

TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED

**1X800 MW TANGEDCO NORTH CHENNAI TPP
STAGE-III-BTG**

**TECHNICAL SPECIFICATION
FOR
METAL EXPANSION BELLOWS**

SPECIFICATION NO. PE-TS-423-100-M021-REV-00



**BHARAT HEAVY ELECTRICALS LIMITED, POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA**

	TECHNICAL SPECIFICATION METAL EXPANSION BELLOWS	SPECIFICATION NO. PE-TS-423-100-M021
		REV. NO.: 00
		DATE: 10/02/2017
		SHEET 1 OF 1

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SECTION-I

SPECIFIC TECHNICAL REQUIREMENTS

	SPECIFIC TECHNICAL REQUIREMENTS METAL EXPANSION BELLOWS		SPECIFICATION NO. PE-TS-423-100-M 021
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1 GENERAL

- 1.1 The Metal expansion Bellows shall meet the technical requirements and conform to the requirements of Section-I and Data Sheet-A of section II. However, in the event of contradictions between Section-I & Section-II/Data Sheet-A, Data Sheet-A will prevail.
- 1.2 Vendor to manufacture bellows as per final BHEL approved GA drawings which will be prepared in accordance with reference drawings & DATA Sheet-A of section-II. Any ambiguity in constructional/dimensional details must be communicated to BHEL during the enquiry stage. Such changes, if any, will be subjected to BHEL approval and will **NOT** have any cost implication on BHEL.

2 SCOPE OF SUPPLY

- 2.1 The bellows to be supplied shall be as per Data Sheet-A of Section-II. For detail, refer the same.
- 2.2 Special Tools and tackles, if any.

3 CODES & STANDARDS

- 3.1 The design, manufacturing, performance and testing of the expansion bellows shall conform to the latest editions of the relevant codes and standards inclusive of the stipulations in the latest editions of Expansion Joint Manufacturers Association Standards (EJMA) as well as ASME Section III, ASME Section VIII, ASTM E-165 and ASME- B31.1.
- 3.2 In case of any conflict between the above Codes/Standards and this specification, the latter shall prevail and in case any further conflict in this matter, the interpretation of the specification by the Engineer shall be final & binding.

4 DESIGN REQUIREMENTS

- 4.1 The design calculations of bellows shall be as per EJMA.
- 4.2 Dimensional tolerance for the expansion bellows should be as per EJMA.
- 4.3 The expansion bellows shall be capable of withstanding design pressure and full vacuum also wherever applicable.
- 4.4 FEA analysis shall be carried out for Hinged and Gimbal Bellows of all sizes. The FEA report shall be submitted for approval to BHEL/Customer.
- 4.5 The expansion bellows shall be designed for the deflections /angulations indicated in Data Sheet-A. The spring rates of the bellows expansion joints shall be within the values specified.
- 4.6 The cyclic life of the expansion bellow shall be minimum of 10,000 cycles.
- 4.7 Stress relieving or annealing after forming of bellows is not recommended.
- 4.8 No pre-tension of bellows is permitted.

5 MATERIAL

- 5.1 The material of construction of main parts of bellows shall be as indicated in reference GA drawings.

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- 5.2 The materials of construction of the remaining parts shall be to suit service conditions. These materials shall be subject to approval of the purchaser.
- 5.3 Materials used in manufacturing of bellows shall be of tested quality.

6 CONSTRUCTIONAL FEATURES

6.1 METALLIC BELLOWS

- The bellows shall be manufactured by hydraulic forming, roll forming or any other method specified in latest edition of EJMA. They should be formed from perfect cylinders of single ply, 304 grade stainless steel.
- The number of longitudinal weld seam shall be minimum & Circumferential welding of elements to make bellows is not permitted. The welding procedure and welder qualification shall be as per ASME Section IX.
- Cold-formed stainless steel bellows shall not be heat-treated.
- All bellow elements shall be pickled after forming.
- Butt welded expansion joints shall have adequate length of pipe so that site welding does not impair or reduce the metallic expansion bellow efficiency.
- Bidder to ensure that thinning due to forming shall be less than 15%.

6.2 SLEEVES

- Expansion joints will be furnished with internal sleeves of the same material as the bellows and installed with sufficient clearance to allow full rated deflection. The sleeves shall be welded on the flow inlet end of the bellows only. The sleeve shall also be provided with a drain hole wherever necessary to avoid condensate accumulation.
- Bellow shall have external sleeves with an arrow indicating the direction of flow on the outside. The external steel covers provided to protect bellows from physical damages during shipping, installation and while in operation. The arrangement of such cover shall be suitable for supporting insulation where necessary and shall be detachable. The cover shall not restrict the free deflection of bellows.

6.3 TIE BARS

- All untied expansion joints shall have a minimum of two limit rods across the bellows to prevent the bellows from closing/opening under vacuum / pressure beyond limit.
- Tied lateral angular expansion joints shall be provided with two tie rods to take vacuum/pressure thrust and these tie rods shall have spherical washers with sufficient clearances in flange holes to accommodate lateral deflections of bellows. These bellows shall be capable of taking care of angulation in one plane.
- Spherical washers/hinges should have a low coefficient of friction preferably with P.T.F.E. lining.
- Bellows shall be provided with complete round flanges housing the tie rods/limit rods.
- The tie rods and limit rods shall be adequately sized to absorb pressure thrust and prevent buckling in vacuum service or service with other external loads.

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6.4 HINGE

- a) Hinged bellow shall be provided with hinge plates and hinge pin permitting the bellows for angulating about one plane while taking the pressure thrust.
- b) Gimbal bellows shall have a gimbal ring, which is square (as indicated in standard GA drawing) with hinge plates and pins allowing the bellows to angulate in both planes while taking the pressure thrust.

