

MEGHA ENGINEERING & INFRASTRUCTURES LTD.
1X525 MW TUTICORIN (UNIT-1) AT THOOTHUKUDI DISTRICT TAMILNADU

**TECHNICAL SPECIFICATION
FOR
VIBRATION ISOLATION SYSTEM
FOR
ID FAN (2 NOS) FOUNDATION**

SPECIFICATION NO. : PE-TS-422-618-C001 (Rev 0)



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



TITLE :
TECHNICAL SPECIFICATION FOR
VIS FOR ID FAN (2 NOS) FOUNDATION

SPECIFICATION NO. PE-TS-422-618-C001

SECTION

REV. NO. 0

DATE 12.09.2016

CONTENTS

This Technical Specification consists of two Sections:

SECTION I

- SPECIFIC TECHNICAL REQUIREMENTS.

SECTION II

- STANDARD TECHNICAL SPECIFICATION.
- REFERENCE QUALITY PLAN



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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.



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SECTION-I

SPECIFIC TECHNICAL REQUIREMENTS



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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 5 % 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.



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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 Steel helical springs and viscous damper shall be provided as vibration isolation system (VIS).
- 2.3 The supplier must have requisite experience and proven track record of similar installation in power plants of unit capacity not less than 500 MW.
- 2.4 Approved manufacturer will be used in which case the guaranteed life to be equal to the project life is to be provided by the BIDDER.
- 2.5 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

<u>Sl. No</u>	<u>TITLE</u>	<u>DRAWING NO.</u>
1	GENERAL ARRANGEMENT OF INDUCED DRAFT FAN	0-00-099-27571 (R01)

- 2.6 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.
- 2.7 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:



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PACKAGE	BHEL DRG NO	DRG TITLE	Drg Submission schedule
VIS FOR ID FAN	Primary Documents - affecting Manufacturing/ Delivery Directly		
	PE-V0-422-618-C201	Data sheet of VIS FOR ID FAN	R-0 within Two (02) weeks from LOI/PO & subsequent revisions within 10 days of comments received from BHEL/customer.
	PE-V0-422-618-C202	QAP FOR VIS FOR ID FAN	
	PE-V0-422-618-C203	Test certificate of VIS FOR ID FAN	
	PE-V0-422-618-C204	Static & dynamic Analysis of ID FAN	
	PE-V0-422-618-C001	Civil GA drwg of ID FAN	
	Secondary Documents - NOT affecting Manufacturing / Delivery Directly		
	PE-V0-422-614-C002	RC details of TOP DECK OF ID FAN	R-0 within Two (02) weeks of Cat-I(or)II approval on GA drawing

3.2 The documents shall be submitted as mentioned below:

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

Table-2

	Drawing	Document
For Approval	Soft copy + 5 nos. hard copies	Soft copy + 5 nos. hard copies
For RFC	Soft copy + 5 nos. hard copies	

4.0 SEISMIC LOADING:

The lateral forces will be established in accordance with the recommendations of IS-1893. The site falls in Zone-II as per IS 1893:2002. However all the structures have to designed and detailed as per provision of Zone-III. Importance factor (I) shall be taken as 1.75 (Table 2 of IS 1893 (PART IV): 2005).

5.0 WIND LOADING:

Wind loading will be in accordance with Indian Standard Code IS: 875 (Part 3) for a basic wind speed of 37 m/sec. Terrain Category-2 shall be considered for all structures.

Risk coefficient (k1), terrain category & topography factor shall be followed as per IS 875 (part III) for all structures.

6.0 MATERIAL OF CONSTRUCTION

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



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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 including electric pumps, high pressure tubes etc. required for the erection, alignment etc. of the spring units. One set of extra hydraulic jacks, and hand operated pumps shall also be provided.
- 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 objective of designing the supporting arrangement for any rotating equipment shall be so that the vibration level is maintained as minimum as possible under all operating conditions. Accordingly respective rotating equipment shall be supported on RCC deck slab which in turn shall rest on vibration isolation unit consisting of steel helical springs and viscous dampers, which in turn shall be supported on RCC supporting structure. The above design shall form part of this specification.

7.3 The spring units should have stiffness in both vertical and horizontal directions with the horizontal stiffness not less than 30% of vertical stiffness. The stiffness should be such that the vertical natural frequency of any spring unit at its rated load carrying capacity is not more than 3 to 5 Hz.

7.4 The damper units or spring cum damper units should be of viscous type offering velocity proportional damping. The damper units should be suitable for temperatures ranging from 0 to 50^o c. The damping resistance of the individual damper units should be such that the designed damping can be provided using reasonable number of units. Damper units shall have damping resistance ranging from 40kNsec/m to 750 kN-sec/m.

7.5 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.

7.6 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.



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- 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.
- 9.3 The vendor shall guarantee the performance of the steel helical springs and viscous dampers for 24 months from the date of commissioning of each machine which shall be termed as "Guarantee Period".

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.



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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.



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SECTION-II

STANDARD TECHNICAL SPECIFICATION

AND

REFERENCE QUALITY PLAN



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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



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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.

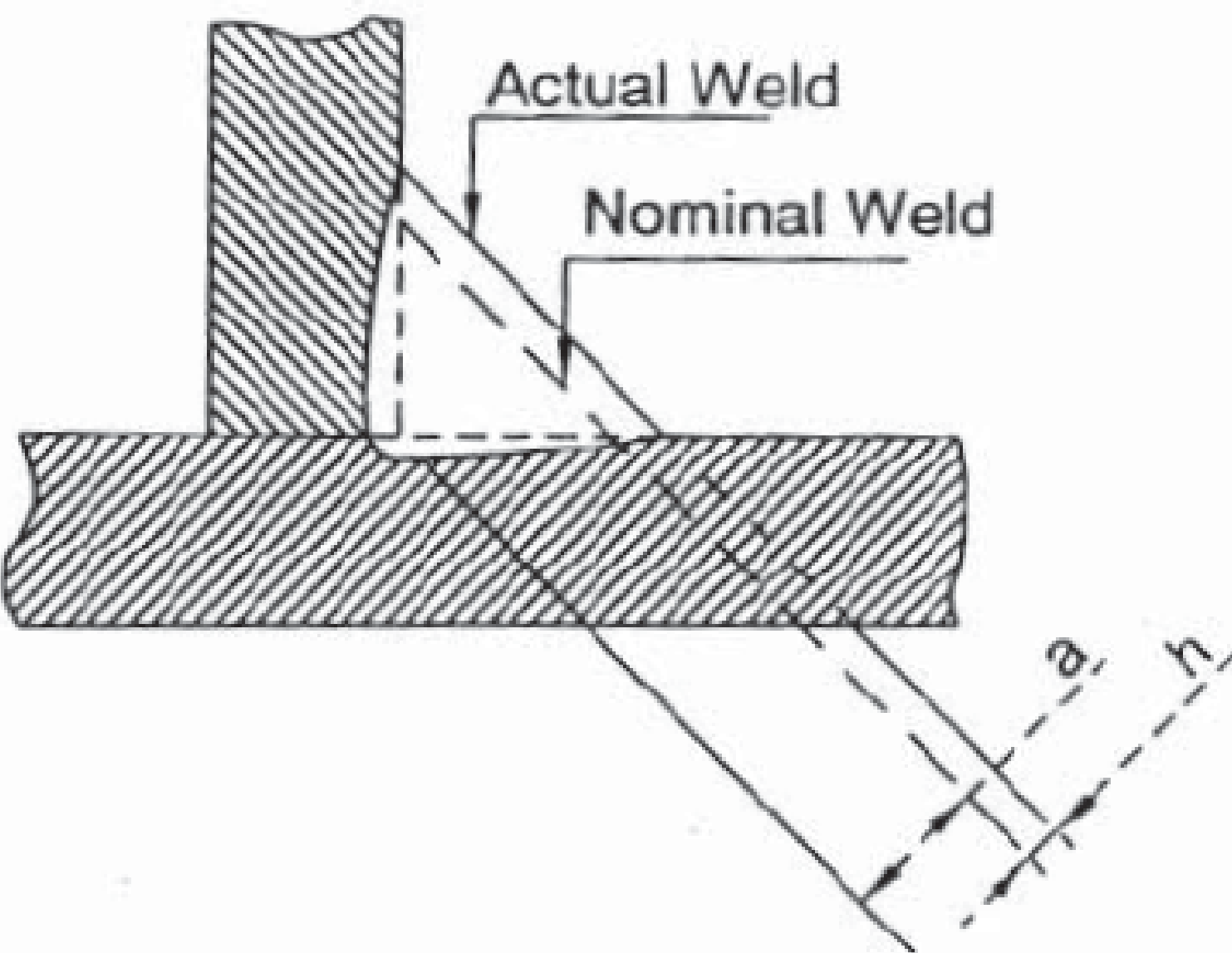
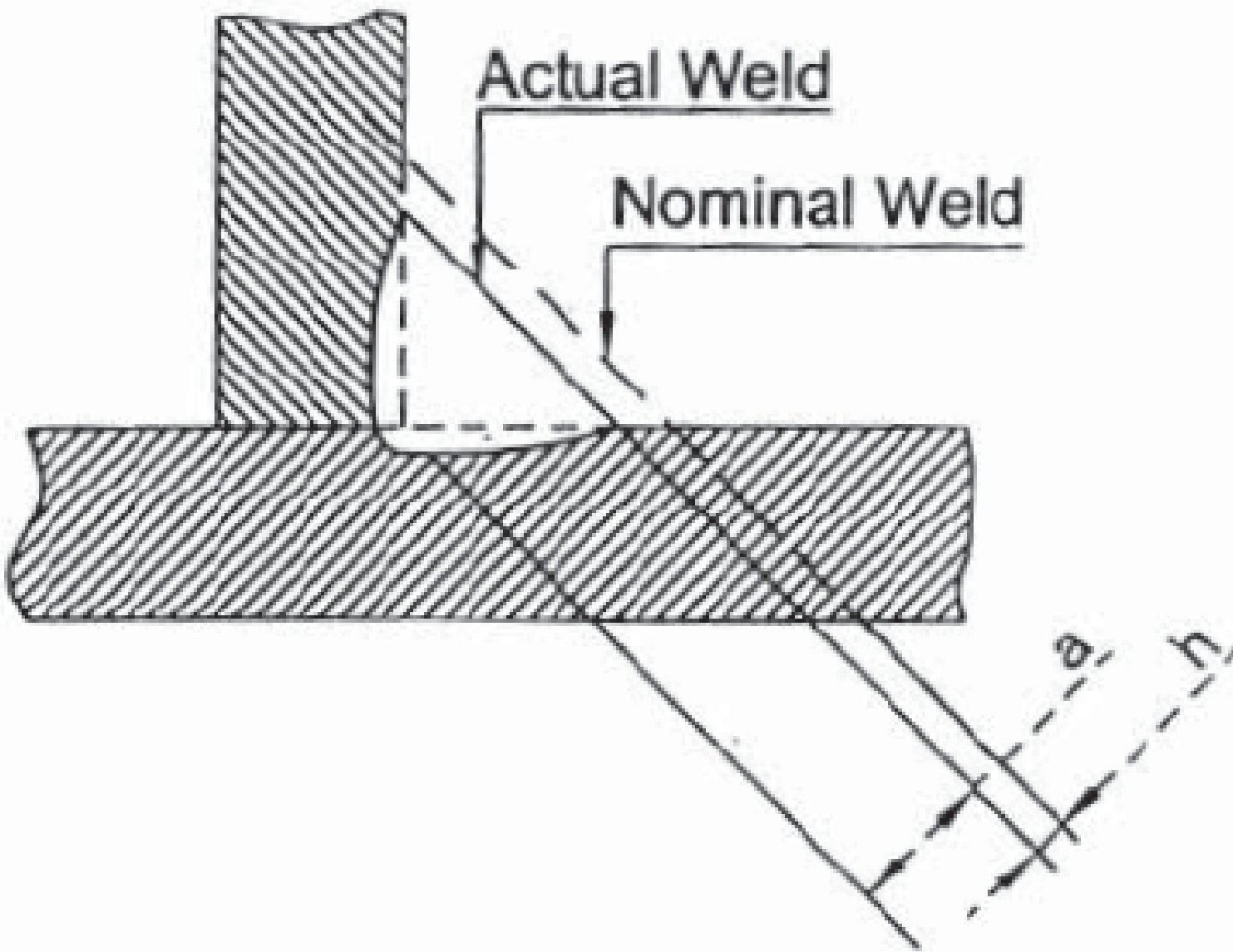
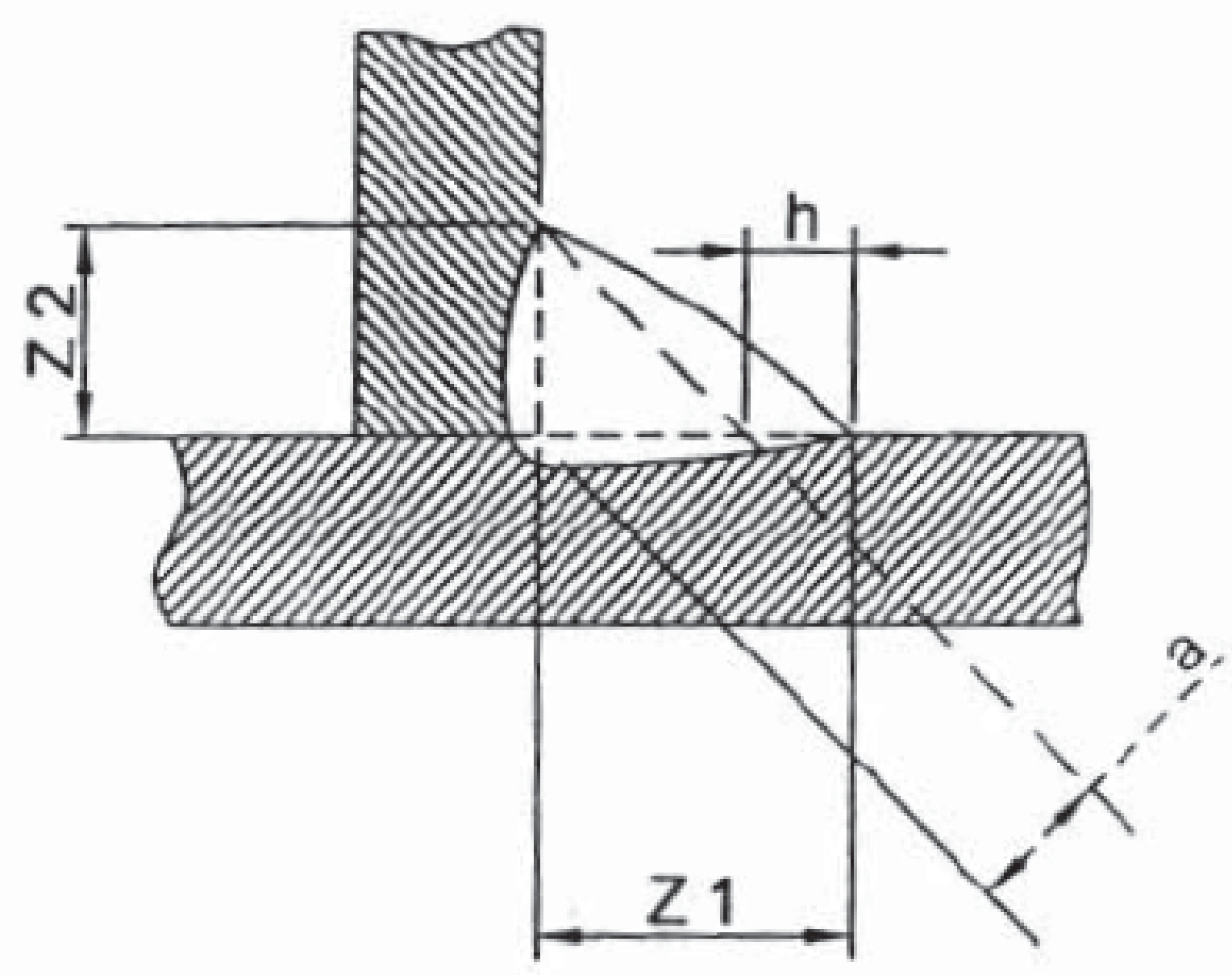
REFERENCE QUALITY PLAN

