GAS TURBINE EXHAUST DUCTING AND BYPASS SYSTEM

1.0 Scope:

This specification covers design Manufacturing and supply of Gas Tubing exhaust ducting arrangement which includes exhaust plenum covers and exhaust stack silencer. Insulation and outside corrugated sheet etc. As per GA drawing Mentioned in variant table.

2.0 Technical Requirements:

2.1 Input Parameters: Ref var table

2.2 Design Loads:

Humidity : 0-100% RH

Design life : 20 years or higher

Transient loads due to starting shall be considered

No. of load cycles: 10,000

Time for start up : 25^{0}C to max temp in 8 min

2.3 Noise Levels:

	Frequency (HZ)	31.5	63	125	250	500	1000	2000	4000	8000
(A)	Fr1	102	102	107	109	113	110	106	101	100
(B)	Fr3, Fr5, Fr6	129	127	129	130	130	128	122	117	128
(C)	Fr9	139	124	143	145	144	142	140	136	130
(D)	Exit	127	124	120	119	115	108	102	98	94

The values given in above table are typical sound power levels generated by gas turbine under base load conditions at exhaust plenum flange to exhaust system for various gas turbines in DB

The values in row (D) are expected sound power levels at exit of exhaust silencer which are to be guaranteed by vendor.

For the above table Ref. Sound power level is 1.0 x EX-12 watts.

2.4 Nature of Exhaust Gas:

The exhaust of gas turbine carries products of combustion of burning of fuels like diesel. Natural Gas, Naphtha, Crude oil, HSD, etc with contaminants like Sulphur and other corrosive elements in them.

2.5 Applicable codes / standards:

Following codes / standards shall be applicable if not other wise given in var table.

SSPC-SP6		Cleaning before painting (steel structures painting council)
IS	800	For structure steel
IS	875	For wind loads
IS	6533	For stack design
IS	1893	For seismic loading
IS	2062	Weld able steel
IS	3502	Chequered plates
IS	10534	Method of measurement of airborne noise for GT
IS	2309	Protection against lightning
	ASTM	A193/193M as/ss fasteners for high temp service.
	ASTM	A453/453M bolt material
	ASTM	A194 nuts
	ASTM	Section IX for welding
	ASTM	Section VIII div I for boilers & Unfired pressure vessels
	ASTM	A105 forged pipe fittings
	ASTM	A53 galvanized pipe ach 80 screwed
	ASTM	A176 TP 409 for SS sheet (Lining)

BHEL Standards

AA	0233103	Transport by rail
GT	54031	Welding
GT	10112	Painting (project painting schedule if specifed in variant table.)
HY	0490569	sea worthy shipping packing

2.6 Material standards for critical items:

Refer GA drawing no given in variant table

3.0 General Requirements:

3.1 Ducting shall be as per GA drawing mentioned in variant table. Exhaust duct shall be internally insulated with SS cladding corrugated sheet siding shall be provided around duct if shown in G.A. Drawing.

3.2 Exhaust silencer:

Exhaust silencer shall be as per details given in GA Drawing, to attenuate noise. Vendor to submit design report on silencer sizing. From a reputed institutes for BHEL approval.

3.3 Trail assembly:

All main components to be trail assembled and ref line. Segment no marked at vendors works. To avoid mismatch and rework / rejection at site. BHEL has the right to witness this trail assy. For this vendors to indicate to BHEL at least 10 days in advance for witnessing this trail assembly at vendor's works.

3.4 Insulation

Suitable material & thickness to be selected to limit skin temp of exhaust duct to 60^{0}C when ambient temp is 45^{0}C and GT operating at full load. Insulation material as per 2.6 of this spec vendor to submit supporting design calculations for thickness selected. SS cladding sheet is to be over lapped between two duct sections to prevent leakage thro flange the thickness shall be not be lower than the values speed in GA drawing .For specification of ceramic insulation refer to annexure number-Ia

3.5 Expansion joint :

The expansion joint is component of an exhaust ductwork system that will direct the exhaust gas of a gas turbine through the exhaust plenum and into an exhaust system of GT.

The expansion joint allows for movement due to thermal growth, mechanical deflection and misalignment between the exhaust plenum and the rest of the exhaust system. The expansion joint does not allow forces and moments to be transmitted from the exhaust system provided by others to the exhaust plenum. For detailed specification Please refer to

4.0 Painting

All ferrous components items shall be cleaned by shot blasting to near white as per sa2 ½ - SSPC-SP6

Use primer for both inside and outside as per item – 1 of product standards GT10112 or its equivalents. For finish (out side duct) painting use paint as per item 4 of product standards GT10112 or its equivalent and SS shall not be painted. Any specific SS Surface finish paint color will be informed during drawing approval.

All the temporary shipping-bars shall be painted yellow will re removed during erection.

The duct pieces & silencer shall be painted with flow direction (painting requirements of project specific painting doc shall take precedence

5.0 Marking & identification:

All shipping containers shall be identified with the BHEL code no & purchase orders number. Drawing number and part / position no the vendors packing list and shipping numbers. Each shipping container shall contain three packing lists. Listing all contents of the particular container and attached in a secure manner. Each part will be identified and keyed to the packing list.

Each component shall be marked with its part / posn-no-per approved drawing

Each duct PC & structural must have its weight painted (un washable paint) on them packing procedure packing vendor to submit for BHEL's approval.

6.0 <u>Shipment:</u>

Each piece of duct silencer. Composite structural if any shall have min 4 places of lifting lugs during transportation. (Lugs shall be tested with 100% DPT)

IT shall be the vendor's responsibility to assure that shipment is made consistent with providing the equipment at the specified destination in an undamaged condition. The vendor's method of assuring compliance with this requirement. Including mode of transportation. Shipping rig and/or container design. Shipping outline and specific precautionary measures to be imposed on the carrier shall be submitted to BHEL for approval / comments. Additional specific shipping instructions if any shall be as specified in the BHEL purchase order.
For seaworthy packing refer HY0490569. (Applicable for overseas projects)

7.0 Inspection & Testing:

The vendor shall prepare a quality plan. Specifying the in-process inspections and tests to be performed to assertain compliance with the specification requirements. QA-Plan to be furnished within 4 wks of placement of L.O.I. for comments & approval by BHEL & / or BHEL 's customer. This plan shall identify the stages in manufacturing at which the inspection or test will be conducted. The data to be taken and the procedure to be used.

The quality – plan including a delineation of data to be taken and procedure to be used shall be submitted by the vendor for buyer's approval & subsequent stages & final inspection by approved inspection agency / BHEL and / or BHEL 's customers

8.0 Review documentation and drawings:

S.No.	Document	No. of copies	schedule	Remarks
1	GA Drg with Bill of matl	2	A	A: Along offer
2	Performance calculation	3	B	
3	Structural calculations	2	B	B: Within 2 weeks
	in STADD	3	B	of LOI
4	Q.A. Plan	3	B	
5	Sub assy drawing with BOM	3	B	C:4 weeks in Advance
6	Shipment plan indicating	1	B	of Actual shipment
7	size and no of boxes.	2	B	
8	Erection procedure	4	B	
9	O&M manuals + CD	10	C	

9.0 Guarantee:

Vendor to Guarantee following:

Noise performance as per Clause 2.3

Insulation performance per clause 3.4

Workmanship : Any deficiency in design, quality of fabrication shall be work man ship shall be made good.

The Guarantee shall be for 18 months from date of shipment and 12 month from date of commissioning which ever is earlier.

10.0 Separate quotation to be given by vendor along with main offer for

1) Erection supervision (Estimated man hours to be indicated) on per diem basis
2) Any special tool required for erection
3) Recommended spares for 3 years of continuous operation
4) Erection and commission (if any) spares

11.0 Conflicting requirements

In the event of conflicts in the ordering requirements (specification, drawings, and subtitled specifications of standards. The vendor shall notify the buyer immediately upon recognition.

11.01 Exceptions / Clarifications to this specification

Exceptions, where necessary, shall be documented by supporting analysis and / or data delineating the engineering logic and technical basis for the exception. These exceptions shall be presented to BHEL engineering for review. Exceptions resulting in a material or process substitution shall be submitted to the BHEL for approval.

Var No.	Project	Ref. Drg. No.	Remarks	BHEL Matl. Code.
01	Essar Vadhinar Jamnagar	1-364-09-91005	Noise: 85 DB(A) Near field Steel design as per: IS 800 Altitude: 31.5m above MSL Min temperature (Dry bulb):5^{0}C Max temperature (BD): 48^{0}C Normal ambiant temp (DB):33^{0}C RH max / design / min :27/70/96 Design wind velocit / direction : Wind speed m/s: 50 62.5 75 85 Elévation m : 10 20 40 60 seismic zone: Zone- IV as per IS 1893 Exhaust parameters : Maximum flow = 1555800 kg/hr Maximum temperature=595 deg C Maximum pressure=762mm WC(g) Painting scheme GTEG/ESSAR/001	GT9754313016
02	Fr-6 RIL-DAHEJ	1-364-09-61012	NOISE: 85DB(A) NEAR FIELD STEEL DESIGN AS PER IS800 wind as per IS 875,sesmic as per IS 1893 EXHAUST FLOW: 624690 kg/hr at 615°C DESIGN PRESSURE: 650WC DAMPER INTER FACE DRAWING:- 2-365-02-61001 Min temp: 13°C , Max temp: 45°C RH: 30% - 100% Seismic: Zone - V ISI893 Wind: 235 kg/M2 Outdoor Altitude: 6m above MSL	GT9754313024

Var No.	Project	Ref. Drg. No.	Remarks	BHEL Matl. Code.
03	Fr-5 BARAMURA	1-364-09-51008	NOISE: 85DB(A) NEAR FIELD STEEL DESIGN AS PER IS800 wind as per IS 875,sesmic as per IS 1893 EXHAUST FLOW: 624690 kg/hr at 615°C DESIGN PRESSURE: 650WC DAMPER INTER FACE DRAWING:- 2-36502-51001 Min temp: 13°C , Max temp: 45°C RH: 30% - 100% Seismic: Zone - V ISI893 Wind: 235 kg/M2 Outdoor Altitude: 6m above MSL	GT9754313032
04	Fr-5 MUL	1-364-09-51007	NOISE: 85DB(A) NEAR FIELD STEEL DESIGN AS PER IS800 wind as per IS 875,sesmic as per IS 1893 EXHAUST FLOW: 624690 kg/hr at 615°C DESIGN PRESSURE: 650WC DAMPER INTER FACE DRAWING:- 2-36502-51001 Min temp: 13°C , Max temp: 45°C RH: 30% - 100% Seismic: Zone - V ISI893 Wind: 235 kg/M2 Outdoor Altitude: 6m above MSL	GT9754313040
05	Fr-6 GGSR	1-364-09-61014.	NOISE: 85DB(A) NEAR FIELD STEEL DESIGN AS PER IS800 wind as per IS 875,sesmic as per IS 1893 EXHAUST FLOW: 624690 kg/hr at 615°C DESIGN PRESSURE: 650WC DAMPER INTER FACE DRAWING:- 2-365-02-61001 Min temp: 13°C , Max temp: 45°C RH: 30% - 100% Seismic: Zone - V ISI893 Wind: 235 kg/M2 Outdoor Altitude: 6m above MSL	GT9754313059

Annexture-I
SPECIFICATION FOR NON-METALIC EXPANSION JOINTS

1.1 Expansion joints shall be supplied as a complete unit consisting of fabricated metallic parts including flanges, composite non-metallic fabric parts, back up bars, insulation, stud assemblies, retainers, and seal plates as shown in the BHEL GA drawing in mentioned in Variant table. All the parts of the expansion joint shall be assembled and dispatched as a single unit i(f possible) insulation provided shall not be exposed to gas flow path and shall be sealed all round.

1.2 Expansion joints shall be designed to meet the requirements specified in the data sheet enclosed. Material selection and design of expansion joints shall be suitable for continuous operation of gas turbines, meeting all the requirements as indicated in this standard. Supplier shall furnish the configuration of expansion joint composite fabric material along with the offer.

1.3 Supplier should substantiate with relevant back up information on how the materials selected will meet the functional requirements and other design requirements specified in this standard including temperature, pressure, chemical/corrosion and abrasion resistance. The supplier should also guarantee its performance. Insulation materials used should reduce interface temperatures and permit satisfactory performance of expansion joints. Surface temperature of the expansion joint should not exceed 70^0C. Supplier shall furnish design calculations along with his offer for surface temperature of expansion joint for review and approval by BHEL.

1.4 Expansion Joint

The exhaust system expansion joint shall be a flexible membrane type (fabric) based on the Vendor's standard design practice and materials with history of successful operation in gas turbine systems. The

expansion joint shall be internally insulated to include the inlet and outlet flanges (cold flange design) and shall include he following components: flexible membrane, insulation, ASTM A176 GR109 stainless steel gas path liner (11gauge minimum). Inlet and outlet flanges and fabric attachment flanges with back up bars.

The expansion joint shall be designed for the following movements:

Axlal compression	2.00 Inches
Axlal Extension	1.00 Inches
Lateral offset	0.50 Inches

The Expansion joint constant" shall not exceed 15 pounds per linear foot for each 1.00 inch of compression.

The inlet flange of the exhaust plenum outlet expansion joint shall be designed to match the exhaust plenum outlet flange and shall be bolted and gasketed. The inlet flange bolt holes shall be slotted (1.50 x 1.00 inches) with the slot length running in the vertical direction.

The outlet flange of the exhaust plenum outlet expansion joint shall be designed for bolting and seal welding to the adjacent duct. For this duct insulation tackness is a factor to be considered.

2.3 The supplier shall provide original material test certificates for all materials used in the expansion joint including raw materials listed in clause in 2.4.

2.4 Material specification:

The supplier should comply with the following material specifications as minimum requirement, if no material specification is given in BHEL

drawing. All these sizes and specifications must appear on the drawing submitted for BHEL approval.

2.5 The expansion joint shall be designed and fabricated to good engineering and manufacturing practices and in accordance with the applicable codes and standards. Exceptions, where necessary, shall be documented by supporting analysis and/or data delineating the engineering logic and technical basis for the exception. These exceptions shall be presented to be engineering for review.

All Materials of the expansion joint shall be suitable for the gas turbine exhaust environment and their intended function and shall be in accordance with the material specifications of ASTM or ASME, structural shapes shall be in accordance with AISC. Manual of steel construction or is specification.

All manufacturing and inspection processes used in the fabrication of the expansion joint shall be in accordance with AWS, ASME ,ASTM and ASNT. Carbon steel and low alloy steel welding shall be in accordance with AWS 01.1 and B2.1 or ASME. Stainless steel welding shall be in accordance with ASME Boiler be in accordance with these codes and welders shall be qualified to these welding procedures. Visual inspection and acceptance standards for all welds shall be in accordance with AWS 01.1

The insulation shall be ceramic fiber (8 LB / cuft density) as specified in (Thermal insulation ceramic fiber). The insulation finishes and application methods shall be in accordance with the vendor standard practices and shall be compatible with the temperature and

environment of the gas turbine exhaust gas throughout the ambient temperature range.

Applied in small sections to allow movement relative to the attachment studs. The logging and attachment studs shall be designed such that the insulation shall not be exposed to the hot gas flow for any movement of the lagging system. Lagging sections shall overlap in the direction of gas flow.

The flanged joint between the expansion joint and the exhaust plenum shall be bolted and gasketed.

All external welds (columns, stiffeners, flanges, etc) shall be continuous (stitch welding is not permitted).

Normal operating conditions shall include full dead load, pedestrian live load and maximum interior pressure loading (GT Operating point appendix II)
The expansion joint shall be designed for the exhaust gas velocity distribution at the exhaust gas velocity distribution at the outlet flange of a GE MS9001E exhaust plenum for a side exhaust.

All flanges and stiffener connection, factory and field joints, shall be reinforced to transmit all loading associated with the operation of the gas turbine exhaust ductwork system (steady state and transient operation, mechanical and thermal loading). All loadings shall be clearly identified in the structural design calculations report.

2.6 Design Loads

a. The exhaust ductwork system shall be designed by the vendor for the following loads:

1) Dead Loads

2) Live Loads

3) Operational Loads (Termal, pressure, and flow)

a.	Maximum allowable working pressure	20 inches water (Gauge)
b.	Normal internal pressure (Maximum)	4.0 inches water (Gauge)
c.	Maximum operation Temperature	1150 deg F
d.	Gas turbine startup and shutdown data	Appendix IV
e.	Gas turbine exhaust gas Data (Steady state)	Appendix II
f.	Exhaust gas velocity profile at exhaust plenum outlet	Appendix III

Transportation loads

b. The expansion joint shall be functional after the combined application of all loads in their various load combinations. Load factors for the loads shall be determined by the vendor using industry standards.

c. The loading combination producing the maximum stress shall be considered. The maximum stress shall not exceed the allowable stress permitted by AISC. All load combinations shall be identified in the

structural design calculations IS800 to be submitted for BHEL's approval.

3 Testing:

3.1 Supplier should provide sample test data demonstrating the ability of the selected expansion joint composite fabric materials to withstand the maximum temperature required as specified in this standard/BHEL drawing. The data should include temperature at the inside and outside surface of the fabric, both outside and under the back up bar, and the ambient external air temperature. The fabric materials shall be tested for a minimum of 4 hours after steady state condition are achieved. At the end of test the fabric materials shall checked for visual damages, if any damage in fabric materials is not acceptable. BHEL inspector will witness this test.

Further the tested samples shall again be tested for tensile and elongation. The achieved tensile and elongation values shall be within 80% of original tensile and elongation values of the fabric material.

3.2 Supplier shall also provide expansion joint composite fabric configuration and joint efficiency test data for the fabric material. The tensile strength of the joint shall match to the minimum tensile strength of the composite fabric material (Excluding ceramic insulation layer).

3.3 Supplier shall produced type test certificate for the construction proposed for axial compression, axial tension and lateral movement as specified in our drawing. BHEL inspector will witness this test

3.4 The vendor shall provide the inspection and test plan which shall include the vendor's standard plan plus any specification imposed inspection and testing.

4 Painting:

Unless otherwise specified all the parts of the expansion joint shall be thoroughly cleaned of all mill scales, rust, grease and other foreign matter. All metal surfaces shall be blast cleaned to SA 2-1/2 grade and applied with 75 microns of heat resistant (400^{0}C) inorganic zinc silicate primer paint and 25 microns of heat resistant (600^{0}C) aluminum final paint. Adhesion test as per astm D3359 IS to be carried out on primer painted surface and finish painted surface to ensure proper adhesion of paint to the metal surface.

Project specific paint schedule shall take precedence .

5 Marking:

5.1 Each joint shall be provided with a name plate having the following details:

1. Errection mark :
2. Manufacturer's name :
3. Month and year of manufacture :
4. BHEL purchase order number :
5. BHEL customer name :
6. Gas turbine frame size :

5.2 Each expansion joint shall be clearly and permanently marked showing the gas flow direction.

5.3 Each expansion joint is to be held with adequate number of hold up bars which are to be removed after installation of expansion joints at site. These bars will normally be painted a bright yellow color enamel paint after suitably cleaning the surface with rust remover.

6 Packing and supply:

6.1 Supplier shall submit packaging details to BHEL along with offer for approval. Generally the packing provided should prevent mechanical damages as caused by stacking, bumping, dropping or dragging.
Packing shall also prevent rain water ingress.

6.2 Supplier should intimate special storage requirements, if necessary, for their expansion joints.

6.3 Supplier shall provide installation procedure documents inside each expansion joint packing and also supply separately three copies of installation procedure documents one of which is to be directly dispatched to the engineering department.

6.4 Prior to shipment the following items of expansion joints should be checked to ensure maximum integrity of the product:

a) Dimensional compliance with approved manufacturing drawings including flange details.

b) Security of nuts and bolts on back up bars and hold up bars.

c) Existence of name plate and flow direction

d) General condition of fabric element, frame fit up and painting in accordance with our requirements and good manufacturing practices.
Sea worthy packages required if mentioned in variant table

7 Expansion joint data sheet

Flowing Medium		Flue Gas
Flow velocity		30 to 45 M/sec
Design pressure		700 MM WC
Maximum Gas Temperature		680^{0}C
Movements	Axial	Ref. BHEL GA Drawing.

	Lateral	Ref.BHEL GA Drawing
Ambient temperature	Maximum	50° C
	Minimum	5° C
Fabric construction layer details		

8 QA plan shall to show following

8.1 Welding procedures

8.2 Procedure qualification record

8.3 Welder performance qualification record

8.4 Temperature with standability test procedure

8.5 Joint efficiency test procedure

NOTE:

All expansion joint for a project have to be procured from single vendor only

8.01 Weight & CG drawing must to include:

1 Outline of each major piece of equipment with overall dimensions and lifting tug locations.

2 Weight of each major place of equipment.

3 CG of each major place of equipment located from a reference.

4 Recommended lifting method (spreader bar straight lift etc)

5 Any precautions in lifting and handling the equipment (removal of shipping braces lifting C-sections etc)

C Installation drawing instructions and bill of materials

All materials shall be identified by the full material specification designation (ASTM ASME) all field welds shall be fully identified (size, length, material) identification fit-up requirements) and in accordance with the BHEL general welding specification all component and

material part numbers shall be clearly marked on the installation drawing.

D As installed drawings to include:

Upon completion of the project and after the equipment has been accepted by the plant owner / agent for commercial operation drawing shall be revised if changes were made in the field during construction. These drawings shall be submitted to BHEL as"AS INSTALLED" BHEL will advise vendor of changes which shall be required.

8.02 Design Report

The design report shall include the following as a minimum:

Structural design calculation with all loads and load combination identified along with the design criteria and allowable stress levels and deflections.

9.0 Gurantee:

Vendor to guarantee following:

1) Pressure drop as per var table
   (Calculation to be submitted)
2) Noise levels as per given in cl 2.3. row 4 and near field required as given in var table
   (Calculations be submitted)
3) Maximum skin temperature (Calculation is to be submitted)

Warrantee: General performance for 1.5 years from date of supply or 1.5 years from date of commissioning.

9 Table of compliance for Expansion joint:

Vendor to fill up table of compliance confirming each of this specification clause along with the offer .

Annexture-IA
Specification for Insulation.

This specification covers ceramic fibre insulation blankets as per details given below.

Chemical composition:

Alumina, al203, % Min	:	43
Silica, sio2, %	:	Balance
Impuretés, % Max	:	1
Leach able chlorites, ppm, Max	:	10

Thermal conductivity : ($W/m^{\circ}K$)

	Mean température °C						
	90	205	315	420	540	650	870
Max	0.05	0.07	0.10	0.13	0.18	0.21	0.33
Min	0.05	0.07	0.09	0.12	0.16	0.20	0.29

Test certificate for above properties reqd.

Thickness in MM	Density in Kg/M^3
25	96
50	96
25	128
50	128
25	64

Tolerances:

1. Thickness : +10MM, -5MM
2. Width : +20MM, -5MM
3. Length : +10MM, -0MM
4. Density : +15%, -15%

Ref. Doc
354A2707

Reference Documents

Appendix II	Gas turbine operational conditions
Appendix III	Gas turbine plenum outlet flange velocity Distribution
Appendix IV	Gas turbine typical start and shutdown data
Appendix V	Expansion joint interfaces

APPENDIX II

Gas turbine exhaust gas data
(Steady State conditions)

GT operatin point	1	2	3
Ambient temperature (deg F)	-20	59	120
Ambient pressure (Psia)	14.7	14.7	14.7
GT Fuel	No. 2	No. 2	No. 2
GT Load (%)	Distribute	Distribute	Distribute
	100%	100%	100%
Exhaust gas flow (x 10^3 1b/hr)	3877	3265	2768
Exhaust gas temperature (deg F)	1012	1067	1112

GT Operating point

1. Maximum Exhaust Temperature point
2. Guarantee point
3. Max Exhaust flow point

NOTE: Data in variant table shall take precedence over this data.