7 QUALITY ASSURANCE, TESTING AND INSPECTION

- 7.1 The items covered under this contract shall be subjected to inspection, testing and quality surveillance. The Inspection Agency shall, at all reasonable times have access to Vendor's works, Quality Control records and all facilities as reasonably required for carrying out the inspection and testing efficiently, and these shall be provided by the vendor free of cost.
- 7.2 The Quality Plan enclosed with this specification specify minimum quality control requirement. During contract stage vendor shall furnish this Quality Plan duly signed & stamped for BHEL approval. The final quality plan may incorporate some changes based on customer comments (if any). Quality plans shall be approved by BHEL and customer. All inspection and testing shall be carried out by BHEL/ BHEL representative and customer (as applicable). In case inspection is by both BHEL and their customer, then the inspection can be carried out jointly or separately, which will be informed later. In case of the foreign bidder, inspection shall be carried out by reputed third party.
- 7.3 The third party inspection (Lloyds, TUV or equivalent) for foreign bidders shall be included in the base price of the item by the bidder. This third party agency shall be approved by BHEL. Bidder to inform the same in the offer and mention the same in Quality Plan.

Note: There may be minor changes in quality plan depending on customer/consultant comments which will have to be accommodated by vendor at no extra cost.

- 7.4 Bellows shall be subject to all test and inspection required by the applicable codes and standards as per quality plan and those specified below. The vendor shall fully shop assemble the expansion bellow and perform test to demonstrate that its performance is as specified:
 - a) All welds shall be dye-penetrant tested as per ASTM E 165/ASME SEC-V. Post cleaning of dye penetrant shall be taken care.
 - b) Material test certificates for both chemical and mechanical as per code requirements shall be furnished.
 - c) The expansion bellow shall be assembled and hydro-statically tested with calibrated gauge at shop at 1.5 times the design pressure for a period of half-an hour.
 - d) The expansion bellow shall be subject to vacuum test with calibrated gauge at the shop at a pressure of 50 mmHg (abs) for a period of half-an hour.
 - e) All attachment welds and fillet welds in the bellow assembly shall be either magnetic particle tested or dye-penetrant tested or as per quality plan.
 - f) Axial spring rate test (stiffness test) for verifying actual spring rate with theoretical value.
 - g) Deflection test for maximum permissible movements in any direction when induced individually or simultaneously. Deflection test is to ensure that bellows deflect for the designed movement without any obstruction. Axial deflection will be seen by deflecting the bellows axially and lateral and angular deflection by deflecting the bellows laterally and angularly. No equivalent movement need be seen.
 - h) Examination of radiography including radiographic techniques, radiographic examination of the longitudinal seam of the bellow should be performed before the bellow is convoluted. No lack of fusion is allowed. The test procedures shall be as per ASME Sec.V & acceptable norms as per EJMA.

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i) Test will be witnessed by customer / consultants/BHEL unless otherwise waived.

8 TYPE TESTS (CYCLE LIFE, SQUIRM AND YIELD RUPTURE TESTS)

8.1 Type tests as per EJMA are required to be carried out for bellows. If type tests have been successfully done for earlier BHEL projects for the bellows of the *same type (as required in the project) in a group (as indicated in cl. 8.2 below), then test certificates of same will be reviewed and no type test needs to be carried out. But, these test certificates shall not be older than 5 years from project bid opening date, i.e 29-Jan-2016. However, in this case, type test clearance shall be taken from BHEL prior to offering to routine test. In case no type test has been conducted for earlier projects or type test reports are older than 5 years or available type reports are not for *same type (as required in the project) bellows then type test shall be carried out and type test procedure approval shall be taken from BHEL prior to offering to routine test.

Final decision regarding conductance of type test will be conveyed by BHEL at a later date after award of contract, which will be binding on the bidder without commercial implication.

Note: *Same type means bellows having same diameter, height, pitch, convolution profile & ply thickness.

8.2 TYPE TEST REQUIREMENTS

Type tests as per EJMA are required to be carried out for bellows. These shall be done as per classification given below:

Based on Diameter of Bellows: The categories are as follows:

- Nominal dia upto 800mm NB.
- Nominal dia greater than 800mm NB upto 1600 NB.
- Each size above 1600mm NB shall be a separate category.

8.3 CRITERIA OF TEST

From each group of bellows, as per clause 9.2 above, Type tests shall be carried out on two nos. of bellows which has maximum total stress as per EJMA among the bellows of the same group. One bellow shall be used for life cycle test and the other for Squirm & Yield rupture test. Other bellows of this group shall be qualified on the basis of this test.

8.4 NO. OF CYCLES

For the life cycle test, the number of test cycles shall be minimum 10,000 cycles. The squirm and yield pressure shall be as per approved pressure and calculations.

9 PAINTING REQUIREMENT

Painting for metal expansion bellows shall be done as per details given below:

9.1 COASTAL ENVIRONMENT

SERVICE	SURFACE CLEANING	PAINTING DETAIL	COLOUR SHADE
Condensate suction line	SP3, Power tool cleaning	The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manners: 1.Primer coat- Two coat of epoxy red oxide zinc phosphate with each coat of DFT equal to 25-35 µm. Total min DFT of primer coats should be 50 µm.	Sea green shade no. ISC -217

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		2.Intermediate coat- One coat of epoxy based TiO ₂ pigmented paint with min. total DFT of 50 µm. 3.Finish coat- Two coat of epoxy based finish paint with min. total DFT of 50 µm.	
Flash Tank Vents	SP3, Power tool cleaning	2 coats (Total DFT 40 µm) of heat resistant aluminium paint to IS 13183 Gr.2	Aluminium
TD BFP Exhaust	SP3, Power tool cleaning	2 coats (Total DFT 40 µm) of heat resistant aluminium paint to IS 13183 Gr.2	Aluminium

10 CLEANING

- All parts which are not made of stainless steel or other corrosion resisting materials shall be cleaned, flushed and coated with anti-corrosive paints of approved make and quality before shipment. Before painting, the surfaces shall be thoroughly cleaned of grease, dirt etc.
- Prior to inspection and shipment the expansion bellow shall be cleaned from inside and outside to remove all manufacturing wastes, scrap, mill scale, rust, etc.
- Each expansion bellow shall be prepared for shipment in such a manner that the quality and cleanliness and finish shall be maintained during shipment.