						MANUFACTURING QUALITY PLAN (I-QAP)									
						ITEM : Equipment: Spring Unit:		QP No: Rev : Date : Page :							
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	Certificate	✓	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	Same as column "7"	Certificate	✓	P	V	V			
1.9	Studs & Nuts	Chemical Dimensions (mm)	Minor Minor	Verify Measure	One / Lot 5%	IS 1367 (Grade 6.8 & Class 6) IS 4218 (Tolerance Class 6g & 6H)	Same as column "7" 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	W			
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	W			
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: # RECORDS, IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION M: MANUFACTURER/ SUB-CONTRACTOR C: : MAIN SUPPLIER, B: BHEL/CUSTOMER INDICATE 'P' PERFORM 'W' WITNESS AND 'V' VERIFICATION		REVIEWED BY		NAME & SIGNATURE OF APPROVING AUTHORITY WITH SEAL				
SIGNATURE															

ANNEXURE - 1

WELDING

WELDING DETAILS

SI No	Imperfection Designation	Outside status	Limits for Imperfection with reference to quality level: DIN EN 25817 / D
1.	Excessive convexity		$h \leq 1\text{mm} + 0.25\text{ } b \text{ ; max. } 5\text{mm}$
2.	Fillet weld having a throat thickness smaller than the nominal value	 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.	Short imperfections: $h \leq 0.3\text{ mm} + 0.1.a \text{ ; max. } 2\text{mm}$ Long imperfections: Not Permitted
3.	Excessive asymmetry of fillet weld	 It is assumed that the asymmetric fillet weld has not been expressly prescribed.	$h \leq 2\text{mm} + 0.2\text{ } a$

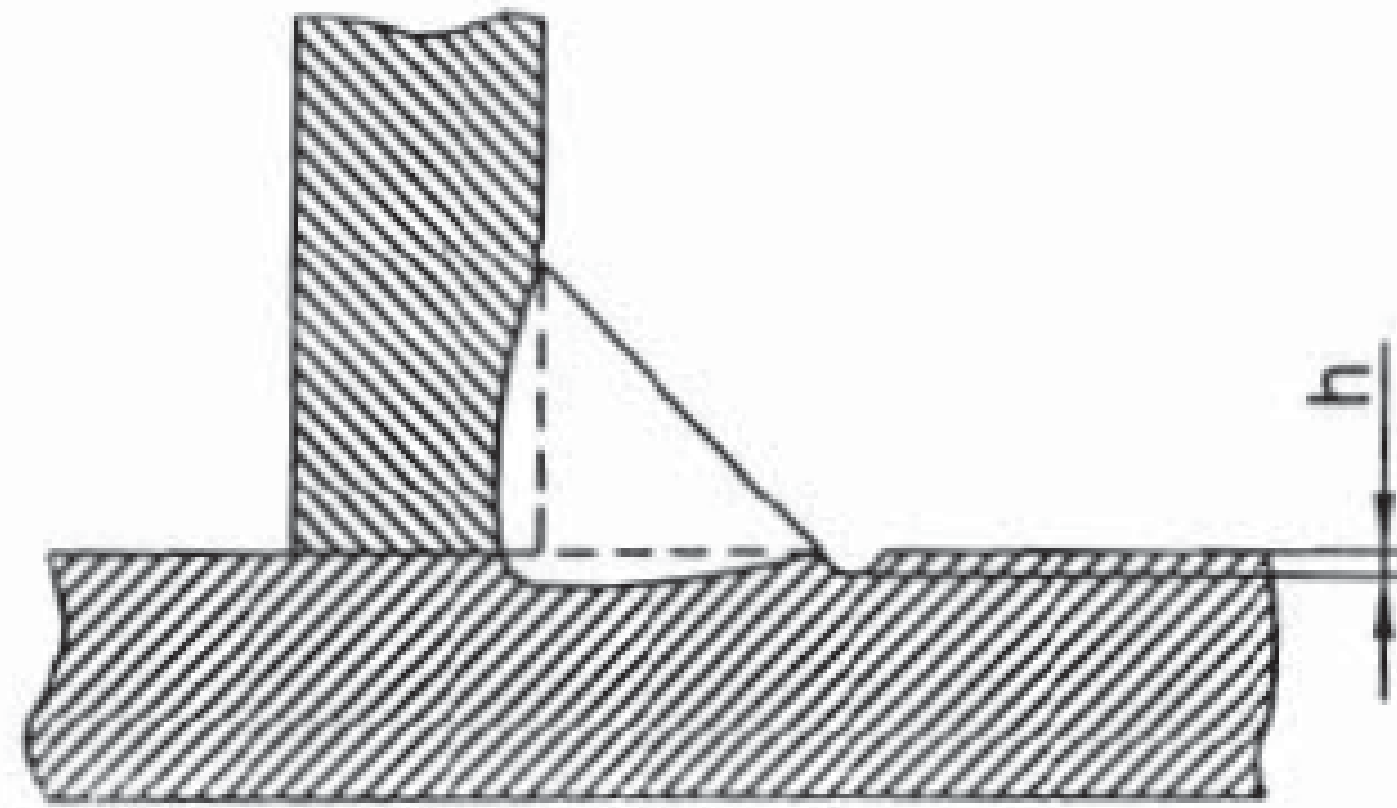
WELDING DETAILS

Limits for Imperfection with
reference to quality level:
DIN EN 25817 / D

SI
No Imperfection
Designation

Outside status

4. Undercut



Smooth transition is required

$h \leq 1.5\text{mm}$

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
-butt welds
-fillet welds

$d \leq 0.5 s$
 $d \leq 0.5 a$

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 surface crack area of the imperfection