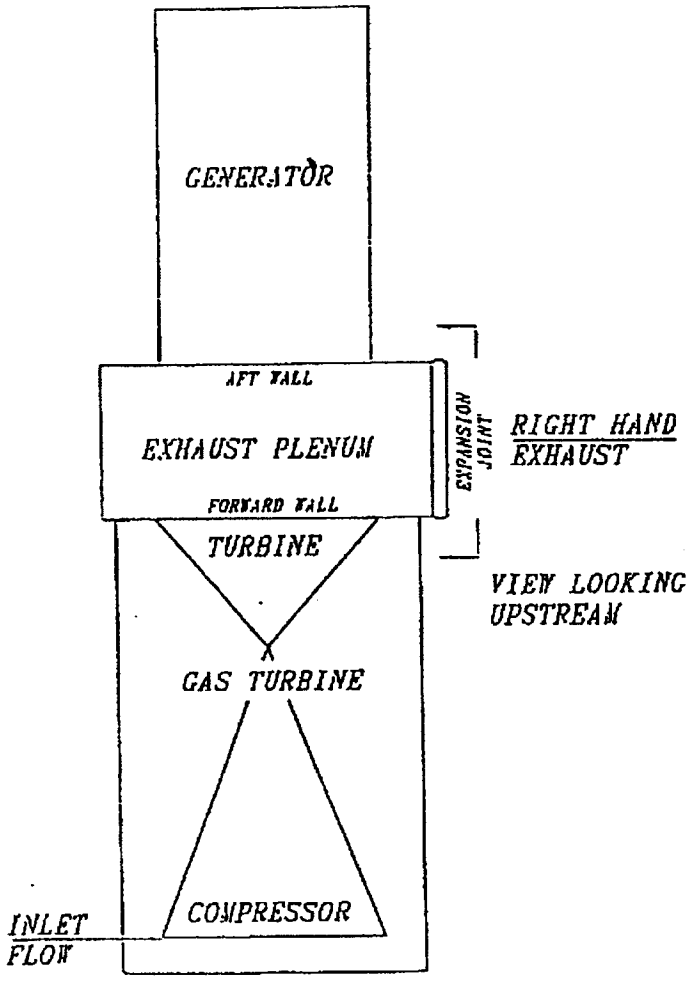
Appendix III

Gas Turbine plenum outlet flange

Velocity Distribution

GT EXHAUST PLENUM EXPANSION JOINT OUTLET FLANGE
EXHAUST GAS VELOCITY DISTRIBUTION

GE GT MODEL MS9001(E)
RIGHT HAND EXHAUST



PRODUCT STANDARD

HYDERABAD

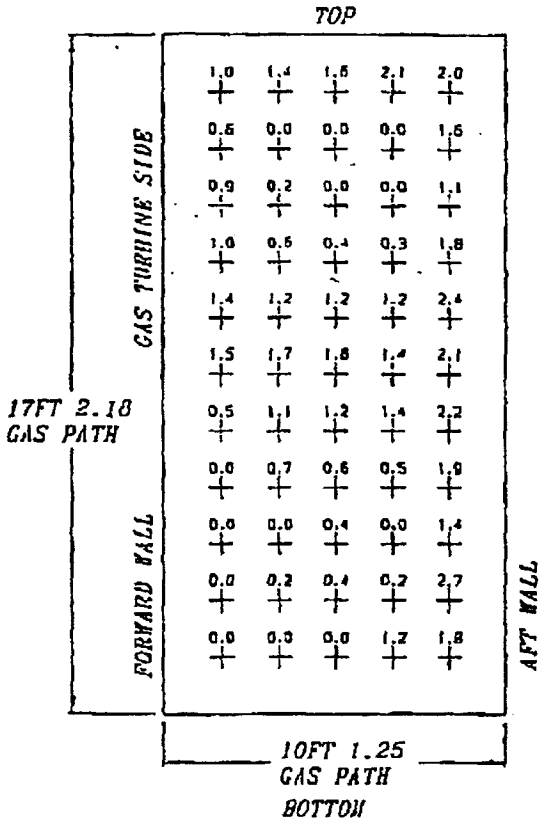
GT54313

REV.NO. 02

Ref. Doc
354A2707

GT EXHAUST PLENUM EXPANSION JOINT OUTLET FLANGE EXHAUST GAS VELOCITY DISTRIBUTION

GE GT MODEL MS9001(E)
RIGHT HAND EXHAUST
VIEW LOOKING UPSTREAM



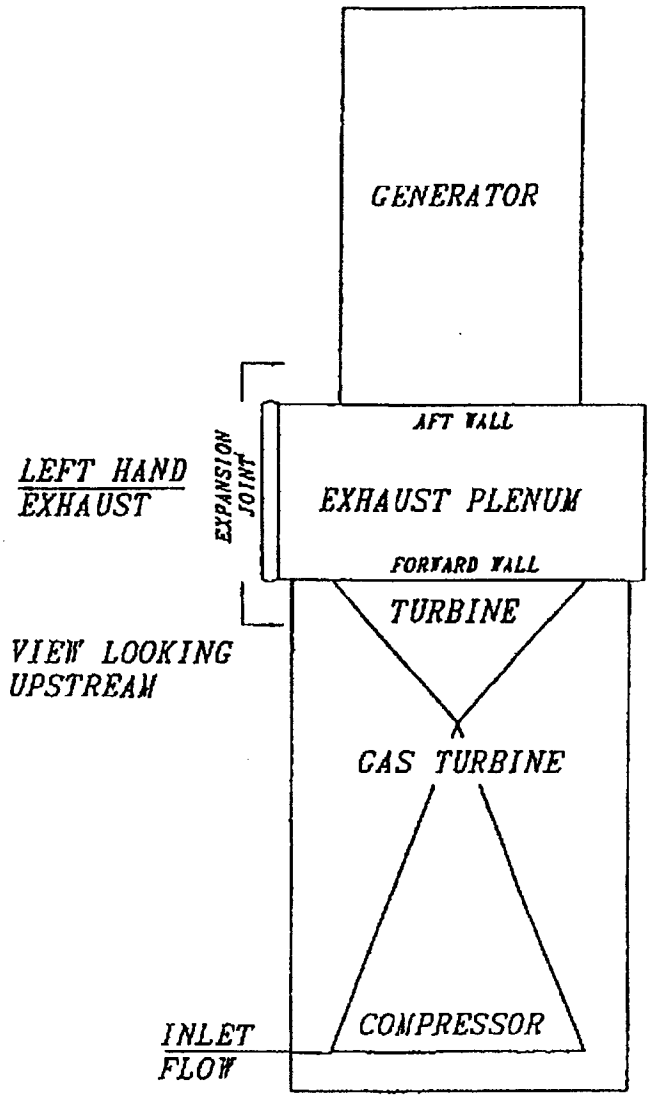
EQUALLY SPACED POINTS.
VALUES SHOWN ARE
NORMALIZED VELOCITIES
AT ISO CONDITIONS, V/V_{AVG}

V_{AVG} = 189 FT/SEC
(ISO CONDITIONS)

V= ACTUAL EXHAUST GAS VELOCITY

GT EXHAUST PLENUM EXPANSION JOINT OUTLET FLANGE EXHAUST GAS VELOCITY DISTRIBUTION

GE GT MODEL MS9001(E)
LEFT HAND EXHAUST



PRODUCT STANDARD

HYDERABAD

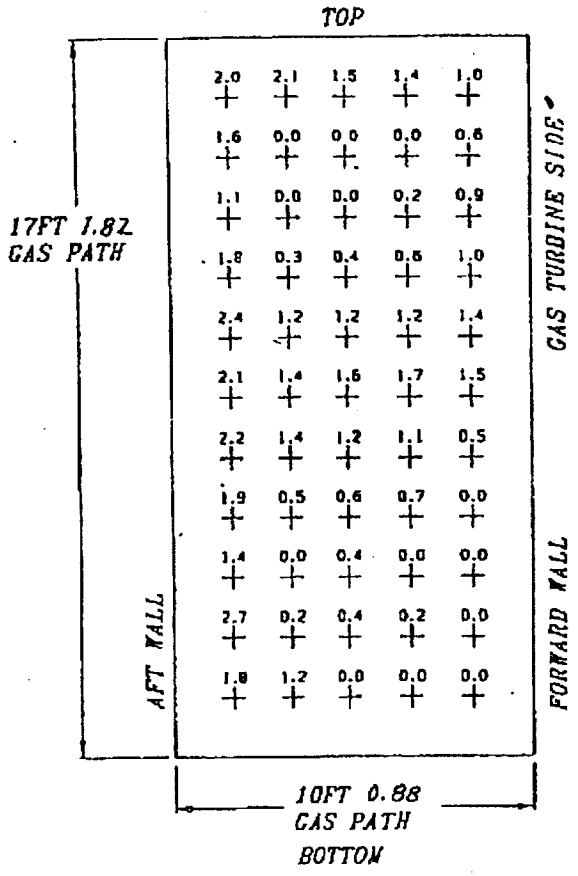
GT54313

REV.NO. 02

Ref. Doc
354A2707

GT EXHAUST PLENUM EXPANSION JOINT OUTLET FLANGE EXHAUST GAS VELOCITY DISTRIBUTION

GE GT MODEL MS9001(E)
LEFT HAND EXHAUST
VIEW LOOKING UPSTREAM



EQCALLY SPACED POINTS.
VALUES SHOWN ARE
NORMALIZED VELOCITIES
AT ISO CONDITIONS, V/V_{ISO}

V_{ISO} = 189 FT/SEC
(ISO CONDITIONS)

V= ACTUAL EXHAUST GAS VELOCITY

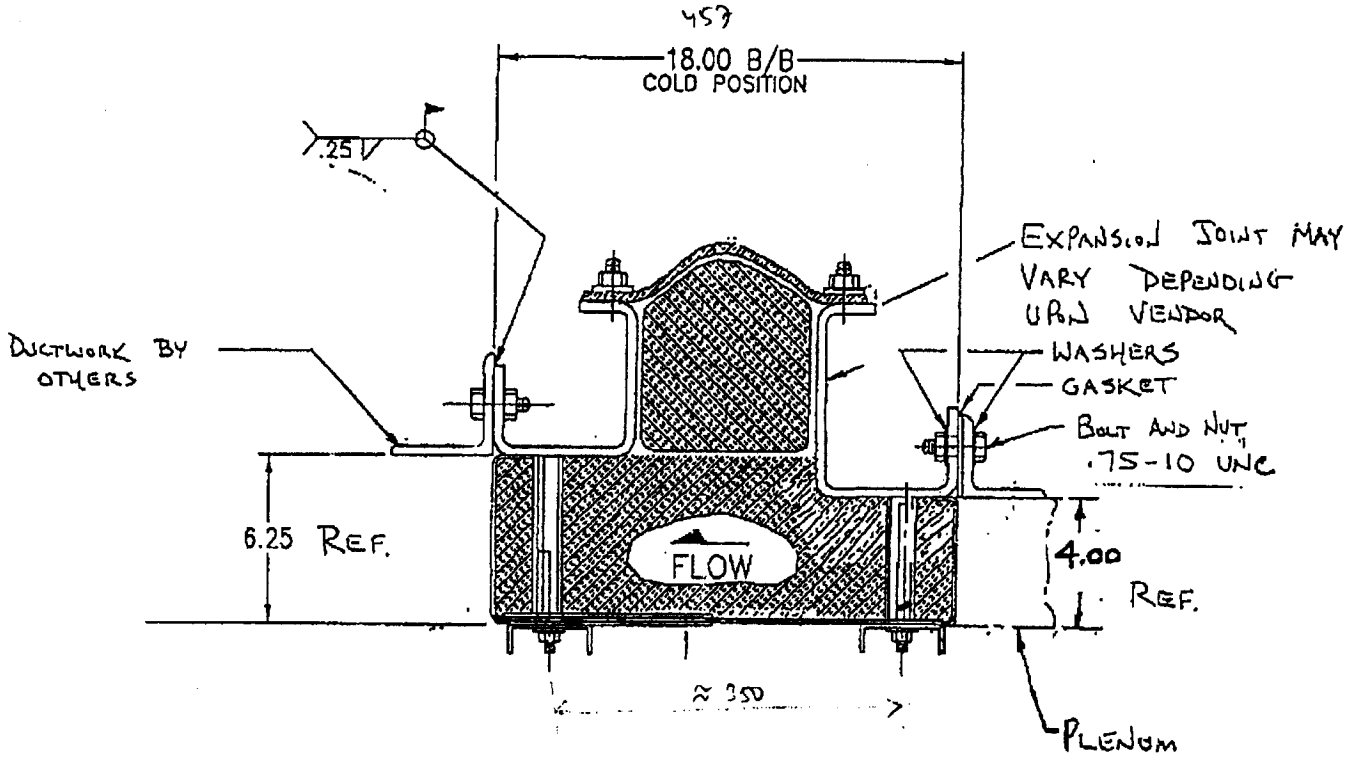
APPENDIX IV

GAS TURBINE STARTUP AND SHUTDOWN DATA

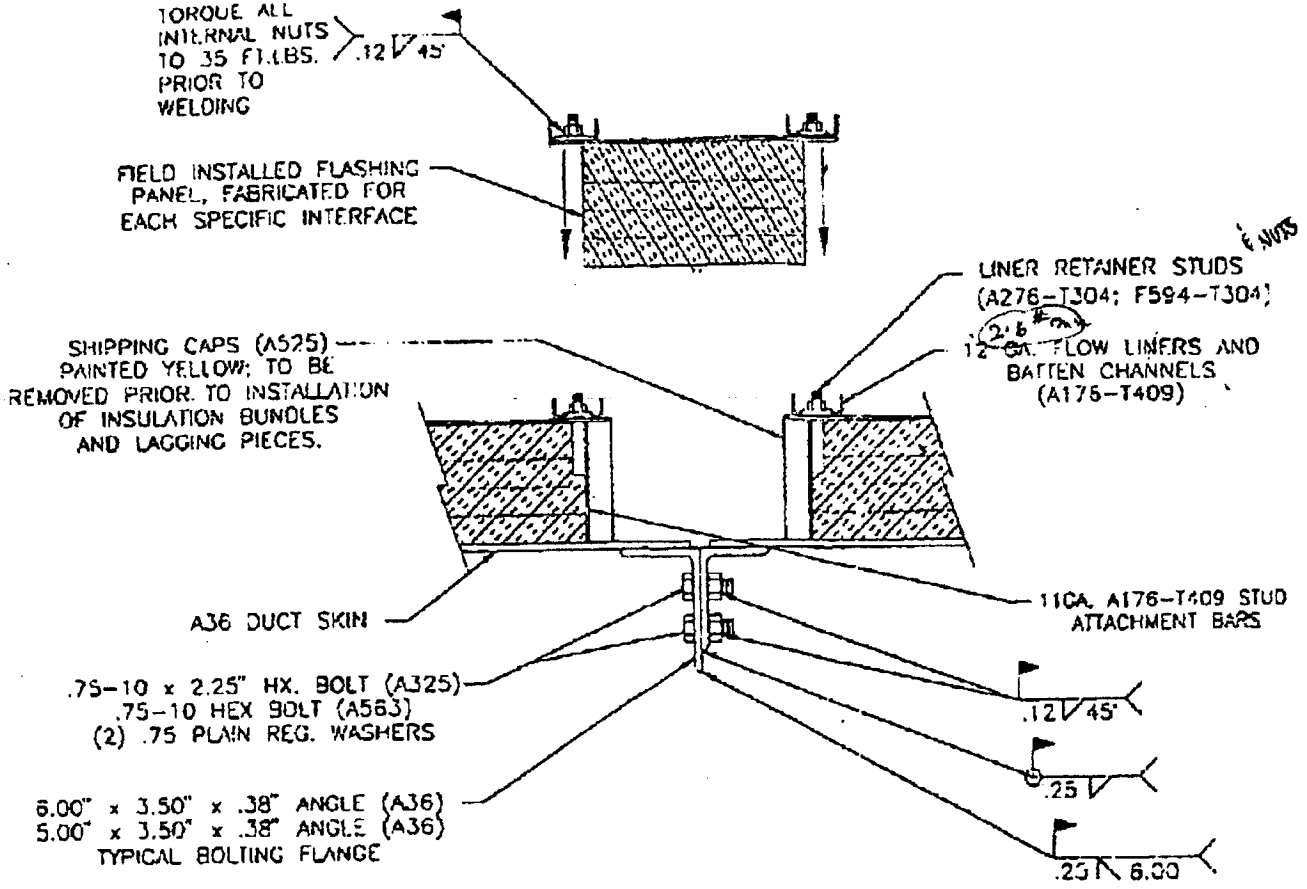
The startup & shutdown data and curves along with other reference documents like exhaust plenum drawings, welding instructions will only be provided after award of contract.

APPENDIX IV

EXPANSION JOINT INTERFACES



SECTION A–1 (SHT 28)



Appendix VII - Field-lagged Joint Typical Cross Section

PRODUCT STANDARD

HYDERABAD

GT54313

REV.NO. 02

RECORD OF REVISIONS

Part No.	Date	Revision Data	Revised	Approved
00		First Mode		
01	05.07.08	VAR 02 ADDED	PRAMOD	BSN
02	01-9-08	Var 03 to 05 added.	Suresh.V	BSN

Ref. Doc		Revisions: Refer to record of revisions:	Prepared.	Approved.	Date:

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BHEL

PRODUCT STANDARD

GAS TURBINES

GRATING ANTI SKID GALVANISED (HOT DIP)

1.0 SCOPE: This specification is meant for supplying the Grating-Anti Skid, Galvanised, to be used in Platforms for Gas Turbine equipment.

The suply shall be as per the varient no. asked for, in the enquiry & as per Drg. in Sheet 3.

2.0 VENDOR'S DRG: The supplier shall furnish Vendor's Drg. within 1 Week of placement of order/LOI. All manufacturing, details are to be furnished in this drg.

3.0 QUALITY ASSURANCE: Strict quality assurance procedures are to be Adopted during the manufacturing of the Gratings.

Facility for Inspection by BHEL/BHEL'S Representative shall be provided by the vendor during manufacturing And/OR final inspection.

4.0 GENERAL:

4.1 One copy of Drg. is enclosed along with enquiry for Ref use by vendor.(Sheet No.3)

4.2 DESPATCH: Each Assy shall be packed together and marked with BHEL code (From Purchase Order).

4.3 Care should be taken to avoid damages during Transport, Handling & Storage.

Concurred: STANDARDS

Issued
GAS TURBINES
HYDERABAD-500 032 (INDIA)

Prepared	Approved	Date
(B.S.N.)		930503

VARIANT TABLE:-

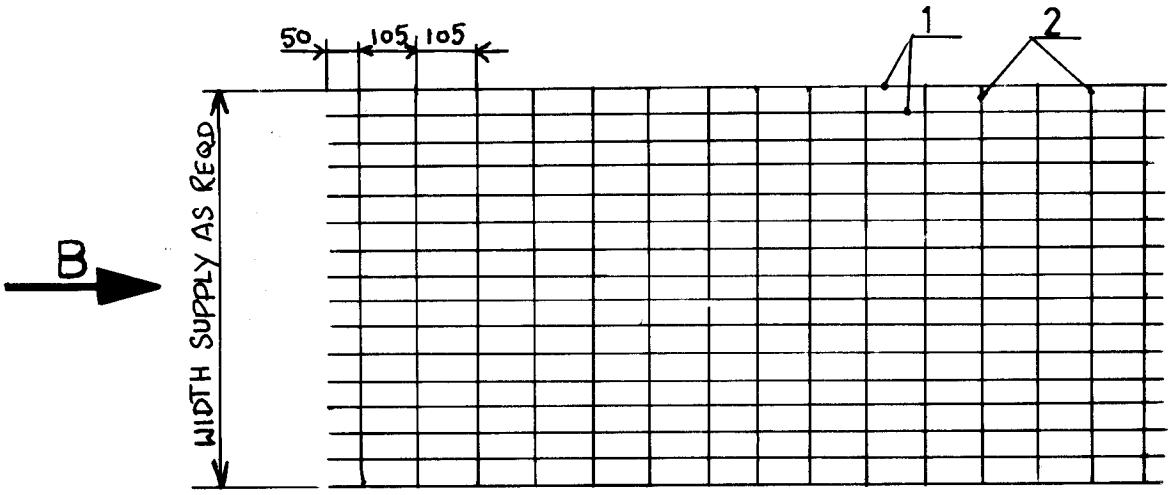
VAR NO	GRATINGSIZE LENGTH	GRATINGSIZE WIDTH	BHEL MATL CODE	REMARKS
01	1500	1000	GT9754155011	

PRODUCT STANDARD

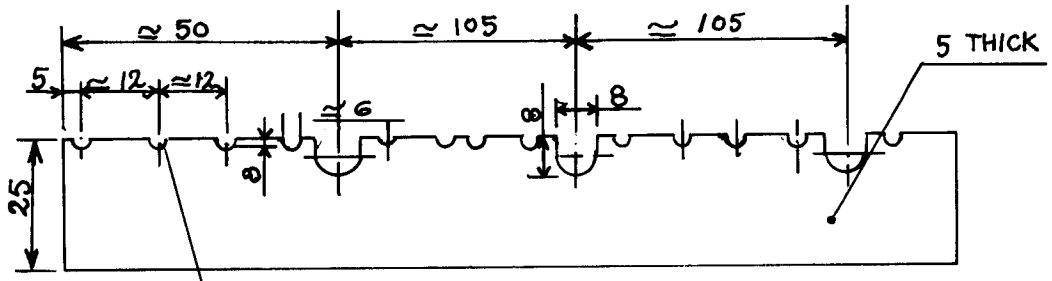
GAS TURBINES

GT54155

REV NO: 01

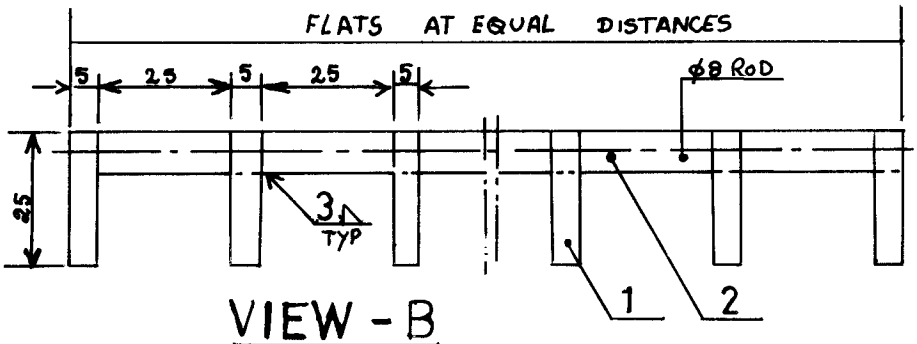


12.5



DETAIL OF POSITION-1

DEPRESSIONS OF APPROX. 3 mm TO BE DRILLED OR CHISELLED OUT AS PER MANUFACTURER'S SUITABILITY



VIEW - B
TURNED

POSITION NO	DESCRITION	MATERIAL	REMARKS
1.	FLAT 25 x 6	IS:226	
2.	ROD ϕ8	IS:1570	

NOTE:- COMPLETE ASSLY SHALL BE HOT-DIP GALVANISED 80÷100μ THK.

TD -106 -3 | Rev. No. 5 Form No.

PRODUCT STANDARD

HYDERABAD

Prod. Std. No. GT54155

Rev. No. 01

Page 4 of 4

RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised	Approved
00	03-05-93	First Made.	(B.SN)	(AK.HOM)
01	30.10.04	Round Ø8 type Changed from "Torsion to Plain"	(LVR)	(BSN)

Ref. Doc

Form No. TO-106-2 REV. 2

287A7192

BOLT HOLE GASKETING TAPE (REFRASIL CLOTH).

1. DESCRIPTION

1.1 This specification applies to gaskets used in Gas Turbine exhaust systems.

2. DESIGN DATA

2.1 Make from refrasil cloth U-9996HT of M/s Breton, Amsterdam, USA, or Equivalent. Temperature resistance 800°C to 1100°C.

3. QUALITY ASSURANCE PROVISIONS

3.1 Responsibility for Tests and Inspections: Unless otherwise specified on the ordering drawing or purchase order, the supplier is responsible for the performance of all test and inspection requirements. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Gas Turbine Designs Dept. BHEL in addition, reserves the right to perform any of the required inspections or tests where such inspections and tests are considered to be necessary to assure that the item supplied conforms to the requirements of this specification.