11 PROTECTION, PACKING & DESPATCH

- Each expansion bellows shall be fitted with a 2 mm thk rectangular stainless steel name plate indicating the following:
 - Manufacturer's Name
 - Expansion Joint Size
 - Expansion Joint Type
 - Tag No.
 - Assembly Weight

All detail shall be engraved 1 mm deep and filled with black enamel paint.
- Bellows Tag Nos. shall be incorporated in all the despatch documents.
- Exposed finished surface of each metal expansion bellows shall be thoroughly greased before transportation and suitably protected in such a way so as to minimize the possibility of damage and deterioration during transit and storage.
- The bellows has to be despatched in total assembled form and shall be shipped at neutral length. They shall be provided with suitable erection and knock-off type temporary tie bars, wherever required, to prevent damage and misalignment during transit. These rods shall be tagged with instruction that they are to be left in place during erection but shall be removed before the system is placed in operation. These rods shall be provided in yellow colour for each expansion bellow.
- Proper care shall be taken to avoid damage to the painted surface during transit and storage.
- All bellows shall be individually wrapped in following manner:
 - First layer of hessian cloth
 - Second layer of bubble sheet wrapping
 - Third layer of stretch sheet wrapping.

Wrapped Bellows upto 1200 NB (inclusive) size shall be packed in wooden box suitable for handling.

Wrapped Bellows above 1200 NB shall be placed in wooden box suitable for storage purpose. The box shall have clear marking that "The bellows to be handled separately from box."

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The wooden boxes shall be suitable for storage at site in tropical climate conditions for a period of 15-18 months.

- g) Vendor to provide soft copy of photos/snaps of duly packed ME Bellows. The soft copies to be provided by vendor to BHEL Engineering after final inspection of ME Bellows. Clearance for dispatch of ME Bellows will be given only after verification of satisfactory packing conditions of ME Bellows from vendor's works.

12 DOCUMENTS TO BE SUBMITTED ALONG WITH OFFER

Bidder shall submit the following documents duly filled, signed and stamped along with the bid:

- a) Compliance sheet
- b) Documents as per the list indicated in the NIT

The above are the only documents which will be used for technical evaluation unless other documents are asked for during technical clarifications. Any other technical document enclosed with the bid shall be ignored for the purpose of technical evaluation. All other documents attached with the specification are for information of the vendor and no comments shall be marked on these.

13 EXCLUSIONS

Erection & commissioning at site are excluded from the bidder's scope.

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SECTION-II

- BOQ
- DATA SHEET-A (PART1, PART2, PART3)
- QUALITY PLAN
- COMPLIANCE SHEET

	DATA SHEET-A METAL EXPANSION BELLOWS		SPECIFICATION NO. PE-TS-423-100-M021
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BOQ FOR METAL EXPANSION BELLOWS

Below is the project specific requirement of Metal expansion bellows for 1X800 MW North Chennai STPP:

SL. NO.	ITEM DESCRIPTION			LOCATION	INSTALLATION	QTY PER UNIT	TOTAL QTY
	SIZE	TYPE	TAG NO.				
1	2000 NB	GIMBAL BELLOWS	E1,E2,E4,E5	BFPT-B/A EXHAUST TO CONDENSER	VERTICAL	4	4
2	2000 NB	HINGED ANGULAR BELLOWS	E3, E6	BFPT-B/A EXHAUST TO CONDENSER	HORIZONTAL	2	2
3	1100 NB	GIMBAL BELLOWS	E7,E12	FLASH TANK –A/B VENT TO CONDENSER	VERTICAL	2	2
4	1100 NB	HINGED ANGULAR BELLOWS	E8,E9, E10,E11	FLASH TANK –A/B VENT TO CONDENSER	HORIZONTAL	4	4
5	300 NB	UNTIED BELLOWS	E13,E14,E15,E16	MAIN CONDENSATE SUCTION	VERTICAL	4	4
6	600 NB	UNTIED BELLOWS	E17,E18,E19	MAIN CONDENSATE SUCTION	HORIZONTAL	3	3
TOTAL						19	19

	DATA SHEET- A METAL EXPANSION BELLOWS		SPECIFICATION NO. PE-TS-423-100-M 021	
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SL. NO.	DETAIL OF GENERAL AND DESIGN PARAMETERS FOR METAL EXPANSION BELLOWS						
1	TYPE OF BELLOWS	GIMBAL	HINGED	GIMBAL	HINGED	UNTIED	UNTIED
2	BELLOWS SIZE (NB)	2000	2000	1100	1100	300	600
3	PIPE SIZE (OD X THK)	2032X16	2032X16	1118X10	1118X10	323.9X9.53	610X10
4	ASSEMBLY TYPE	SINGLE	SINGLE	SINGLE	SINGLE	UNIVERSAL	UNIVERSAL
5	OVERALL LENGTH (MM)	1100	900	900	900	600	900
6	PLY THICKNESS (MM)	1.2	1.2	1.2	1.2	0.5	0.6
7	BELLOWS WIDTH (MM)	49	49	40	40	20	25
8	BELLOWS PITCH(MM)	33	33	40	40	20	25
9	CONVOLUTION	10	10	4	4	5	5
10	TANGENT THICKNESS (MM)	1.2	1.2	1.2	1.2	0.5	0.6
11	TANGENT LENGTH (MM)	20	20	20	20	20	20
12	COLLAR THICKNESS (MM)	2	2	1.2	1.2	1	1
13	COLLAR LENGTH (MM)	20	20	20	20	20	20
14	SPOOL/MID PIPE LENGTH (MM)	NA	NA	NA	NA	90	150
15	SLEEVE THICKNESS (MM)	10	10	6	6	1.5	1.5
16	ROUND FLANGE THICKNESS (MM)	60	60	30	30	16	24
17	SQUARE GIMBAL RING THICKNESS (MM)	60	NA	36	NA	NA	NA
18	SQUARE GIMBAL RING WIDTH (MM)	350	NA	200	NA	NA	NA
19	HINGE MAIN PLATE THICKNESS (MM)	NA	60	NA	36	NA	NA
20	HINGE SUPPORT PLATE THICKNESS (MM)	30	30	18	18	NA	NA
21	HINGE PIN/GIMBAL PIN DIA. (MM)	75	75	45	45	NA	NA
22	GUSSET PALTE THICKNESS (MM)	30	30	18	18	NA	NA
23	TIE ROD DIA. (MM)	NA	NA	NA	NA	25	30
24	THICKNESS OF END PIPE LOCAL TO FLANGE (MM)*	22	22	16	16	NA	NA

NOTE:

1. Thickness of end pipe local to flange to be as specified. It is to be step machined equal to pipe thickness near the bellows convolution and edge prepared to suit matching pipe at other end.
2. Thickness of pressure parts indicated are minimum requirements and the same shall be as per Finite Element Analysis.