16%

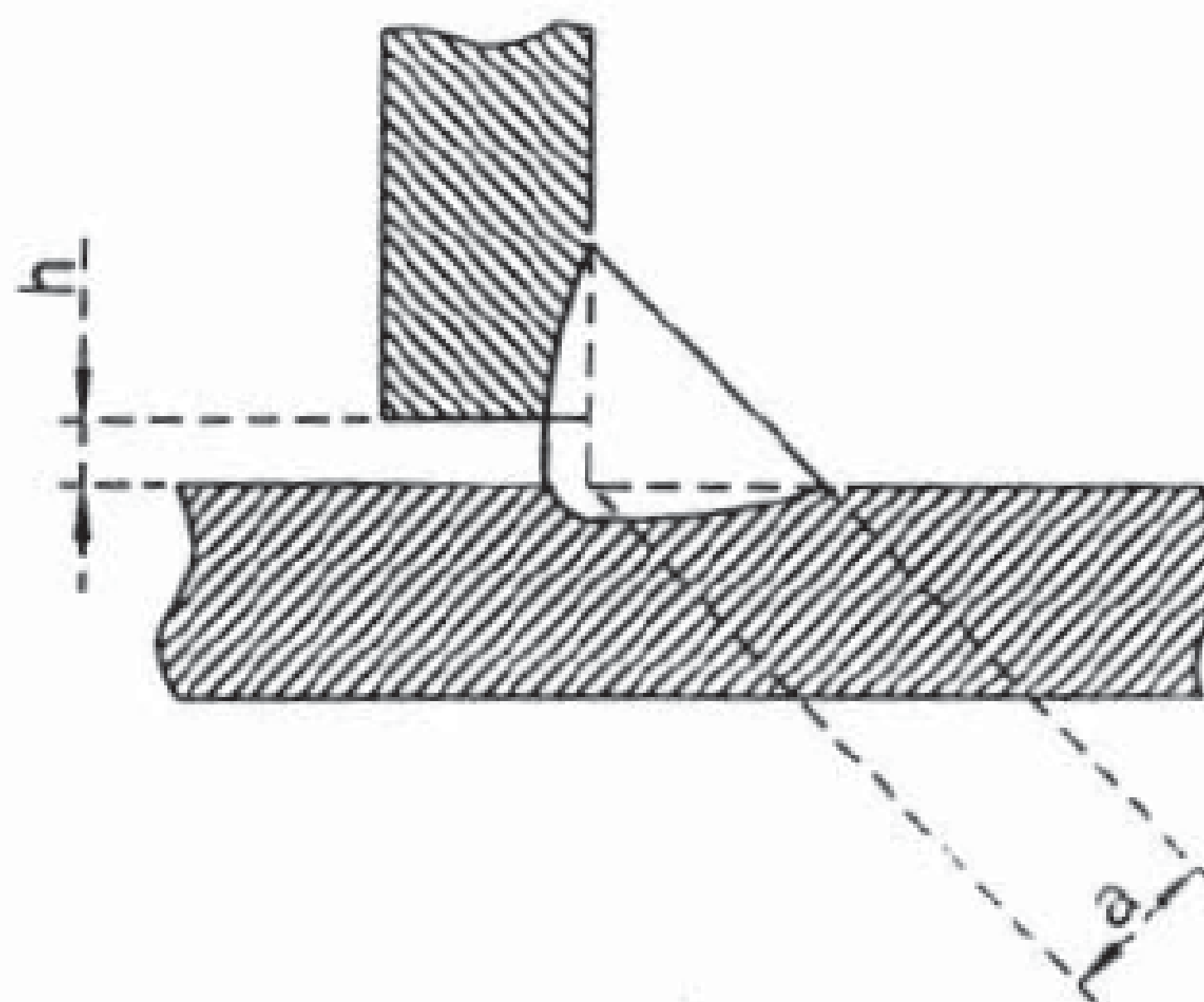
b) Maximum dimension of a single pore for
-butt weld
-fillet weld

$d \leq 0.5 s$
 $d \leq 0.5 a$

c) Maximum dimension for localised clustered porosity.

4mm

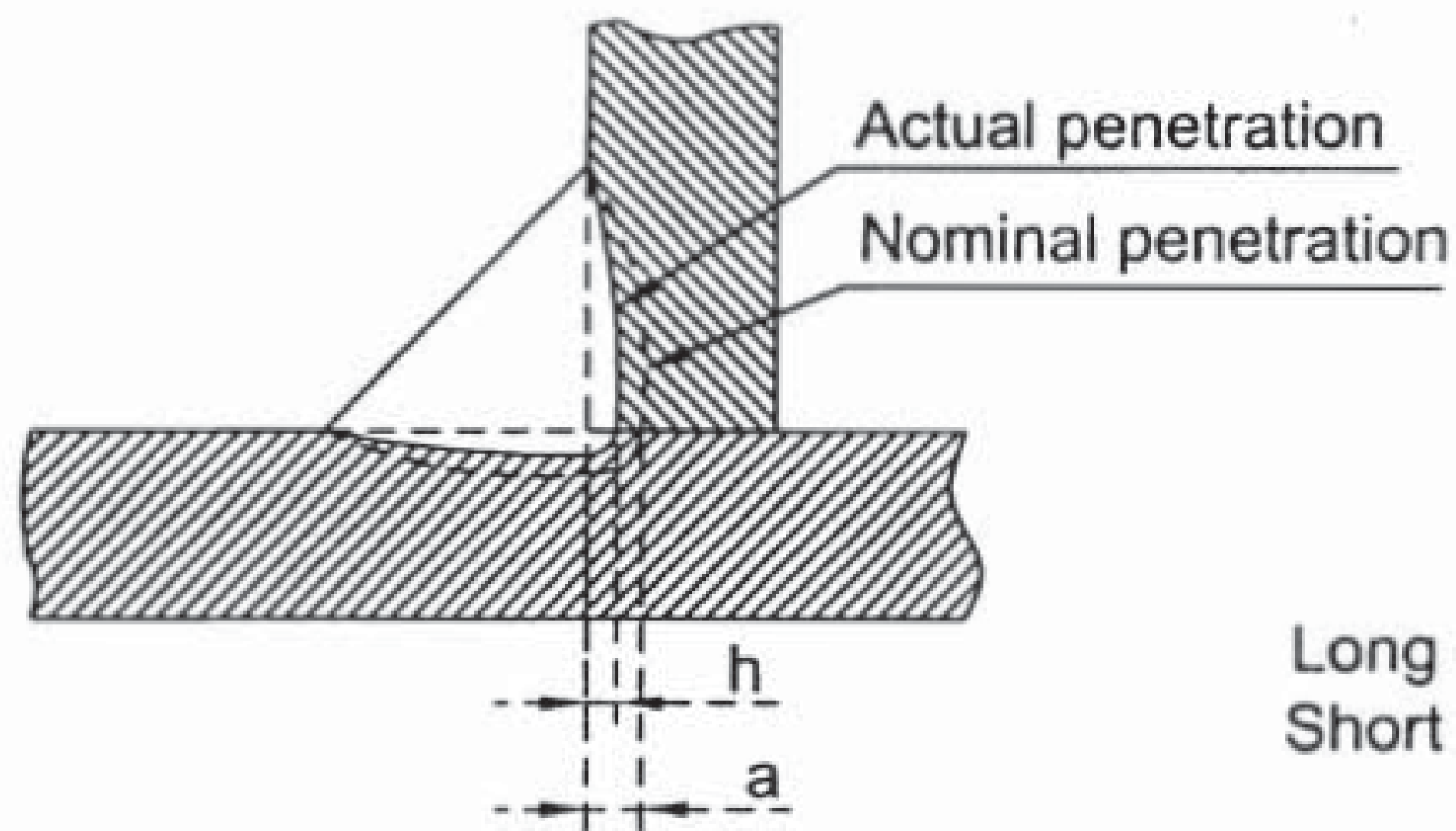
WELDING DETAILS

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 -butt welds -fillet welds In any case, maximum dimension for elongated cavities, worm holes	$h \leq 0.5 s$ $h \leq 0.5 a$ 2mm
		Short imperfections for -butt welds -fillet welds In any case, maximum dimension for elongated cavities, worm holes	$h \leq 0.5 s$ $h \leq 0.5 a$ 4mm or Not Larger Than Thickness (NLTT)
8.	Solid inclusions (other than copper)	Long imperfections for -butt welds -fillet welds In any case, maximum dimension for elongated cavities, worm holes	$h \leq 0.5 s$ $h \leq 0.5 a$ 2mm
		Short imperfections for -butt welds -fillet welds In any case, maximum dimension for elongated cavities, worm holes	$h \leq 0.5 s$ $h \leq 0.5 a$ 4mm or Not Larger Than Thickness (NLTT)
9.	Lack of fusion (Incomplete fusion)		Permitted, but only intermittently and not breaking the surfaces
10.	Bad fit-up, fillet weld		
		An excessive or insufficient gap between the parts to be joined. Gaps exceeding the appropriate limit may in cases be compensated for by a corresponding increase in the throat.	$h \leq 1\text{mm} + 0.3 a$ max. 4mm

SI
No Imperfection
Designation

Outside status

11. Incomplete penetration



Long imperfections: Not permitted

Short imperfections: $h \leq 0.2 s$,
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.

Permissible

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.

Permissible

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 imperfection, 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 $z = a \cdot \sqrt{2} / 2$) 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 Nabal 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.