All tests and inspections shall be conducted in a manner to permit the recording of pertinent data in reliable and accurate values so as to permit proper evaluation of inspection and test results by the Gas Turbine Designs Dept. The vendor contract shall specify the frequency and scope of vendor test reports to be supplied to G.T. Designs.

3.2 Designs Qualification Inspection and Test Requirements: None.

3.3 **Production Inspections and Test:** See purchase order or quotation request package for instructions regarding production inspections and tests to be performed by the supplier for repeat orders. Supplier shall be required to supply inspection and test data, as specified by the purchase order, ordering sheet or quotation request, for approval by the GAS TURBINE DESIGNS DEPT, BHEL.

3.4 "All material will be delivered in a clean and usable condition. Openings will be securely covered against entry of foreign material where appropriate."

4. **PREPARATION FOR DELIVERY**

4.1 **Preservation:** Preservation shall be accomplished in accordance with acceptable commercial practices (for domestic or foreign shipments) unless otherwise indicated in the purchase orders or quotation request.

4.2 **Packaging:** Packaging shall be accomplished in accordance with acceptable commercial practices (for domestic or foreign shipments) unless otherwise indicated in the purchase order or quotation request.

4.3 **Packing:** Packing shall be accomplished with acceptable commercial practices (for domestic or foreign shipments) unless otherwise indicated in the purchase orders or quotation request.

The vendor shall make shipment using the minimum number of shipping containers consistent with the requirements of safe transit, available modes of transportation and routing. It shall be the vendor's responsibility to determine that packaging as done is adequate to assure that all equipment shall arrive at destination in an undamaged condition and ready for intended use.

When more than one shipping container is required, the vendor shall provide suitable container markings for recognition of parts of one unit. Assembly instructions should be included with each such shipment.

4.4 **Marking:** All shipping containers shall be identified with the Customer Order Number, BHEL Field Requisition Number, Turbine Serial Number, (Where specified to the vendor), BHEL Purchase Order Number, Drawing Number and Part Number and the vendor Packing List and Shipping Numbers. Each shipping container shall contain three packing lists, listing all contents of the particular container with one copy attached in a secure manner to the outside. Each part will be identified and keyed to the packing list.

4.5 **Shipment:** For specific shipping instructions, see Purchase Order or Quotation Request. Approval to ship must be obtained from the applicable Purchasing Unit either by telephone call or by telegram. If shipment will be short, the Purchasing approval of all shortage items must be obtained prior to shipment. At time of shipment, two copies of the packing list and shortage list, with promised shipping dates, if applicable, must be airmailed to the applicable Purchasing unit as noted on the Purchase Order.

5. OUTLINE

See Sheet 5

6. DATA, DRAWINGS AND DOCUMENTS

6.1 All vendor drawings and document requirements for this design shall be ordered by the purchase order.

6.2 The vendor shall make no changes to approved drawings without the approval of the BHEL GAS TURBINE DESIGN DEPT. The approval of drawings in no way relieves the vendor of responsibility for meeting the requirements of the Specification, Ordering Sheet or Outline Drawing.

7. TRANSMITTAL INSTRUCTIONS

7.1 Transmittal instructions for this design shall be identified by the purchase order.

8. NOTES

8.1 The vendor shall submit, with the quotation, engineering drawings, specifications and other information sufficient to permit analysis of, and a determination as to the suitability of, the design of the equipment to be supplied.

In order to comply with the intent and spirit of this specification, an item not specifically referred to, but considered to be necessary to the fulfillment of the requirements of this specification shall be included in the Vendor's quotation and so noted.

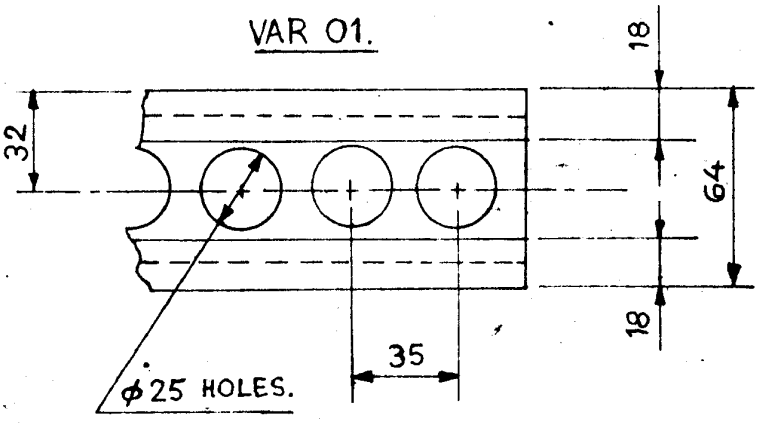
In the event of conflict between this specification and associated ordering sheet, outline or reference drawing, or referenced specifications and standards, the vendor shall advise the Gas Turbine Designs Dept. Purchasing Unit immediately upon the recognition of such conflicts, so that corrective action may be taken.

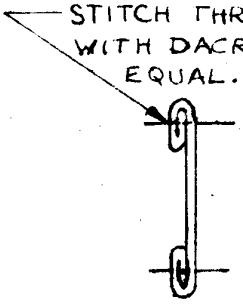
9.0 Vendor to submit material test certificates with the supplies and also one copy of the proposed material test certificate for engineering approval prior to undertaking manufactu

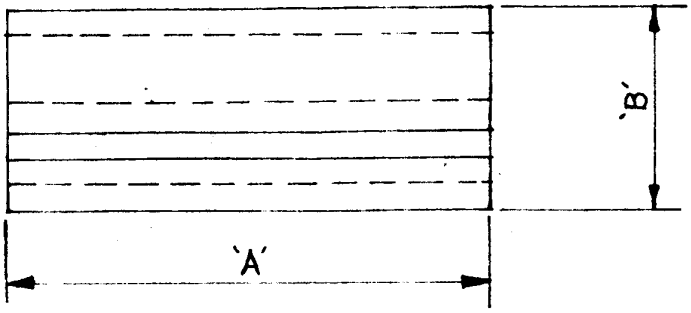
PRODUCT STANDARD

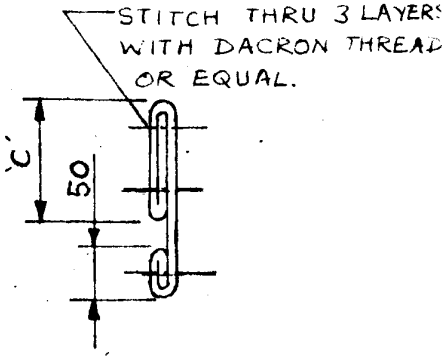
GT 51115
REV: 02

VAR 01.



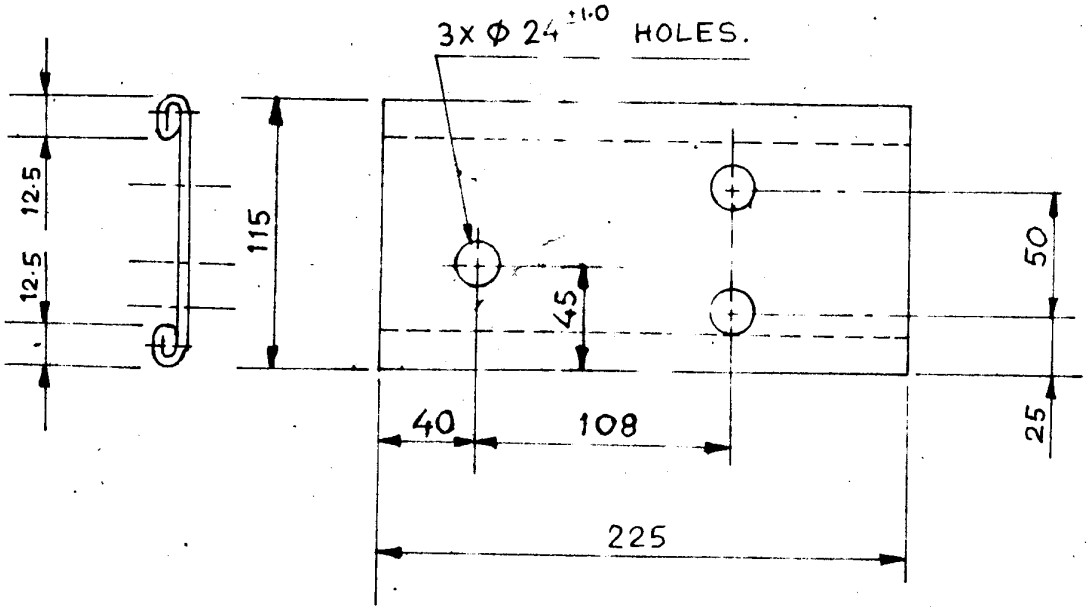




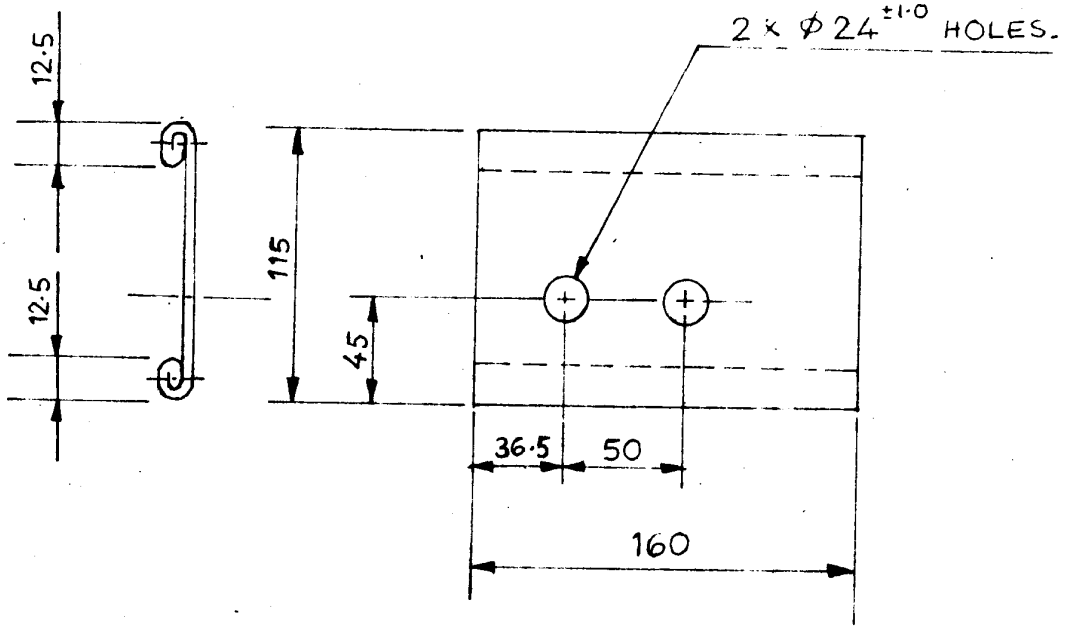


VAR	A	B	C
02	410	190	125
03	630	225	160

VAR 04. (3.15 THK)



VAR 05. (3.15 THK)



VAR	BHEL CODE.
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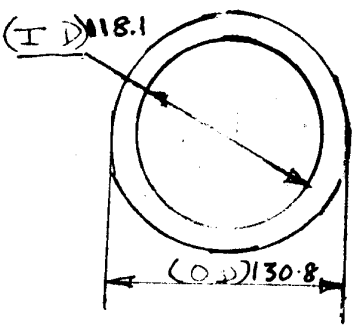
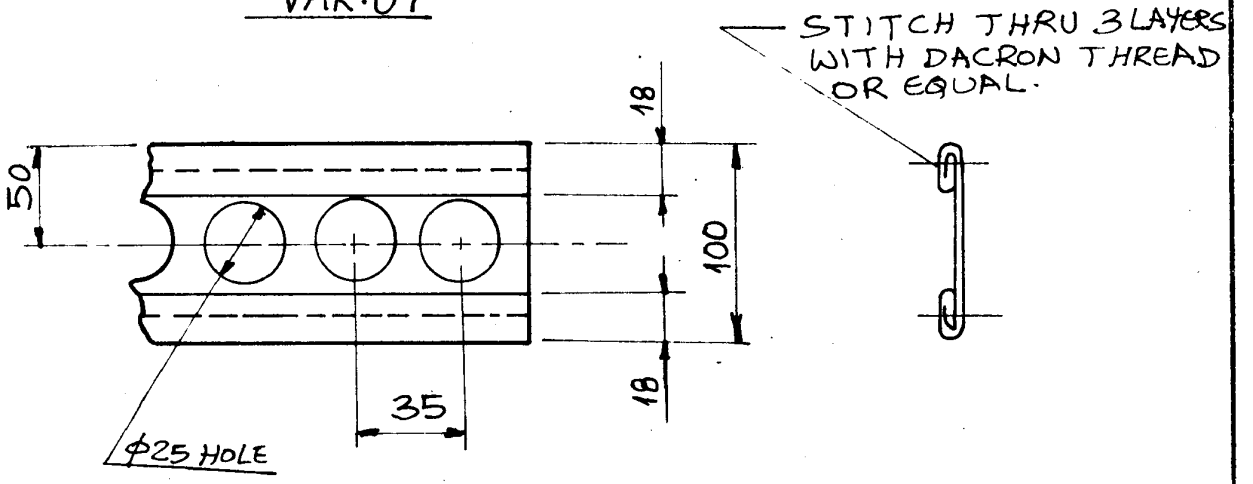
02	
03	
04	
05	
06	GT 9751115060
07	GT 9751115078



VAR (06)

VAR·07



RECORD OF REVISIONS

Rev. No.	Date	Revision Details	Revised	Approved
00	19.1.88	First made	—	—
01	23.3.94	Var - 07 added	E.V. Aditya (EVA)	(KRMR) 12.7.9.
02	12.7.95	Item - 9.0 added	E.V. Aditya (EVA)	(KRMR) 12/7/.

Ref. Doc

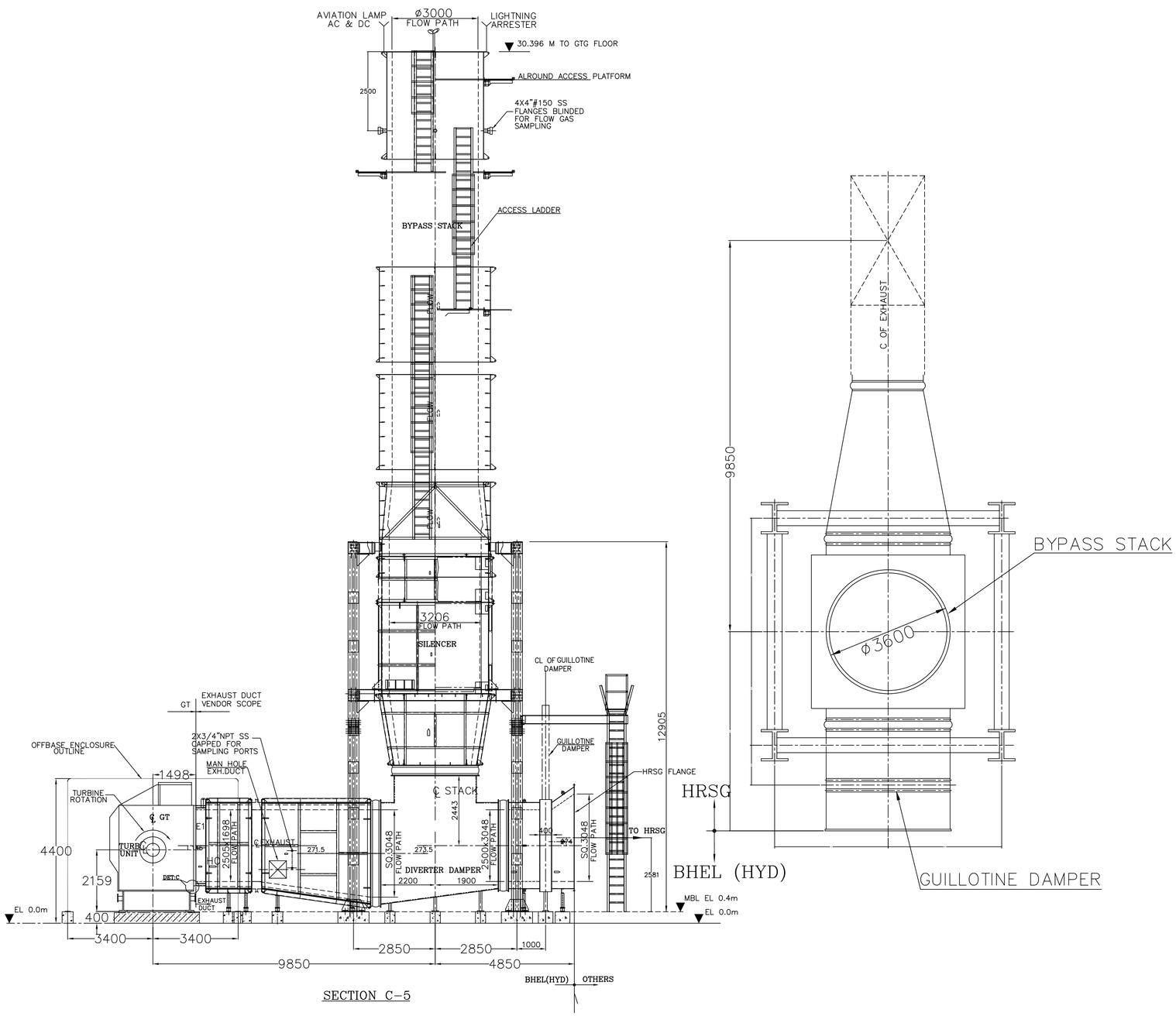
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-364-09-51007 SH. 01 OF 02

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME 1364095100 7-S01-R00.DWG | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO



SECTION C-5

VIEW-A

(NOT TO SCALE)

* MARKED DIMENSIONS ARE INDICATIVE ONLY

NOTES:

1. EXHAUST DUCTING IS INTERNALLY INSULATED WITH CERAMIC WOOL. PLATFORMS SHOWN FOR BY-PASS STACK ARE INDICATIVE ONLY. ACTUAL REQUIREMENT MAY VARY.
2. REFER GENERAL ARRANGEMENT FOR GTG(1-366-09-59037) SPECIFIC TO THE PROJECT FOR LAY OUT & INTERFACE INFORMATION.
3. EXPANSION JOINTS EJ1,EJ2,EJ3,EJ4 AND DUCT BETWEEN DIVERTER & GUILLOTINE DAMPER ARE IN VENDOR"S SCOPE OF SUPPLY.
4. EXHAUST PLENUM TO OUT SIDE OF ENCLOSURE ie UP TO EXPANSION JOINT EJ-1 IS STRAIGHT DUCT.
5. DIVERTER DAMPER & GUILLOTINE DAMPER IS NOT IN THE SCOPE OF SUPPLY.
   FOR DIVERTER DAMPER DIMENSIONS & FOUNDATION, REFER BHEL DRAWING NO: 2-365-02-51001
6. FOR INTERFACE WITH EXHAUST PLENUM,BHEL DRAWING No: Fr 5 PLENUM DRAWING 13591251001
7. FABRIC EXPANSION JOINT SHOULD CONSIST OF LAYERS WITH SS WIRE MESH, CERAMIC FIBRE,GLASS FABRIC,2 LAYERS OF PTFE FOIL,SILICON COATED GLASS FABRIC.
   EXPANSION JOINT SHALL BE OF FABRIC TYPE, TO BE PROCURED FROM BHEL APPROVED VENDORS.. VENDOR TO SUBMIT THE CONSTRUCTION DRAWINGS & MATERIALS FOR SCRUTINY.
8. DUCTING:
   VENDORS: KELD ELLENTOFT/BACHMANN/KE BURGMAN
   VERTICAL DUCT & HORIZONTAL DUCT FRAME MATERIAL :IS2062 GR-B, MIN 8 MMTHK
   LINER MATERIAL : SS 409, 3.15MM THK
9. SILENCER:
   SILENCER SHALL BE IN VERTICAL POSITION.VENDOR TO SUBMIT THE CONSTRUCTION DRAWINGS, ACCOUSTIC DESIGN CALCULATIONS & MATERIALS FOR SCRUTINY.
   FRAME: CS 8 THK
   LINER MATERIAL & SPLITTERS : SS 409, 3.15MM THK
   SILENCER SHALL BE AS SPECIFIED BELOW
   PANEL LENGTH & WIDTH : 3418MM x 260MM
   PANEL SPACING: 260MM (9 IN AIR GAPS,10.5 IN AIR GAPS)
   NO. OF PANELS: 8
   SILENCER GAS PATH WIDTH&HEIGHT: 3418MM X 4780MM
   PANEL FILL MATERIAL: 6lb/ft3 CERAMIC WOOL WRAPPED WITH FINELY WOVEN FIBRE GLASS CLOTH AND SS STAPLED AT THE ENDS.
   PANEL PERFORATED COVER SIDE WALLS: 0.188 IN DIA HOLES ON 0.312 IN STAGGERED CENTRES ASTM A 176 GR409,3.15MM THK,CERAMIC FIBRE INSULATION(8lb/ft3 density) 150MM THK WRAPPED AND COVERED WITH PERFORATED INTERNAL LAGGING.
   THE SILENCER SECTION SHALL BE DESIGNED SUCH THAT THE SILENCER PANEL INLET BULL NOSE EXTEND BEYOND THE INLET FLANGE OF THE SILENCER DUCT.
10. MATERIALS:
    END FLANGES MATERIAL: CS, 12MM THK
    PARTITION FLANGES: CS,12MM THK
    TRANSITION PIECE: CS,8MM THK MIN
    CLADDING STUDS(WITH SS SCALLOPED BARS): SS304 DIA16MM(MIN)
    SPACING BETWEEN STUDS SHALL BE OF MAX. 300MM
    STRUCTURAL STEELS: IS2062 GR-B
11. INSULATION:
    INSULATION THICKNESS FOR VERTICAL STACK 150 MM & HORIZONTAL DUCT 250 MM.
    H4 DUCT INSULATION THICKNESS 325 MM.
    INSULATION SHALL BE OF CERAMIC WOOL OF 128 kg/m3(8 lb/in3) DENSITY.
    CERAMIC BLANKET INSULATION SHALL BE WRAPPED IN FIBER GLASS CLOTH ALL ROUND THE INSULATION AND SS STAPLED.
    GLASS CLOTH MATERIAL -0.2kg/cm2, 0.18 mm THK,UNIVERSAL DESIGNATION HPL STYLE 7628
12. SURFACE PREPARATION & PAINTING:
    ALL INTERNAL & EXTERNAL SURFACES SHALL BE DEGREASED AND SURFACE CLEANED BY GRIT BLASTING SA 2 1/2 STANDARD.
    PAINTING SHALL BE 50 MICRON INORGANIC ZINC SILICATE AND 50 MICRONS HIGH TEMPERATURE ALUMINIUM SILICON. (TOTAL DFT 100 MICRONS)

NOTES CONTNUED ON SHEET 2..

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD	02	23.08.07	CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE		

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: 2 X FR 5 MUL

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	PRIYA		21.08.08	
CHD.	V.SURESH		21.08.08	
APPD.	BSN		21.08.08	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
GTD	GR. C/M/F	NA	-N.A.-	-N.A.-	-N.A.-	-N.A.-
CODE 423						

TITLE: EXHAUST DUCT & BYPASS STACK

CARD CODE: N.A.