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MATERIAL OF CONSTRUCTION

Material used for manufacture of various bellows components are mentioned in Table-I.

<u>TABLE-1</u>		
SL. NO	PART NAME	MATERIALS FOR BELLOWS/PRESSURE PARTS/OTHER ATTACHMENTS
1	BELLOWS	ASTM 240 TP 304
2	INTERNAL SLEEVE	ASTM 240 TP 304
3	COLLAR	ASTM 240 TP 304
4	END PIPE/MID PIPE OR SPOOL PIPE	SA 672 GR.B 70/ SA 672 GR.C 70/ SA515 GR. 70/516 GR.70
5	HINGE PLATE SUPPORT FLANGE/HOUSING FLANGE/RING	IS 2062 GR.B/ SA515 GR. 70/516 GR.70
6	HINGE PIN / GIMBAL PIN	CARBON STEEL CL.8.8
7	GIMBAL PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B
8	HINGE MAIN PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B
9	HINGE SUPPORT PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B
10	GUSSET PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B
11	TIE ROD/LIMIT ROD WITH NUT & LOCKNUT	CARBON STEEL (CL. 6.8 & 6.0)
12	SPHERICAL WASHER	SA515Gr.60/ SA515Gr.70 /SA516Gr.60/SA516Gr.70
13	EXTERNAL SLEEVE/COVER/SHROUD & SHROUD SUPPORT	IS 2062 Gr. A/B
14	CIRCLIPS/WASHER	MILD STEEL
15	BOLT & NUT	IS1367 CL4.6/4
16	ANY OTHER COMPONENT	SPECIFIED BY BIDDER AND SHALL BE SUITABLE FOR INTENDED DUTY

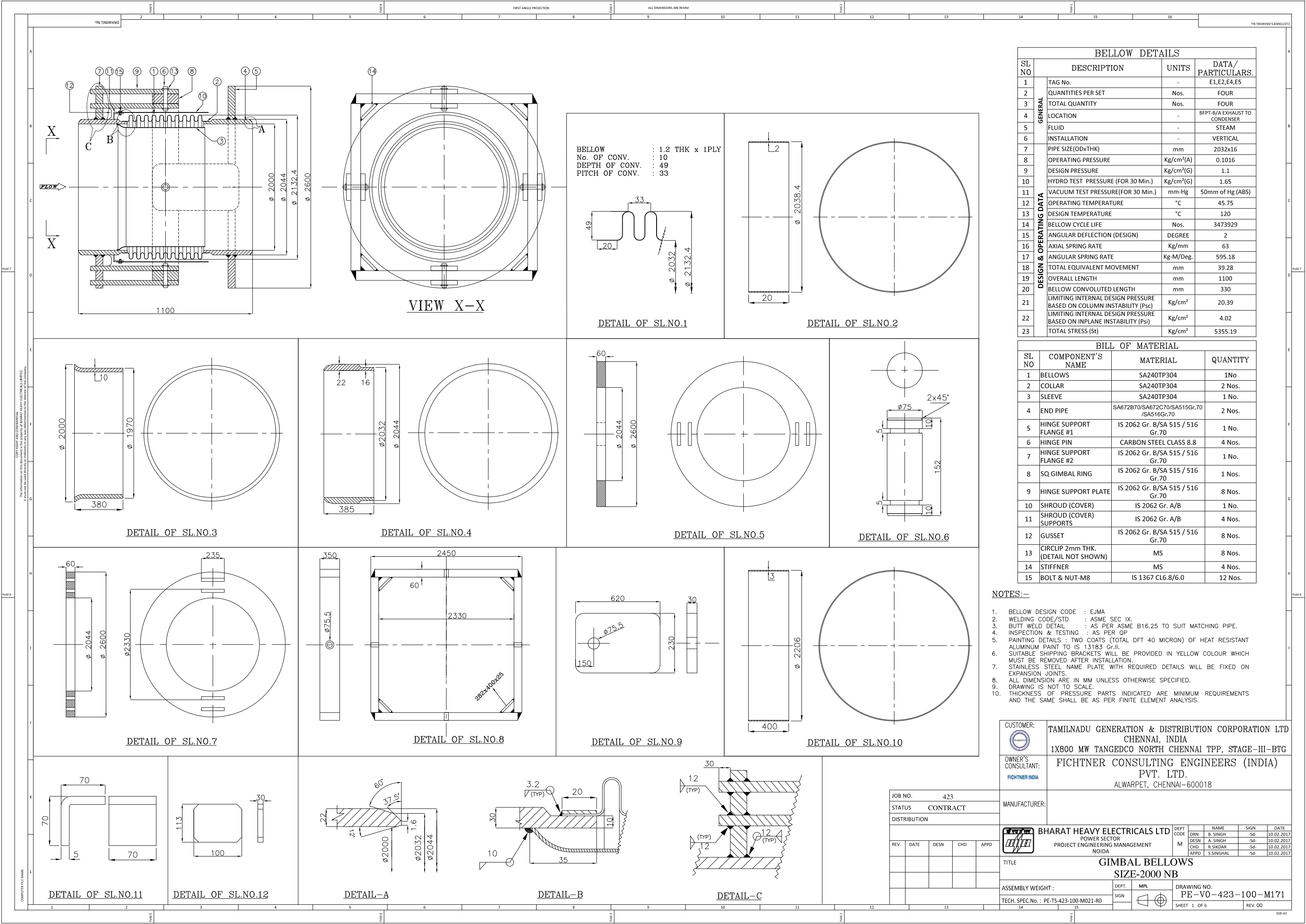
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DATA SHEET-A METAL EXPANSION BELLOWS