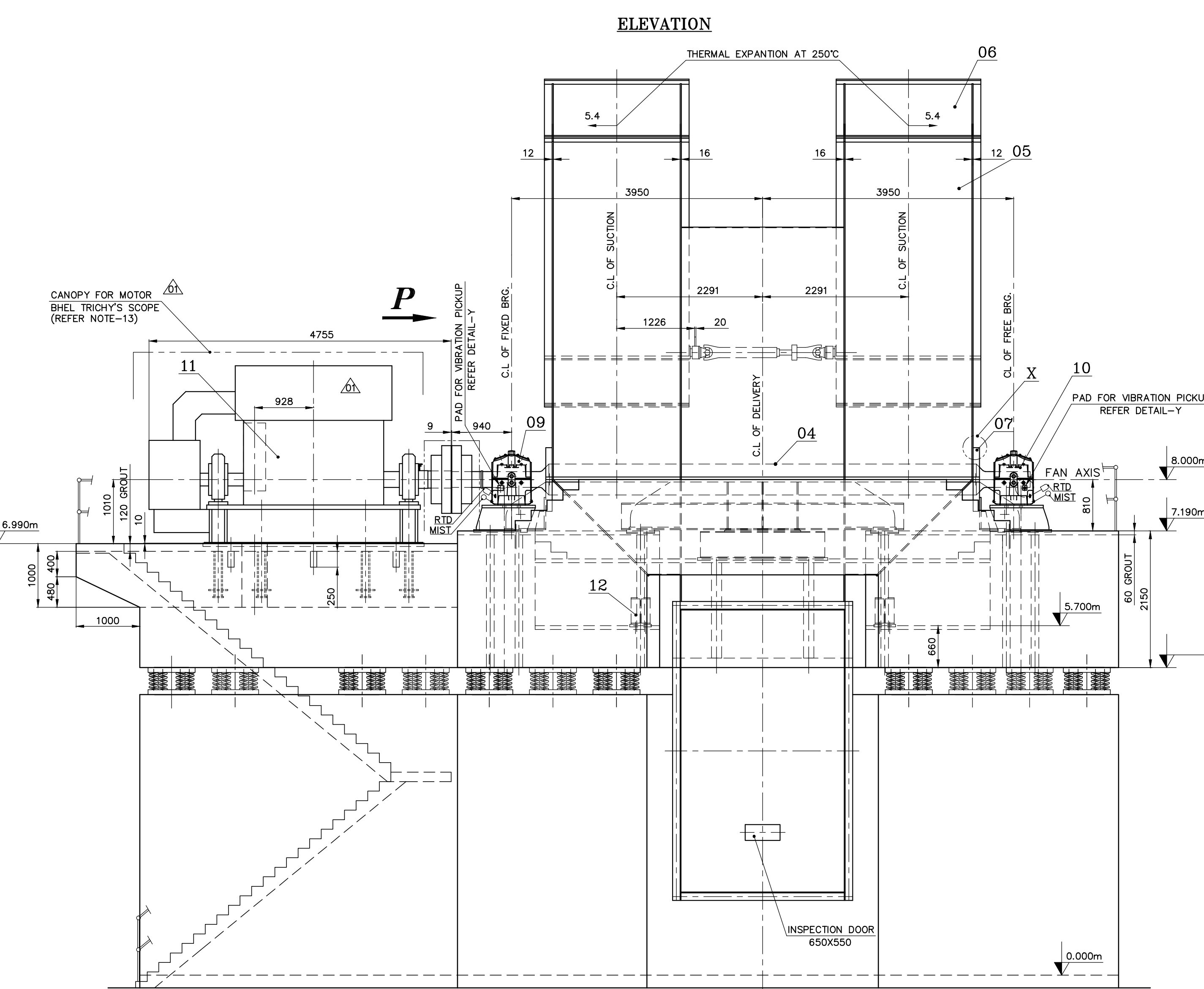
2. Springs

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

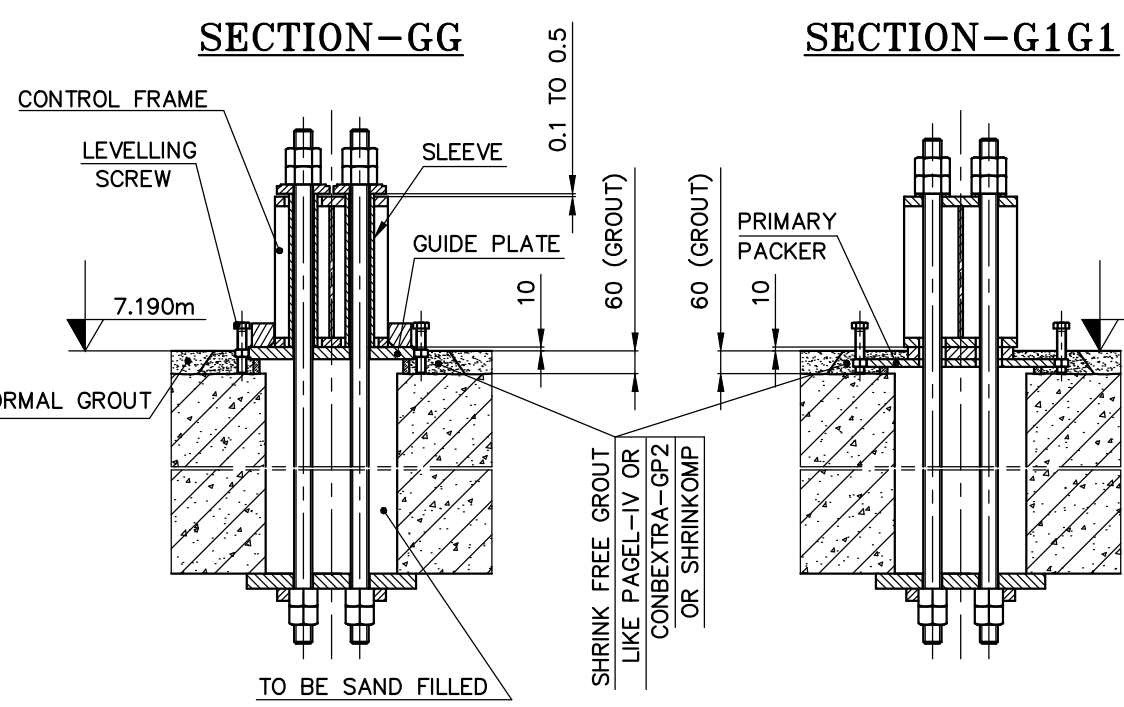
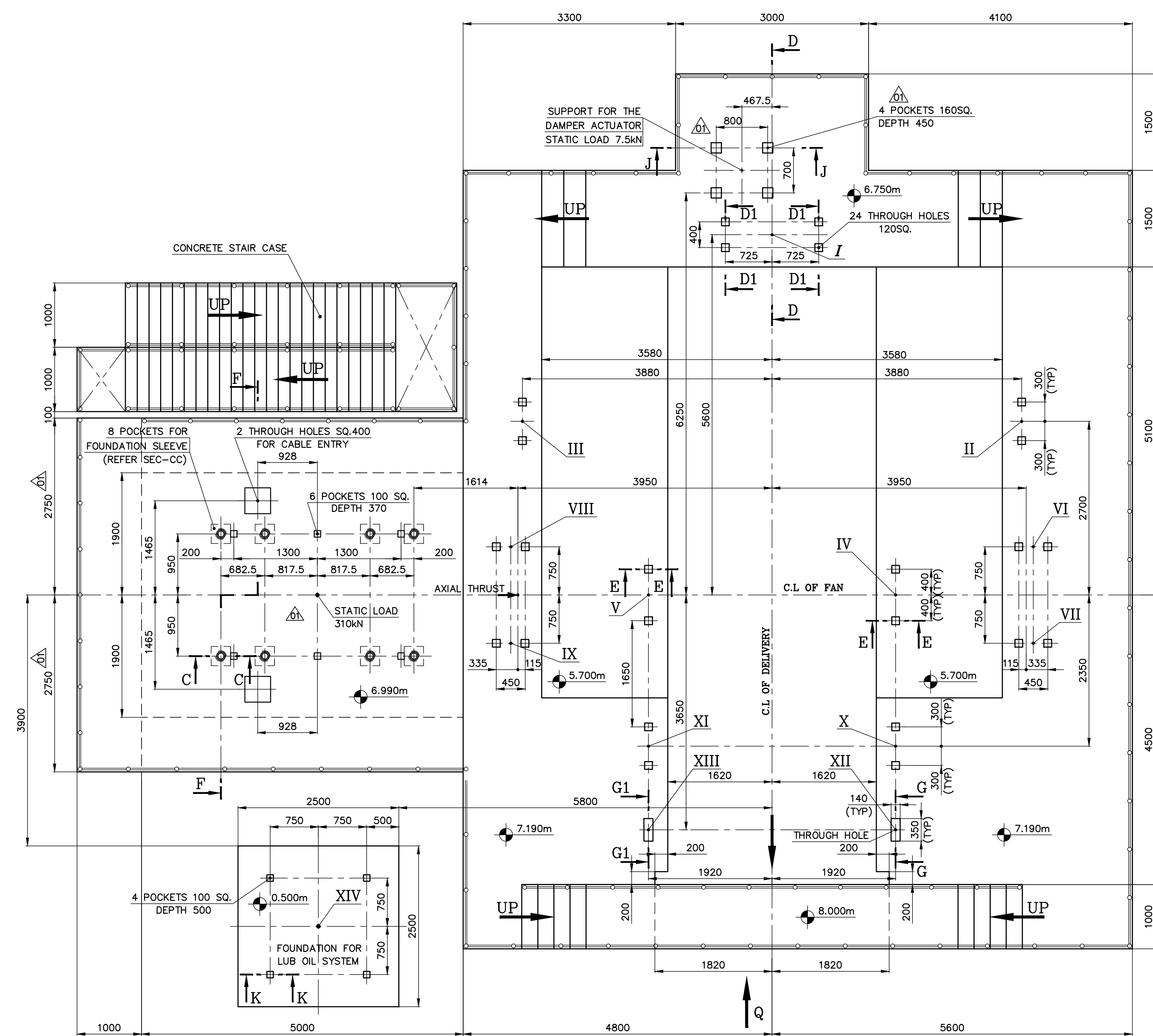
- a. Preparation:
 - Springs must be oil free
- b. Execution:
 - Electrostatic spray coating with an epoxy polyester powder. Baking temperature 190 °C +10 °C. furnace exposing time of 40 minutes.
 - Colour: Black.
- c. Coating thickness:
 - Coating thickness must be minimum of 70 microns.

Note.