DRAWING NO. 1-364-09-51007 REV. 00

SHT. No 01 NO. OF SHT. 02

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-364-09-51007 SH. 02 OF 02

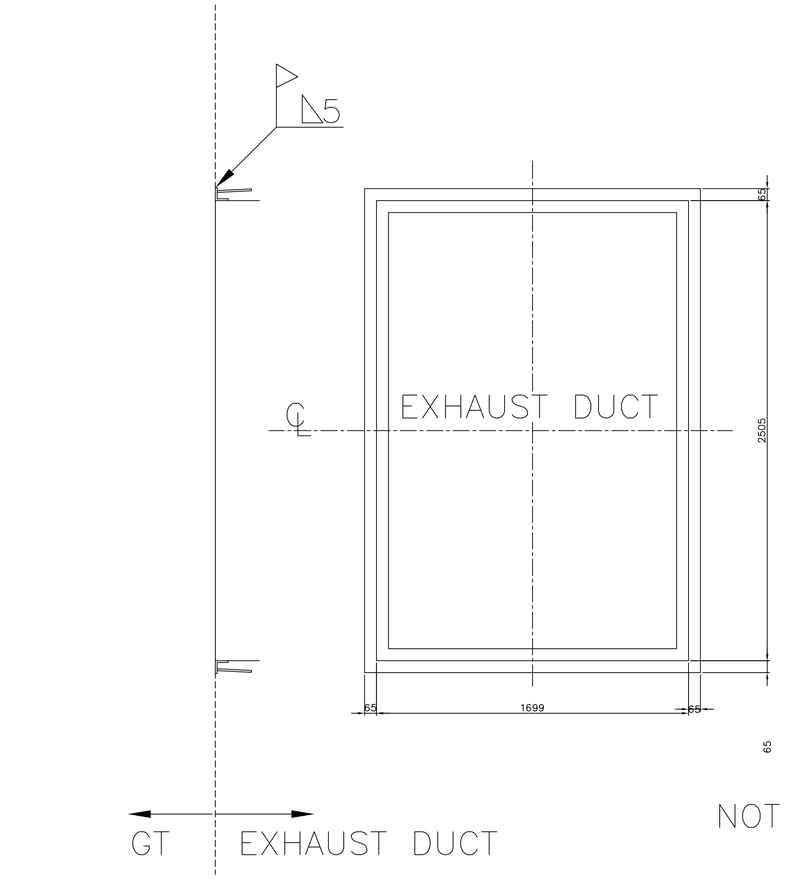
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME 1364096100 7-S02-R00.DWG

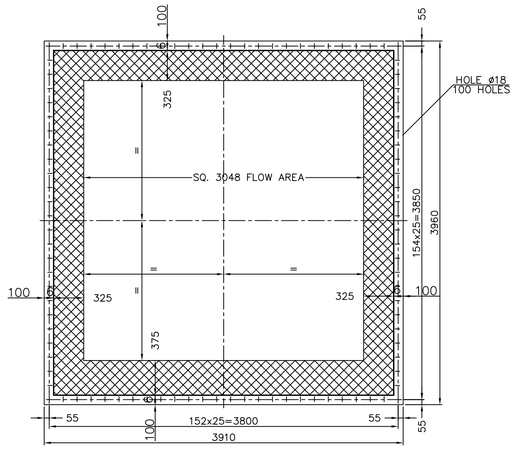
REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO



DETAIL – C
(EXHAUST DUCT INTERFACE DETAIL)
(EXHAUST DUCT GAS FLOW AREA SHOWN FOR CLARITY)

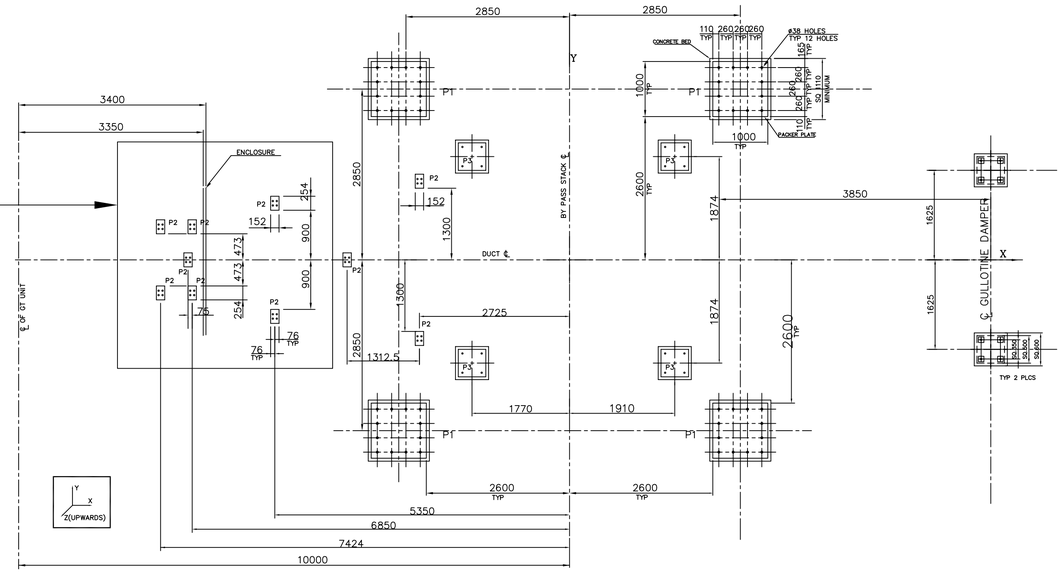


DETAIL–A
HRSG END FLANGE DETAIL IN EXHAUST DUCT

NOT FINAL

NOTES:(CONTD FROM SHEET1)

13. PLATFORM & RAILING SHALL BE WITH GALVANIZED ASTM A53.
    GALVANIZING SHALL BE DONE AS PER GT54155.
    PLAT FORMS & RAILINGS DESIGN & REQUIREMENTS SHALL BE IN ACCORDANCE WITH OSHA STANDARDS.
    DIVERTER DAMPER & GUILLOTINE DAMPER MAINTAINANCE ASPECT SHALL BE CONSIDERED
14. GASKETS IN DUCTING SHALL BE OF REFRASIL CLOTH AS PER GT51115.
15. ALL MATING COMPONENTS(LIKE SHELL HALFS & SHELL TO SHELL..ETC) SHALL BE TRIAL ASSEMBLED.
16. FOUNDATION DESIGN & ANALYSIS (REFER VAR TABLE), FOUNDATION EMBEDMENTS ARE IN VENDOR'S SCOPE OF SUPPLY.



FOUNDATION PLAN

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD	01	18.08.07	CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE		

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: 2 X FR–5 MUL

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	PRIYA		21.08.08	
CHD.	V.SURESH		21.08.08	
APPD.	BSN		21.08.08	

DEPT. GTD	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
CODE 423	C/M/F	NA	–N.A.–	–N.A.–	–N.A.–	–N.A.–

TITLE: EXHAUST DUCT & BYPASS STACK

CARD CODE: N.A.

DRAWING NO. 1–364–09–51007 REV. 00

SHT. No 02 NO. OF SHT. 02

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 2-365-02-51001

SH. 01 OF 01

COMPUTER FILE NAME 23650251001-S01-R00

REF. DRG. NO. HY0230261

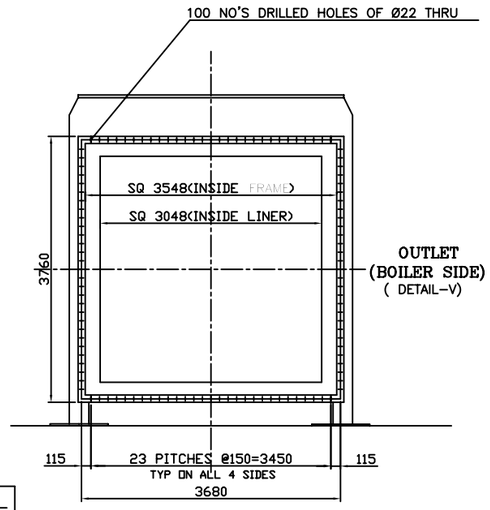
SIGN. AND DATE

INVENTORY NO

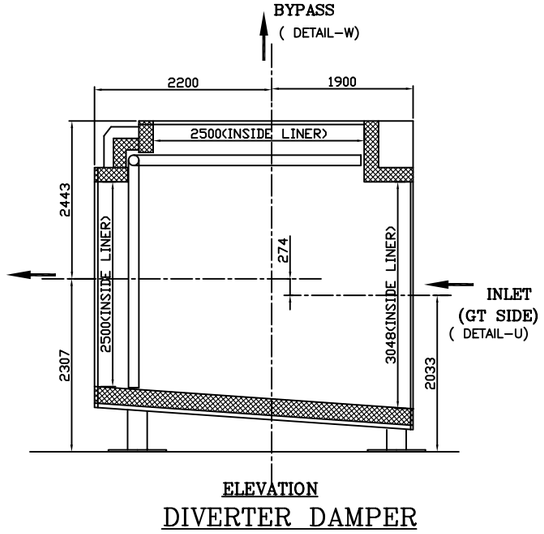
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER

NOTES: –

1. DIVERTER DAMPER SUPPLY SHALL BE AS PER GT54276.
2. GUILLOTINE DAMPER SUPPLY SHALL BE AS PER GT54277.
3. SEAL AIR FANS LOCATION WILL BE FINALISED DURING DETAILED DESIGN.

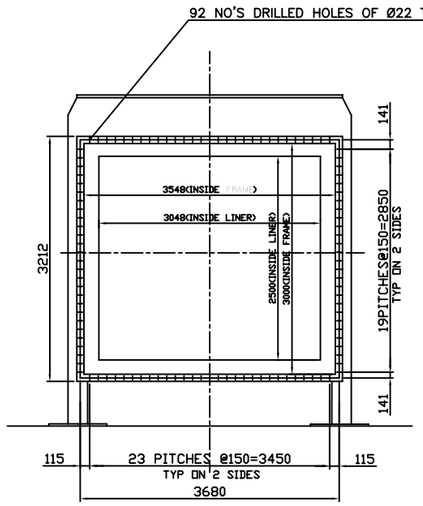


DETAIL–U

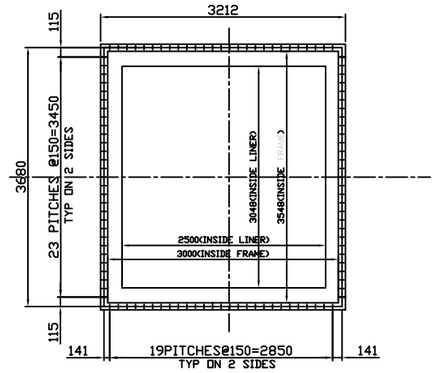


ELEVATION

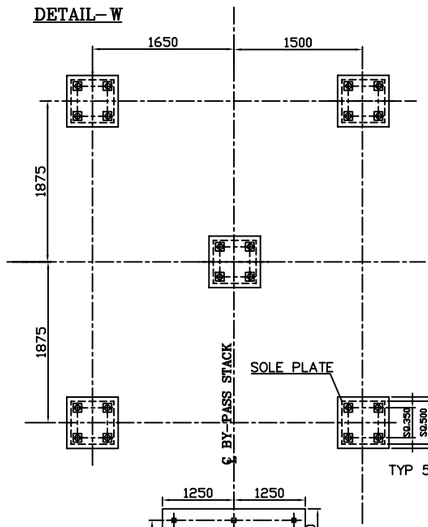
DIVERTER DAMPER



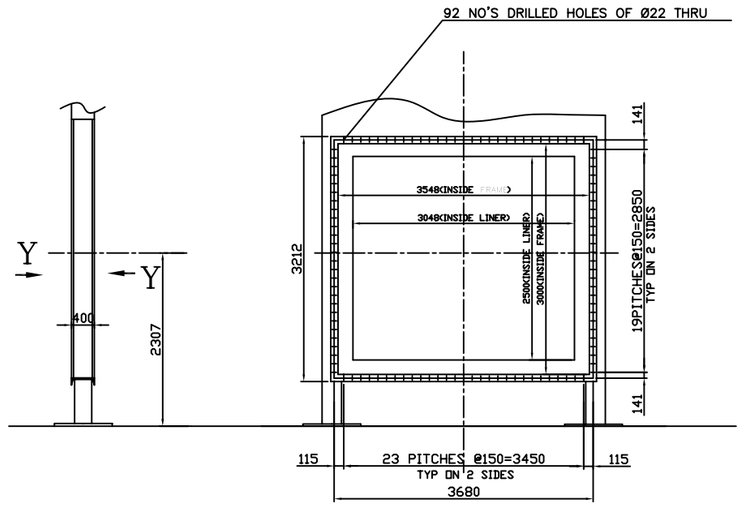
DETAIL–V



DETAIL–W



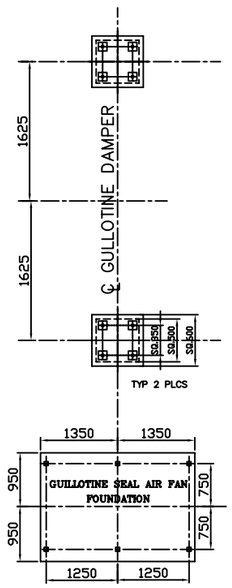
FOUNDATION DETAIL



ELEVATION

VIEW–Y

GUILLOTINE DAMPER



FOUNDATION DETAIL

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE			ZONE			ZONE		

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: FR–5 ,GT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	G.J.C.		11.08.04	
CHD.	B.S.N.		11.08.04	
APPD.	B.I.B.		11.08.04	

DEPT.	OVERALL DIMS.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
G.T.D	GR. ~~C/M/F~~		1:75	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 423							

TITLE: DIVERTER & GUILLOTINE INTERFACE INFO

CARD CODE N.A.

DRAWING NO. 2-365-02-51001 REV. 00

SHT. No 01 NO. OF SHT. 01

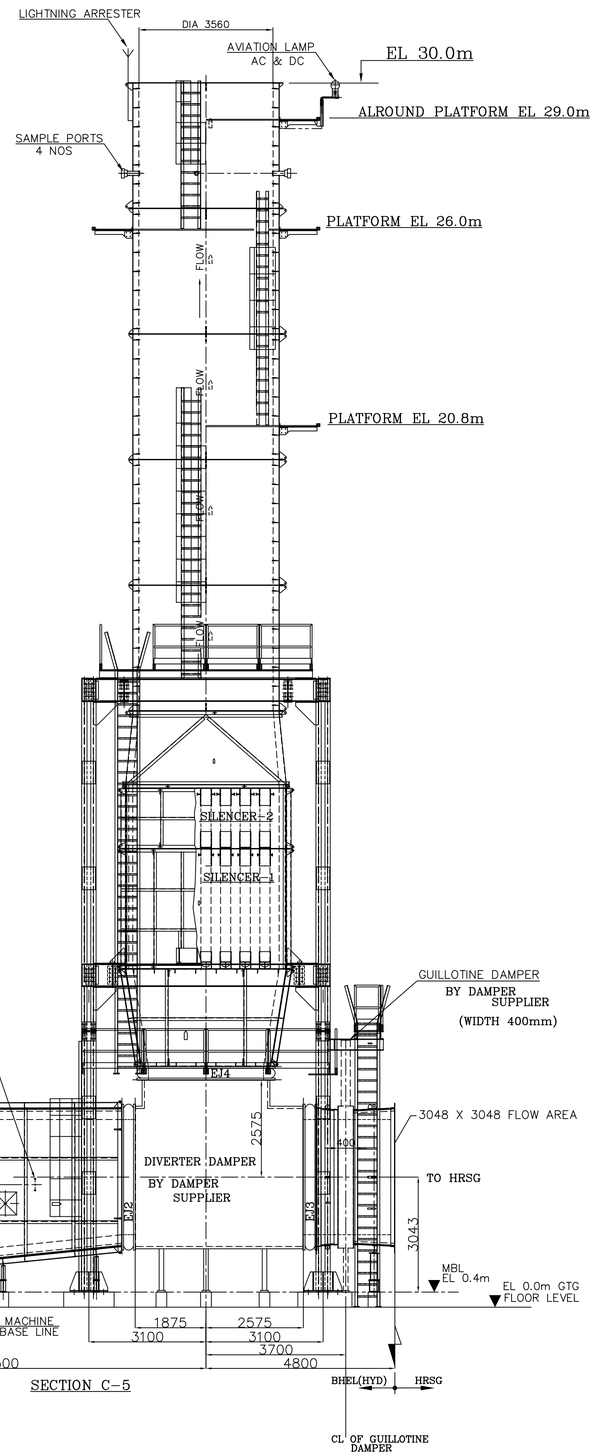
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

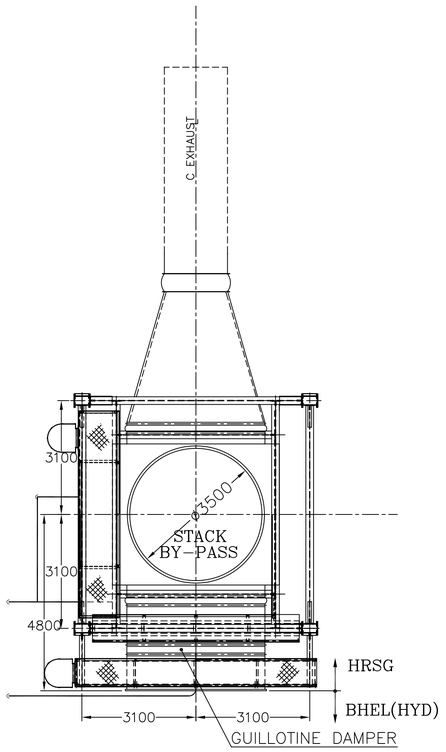
COMPUTER FILE NAME 1364096101 4-S01-R00.DWG

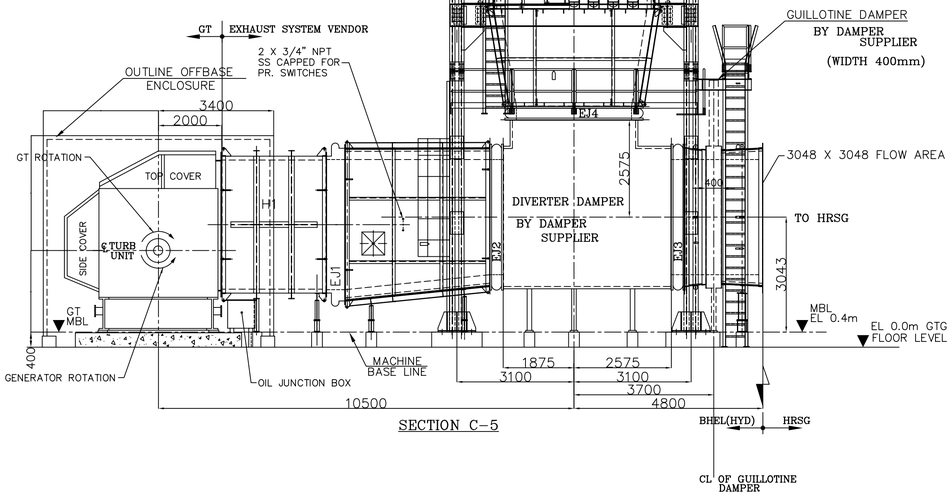
REF. DRG. NO.

SIGN. AND DATE

INVENTORY NO







SECTION C-5

NOTES:

1. EXHAUST DUCTING IS INTERNALLY INSULATED WITH CERAMIC WOOL. PLATFORMS SHOWN FOR BY-PASS STACK ARE INDICATIVE ONLY. ACTUAL REQUIREMENT MAY VARY.
2. REFER GENERAL ARRANGEMENT FOR GTG(1-366-09-69058) SPECIFIC TO THE PROJECT FOR LAY OUT & INTERFACE INFORMATION.
3. EXHAUST PLENUM COVERS(SIDE & TOP COVERS) , EXPANSION JOINTS EJ1,EJ2,EJ3,EJ4 AND DUCT BETWEEN DIVERTER & GUILLOTINE DAMPER ARE IN VENDOR"S SCOPE OF SUPPLY.
4. EXHAUST PLENUM TO OUT SIDE OF ENCLOSURE ie UP TO EXPANSION JOINT EJ-1 IS STRAIGHT DUCT.
5. DIVERTER DAMPER & GUILLOTINE DAMPER IS NOT IN THE SCOPE OF SUPPLY.
   FOR DIVERTER DAMPER DIMENSIONS & FOUNDATION, REFER BHEL DRAWING NO: 2-365-02-61001
6. EXHAUST PLENUM COVERS IN VENDOR SCOPE, REFER FOLLOWING DRAWINGS,
   i) DRAWING NUMBER – 19658597935-S01-R00
   ii) DRAWING NUMBER – 19658597935-S02-R00
   iii) DRAWING NUMBER – 19658597937-S01-R02
   iv) DRAWING NUMBER – 19658597937-S02-R02
   v) DRAWING NUMBER – 19658597937-S03-R02
   FOR INTERFACE WITH EXHAUST PLENUM,BHEL DRAWING No: 0-359-12-61003
7. FABRIC EXPANSION JOINT SHOULD CONSIST OF LAYERS WITH SS WIRE MESH, CERAMIC FIBRE,GLASS FABRIC,2 LAYERS OF PTFE FOIL,SILICON COATED GLASS FABRIC.
   EXPANSION JOINT SHALL BE OF FABRIC TYPE, TO BE PROCURED FROM BHEL APPROVED VENDORS.. VENDOR TO SUBMIT THE CONSTRUCTION DRAWINGS & MATERIALS FOR SCRUTINY.
   VENDORS: KELD ELLENTOFT/BACHMANN/KE BURGMAN
8. DUCTING:
   VERTICAL DUCT & HORIZONTAL DUCT FRAME MATERIAL :IS2062 GR-B, MIN 8 MMTHK
   LINER MATERIAL : SS 409, 3.15MM THK
9. SILENCER:
   SILENCER SHALL BE IN VERTICAL POSITION.VENDOR TO SUBMIT THE CONSTRUCTION DRAWINGS, ACCOUSTIC DESIGN CALCULATIONS & MATERIALS FOR SCRUTINY.
   FRAME: CS 8 THK
   LINER MATERIAL & SPLITTERS : SS 409, 3.15MM THK
   SILENCER SHALL BE AS SPECIFIED BELOW
   PANEL LENGTH & WIDTH : 3418MM x 260MM
   PANEL SPACING: 260MM (9 IN AIR GAPS,10.5 IN AIR GAPS)
   NO. OF PANELS: 8
   SILENCER GAS PATH WIDTH&HEIGHT: 3418MM X 4780MM
   PANEL FILL MATERIAL: 6lb/ft3 CERAMIC WOOL WRAPPED WITH FINELY WOVEN FIBRE GLASS CLOTH AND SS STAPLED AT THE ENDS.
   PANEL PERFORATED COVER SIDE WALLS: 0.188 IN DIA HOLES ON 0.312 IN STAGGERED CENTRES ASTM A 176 GR409,3.15MM THK,CERAMIC FIBRE INSULATION(8lb/ft3 density) 150MM THK WRAPPED AND COVERED WITH PERFORATED INTERNAL LAGGING.
   THE SILENCER SECTION SHALL BE DESIGNED SUCH THAT THE SILENCER PANEL INLET BULL NOSE EXTEND BEYOND THE INLET FLANGE OF THE SILENCER DUCT.
10. MATERIALS:
    END FLANGES MATERIAL: CS, 12MM THK
    PARTITION FLANGES: CS,12MM THK
    PLENUM COVERS: CS,10MM THK MIN
    TRANSITION PIECE: CS,8MM THK MIN
    CLADDING STUDS(WITH SS SCALLOPED BARS): SS304 DIA16MM(MIN)
    SPACING BETWEEN STUDS SHALL BE OF MAX. 300MM
    STRUCTURAL STEELS: IS2062 GR-B
11. INSULATION:
    INSULATION THICKNESS FOR VERTICAL STACK 150 MM & HORIZONTAL DUCT 250 MM.
    H4 DUCT INSULATION THICKNESS 325 MM.
    INSULATION SHALL BE OF CERAMIC WOOL OF 128 kg/m3(8 lb/in3) DENSITY.
    CERAMIC BLANKET INSULATION SHALL BE WRAPPED IN FIBER GLASS CLOTH ALL ROUND THE INSULATION AND SS STAPLED.
    GLASS CLOTH MATERIAL –0.2kg/cm2, 0.18 mm THK,UNIVERSAL DESIGNATION
    HPL STYLE 7628
12. SURFACE PREPARATION & PAINTING:
    ALL INTERNAL & EXTERNAL SURFACES SHALL BE DEGREASED AND SURFACE CLEANED BY GRIT BLASTING SA 2 1/2 STANDARD.
    PAINTING SHALL BE 50 MICRON INORGANIC ZINC SILICATE AND 50 MICRONS HIGH TEMPERATURE ALUMINIUM SILICON. (TOTAL DFT 100 MICRONS)

NOTES CONTNUED ON SHEET 2..

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD	02	23.08.07	CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE		

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: 2 X FR-6 GGSR

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	PRIYA		21.08.08	
CHD.	V.SURESH		21.08.08	
APPD.	BSN		21.08.08	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
GTD	GR. f/M/f	NA	-N.A.-	-N.A.-	-N.A.-	-N.A.-
CODE 423						

TITLE: EXHAUST DUCT & BYPASS STACK

CARD CODE: N.A.