REFERENCE GA DRAWINGS

1. Vendor to furnish drawing(s) prepared based on reference drawing with fabrication details included and keeping the basic design same as reference drawing, in case of order. The thickness of pressure parts indicated in reference drawings are the minimum requirement. The same shall be as per Finite Element Analysis.
2. If, during detail engineering, some changes in reference drawing w.r.t. to constructional details/dimensional details is required to suits the bellows technical requirement and functionality by bidder, then same is to be indicated in drawing without any price implication on BHEL. However, prior approval of BHEL is required.
3. All bellows shall be manufactured as per detail given in DATA SHEET-A Part-1. In case of ambiguity in reference drawing and DATA SHEET-A Part-1; later shall prevail.
4. Bill of material mentioned in reference drawing are for indicative purpose only.
5. Material of construction to be followed as indicated in DATA SHEET-A Part-2. In case of ambiguity in material specification between DATA SHEET-A Part-2 and Reference drawing's BOM table, DATA SHEET-A Part-2 shall prevail.
6. Bidder to follow the bellows details table (Indicated in reference drawings) for operating parameters, which are final. However, any change, in theses parameters will be informed during detail engineering.
7. For vertical bellows, sleeve shall be provided with a drain hole to avoid condensate accumulation.
8. There shall be no sharp corners in final assembly. They shall be chamfered suitably.
9. All welds shall be properly done as per ASME section-IX and the assembly finish must be neat & clean.
10. Manufacturing tolerances shall be considered as per details given below or as per latest codes and standards during fabrication:

BELLOWS DIMENSION (mm)	MANUFACTURING TOLERANCE (mm)
Convolution Pitch (q)	
< = 13	± 1.5
> 13 to 25	± 3
> 25 to 38	± 5
> 38 to 50	± 6
> 50	± 8
Convolution Height (w)	
< = 13	± 1
> 13 to 25	± 1.5
> 25 to 38	± 2.5
> 38 to 50	± 3
> 50 to 64	± 4
> 64 to 75	± 5
> 75 to 89	± 5.5
> 89 to 100	± 6
> 100	± 7
Convolution Inside Diameter (Db)	
< = 220	± 1.5
> 200 to 600	± 3
> 600 to 1200	± 5
> 1200 to 1500	± 6
> 1500	± 8



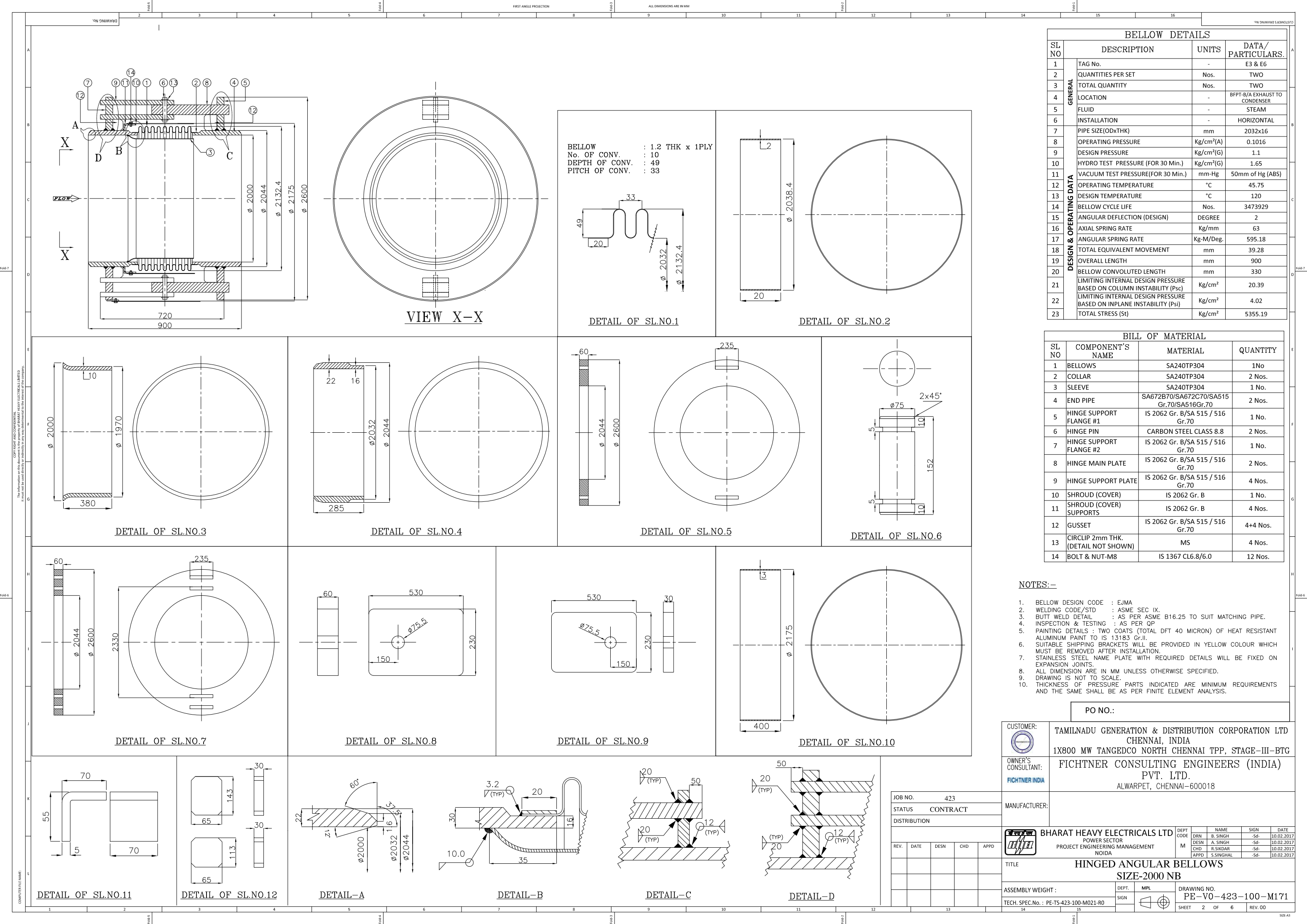
BELOW DETAILS			
SL NO	DESCRIPTION	UNITS	DATA/PARTICULARS.
1	TAG No.	-	E1,E2,E4,E5
2	QUANTITIES PER SET	Nos.	FOUR
3	TOTAL QUANTITY	Nos.	FOUR
4	LOCATION	-	BFPT-8/A EXHAUST TO CONDENSER
5	FLUID	-	STEAM
6	INSTALLATION	-	VERTICAL
7	PIPE SIZE(ODxTHK)	mm	2032x16
8	OPERATING PRESSURE	Kg/cm ² (A)	0.1016
9	DESIGN PRESSURE	Kg/cm ² (G)	1.1
10	HYDRO TEST PRESSURE (FOR 30 Min.)	Kg/cm ² (G)	1.65
11	VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (ABS)
12	OPERATING TEMPERATURE	°C	45.75
13	DESIGN TEMPERATURE	°C	120
14	BELOW CYCLE LIFE	Nos.	3473929
15	ANGULAR DEFLECTION (DESIGN)	DEGREE	2
16	AXIAL SPRING RATE	Kg/mm	63
17	ANGULAR SPRING RATE	Kg-M/Deg.	595.18
18	TOTAL EQUIVALENT MOVEMENT	mm	39.28
19	OVERALL LENGTH	mm	1100
20	BELOW CONVOLUTED LENGTH	mm	330
21	LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm ²	20.39
22	LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm ²	4.02
23	TOTAL STRESS (St)	Kg/cm ²	5355.19