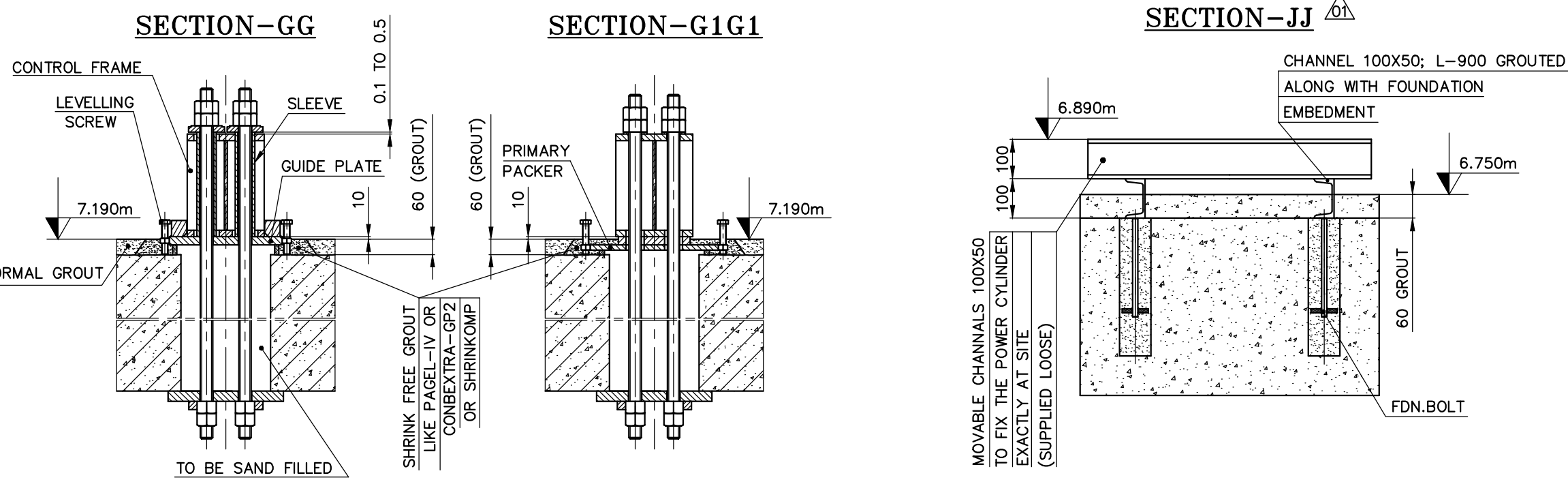
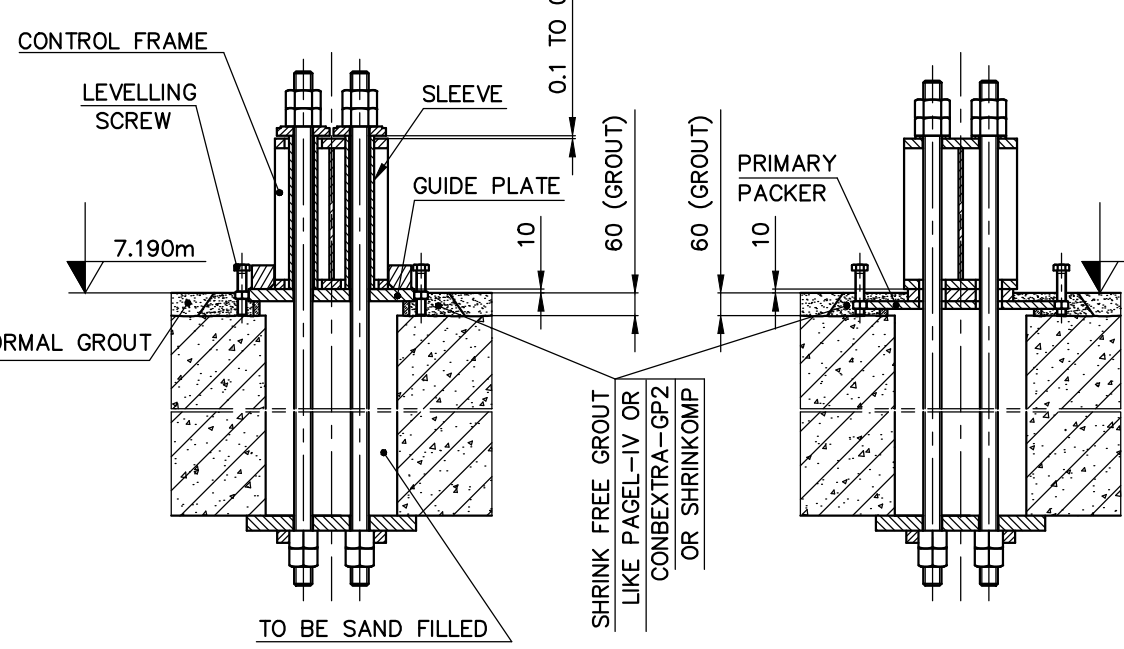
1. The colour of paint is subjected to as per customer requirement.



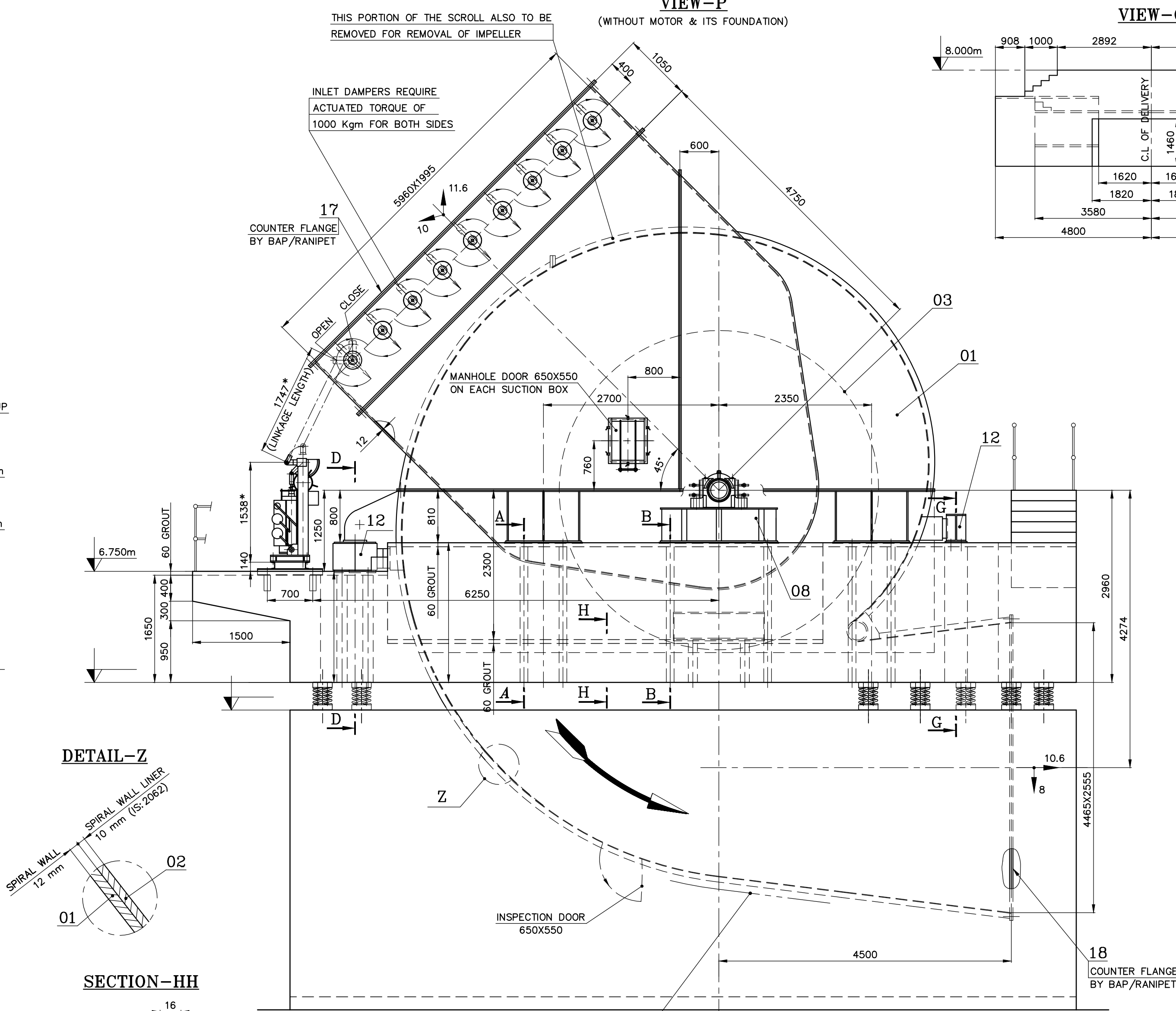
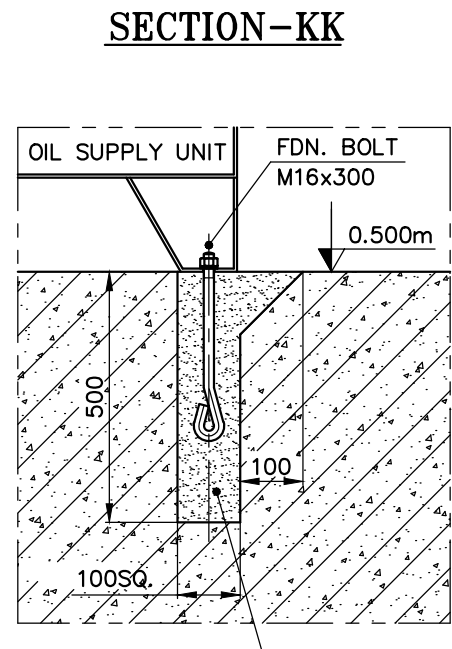
FOUNDATION PLAN



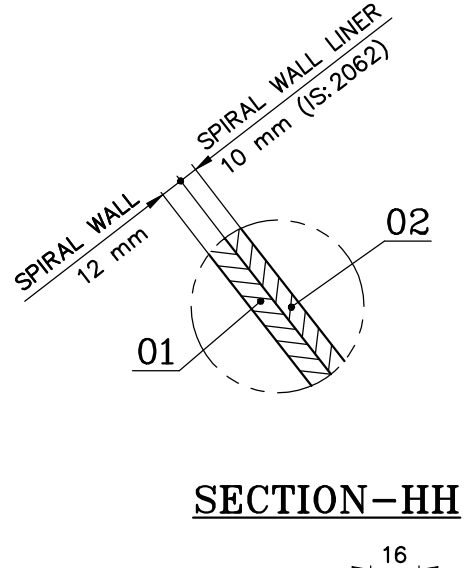
SECTION-G1G1



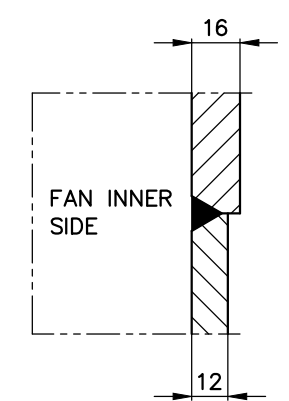
SECTION-KK



DETAIL-Z



SECTION-HH



LOAD DATA FOR FOUNDATION													Σ
LINE	LOAD POINT	LOAD CASE I			LOAD CASE II			LOAD CASE III			LOAD CASE IV		
		Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X
1	I	193	1	1	1	1	1	1	1	1	1	1	1
2	II	186	1	1	1	1	1	1	1	1	1	1	1
3	III	186	1	1	1	1	1	1	1	1	1	1	1
4	IV	5	1	1	1	1	1	1	1	1	1	1	1
5	V	5	1	1	1	1	1	1	1	1	1	1	1
6	VI	75	1	1	1	1	1	1	1	1	1	1	1
7	VII	75	1	1	1	1	1	1	1	1	1	1	1
8	VIII	75	1	1	1	1	1	1	1	1	1	1	1
9	IX	75	1	1	1	1	1	1	1	1	1	1	1
10	X	150	1	1	1	1	1	1	1	1	1	1	1
11	XI	150	1	1	1	1	1	1	1	1	1	1	1
12	XII	8	1	1	1	1	1	1	1	1	1	1	1
13	XIII	8	1	1	1	1	1	1	1	1	1	1	1
14	XIV	35	1	1	1	1	1	1	1	1	1	1	1