DRAWING NO. 1-364-09-61014 REV. 00

SHT. No 01 NO. OF SHT. 02

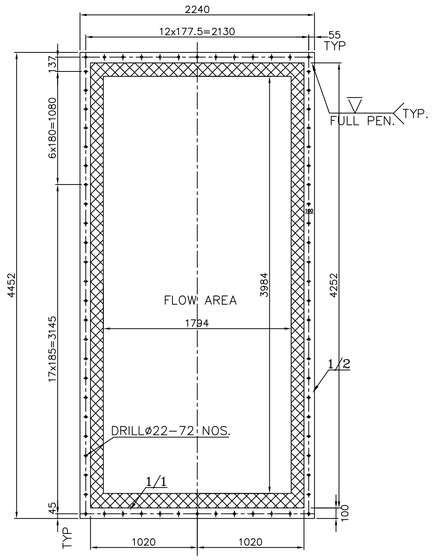
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME 1364096101 42-S02-R00.DWG

REF. DRG. NO.

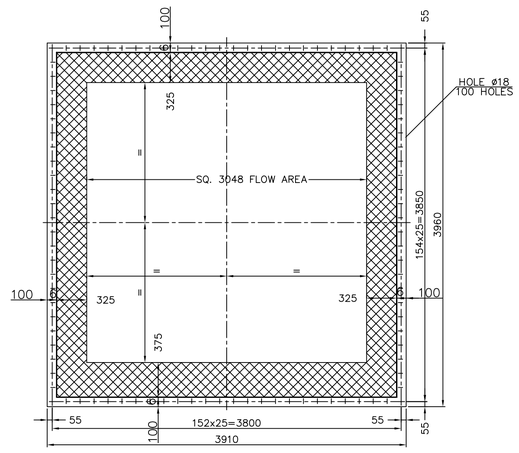
SIGN. AND DATE

INVENTORY NO



(DETAIL-X)

(PLENUM INTERFACE FLANGE DETAIL)



DETAIL-A

HRSG END FLANGE DETAIL IN EXHAUST DUCT

NOTES:(CONTD FROM SHEET1)

13. PLATFORM & RAILING SHALL BE WITH GALVANIZED ASTM A53.
    GALVANIZING SHALL BE DONE AS PER GT54155.
    PLAT FORMS & RAILINGS DESIGN & REQUIREMENTS SHALL BE IN ACCORDANCE WITH OSHA STANDARDS.
    DIVERTER DAMPER & GUILLOTINE DAMPER MAINTAINANCE ASPECT SHALL BE CONSIDERED
14. GASKETS IN DUCTING SHALL BE OF REFRASIL CLOTH AS PER GT51115.
15. ALL MATING COMPONENTS(LIKE SHELL HALFS & SHELL TO SHELL..ETC) SHALL BE TRIAL ASSEMBLED.
16. FOUNDATION DESIGN & ANALYSIS (REFER VAR TABLE), FOUNDATION EMBEDMENTS ARE IN VENDOR'S SCOPE OF SUPPLY.

FOUNDATION PLAN

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT	2 X FR-6 GGSR				
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD		NAME	SIGN.	DATE	NO.OF VAR.
	DRN.	PRIYA		21.08.08	
	CHD.	V.SURESH		21.08.08	
	APPD.	BSN		21.08.08	

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD	01	18.08.07	CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE		

DEPT. GTD	UNTOL. DIMS. GR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
CODE 423	℄/M/F		NA	-N.A.-	-N.A.-	-N.A.-	-N.A.-

TITLE	CARD CODE	DRAWING NO.	REV.
EXHAUST DUCT & BYPASS STACK	N.A.	1-364-09-61014	00
		SHT. No 02	NO. OF SHT. 02

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 2-365-02-61001

SH. 01 OF 01

COMPUTER FILE NAME 2365026101-S01-R00

REF. DRG. NO. HY0230261

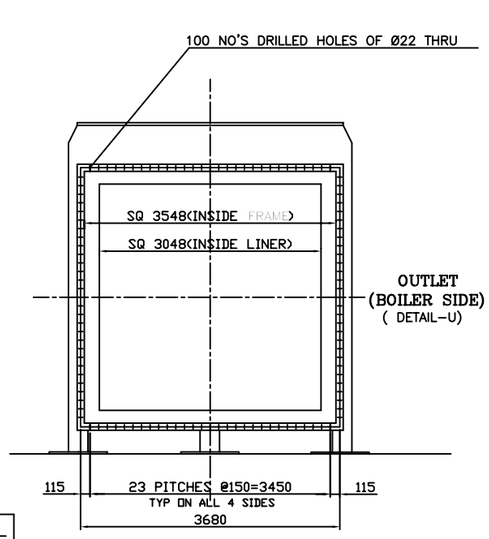
SIGN. AND DATE

INVENTORY NO

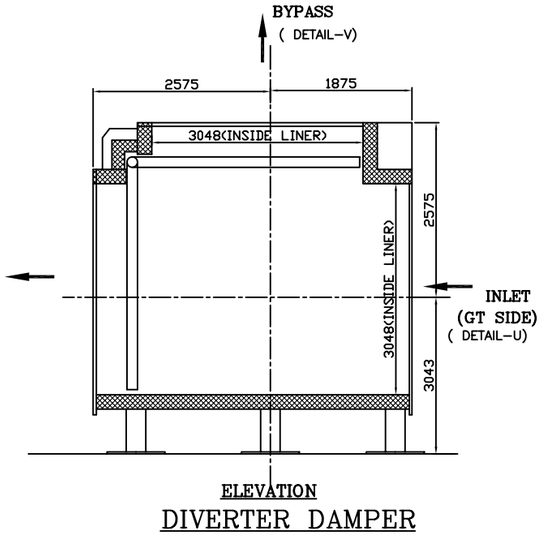
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER

NOTES: –

1. DIVERTER DAMPER SUPPLY SHALL BE AS PER GT54276.
2. GUILLOTINE DAMPER SUPPLY SHALL BE AS PER GT54277.
3. SEAL AIR FANS LOCATION WILL BE FINALISED DURING DETAILED DESIGN.

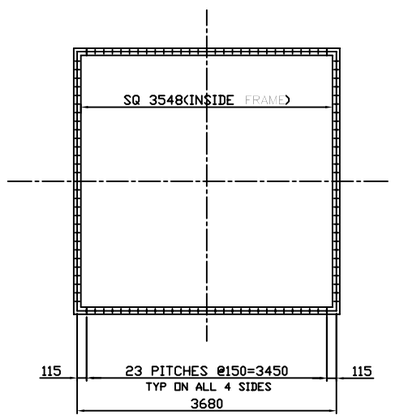


DETAIL–U

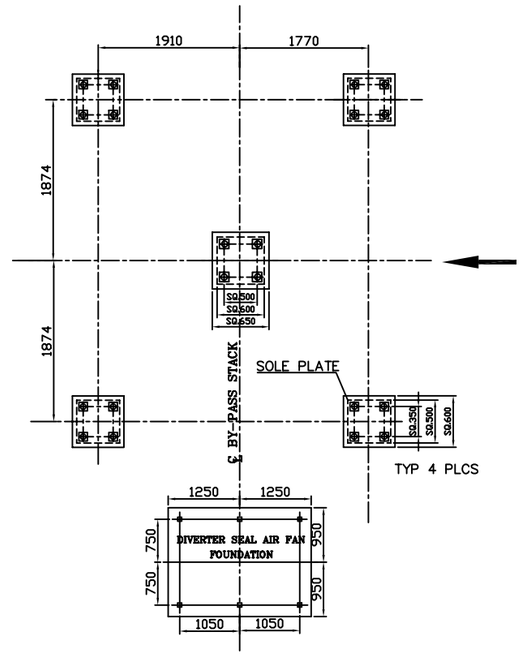


ELEVATION

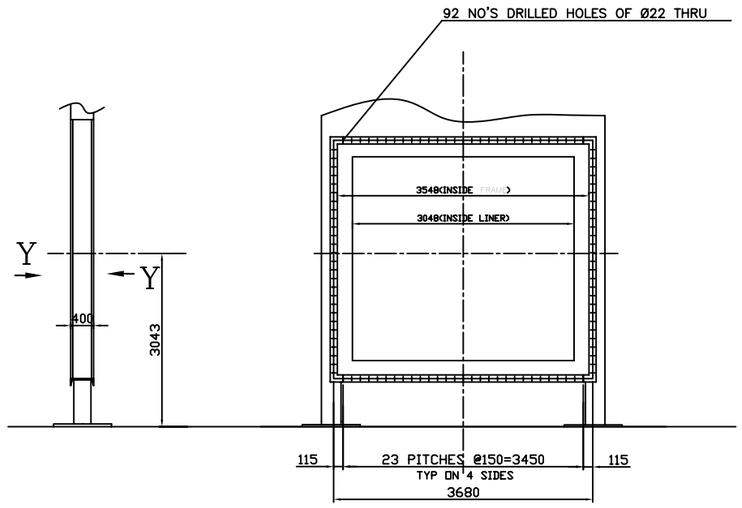
DIVERTER DAMPER



DETAIL–V



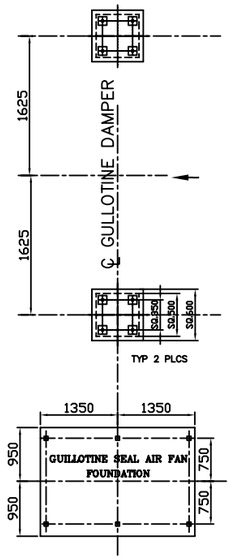
FOUNDATION DETAIL



ELEVATION

VIEW–Y

GUILLOTINE DAMPER



FOUNDATION DETAIL

REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
		CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD
ZONE			ZONE			ZONE			ZONE			ZONE		

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: FR–6 ,GT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	G.J.C.		11.08.04	
CHD.	B.S.N.		11.08.04	
APPD.	B.I.B.		11.08.04	

DEPT.	DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
G.T.D	GR. ~~C/M/F~~	1:75	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 423						

TITLE: DIVERTER & GUILLOTINE INTERFACE INFO

CARD CODE N.A.

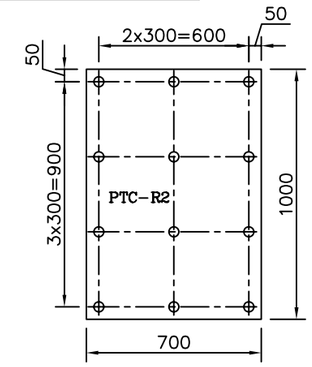
DRAWING NO. 2–365–02–61001 REV. 00

SHT. No 01 | NO. OF SHT. 01

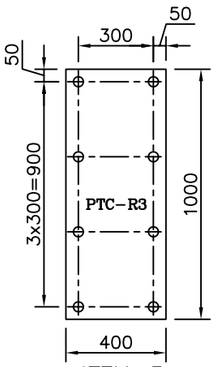
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

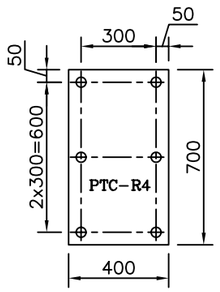
DRG. NO. 1-965-85-97935



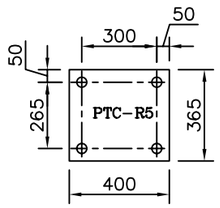
ITEM-2



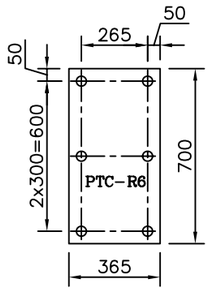
ITEM-3



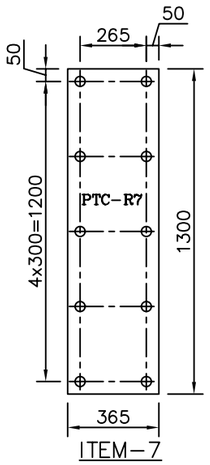
ITEM-4



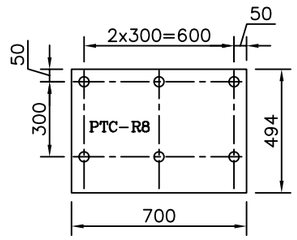
ITEM-5



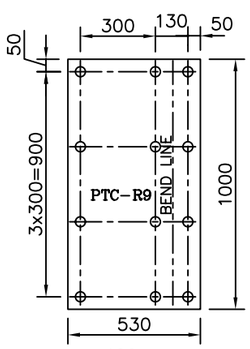
ITEM-6



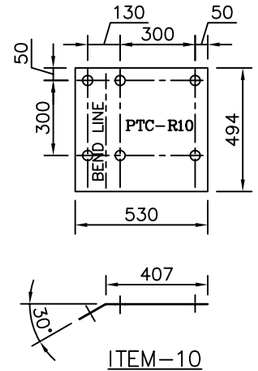
ITEM-7



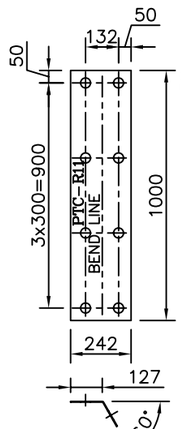
ITEM-8



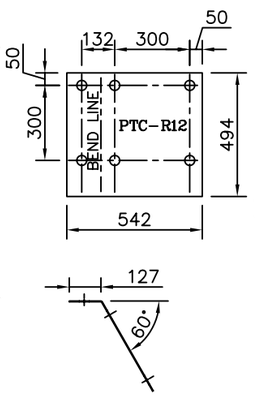
ITEM-9



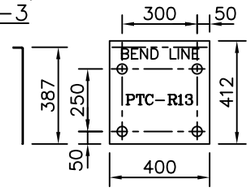
ITEM-10
(NOTE-3)



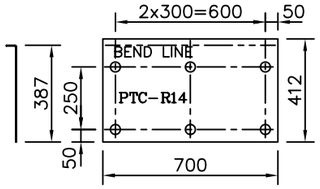
ITEM-11



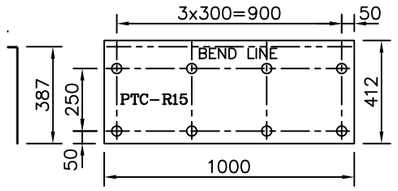
ITEM-12
(NOTE-3)



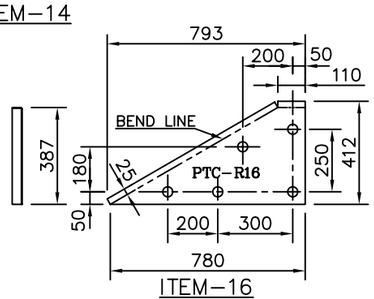
ITEM-13



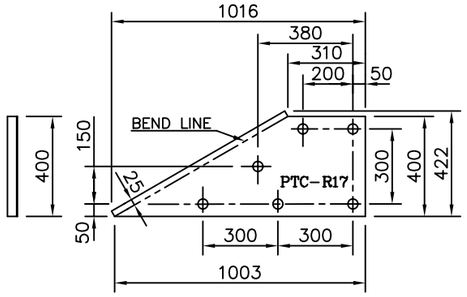
ITEM-14



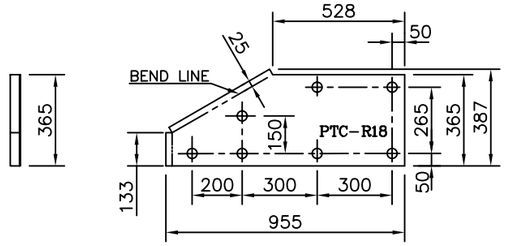
ITEM-15



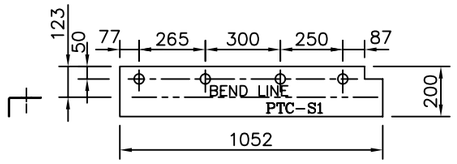
ITEM-16
(NOTE-3)



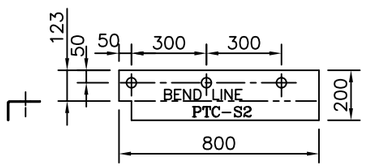
ITEM-17
(NOTE-3)



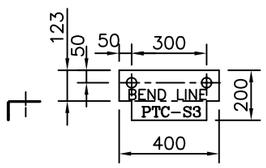
ITEM-18
(NOTE-3)



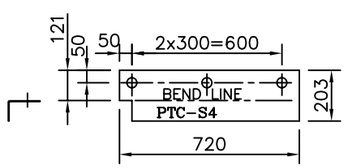
ITEM-19
(NOTE-3)



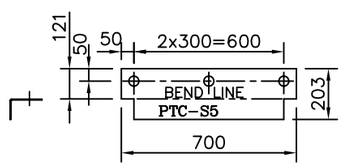
ITEM-20
(NOTE-3)



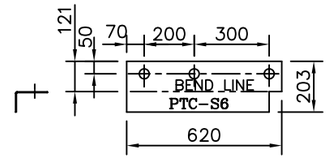
ITEM-21



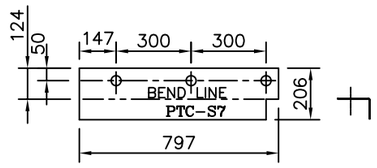
ITEM-22
(NOTE-3)



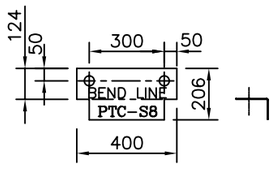
ITEM-23



ITEM-24
(NOTE-3)



ITEM-25
(NOTE-3)



ITEM-26

NOTE
1. DRILL/PUNCH ø40 HOLES IN ALL THE RETAINERS / SEALS.
2. PAINT RESPECTIVE ERECTION MARK ON ALL RETAINERS / SEALS.
3. BEND HALF QTY. OF ITEM NOS. AS SHOWN AND HALF QTY IN OPPOSITE HAND.

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: EXH. DUCTING FR6B

भारत हेवी इलेक्ट्रिकल्स लिमिटेड हैदराबाद
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE
DRN.	P.S.RAO		08.11.04
CHD.	S.S.K		
APPD.	V.S.R.K		

NO.OF VAR.

DEPT.	CODE	SCALE	WEIGHT (KG)	REF. TO ASSY DRG.	ITEM NO.	NO.OF ITEMS
OFE-ENGG	4430	NTS	SEE PLST			

TITLE: PLENUM TOP COVER ASSLY

DRAWING NO. 1-965-85-97935 REV. 00

SHEET NO. 02 NO OF SHEETS 02

REV.	DATE	ALTERED	CHECKED	APPD.	ZONE

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

COMPUTER FILE NAME : | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO. 1-65-6904

1-65-6904

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

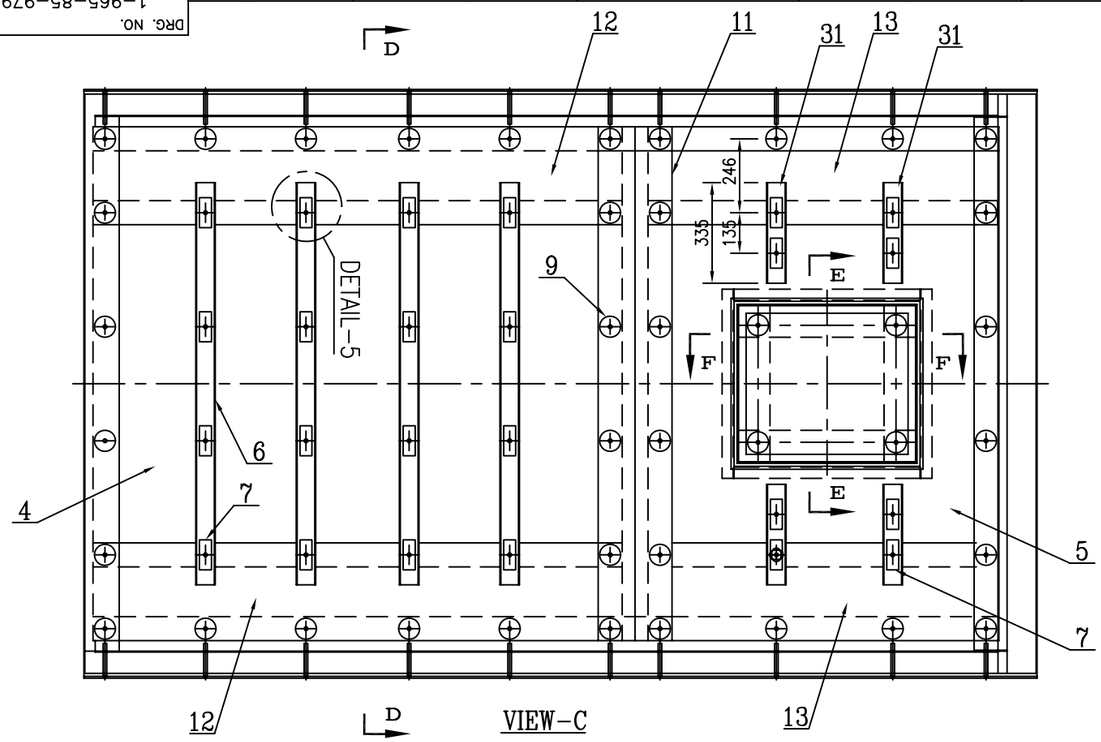
DRG. NO. 1-965-85-97937

COMPUTER FILE NAME :

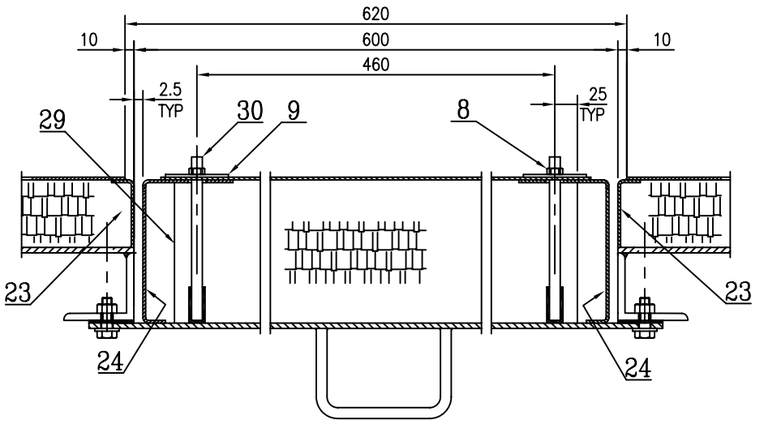
REF. DRG. NO.