BILL OF MATERIAL			
SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	1No
2	COLLAR	SA240TP304	2 Nos.
3	SLEEVE	SA240TP304	1 No.
4	END PIPE	SA672B70/SA672C70/SA515Gr.70 /SA516Gr.70	2 Nos.
5	HINGE SUPPORT FLANGE #1	IS 2062 Gr. B/SA 515 / 516 Gr.70	1 No.
6	HINGE PIN	CARBON STEEL CLASS 8.8	4 Nos.
7	HINGE SUPPORT FLANGE #2	IS 2062 Gr. B/SA 515 / 516 Gr.70	1 No.
8	SQ GIMBAL RING	IS 2062 Gr. B/SA 515 / 516 Gr.70	1 Nos.
9	HINGE SUPPORT PLATE	IS 2062 Gr. B/SA 515 / 516 Gr.70	8 Nos.
10	SHROUD (COVER)	IS 2062 Gr. A/B	1 No.
11	SHROUD (COVER) SUPPORTS	IS 2062 Gr. A/B	4 Nos.
12	GUSSET	IS 2062 Gr. B/SA 515 / 516 Gr.70	8 Nos.
13	CIRCLIP 2mm THK. (DETAIL NOT SHOWN)	MS	8 Nos.
14	STIFFNER	MS	4 Nos.
15	BOLT & NUT-M8	IS 1367 CL6.8/6.0	12 Nos.

NOTES:-

1. BELOW DESIGN CODE : EJMA
2. WELDING CODE/STD : ASME SEC IX.
3. BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
4. INSPECTION & TESTING : AS PER QP
5. PAINTING DETAILS : TWO COATS (TOTAL DFT 40 MICRON) OF HEAT RESISTANT ALUMINUM PAINT TO IS 13183 Gr.II.
6. SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
7. STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
8. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
9. DRAWING IS NOT TO SCALE.
10. THICKNESS OF PRESSURE PARTS INDICATED ARE MINIMUM REQUIREMENTS AND THE SAME SHALL BE AS PER FINITE ELEMENT ANALYSIS.

CUSTOMER:	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD CHENNAI, INDIA 1X800 MW TANGEDCO NORTH CHENNAI TPP, STAGE-III-BTG				
OWNER'S CONSULTANT:	FICHTNER CONSULTING ENGINEERS (INDIA) PVT. LTD. ALWARPET, CHENNAI-600018				
MANUFACTURER:					
JOB NO. 423		STATUS CONTRACT		DISTRIBUTION	
REV.	DATE	DESN	CHD	APPD	
TITLE		GIMBAL BELLOWS SIZE-2000 NB			
ASSEMBLY WEIGHT :		DEPT. MPL	DRAWING NO. PE-V0-423-100-M171		
TECH. SPEC.No.: PE-TS-423-100-M021-R0		SIGN	SHEET 1 OF 6		



BELLOW DETAILS			
SL NO	DESCRIPTION	UNITS	DATA/PARTICULARS.
1	TAG No.	-	E3 & E6
2	QUANTITIES PER SET	Nos.	TWO
3	TOTAL QUANTITY	Nos.	TWO
4	LOCATION	-	BFPT-B/A EXHAUST TO CONDENSER
5	FLUID	-	STEAM
6	INSTALLATION	-	HORIZONTAL
7	PIPE SIZE(ODxTHK)	mm	2032x16
8	OPERATING PRESSURE	Kg/cm ² (A)	0.1016
9	DESIGN PRESSURE	Kg/cm ² (G)	1.1
10	HYDRO TEST PRESSURE (FOR 30 Min.)	Kg/cm ² (G)	1.65
11	VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (ABS)
12	OPERATING TEMPERATURE	°C	45.75
13	DESIGN TEMPERATURE	°C	120
14	BELLOW CYCLE LIFE	Nos.	3473929
15	ANGULAR DEFLECTION (DESIGN)	DEGREE	2
16	AXIAL SPRING RATE	Kg/mm	63
17	ANGULAR SPRING RATE	Kg-M/Deg.	595.18
18	TOTAL EQUIVALENT MOVEMENT	mm	39.28
19	OVERALL LENGTH	mm	900
20	BELLOW CONVOLUTED LENGTH	mm	330
21	LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm ²	20.39
22	LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm ²	4.02
23	TOTAL STRESS (St)	Kg/cm ²	5355.19

BILL OF MATERIAL			
SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	1No
2	COLLAR	SA240TP304	2 Nos.
3	SLEEVE	SA240TP304	1 No.
4	END PIPE	SA672B70/SA672C70/SA515 Gr.70/SA516Gr.70	2 Nos.
5	HINGE SUPPORT FLANGE #1	IS 2062 Gr. B/SA 515 / 516 Gr.70	1 No.
6	HINGE PIN	CARBON STEEL CLASS 8.8	2 Nos.
7	HINGE SUPPORT FLANGE #2	IS 2062 Gr. B/SA 515 / 516 Gr.70	1 No.
8	HINGE MAIN PLATE	IS 2062 Gr. B/SA 515 / 516 Gr.70	2 Nos.
9	HINGE SUPPORT PLATE	IS 2062 Gr. B/SA 515 / 516 Gr.70	4 Nos.
10	SHROUD (COVER)	IS 2062 Gr. B	1 No.
11	SHROUD (COVER) SUPPORTS	IS 2062 Gr. B	4 Nos.
12	GUSSET	IS 2062 Gr. B/SA 515 / 516 Gr.70	4+4 Nos.
13	CIRCLIP 2mm THK. (DETAIL NOT SHOWN)	MS	4 Nos.
14	BOLT & NUT-M8	IS 1367 CL6.8/6.0	12 Nos.