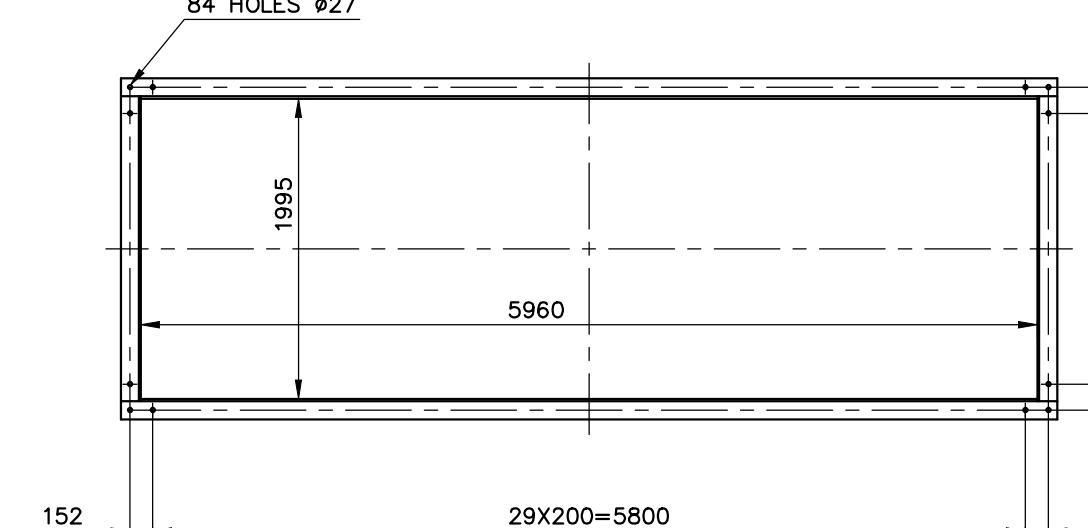
GENERAL DATA			
DESIGNATION	SYMBOL	UNIT	VALUE
WEIGHT OF ROTOR PARTS	mrot	kg	21.5
WEIGHT OF STATOR PARTS	mstat	kg	94.0
MOMENT OF INERTIA	J	kg-m ²	56000
OPERATING SPEED	n	rpm	530
1st CRITICAL BENDING SPEED	n ₁	rpm	821
HOUSING TEMPERATURE	t _h	°C	250
MAX. ROTATING UNBALANCE FORCE AT AXIS LEVEL	F _u	KN	84.2
MAX. ADMISSIBLE HORIZONTAL AMPLITUDE	s _h	mm	250
MAX. ADMISSIBLE VERTICAL AMPLITUDE	s _v	mm	250
AXIAL	s _a	mm	250
THRUST-ACTUATOR	F _{at}	KN	
TORQUE-ACTUATOR	T _{at}	kgm	

1. WITH RIGID BEARINGS.
2. WITHOUT EXTRAS FOR VIBRATIONS INDICATE UNBALANCE FORCES INCLUDING DYNAMIC AMPLIFYING DUE TO RATIO OF CRITICAL BENDING SPEED TO OPERATING SPEED.
DYNAMIC AMPLIFYING $\mu = \frac{1}{1 - \frac{n^2}{n_1^2}} = 1.99832$
3. LOAD CASE I UNBALANCE VECTOR HORIZONTAL H_x
LOAD CASE II UNBALANCE VECTOR HORIZONTAL H_y
UNBALANCE FORCE F_u AXIAL LEVEL
UNBALANCE FORCE F_v VERTICAL LEVEL
UNBALANCE FORCE F_a AXIAL LEVEL
UNBALANCE FORCE F_v VERTICAL LEVEL

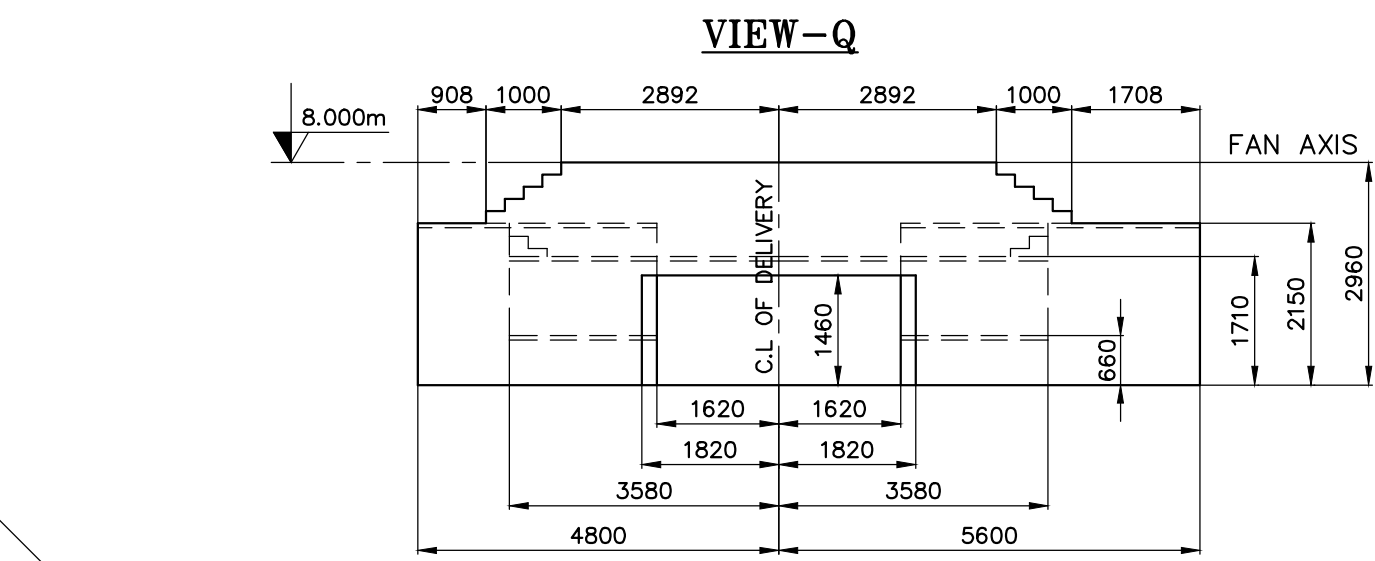
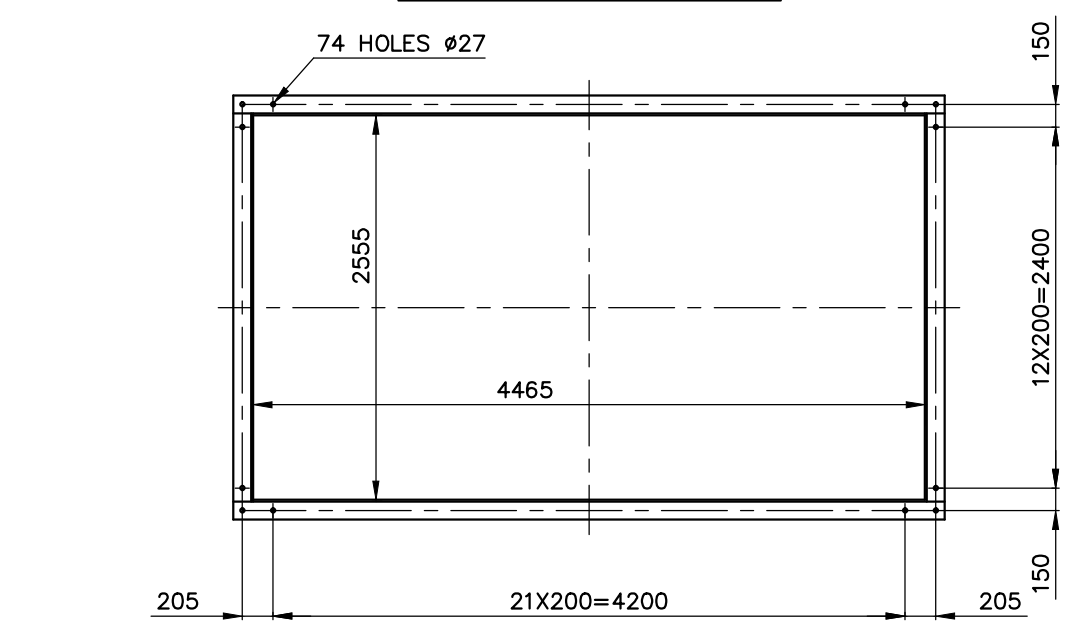
BILL OF MATERIAL

18	COUNTER FLANGE (DELIVERY)	IS 2062	-	1
17	COUNTER FLANGE (SUCTION)	IS 2062	-	2
16	WEAR LINER FOR IMPELLER BLADES	XAR 400	10	11
15	SHIMS	ASTM A240	-	AS REQD.
14	PRIMARY PACKER	IS 2062	-	AS REQD.
13	FOUNDATION FASTENERS FOR FAN	ASTM A105	-	AS REQD.
12	CONTROL FRAME	IS 2062	-	4
11	MOTOR WITH FNDN. FASTENERS	-	-	1
10	FREE BEARING ASSEMBLY	10" RT5	-	1
09	FIXED BEARING ASSEMBLY	10" RT5	-	1
08	BEARING PEDESTAL	IS 2062	-	2
07	LABYRINTH TYPE SHAFT SEAL	IS 2062 WITH NON-ASBESTOS	-	2
06	INLET DAMPER CONTROL ASSEMBLY	IS 2062	8/12	2
05	SUCTION CHAMBER	IS 2062	12	2
04	SHAFT ASSEMBLY	TYPE 10000	-	1
03	BLADES OF IMPELLER	FOR FAN MOTOR	25	11
02	SPIRAL WALL LINER ASSY.	IS 2062	10	1
01	SPIRAL CASING ASSY.	IS 2062	12/16	1
NO	DESCRIPTION	MATERIAL	THICKNESS mm	QTY.