SIGN. AND DATE

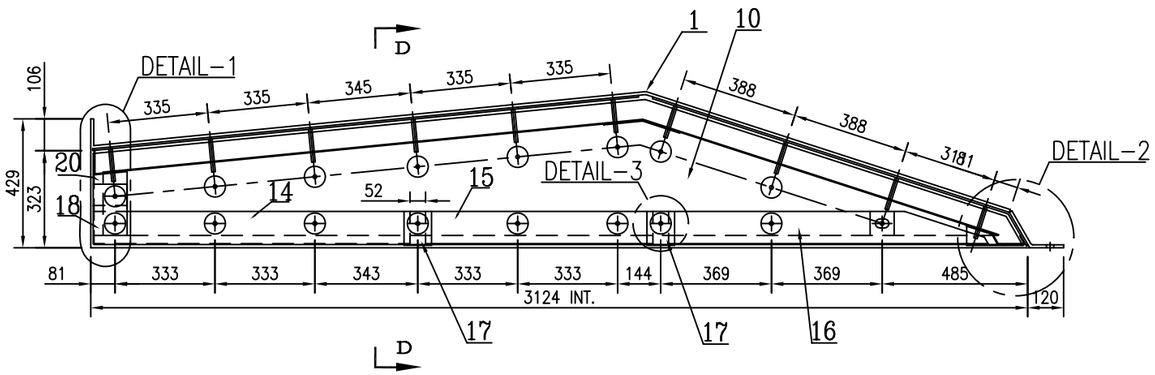
INVENTORY NO 1-65-6906

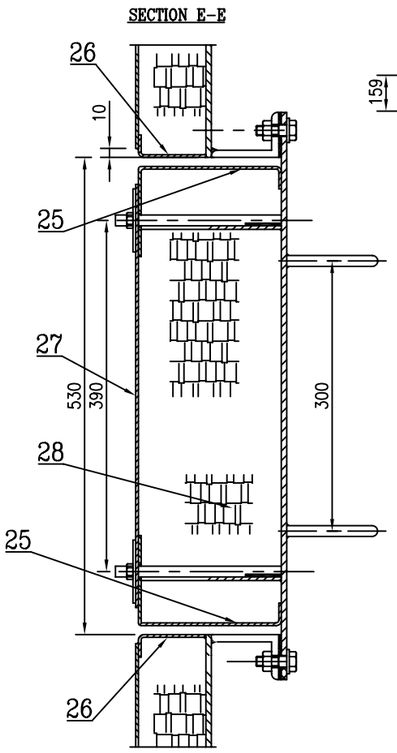


VIEW-C



SECTION F-F





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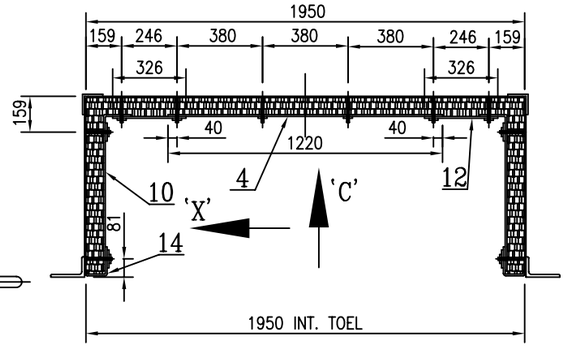

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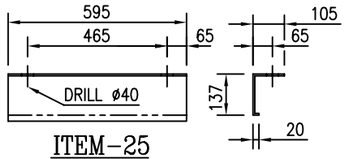
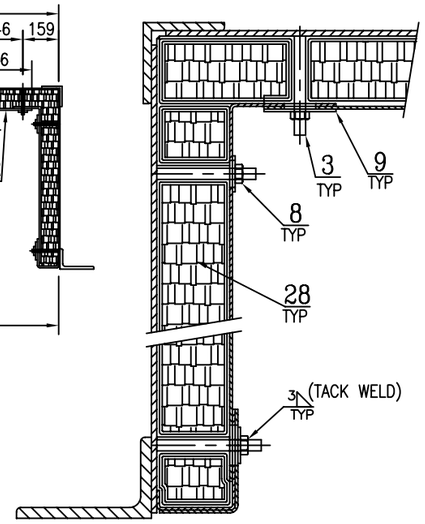
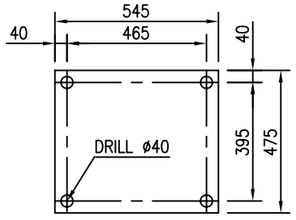


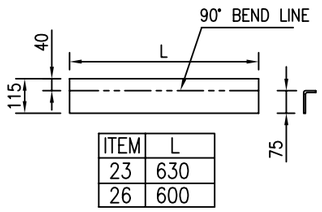
ITEM-25



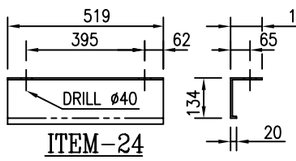
DETAIL ISOLATION ACOUSTIQUE
ACOUSTIC INSUALTION DETAIL



ITEM-27



ITEM	L
23	630
26	600



ITEM-24

NOTE

1. FOLLOW WPS WE006 FOR WELDING MS-MS.
2. FOLLOW WPS WE046 FOR WELDING MS-SS.
3. FOLLOW WPS WE045 FOR WELDING SS-SS.
4. BEND HALF QTY. OF ITEM NOS. 10, 14, 15, 16, 18, 19 & 20 AS SHOWN AND HALF QTY. IN OPPOSIT HAND.
8. BLAST CLEAN TO SA 2 1/2 & PAINT AS PER OE57020.
10. APPLY 1 COAT OF MOLYKOTE PAINT ON EXPOSED SURFACE OF SS CLADDING SHEET.

	BL.CLNG. PRINER	INSULATION	FINAL PAINTING	MOLYKOTE
AREA(SQ.M)	18	8.5	10	8

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: FR6 EXHAUST DUCT

भारत हेवी इलेक्ट्रिकल्स लिमिटेड हैदराबाद
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE
DRN.	POORNIMA		26.11.04
CHD.	VSRK		
APPD.	CSRM		

DEPT. OFE-ENGG | CODE 4430 | SCALE 1:10 | WEIGHT (KG) SEE PLST | REF. TO ASSY DRG. | ITEM NO. | NO.OF ITEMS | NO.OF VAR.

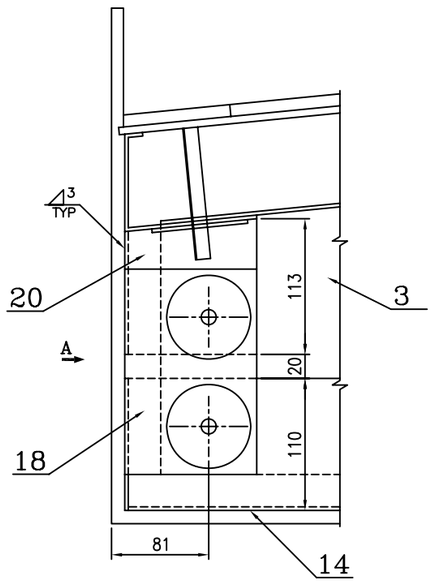
TITLE: GT SIDE EXTENSION ASSLY.

DRAWING NO. 1-965-85-97937 REV. 02

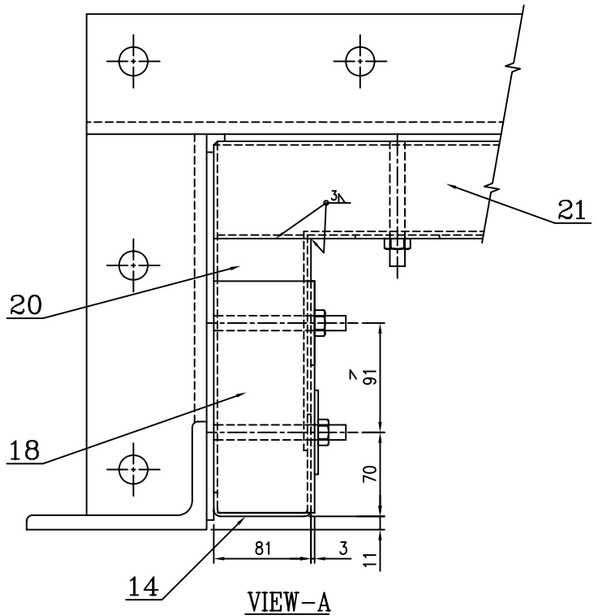
SHEET NO. 01 NO OF SHEETS 03

REV.	DATE	ALTERED	CHECKED	APPD.	ZONE
02	27.03.08	POS.NO.31 ADDED.			B-5
01	22.03.05	IN ITEM-3, END CIRCULAR HOLES CHANGED TO SLOTTED HOLES.			

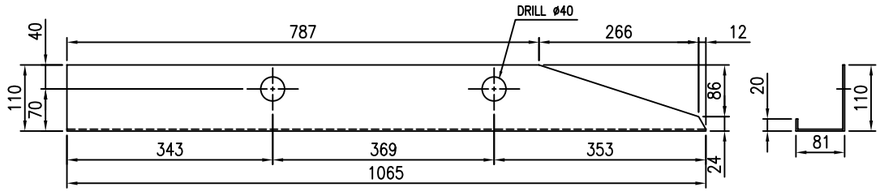
1-65-6906



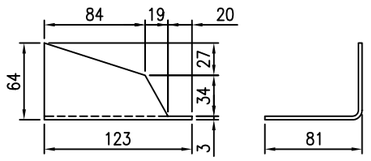
DETAIL-1



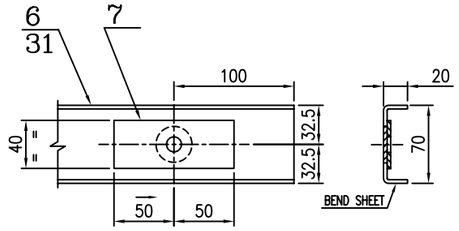
VIEW-A



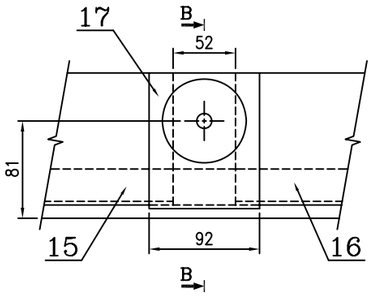
ITEM-16



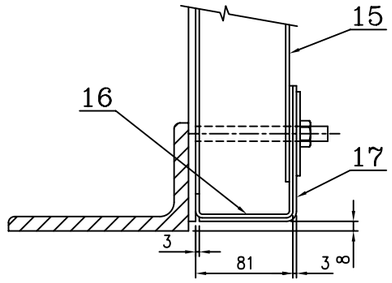
ITEM-19



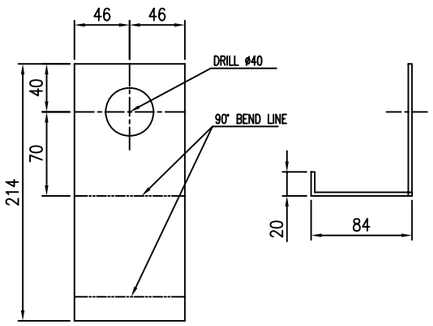
DETAIL-5



DETAIL-3

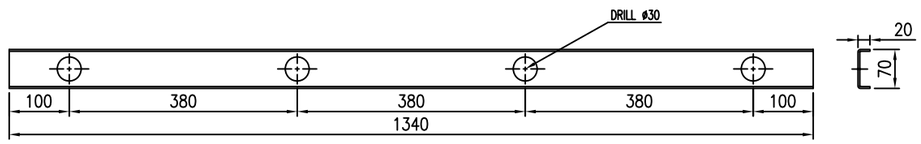


SECTION B-B

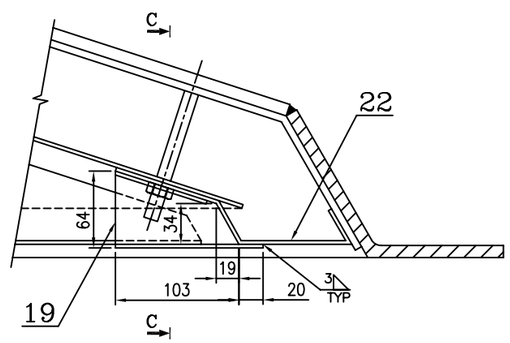


ITEM-17

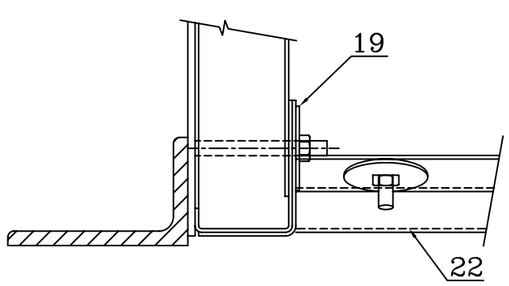
DETAIL PL.-7



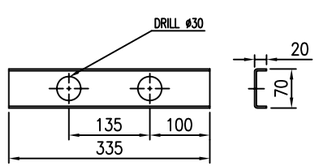
ITEM-6



DETAIL-2



SECTION C-C



ITEM-31

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: FR6 EXHAUST DUCT

भारत हेवी इलेक्ट्रिकल्स लिमिटेड हैदराबाद
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE
DRN.	POORNIMA		26.11.04
CHD.	VSRK		
APPD.	CSRM		

DEPT. OFE-ENGG | CODE 4430 | SCALE NTS | WEIGHT (KG) SEE PLST | REF. TO ASSY DRG. | ITEM NO. | NO.OF ITEMS | NO.OF VAR.

TITLE: GT SIDE EXTENSION ASSLY.

DRAWING NO. 1-965-85-97937 REV. 02

SHEET NO. 02 NO OF SHEETS 03

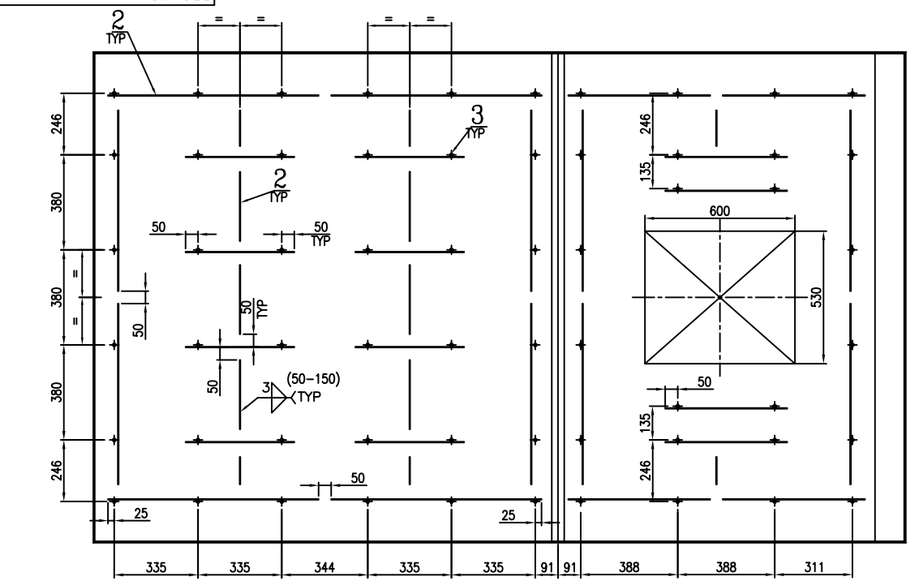
REV.	DATE	ALTERED	CHECKED	APPD.	ZONE
02	27.03.08	ITEM-31 ADDED.			
01	22.03.05	IN ITEM-3, END CIRCULAR HOLES CHANGED TO SLOTTED HOLES.			

COMPUTER FILE NAME : | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO. 1-65-6906

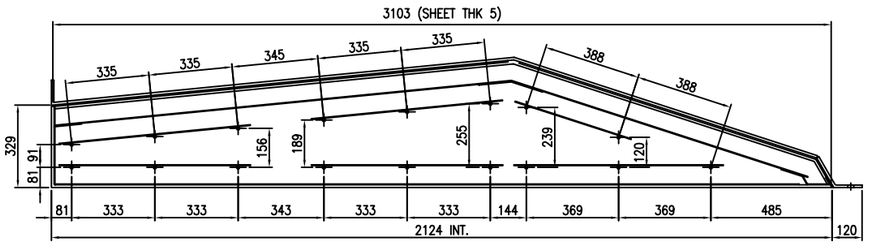
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-965-85-97937

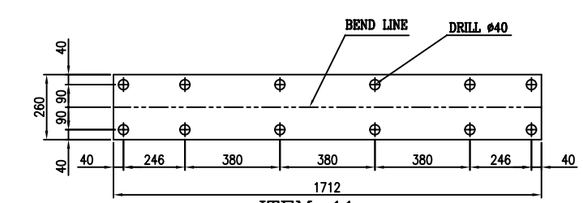


VIEW-C WITH STIFFNER DETAIL
(DEVELOPED VIEW)

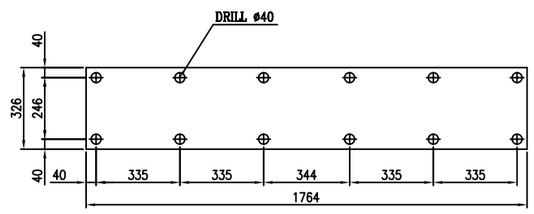


VIEW-X WITH STIFFNER DETAIL

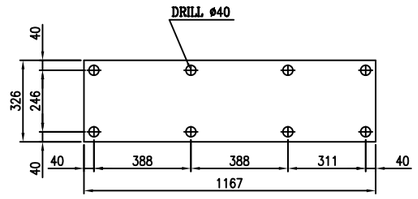
ITEM-10



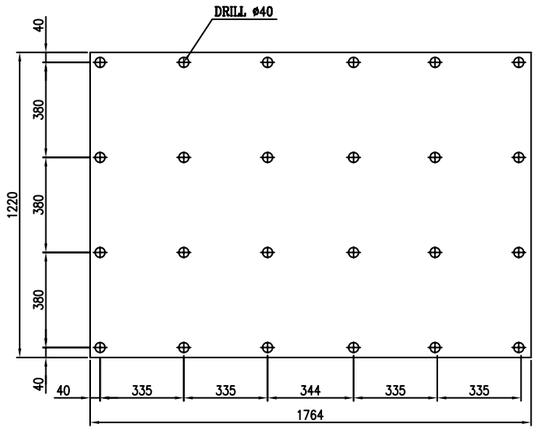
ITEM-11



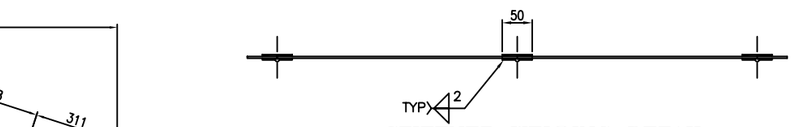
ITEM-12



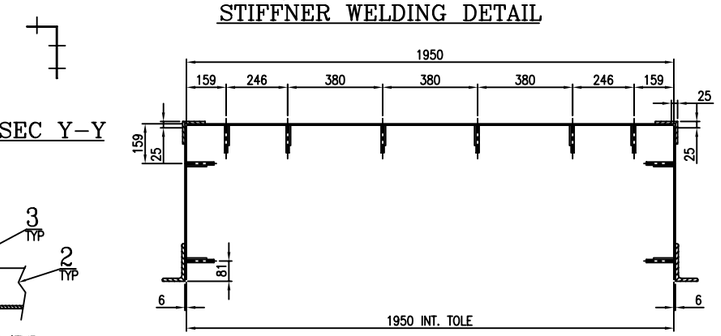
ITEM-13



ITEM-4



STIFFNER WELDING DETAIL



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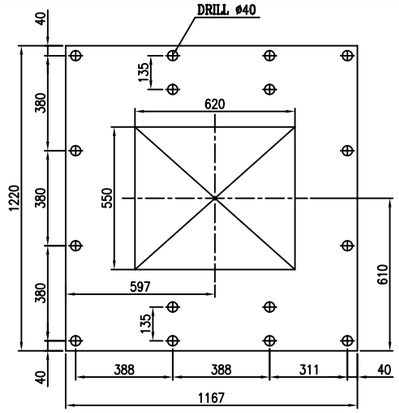
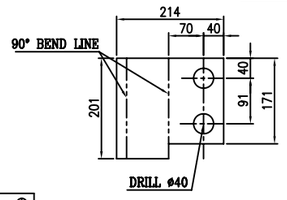


ITEM-5



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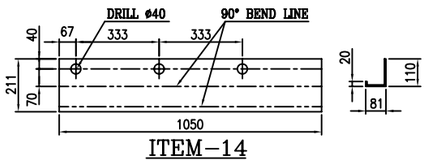
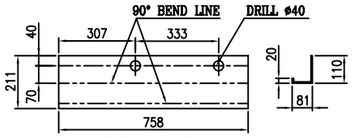
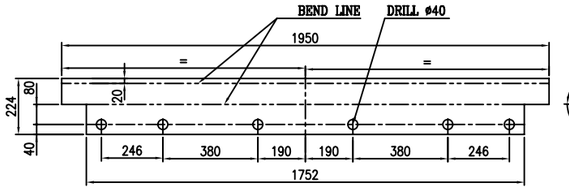


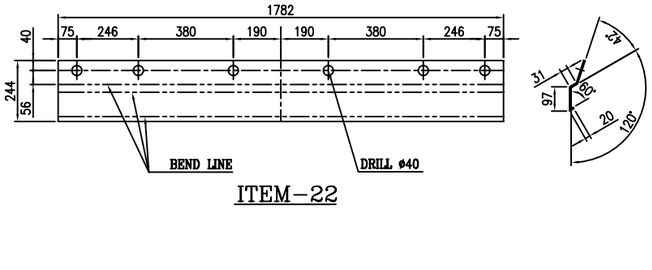
ITEM-14



ITEM-15



ITEM-21



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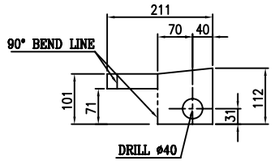
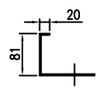




ITEM-20

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

REV.	DATE	ALTERED	CHECKED	APPD.	ZONE
02	27.03.08	ITEM-31 ADDED IN 2ND SHEET.			
01	22.03.05	IN ITEM-3, END CIRCULAR HOLES CHANGED TO SLOTTED HOLES.			

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: FR6 EXHAUST DUCT

भारत हेवी इलेक्ट्रिकल्स लिमिटेड हैदराबाद
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE
DRN.	POORNIMA		26.11.04
CHD.	VSRK		
APPD.	CSRM		

NO.OF VAR.

DEPT. OFE-ENGG | CODE 4430 | SCALE 1:10 | WEIGHT (KG) SEE PLST | REF. TO ASSY DRG. | ITEM NO. | NO.OF ITEMS

TITLE: GT SIDE EXTENSION ASSLY.