- NOTES:-
- BELLOW DESIGN CODE : EJMA
 - WELDING CODE/STD : ASME SEC IX.
 - BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
 - INSPECTION & TESTING : AS PER QP
 - PAINTING DETAILS : TWO COATS (TOTAL DFT 40 MICRON) OF HEAT RESISTANT ALUMINUM PAINT TO IS 13183 Gr.II.
 - SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
 - STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
 - ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
 - DRAWING IS NOT TO SCALE.
 - THICKNESS OF PRESSURE PARTS INDICATED ARE MINIMUM REQUIREMENTS AND THE SAME SHALL BE AS PER FINITE ELEMENT ANALYSIS.

PO NO.:

CUSTOMER:

TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD
CHENNAI, INDIA
1X800 MW TANGEDCO NORTH CHENNAI TPP, STAGE-III-BTG

OWNER'S CONSULTANT:

FICHTNER INDIA
FICHTNER CONSULTING ENGINEERS (INDIA) PVT. LTD.
ALWARPET, CHENNAI-600018

MANUFACTURER:

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

JOB NO.423

STATUSCONTRACT

DISTRIBUTION

REV. DATE DESN CHD APPD

TITLE

ASSEMBLY WEIGHT :

TECH. SPEC.No.: PE-TS-423-100-M021-R0

DEPT. CODE

SIGN

MPL

NAME

B. SINGH

A. SINGH

R. SIKDAR

S. SINGHAL

SIGN

-SD-

-SD-

-SD-

-SD-

DATE

10.02.2017

10.02.2017

10.02.2017

10.02.2017

DEPT. CODE

M

NAME

B. SINGH

A. SINGH

R. SIKDAR

S. SINGHAL

SIGN

-SD-

-SD-

-SD-

-SD-

DATE

10.02.2017

10.02.2017

10.02.2017

10.02.2017

TITLE

HINGED ANGULAR BELLOWS
SIZE-2000 NB

ASSEMBLY WEIGHT :

TECH. SPEC.No.: PE-TS-423-100-M021-R0

DEPT. CODE

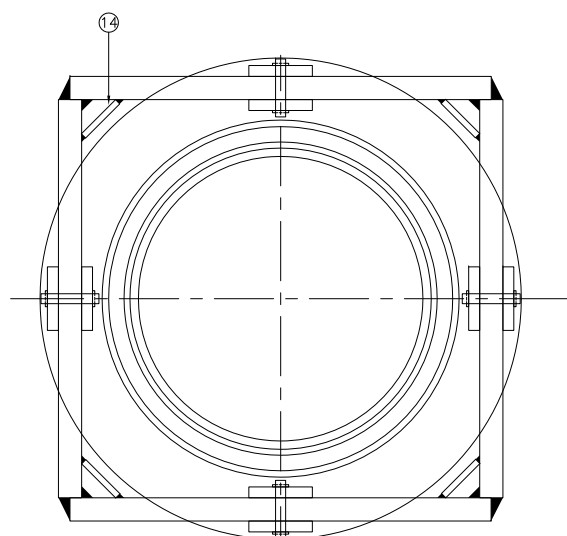
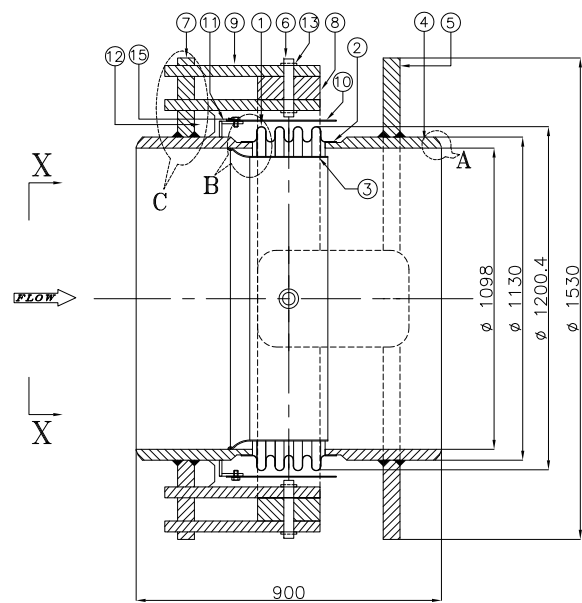
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MPL