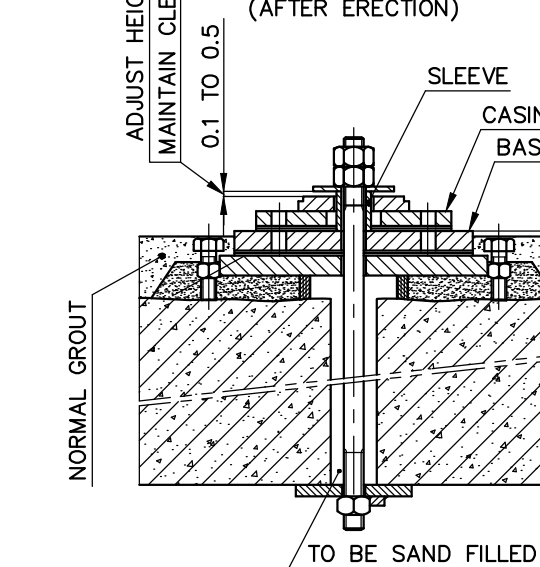
SUCTION FLANGE



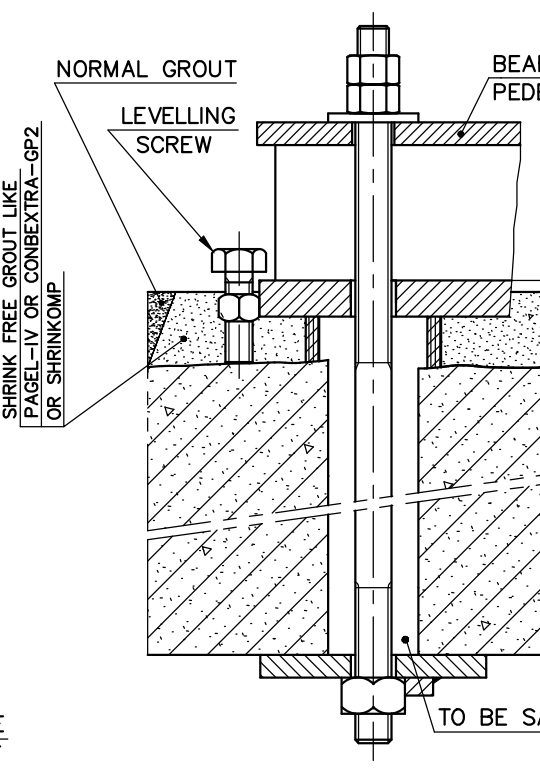
DELIVERY FLANGE



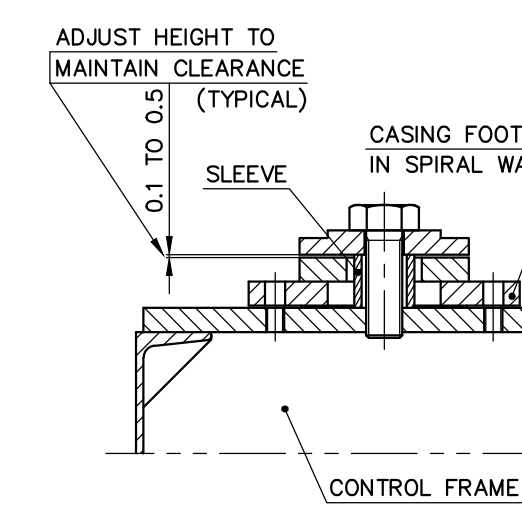
SECTION-AA



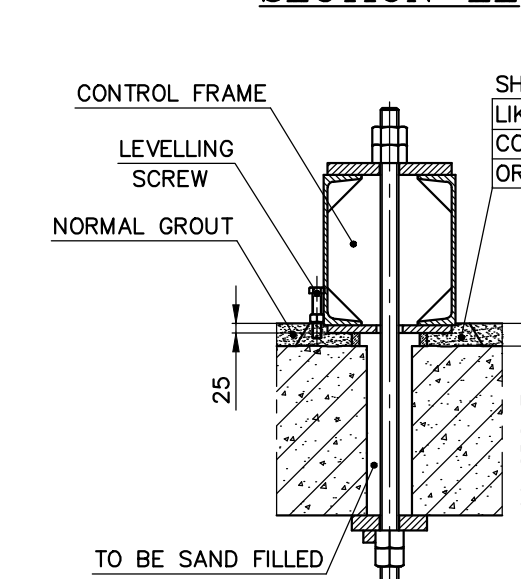
SECTION-BB



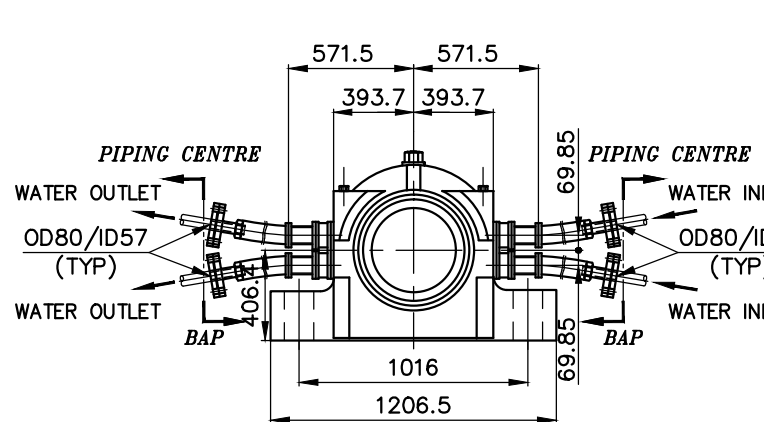
SECTION-DD



SECTION-EE

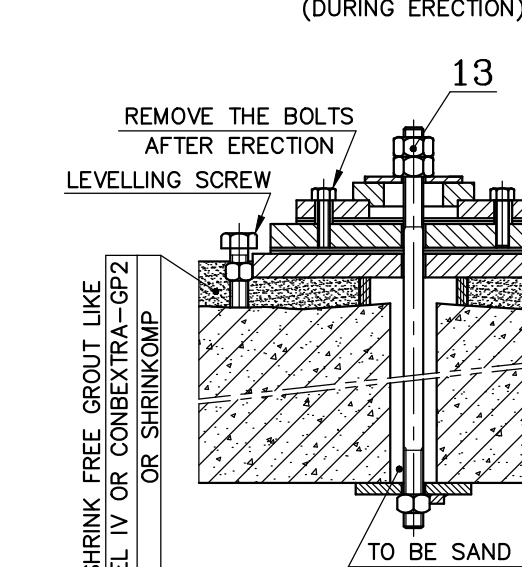


WATER CONNECTING DETAILS OF BEARING (10°RT)