DRAWING NO. 1-965-85-97937 | REV. 02

SHEET NO. 03 | NO OF SHEETS 03

1-65-6906

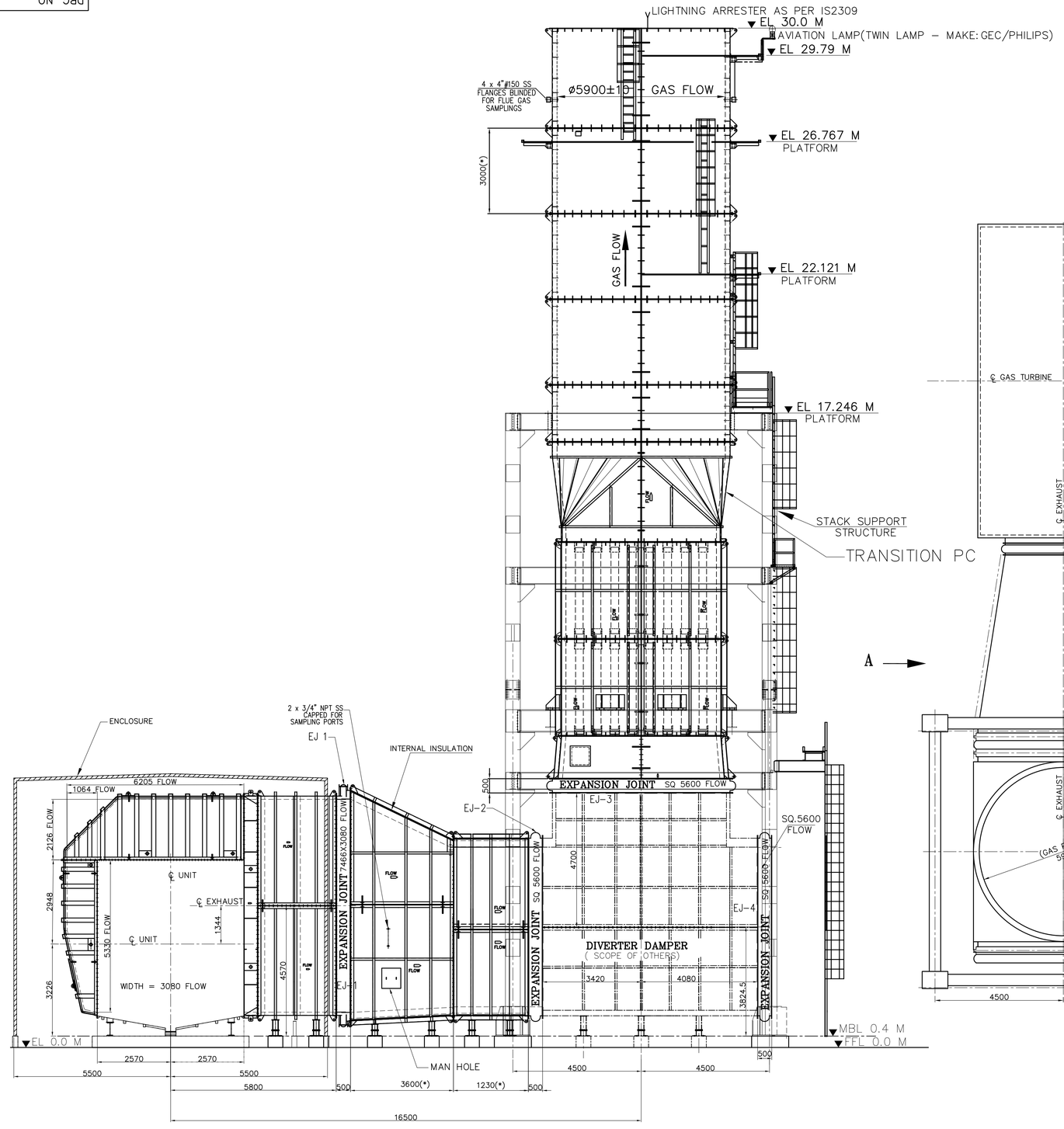
COMPUTER FILE NAME : | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO 1-65-6906

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-364-09-91005

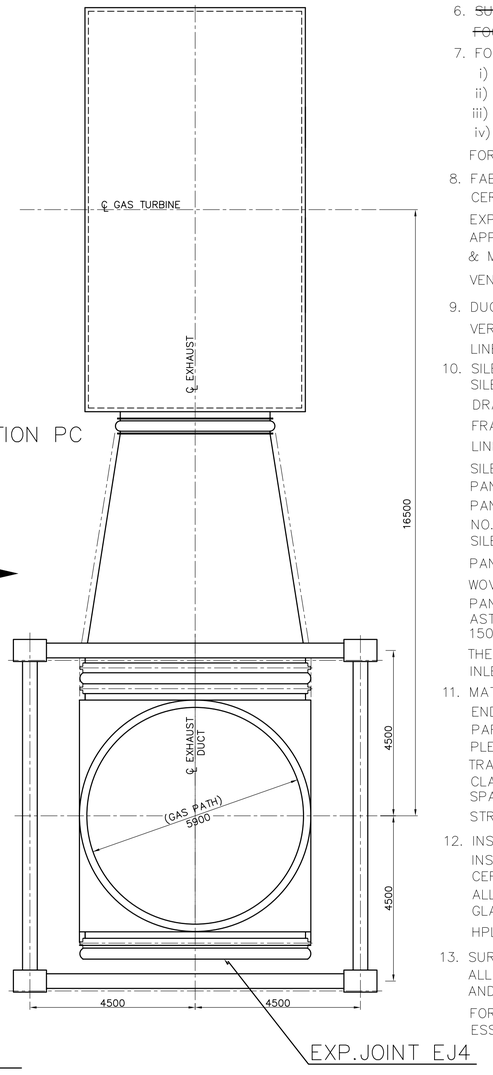
SH. 01 OF 02



VIEW-A

(NOT TO SCALE)

* MARKED DIMENSIONS ARE INDICATIVE ONLY



NOTES:

1. EXHAUST DUCTING IS INTERNALLY INSULATED WITH CERAMIC WOOL (THICKNESS 150 MM). PLATFORMS SHOWN FOR BY-PASS STACK ARE INDICATIVE ONLY. ACTUAL REQUIREMENT MAY VARY.
2. REFER GENERAL ARRANGEMENT FOR GTG(1-366-09-99018) SPECIFIC TO THE PROJECT FOR LAY OUT & INTERFACE INFORMATION.
3. EXHAUST PLENUM COVERS(SIDE & TOP COVERS) , EXPANSION JOINTS EJ1,EJ2,EJ3,EJ4 AND DUCT BETWEEN DIVERTER & GUILLOTINE DAMPER ARE IN VENDOR"S SCOPE OF SUPPLY.
4. EXHAUST PLENUM TO OUT SIDE OF ENCLOSURE ie UP TO EXPANSION JOINT EJ-1 IS STRAIGHT DUCT.
5. DIVERTER DAMPER & GUILLOTINE DAMPER IS NOT IN THE SCOPE OF SUPPLY.
   FOR DIVERTER DAMPER DIMENSIONS & FOUNDATION, REFER BHEL DRAWING NO: 2-365-02-91001
6. ~~SUPPORTING OF ELBOW DUCT SHALL BE DONE FROM THE FOUNDATION FOOT PRINTS GIVEN FOR FUTURE DIVERTER DAMPER.~~
7. FOR EXHAUST PLENUM COVERS DRAWINGS, REFER
   i) DRAWING NUMBER – 19658598054-S01-R00
   ii) DRAWING NUMBER – 19658598054-S02-R00
   iii) DRAWING NUMBER – 19658598058-S01-R00
   iv) DRAWING NUMBER – 19658598058-S02-R00
   FOR INTERFACE WITH EXHAUST PLENUM,BHEL DRAWING No: 0-359-12-91008
8. FABRIC EXPANSION JOINT SHOULD CONSIST OF LAYERS WITH SS WIRE MESH, CERAMIC FIBRE,GLASS FABRIC,2 LAYERS OF PTFE FOIL,SILICON COATED GLASS FABRIC.
   EXPANSION JOINT SHALL BE OF FABRIC TYPE, TO BE PROCURED FROM BHEL APPROVED VENDORS.. VENDOR TO SUBMIT THE CONSTRUCTION DRAWINGS & MATERIALS FOR SCRUTINY.
   VENDORS: KELD ELLENTOFT/BACHMANN/KE BURGMAN
9. DUCTING:
   VERTICAL DUCT & HORIZONTAL DUCT FRAME MATERIAL :IS226 CS, MIN 16 MMTHK
   LINER MATERIAL : SS 409, 3.15MM THK
10. SILENCER:
    SILENCER SHALL BE IN VERTICAL POSITION.VENDOR TO SUBMIT THE CONSTRUCTION DRAWINGS, ACCOUSTIC DESIGN CALCUCLATIONS & MATERIALS FOR SCRUTINY.
    FRAME: CS 20 THK
    LINER MATERIAL & SPLITTERS : AISI 409, 3.15MM THK
    SILENCER SHALL BE AS SPECIFIED BELOW
    PANEL LENGTH & WIDTH : 15FT x 15IN
    PANEL SPACING: 24 IN (9 IN AIR GAPS,10.5 IN AIR GAPS)
    NO. OF PANELS: 6
    SILENCER GAS PATH WIDTH&HEIGHT: 13FTX11FT
    PANEL FILL MATERIAL: 6lb/ft3 MINERAL WOOL WRAPPED WITH FINELY WOVEN FIBRE GLASS CLOTH AND SS STAPLED AT THE ENDS.
    PANEL PERFORATED COVER SIDE WALLS: 0.188 IN DIA HOLES ON 0.312 IN STAGGERED CENTRES. ASTM A 176 GR409,3.15MM THK,CERAMIC FIBRE INSULATION(8lb/ft3 density) 150MM THK WRAPPED AND COVERED WITH PERFORATED INTERNAL LAGGING.
    THE SILENCER SECTION SHALL BE DESIGNED SUCH THAT THE SILENCER PANEL INLET BULL NOSE EXTEND BEYOND THE INLET FLANGE OF THE SILENCER DUCT.
11. MATERIALS:
    END FLANGES MATERIAL: CS, 20MM THK
    PARTITION FLANGES: CS,12MM THK
    PLENUM COVERS: CS,10MM THK MIN
    TRANSITION PIECE: CS,16MM THK MIN
    CLADDING STUDS(WITH SS SCALLOPED BARS): SS304 DIA16MM(MIN)
    SPACING BETWEEN STUDS SHALL BE OF MIN. 300MM
    STRUCTURAL STEELS: IS2062
12. INSULATION:
    INSULATION SHALL BE OF CERAMIC WOOL OF 128 kg/m3(8 lb/in3) DENSITY.
    CERAMIC BLANKET INSULATION SHALL BE WRAPPED IN FIBER GLASS CLOTH ALL ROUND THE INSULATION AND SS STAPLED.
    GLASS CLOTH MATERIAL –0.2kg/cm2, 0.18 mm THK,UNIVERSAL DESIGNATION HPL STYLE 7628
13. SURFACE PREPARATION & PAINTING:
    ALL INTERNAL & EXTERNAL SURFACES SHALL BE DEGREASED AND SURFACE CLEANED BY GRIT BLASTING SA 2 1/2 STANDARD.
    FOR PAINTING, REFER PROJECT SPECIFIC PAINTING SCHEDULE, ESSAR PAINTING DOC NO: GTEG/ESSAR-II/002.

NOTES CONTNUED ON SHEET 2..

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME: 1364091004-S01-R03.DWG

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD	02	23.08.07	CHD/APPD			CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: *VADINAR POWER COMPANY LTD 2 X FR-9 GT*

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	V.B.BASU		03.02.08	
CHD.	BSN		03.02.08	
APPD.	BSN		03.02.08	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
CODE 423	GR: f/M/F	NA	–N.A.–	–N.A.–	–N.A.–	–N.A.–

TITLE: EXHAUST DUCT & BYPASS STACK

CARD CODE: N.A.

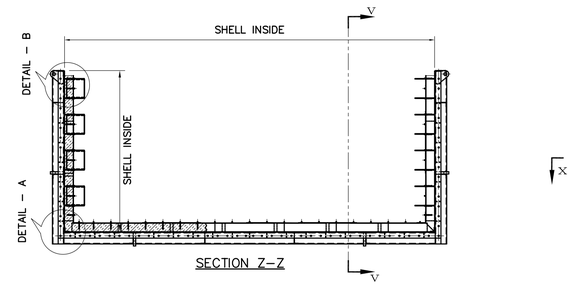
DRAWING NO. 1-364-09-91005 REV. 00

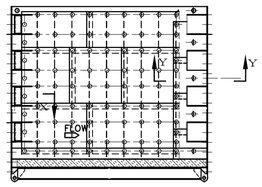
SHT. No 01 NO. OF SHT. 02

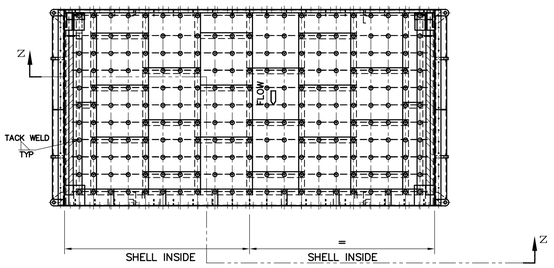
FIRST ANGLE PROJECTION

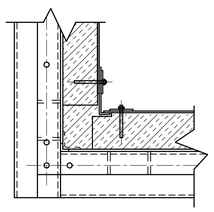
(ALL DIMENSIONS ARE IN mm)

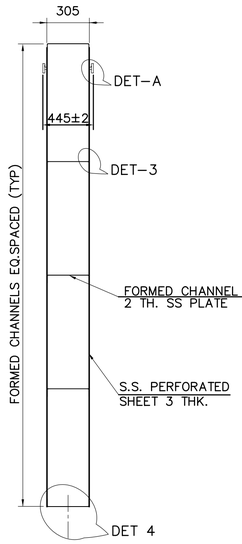
DRG. NO. 1-364-09-91005 SH. 02 OF 02

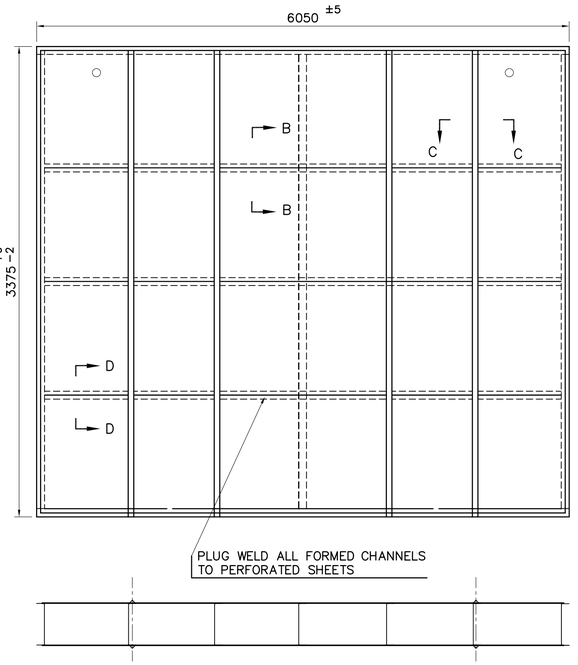


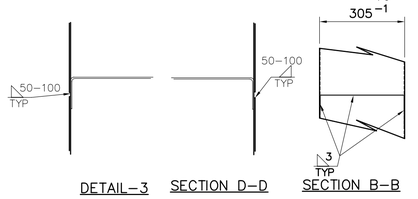


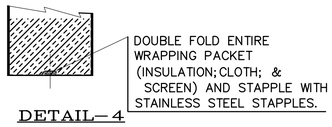


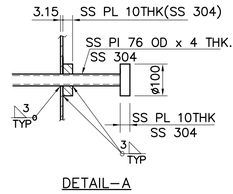


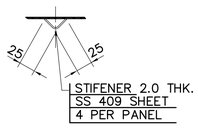






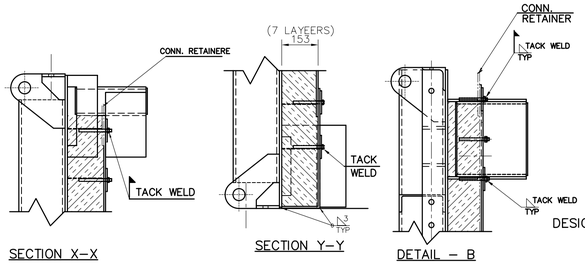






SILENCER PANEL

INDICATIVE

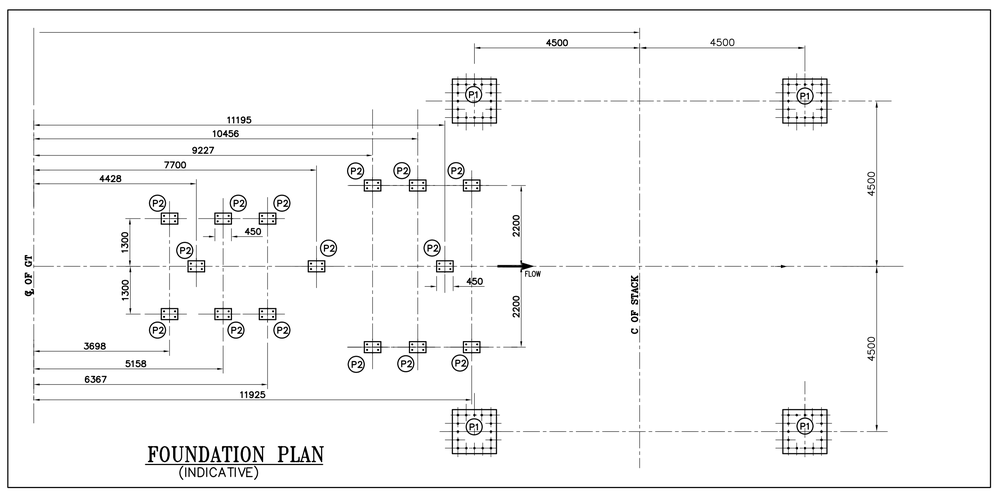


TYPICAL SILENCER DESIGN DETAILS

(NOT TO SCALE)

DESIGN & DIMENSIONS ARE INDICATIVE ONLY. VENDOR TO DESIGN & SUBMIT A DETAILED SILENCER DESIGN REPORT FOR BHEL'S REVIEW AND ACCEPTANCE.

SILENCER ASSEMBLY



FOUNDATION PLAN
(INDICATIVE)

NOTES:(CONTD FROM SHEET1)

14. PLATFORM & RAILING SHALL BE WITH GALVANIZED ASTM A53.
    GALVANIZING SHALL BE DONE AS PER GT54155.
    PLAT FORMS & RAILINGS DESIGN & REQUIREMENTS SHALL BE IN ACCORDANCE WITH OSHA STANDARDS.
    DIVERTER DAMPER & GUILLOTINE DAMPER MAINTAINANCE ASPECT SHALL BE CONSIDERED
15. GASKETS IN DUCTING SHALL BE OF REFRASIL CLOTH AS PER GT51115.
16. ALL MATING COMPONENTS(LIKE SHELL HALFS & SHELL TO SHELL..ETC) SHALL BE TRIAL ASSEMBLED.
17. FOUNDATION DESIGN & ANALYSIS (REFER VAR TABLE), FOUNDATION EMBEDMENTS ARE IN VENDOR'S SCOPE OF SUPPLY.
18. SEA WORTHY PACKING SHALL BE AS PER HY0490569.

ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED	REV.	DATE	ALTERED
CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD			CHD/APPD	01	18.08.07	CHD/APPD
	ZONE			ZONE			ZONE			ZONE			ZONE			ZONE			ZONE		

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: *FR9–ESSAR VADHINAR*

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	V.B.BASU		03.02.08	
CHD.	BSN		03.02.08	
APPD.	BSN		03.02.08	

DEPT.	UNTOL. DIMS. OR.		SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
GTD	℄/M/F		NA	–N.A.–	–N.A.–	–N.A.–	–N.A.–
CODE 423							

TITLE: EXHAUST DUCT & BYPASS STACK

CARD CODE: N.A.

DRAWING NO. 1–364–09–91005 REV. 00

SHT. No 01 NO. OF SHT. 01

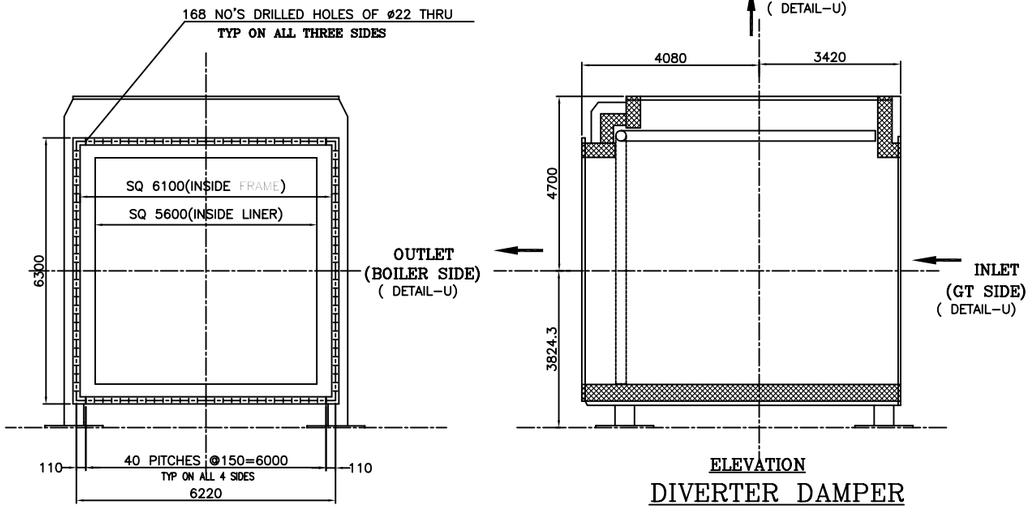
FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 2-365-02-91001

SH. 01 OF 01

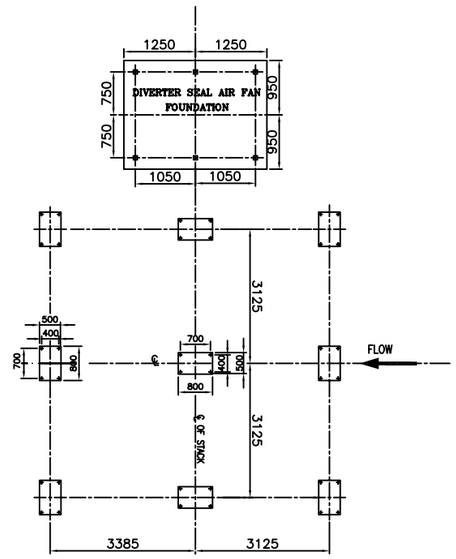
DIVERTER DAMPER FOUNDATION DETAILS



DETAIL-U

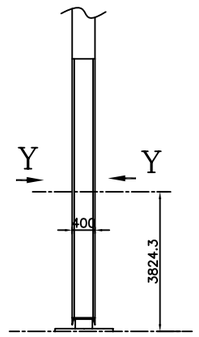
ELEVATION

DIVERTER DAMPER

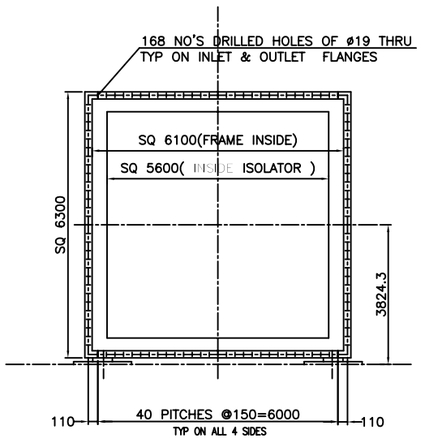


NOTES: –

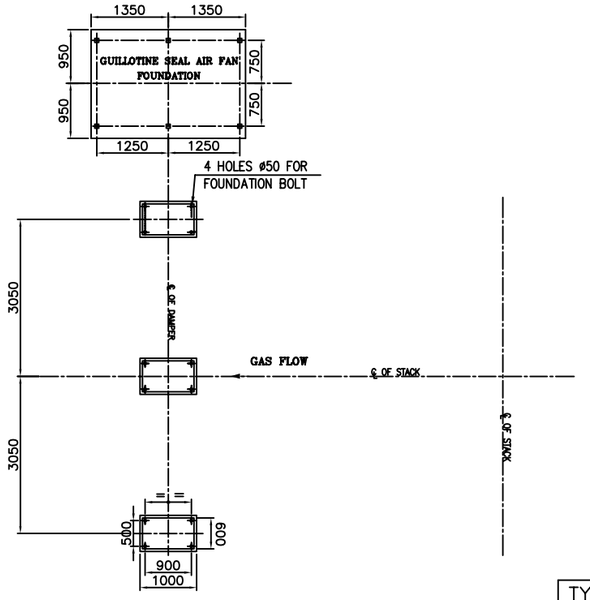
1. DIVERTER DAMPER SUPPLY SHALL BE AS PER GT54220.
2. GUILLOTINE DAMPER SUPPLY SHALL BE AS PER GT54221.
3. SEAL AIR FANS LOCATION WILL BE FINALISED DURING DETAILED DESIGN.



ELEVATION



VIEW-Y



GUILLOTINE DAMPER

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: FR-9E ,GT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	G.J.C.		01.07.04	
CHD.	B.S.N.		01.07.04	
APPD.	B.I.B.		01.07.04	

REV.	DATE	ALTERED	CHD/APPD	ZONE

DEPT.	CONT. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
G.T.D	GR. ~~C/M/F~~	1:75	N.A	–N.A.–	–N.A.–	–N.A.–
CODE 423						

TITLE: DIVERTER & GUILLOTINE INTERFACE INFO

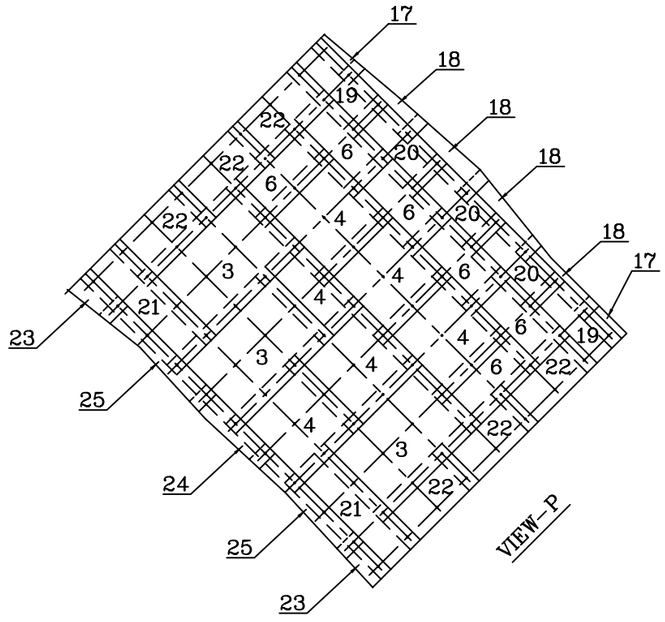
CARD CODE: N.A.

