subjected to as per customer requirement.