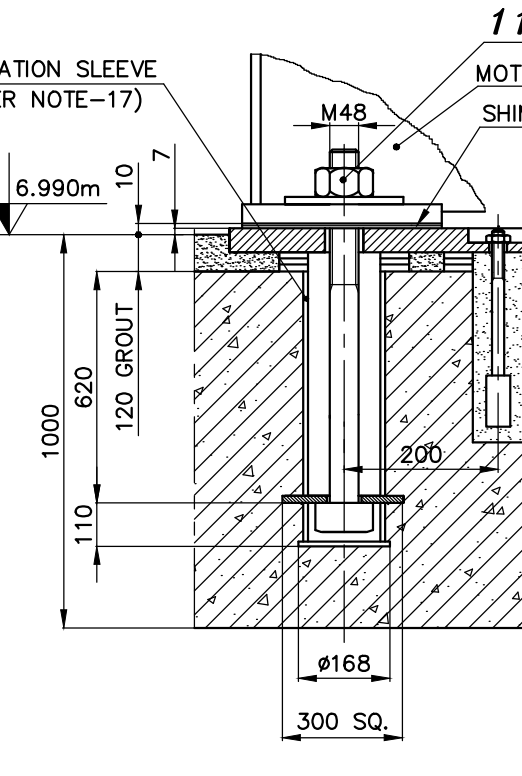


01. QUANTITY OF COOLING WATER REQUIRED/FAN IS 5 m³/hr.

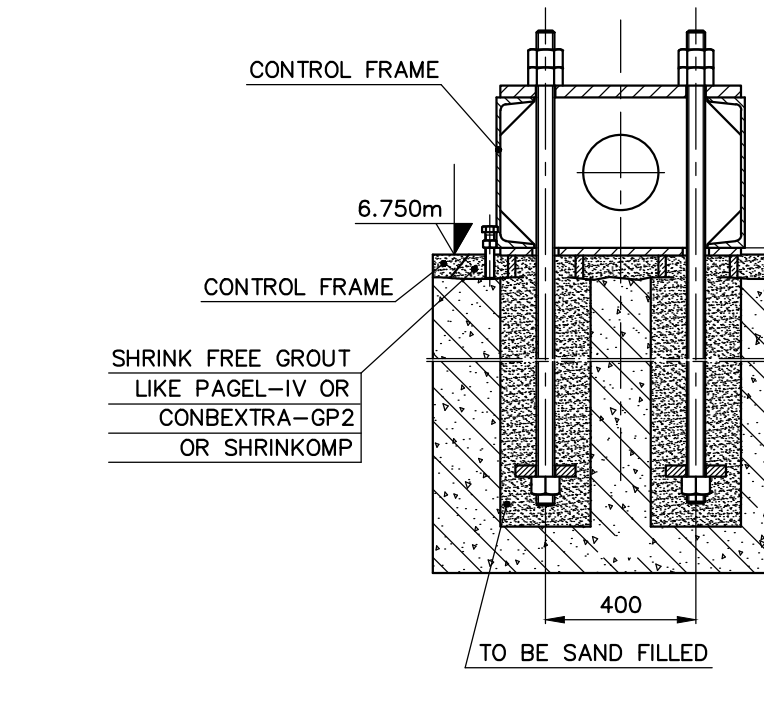
SECTION-AA



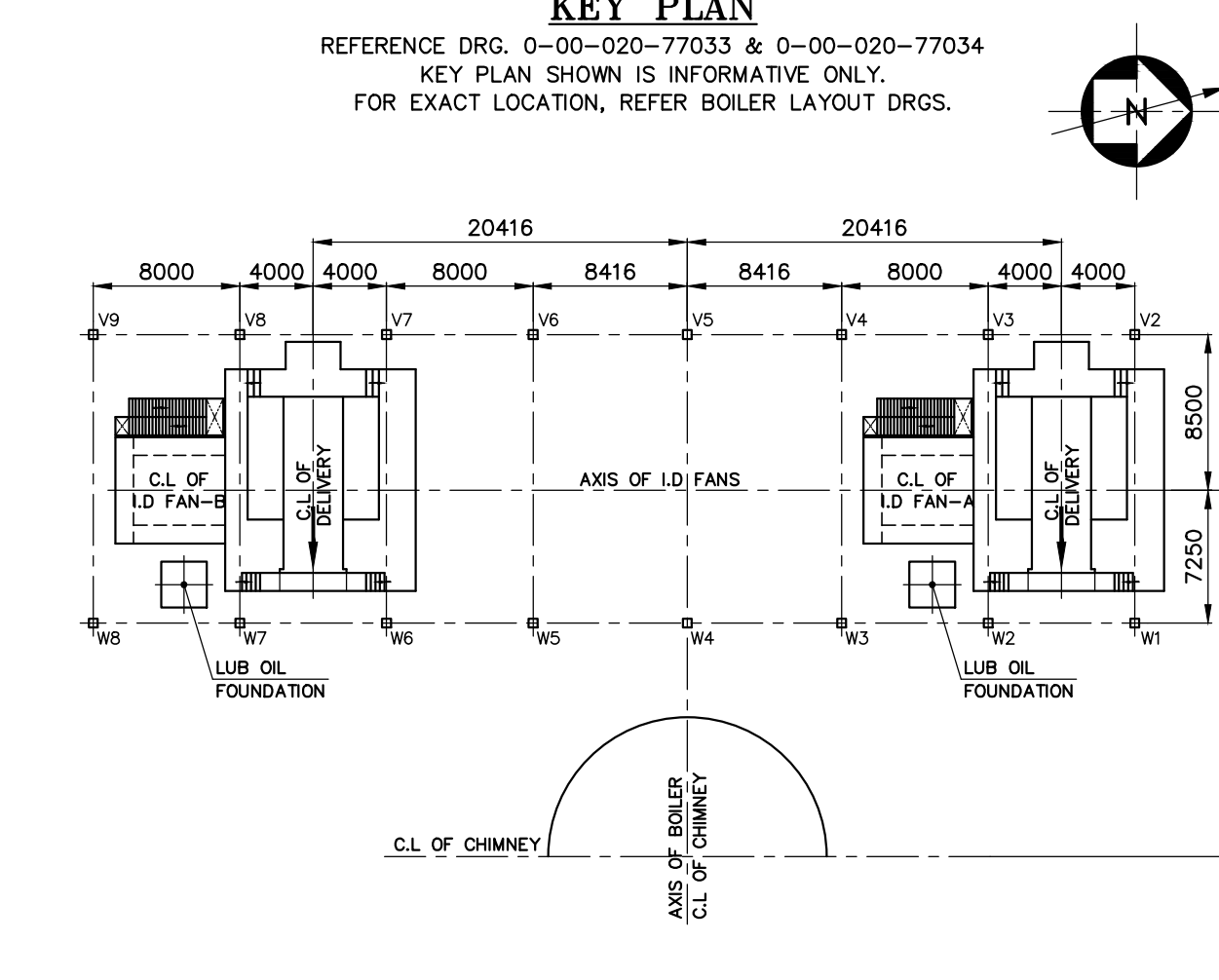
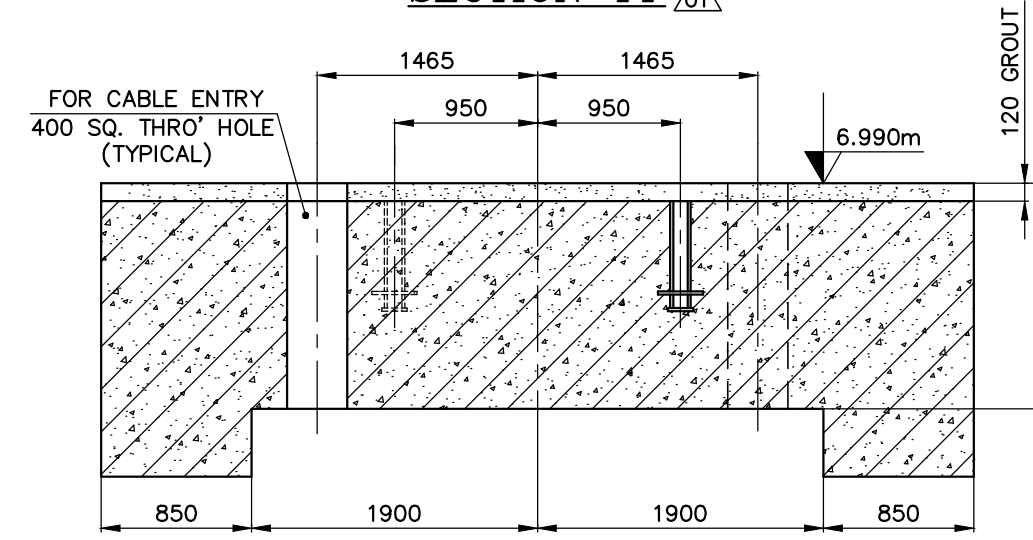
SECTION-CC



SECTION-D1D1



SECTION-FF



- NOTES:-**
- THE LOADS INDICATED ON FOUNDATION ARE WITHOUT ALLOWANCES FOR VIBRATIONS. CIVIL DESIGNER ARE RESPONSIBLE FOR PROPER DESIGN OF FOUNDATION TAKING INTO ACCOUNT OF THE ALLOWANCES FOR VIBRATION ALSO.
 - THE NATURAL FREQUENCY OF THE FOUNDATION SHOULD BE MINIMUM +20% AWAY FROM THE OPERATING FREQUENCY OF THE FAN. THE NATURAL FREQUENCY OF THE CONNECTING DUCT AND SUPPORTING STRUCTURE SHOULD BE CLEARLY AWAY FROM THE OPERATING FREQUENCY OF THE FAN.
 - ADOPT IS: 2974 / PART-IV FOR THE FOUNDATION DESIGN.
 - THE CONNECTING DUCTS AT INLET AND OUTLET OF FAN ARE SELF SUPPORTED AND SHOULD NOT BE WELDED WITH EXPANSION JOINTS.
 - FOUNDATION POCKETS SHOULD BE PERPENDICULAR TO THE FLAT SURFACES OF FOUNDATION.
 - ACCURATE TEMPLATES SHALL BE USED FOR LOCATING CORES FOR POCKET HOLES TO ENSURE THEIR DIMENSIONAL ACCURACY.
 - TOLERANCE BETWEEN ANY TWO POCKET CENTRES ±5 mm.
 - TOLERANCE ON CONCRETE LEVELS ±5mm.
 - IN AREAS WHERE SOLE PLATES AND ANCHOR PLATES ARE TO BE INCORPORATED IN FOUNDATION CONCRETE, THE SIZE OF THE COARSE AGGREGATE USED SHALL NOT EXCEED 20 mm AND DOWN GRADED TO FACILITATE CHIPPING AND SCRAPPING THEREBY ENSURING MAXIMUM CONTACT ON THE MATTING AREAS.
 - NON-SHRINK GROUT IS TO BE USED. REFER GENERAL SPECIFICATIONS ISSUED BY BHEL/RANPET FOR NON-SHRINK GROUT. THIS ALSO CONTAINS THE PREPARATIONS OF PRIMARY PACKERS & SHIMS.
 - GROUTING SHOULD BE DONE ONLY AFTER FINAL ALIGNMENT OF FAN.
 - ELEVATIONS SHOWN IN FOUNDATION PLAN INCLUDE GROUT THICKNESS.
 - HANDRAILS, STEEL PLATFORMS & CANOPY FOR MOTOR AND THEIR EMBEDMENTS ARE IN THE SCOPE OF BHEL/TRICHY.
 - FAN FOUNDATION SHOULD NOT BE USED AS SUPPORT FOR OTHER STRUCTURES OR EQUIPMENTS.
 - FOUNDATION CONFIGURATION SHOWN IN THIS DRAWING IS ONLY INFORMATIVE. TYPE AND DETAILS OF FOUNDATION ARE TO BE FINALIZED BY CIVIL DESIGNERS.
 - FOR MOTOR ERECTION, REFER MOTOR SUPPLIER'S ERECTION MANUAL.
 - FOUNDATION SLEEVE OF THE MOTOR IS TO BE EMBEDDED IN THE CONCRETE AS PER THE DIMENSION SHOWN. AFTER CONCRETE HAS SET, THE EXCESS PROTRUDING HEIGHT TO BE SUITABLY CUT-OFF.
 - LUB OIL SYSTEM WILL BE PROVIDED WITH SUITABLE CANOPY.
 - MAX. AMPLITUDE REFERRED TO SUPPORTING AREA- TOP EDGE OF FOUNDATION IS 250 MICRONS.
 - BASE FRAME, SOLE PLATE, FOUNDATION BRG. FDN. SLEEVE & FASTENERS RELATED TO MOTORS WILL BE IN THE SCOPE OF MOTOR SUPPLIER (BHEL BHOPAL UNIT)

FAN DETAILS:-

TYPE	: NDVZ 47 SIDOR
WEIGHT OF FAN WITHOUT MOTOR & COUPLING	: 98000 kg
WEIGHT OF ROTATING PARTS	: 25000 kg
QD ² OF FAN	: 226400 kgm ²
SPEED OF FAN	: VARIABLE (100-580 RPM)
NO. OF FANS PER BOILER	: TWO (DENTICAL)

MOTOR DETAILS:-

MAKE	: M/V. BHEL/BHOPAL
TYPE	: 100A344
SPEED RANGE	: 100-580 RPM
WEIGHT OF MOTOR COMPLETE	: 31000 kg
WEIGHT OF ROTATING PARTS	: 11300 kg
WEIGHT OF STATOR PARTS	: 10800 kg
QD ² OF MOTOR	: 7000 kgm ²
BRG SIZE & NDE	: #250
LUBRICANT	: IOC SERVOPRIME-68 OR EQUIVALENT

LOADING ON MOTOR FOUNDATION

REACTION DUE TO WEIGHT ON EACH SIDE (G)	= 155 kN
MAX. SHORT CIRCUIT FORCE (MS)	= 376 kN
REACTION DOWNWARD (MS-G)	= 531 kN
REACTION UPWARDS (MS-G)	= 221 kN

- THE FORCES OCCUR ALTERNATIVELY INDEPENDENT OF THE DIRECTION OF ROTATION.
- THE TRANSFER OF VIBRATIONS FROM SURROUNDINGS EQUIPMENT HAS TO BE AVOIDED BY SUITABLE LAYOUT OF FOUNDATION.
- THE FIRST NATURAL FREQUENCIES OF THE FOUNDATION AFTER ERECTION OF THE MACHINE MUST OFFER ATLEAST +25% & -20% FROM ONE & TWO TIMES RUNNING SPEED FREQUENCIES & TWO TIMES THE ELECTRICAL FREQUENCY.

MOTOR COOLER DATA :-

WATER FLOW RATE (FOR TWO ELEMENTS)	= 350 LPM.
WATER INLET / OUTLET TEMPERATURE	= 30° / 45°C
PRESSURE DROP	= 500 mbar.
OPERATING PRESSURE	= MAX. 6 bar
TEST PRESSURE	= 9 bar.

CUSTOMER No : R553

PROJECT : TUTCORIN THERMAL POWER PROJECT STAGE IV-1x525MW (UNIT-I)

THOOTHUKUDI, THOOTHUKUDI DISTRICT, TAMILNADU STATE

OWNER : SEPC SEPC POWER PRIVATE LIMITED

BHARAT HEAVY ELECTRICALS LIMITED., BOILER AUXILIARIES PLANT

RANPET - 632 406

EPC CONTRACTOR : Megha Engineering & Infrastructures Ltd.

S-2, Technocrat Indl. Estate, Balanagar, Hyderabad

EPC CONSULTANT : TPSC (INDIA) PRIVATE LIMITED

(Wholly owned subsidiary of Toshiba Plant Systems & Services Corporation, Tokyo, Japan)

A-1 Module, D-Quadrant, 2nd & 9th Floor, Cyber Towers, Hi-Tec City, Madhapur, HYDERABAD - 500 081, INDIA.

CONSULTANT DRG. NO. REV.

TITLE : GENERAL ARRANGEMENT OF INDUCED DRAFT FAN

NDVZ 47 SIDOR

DWG. NO. 0-00-099-27571 REV. 01

DRAWN : P.SARAVANAN CHECKED : PRASANNA SCALE : N.T.S.

REVIEWED : P.M.J. DATE : 30.05.2016

REV. DATE ALTERED CHECKED APPROVED

01 19.07.2016 P.S.N. S.AGARWAL P.M.J.

02. MOTOR AND ITS FOUNDATION DETAILS

03. SECTION-JJ ALTERED.

Size A0