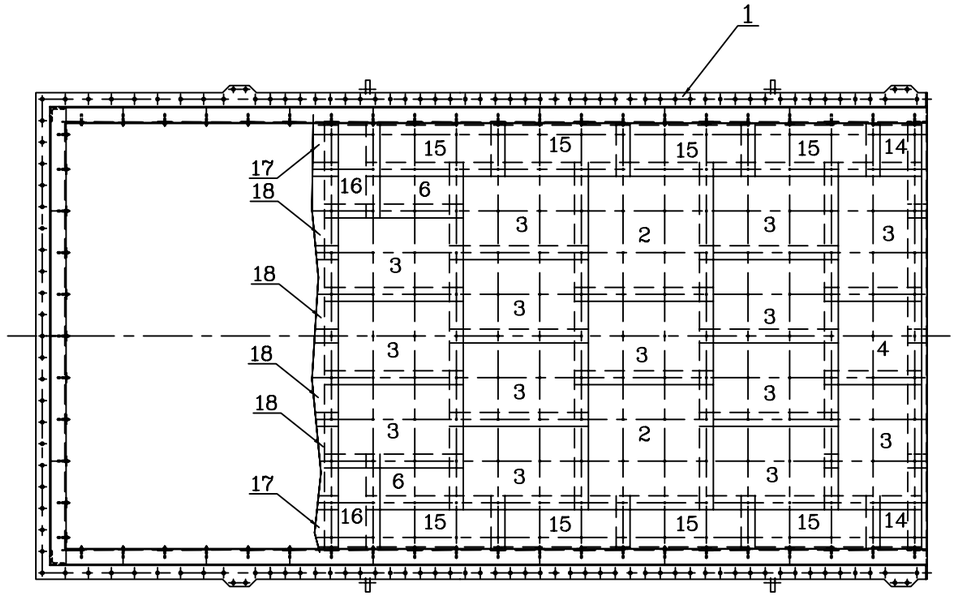
DRAWING NO. 2-365-02-91001 REV. 00

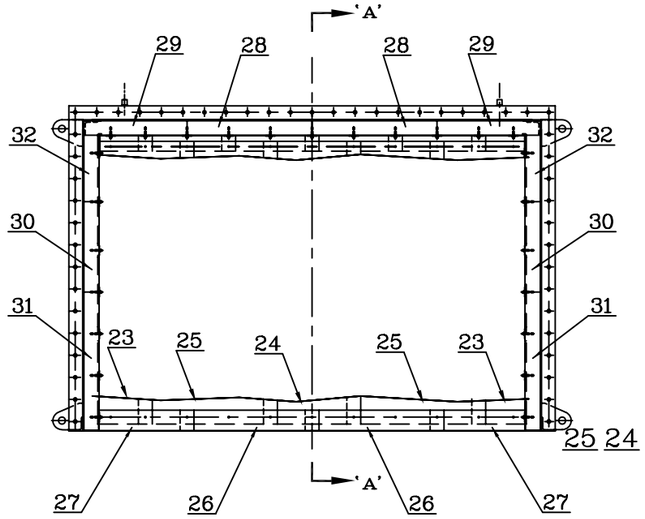
SHT. No 01 NO. OF SHT. 01

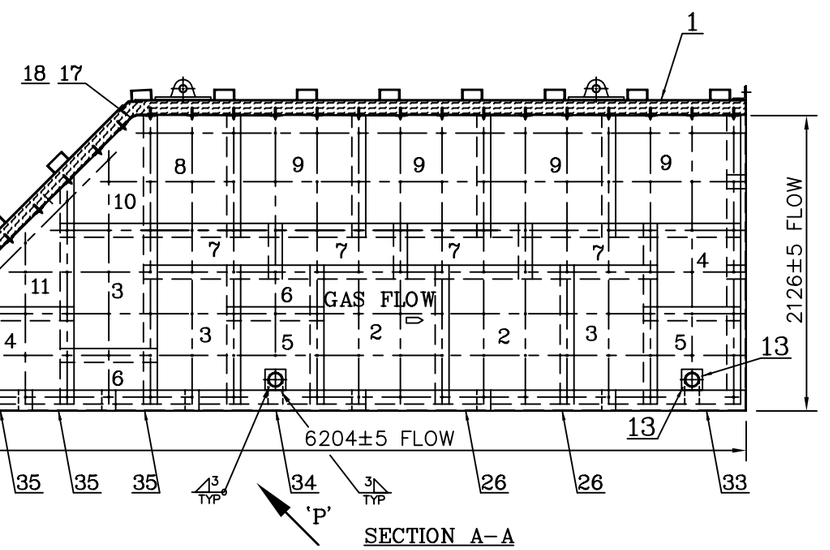
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-965-85-98054

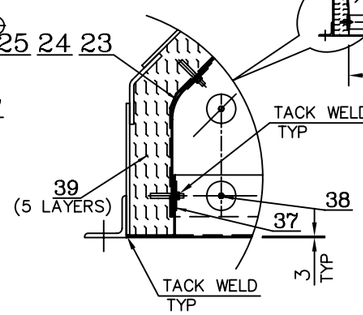








SECTION A-A



NOTES:
1. FOLLOW WPS NO.WE006 FOR MS-MS WELDING.
2. FOLLOW WPS NO.WE046 FOR MS-SS WELDING.
3. FOLLOW WPS NO.WE045 FOR SS-SS WELDING.
4. PAINT "GAS FLOW" AS SHOWN ON DUCT OUTER SURFACE.
5. BEFORE PLACING INSULATION AND FIXING RETAINERS THE DUCT FRAME ALONG WITH STUD ASSLY. ARE TO BE BLAST CLEANING AND APPLIED WITH PRIMER PAINT AS PER OE57020.
6. FINAL PAINTING AFTER PLACING INSULATION AND FIXING RETAINERS AS PER OE57020.

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...
1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: EXHAUST DUCTING PDO-OMAN FR9

भारत हेवी इलेक्ट्रिकल्स लिमिटेड हैदराबाद
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE
DRN.	P.S.RAO		08.12.05
CHD.	S.S.K.		08.12.05
APPD.	V.S.R.K		08.12.05

NO.OF VAR.

DEPT. OFE ENGG | CODE 4430 | SCALE | WEIGHT (KG) | REF. TO ASSY DRG. | ITEM NO. | NO.OF ITEMS

TITLE: EXH.EXTN. UPPER PART ASSLY.

DRAWING NO. 1-965-85-98054 | REV. 00

SHEET NO. 01 | NO OF SHEETS 02

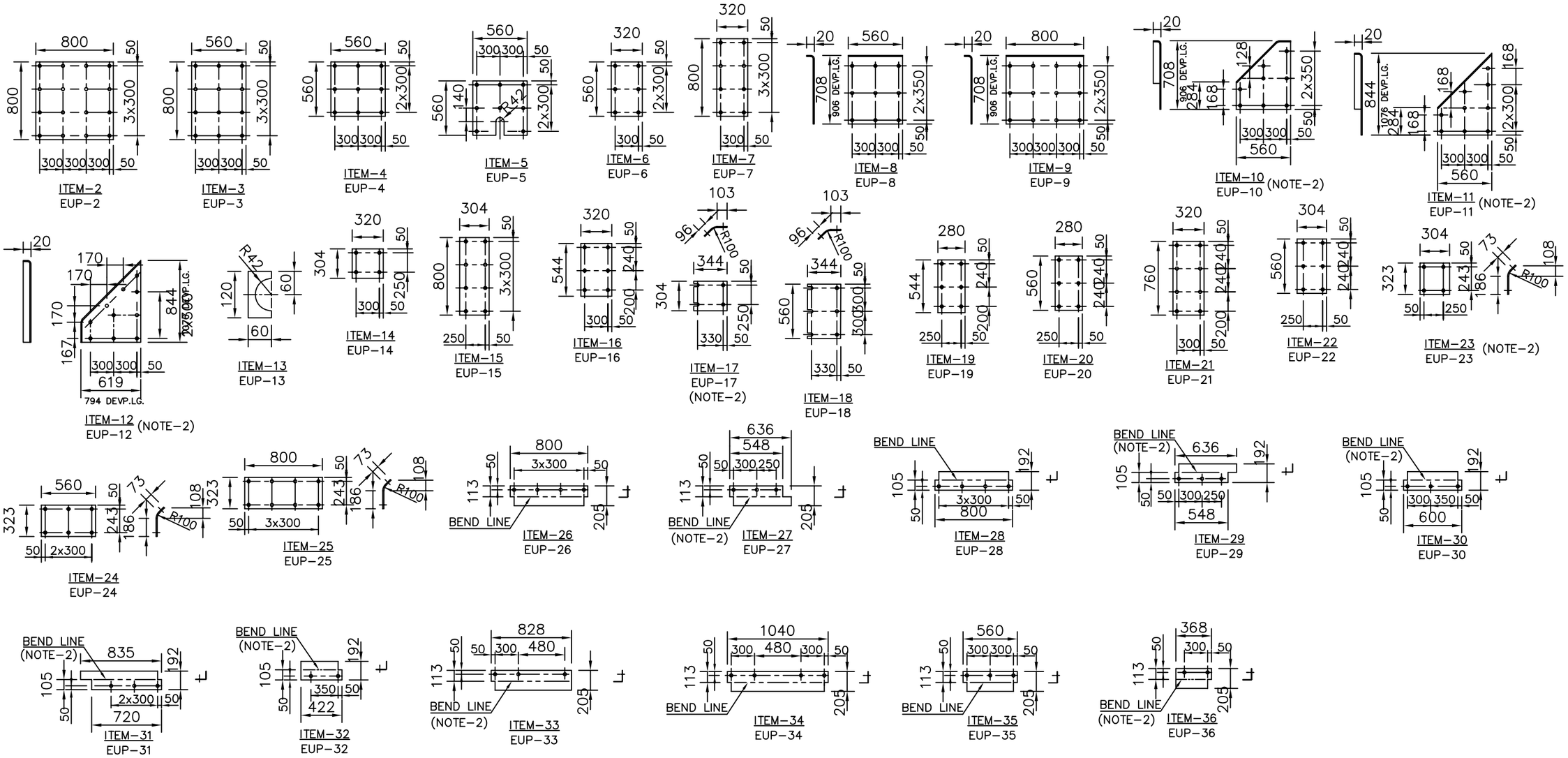
REV.	DATE	ALTERED	CHECKED	APPD.	ZONE

COMPUTER FILE NAME : | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-965-85-98054



NOTES:

1. ALL HOLES PUNCH/DRILL ø40 ON ALL RETAINERS & PUNCH RESPECTIVE ERECTION MARK.
2. BEND (ITEM-10,11,12,17,23,27,29 to 33 & 36) HALF QTY AS SHOWN AND HALF QTY IN OPP.HAND.

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: EXHAUST DUCTING PDO-OMAN FR9

भारत हेवी इलेक्ट्रिकल्स लिमिटेड हैदराबाद
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	P.S.RAO		08.12.05	
CHD.	S.S.K.		08.12.05	
APPD.	V.S.R.K		08.12.05	

DEPT. OFE ENGG | CODE 4430 | SCALE | WEIGHT (KG) | REF. TO ASSY DRG. | ITEM NO. | NO.OF ITEMS

TITLE: EXH.EXTN. UPPER PART ASSLY.

DRAWING NO. 1-965-85-98054 | REV. 00

SHEET NO. 02 | NO OF SHEETS 02

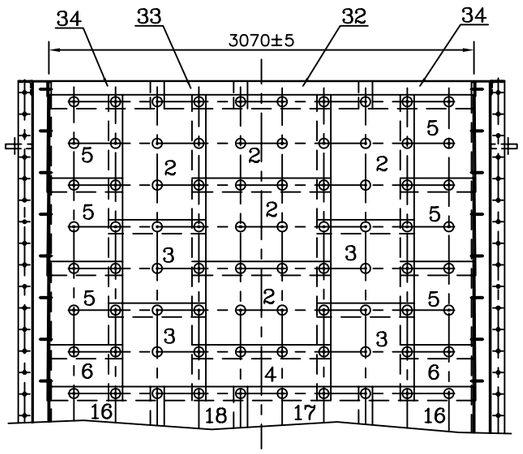
REV.	DATE	ALTERED	CHECKED	APPD.	ZONE

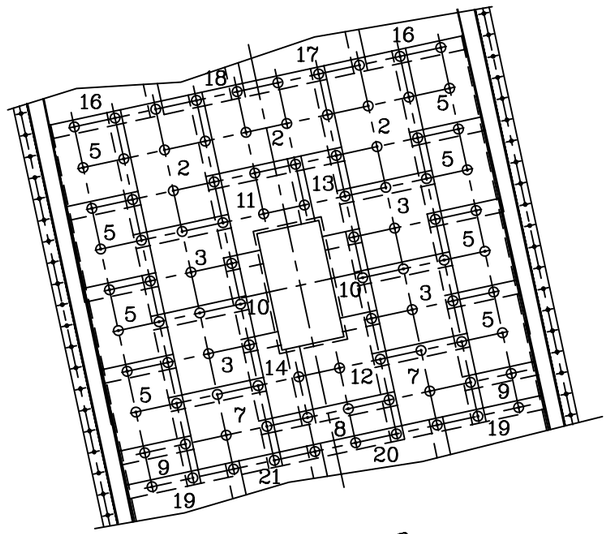
COMPUTER FILE NAME : | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO

FIRST ANGLE PROJECTION

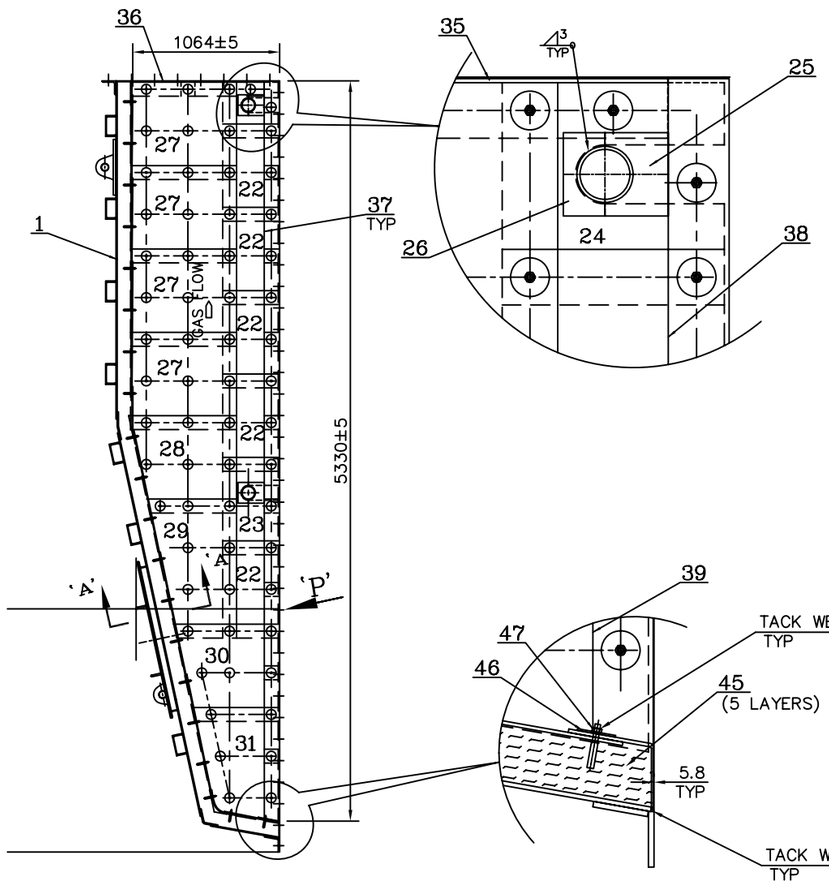
(ALL DIMENSIONS ARE IN mm)

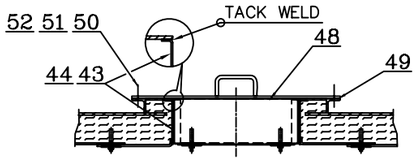
DRG. NO. 1-965-85-98058



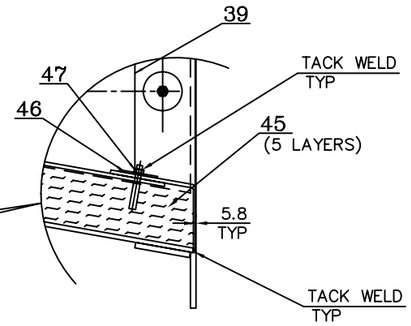


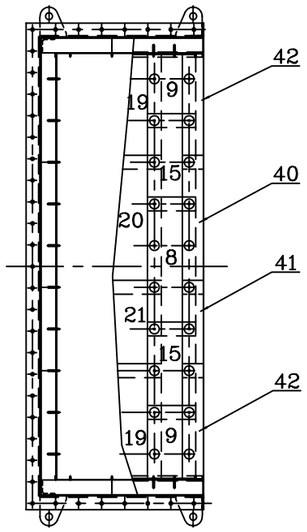
VIEW-P





SECTION A-A





NOTES:

1. FOLLOW WPS NO.WE006 FOR MS-MS WELDING.
2. FOLLOW WPS NO.WE046 FOR MS-SS WELDING.
3. FOLLOW WPS NO.WE045 FOR SS-SS WELDING.
4. PAINT "GAS FLOW" AS SHOWN ON DUCT OUTER SURFACE.
5. BEFORE PLACING INSULATION AND FIXING RETAINERS THE DUCT FRAME ALONG WITH STUD ASSLY. ARE TO BE BLAST CLEANING AND APPLIED WITH PRIMER PAINT AS PER OE57020.
6. FINAL PAINTING AFTER PLACING INSULATION AND FIXING RETAINERS AS PER OE57020.

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE	NET WT.	GROSS WT.
					MATERIAL SPECN.	QUANTITY	

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
2. CHAMFER M/CD SHARP EDGES 1.2 TO 1.0 AT 45°.
3. INTERNAL M/CD CORNER RADII 1 TO 0.7.
4. THE SURFACE ROUGHNESS WHEREVER NOT SHOWN SHALL BE TAKEN FROM THE SURFACE ROUGHNESS SHOWN OUT SIDE BACK SLASHES GIVEN AT THE TOP MOST RIGHT CORNER OF THE DRG.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: EXHAUST DUCTING PDO-OMAN FR9

भारत हेवी इलेक्ट्रिकल्स लिमिटेड हैदराबाद
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	P.S.RAO		08.12.05	
CHD.	S.S.K.		08.12.05	
APPD.	V.S.R.K		08.12.05	

DEPT. OFE ENGG
CODE 4430
SCALE
WEIGHT (KG)
REF. TO ASSY DRG.
ITEM NO.
NO.OF ITEMS

TITLE: EXH.EXTN. END PART ASSLY.

DRAWING NO. 1-965-85-98058
REV. 00
SHEET NO. 01
NO OF SHEETS 02

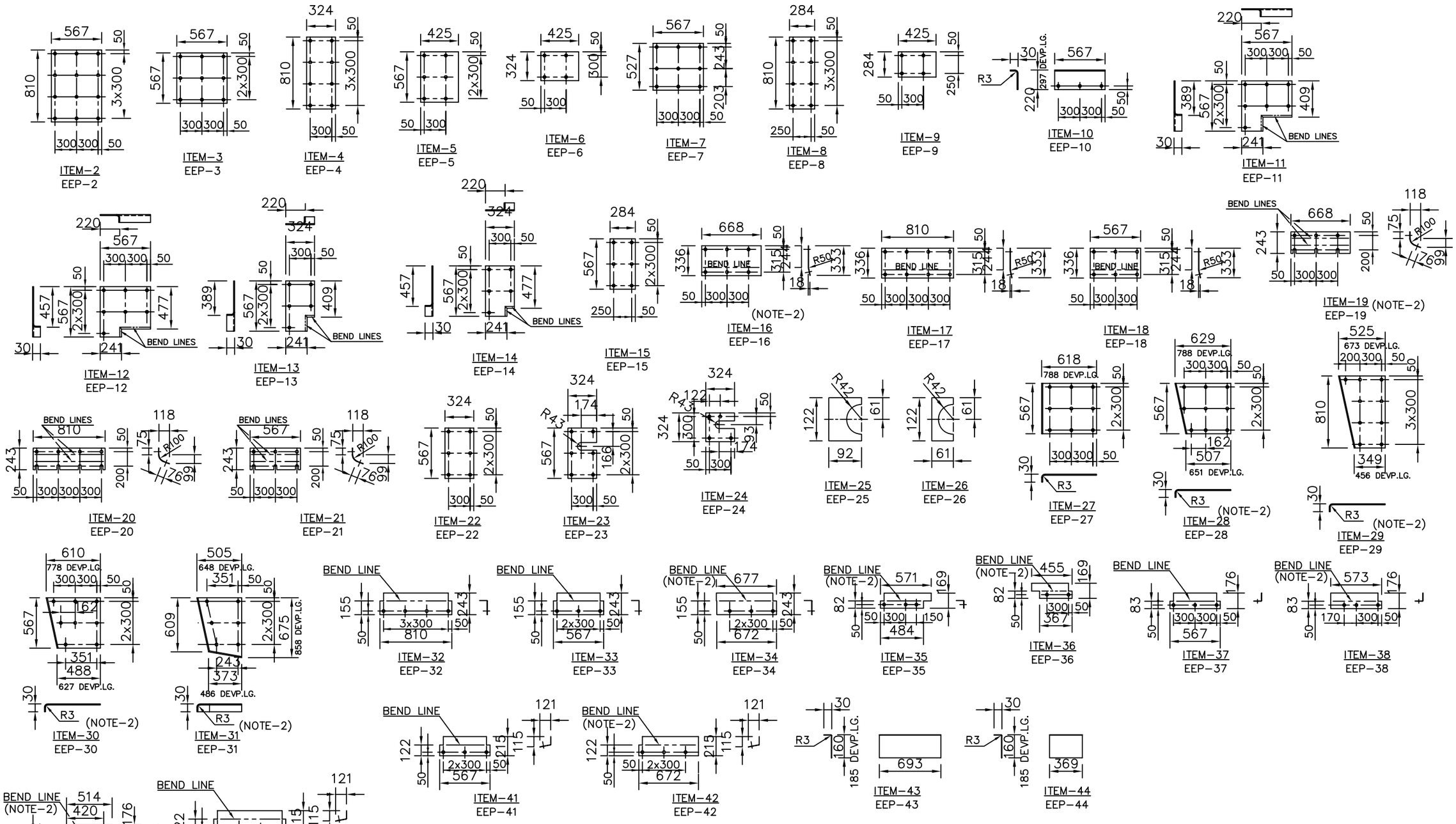
REV.	DATE	ALTERED	CHECKED	APPD.	ZONE

COMPUTER FILE NAME :
REF. DRG. NO.
SIGN. AND DATE
INVENTORY NO

FIRST ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO. 1-965-85-98058



NOTES:

1. ALL HOLES PUNCH/DRILL ø40 ON ALL RETAINERS & PUNCH RESPECTIVE ERECTION MARK.
2. BEND (ITEM-16,19,28 to 31,34 to 36,38,39&42) HALF QTY AS SHOWN AND HALF QTY IN OPP.HAND.

ITEM NO	DESCRIPTION	DRAWING NO.	VAR. NO.	RAW MATERIAL SIZE OR CASTING DRG.NO. OR FORGING DRG.NO.	MATERIAL CODE / MATERIAL SPECN.	NET WT. / QUANTITY	GROSS WT.

THE FOLLOWING CONDITIONS APPLY EXCEPT OTHERWISE STATED...

1. REF.TO HY0230261 FOR UNSPECIFIED TOLERANCES.
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NO.OF VAR.

DEPT. OFE ENGG | CODE 4430 | SCALE | WEIGHT (KG) | REF. TO ASSY DRG. | ITEM NO. | NO.OF ITEMS

TITLE: EXH.EXTN. END PART ASSLY.

DRAWING NO. 1-965-85-98058 | REV. 00

SHEET NO. 02 | NO OF SHEETS 02

REV.	DATE	ALTERED / CHECKED	APPD.	ZONE

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COMPUTER FILE NAME : | REF. DRG. NO. | SIGN. AND DATE | INVENTORY NO