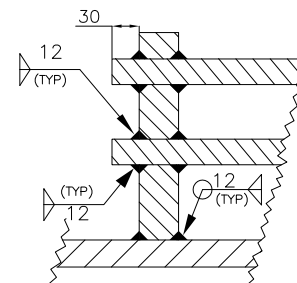
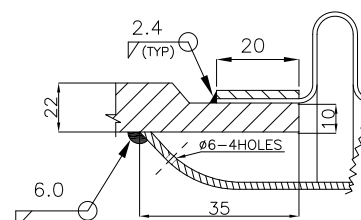
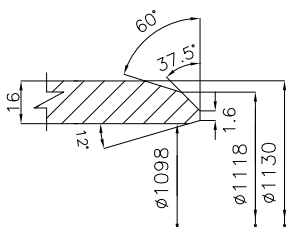
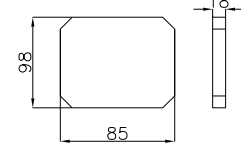
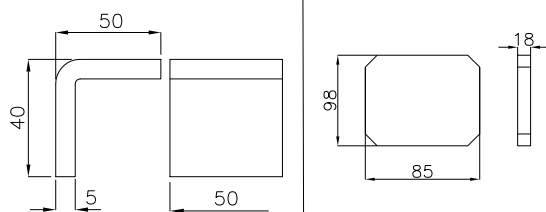
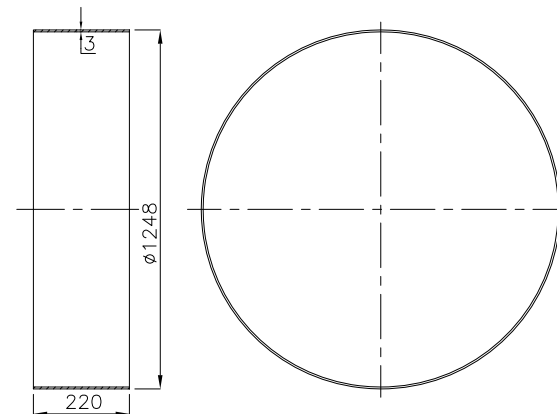
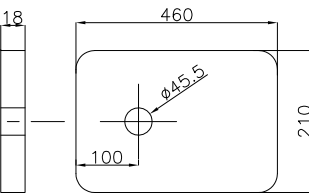
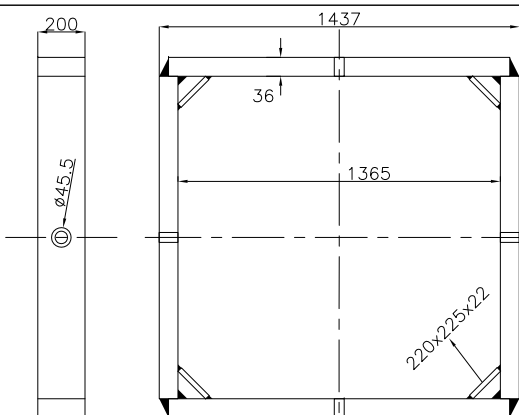
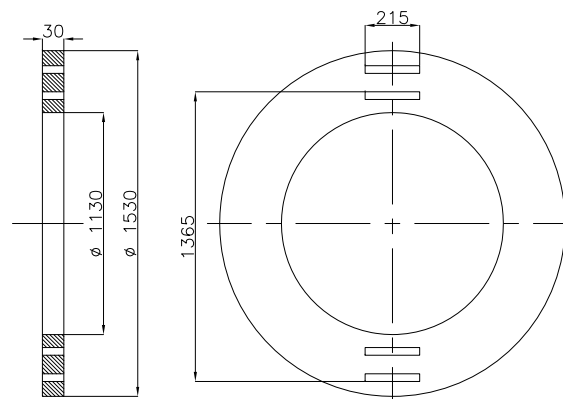
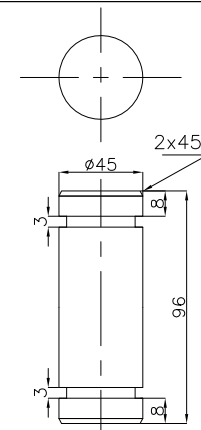
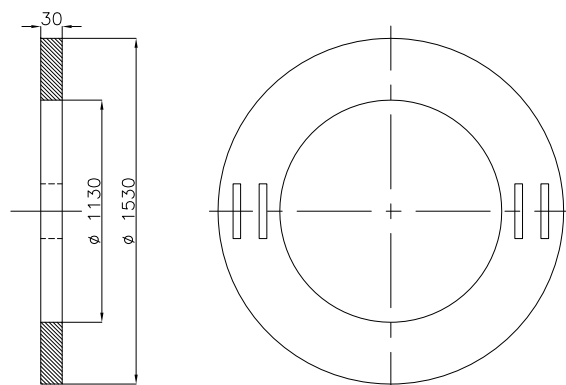
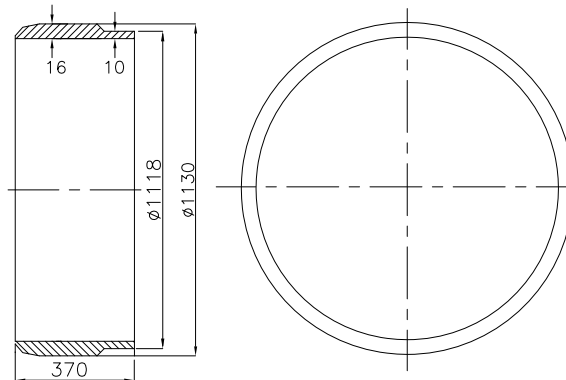
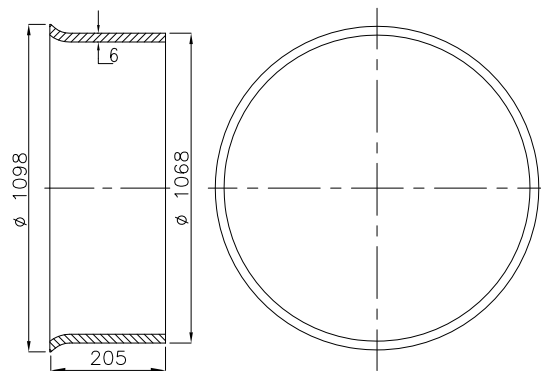
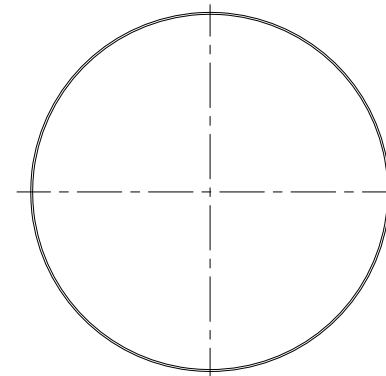
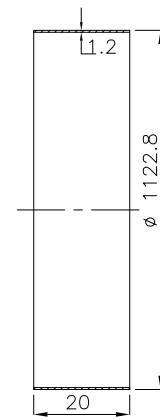
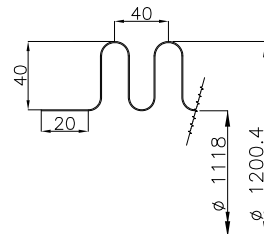
DRAWING NO.
PE-V0-423-100-M171

SHEET 2 OF 6

REV. 00



BELLOW : 1.2 THK x 1PLY
No. OF CONV. : 4
DEPTH OF CONV. : 40
PITCH OF CONV. : 40



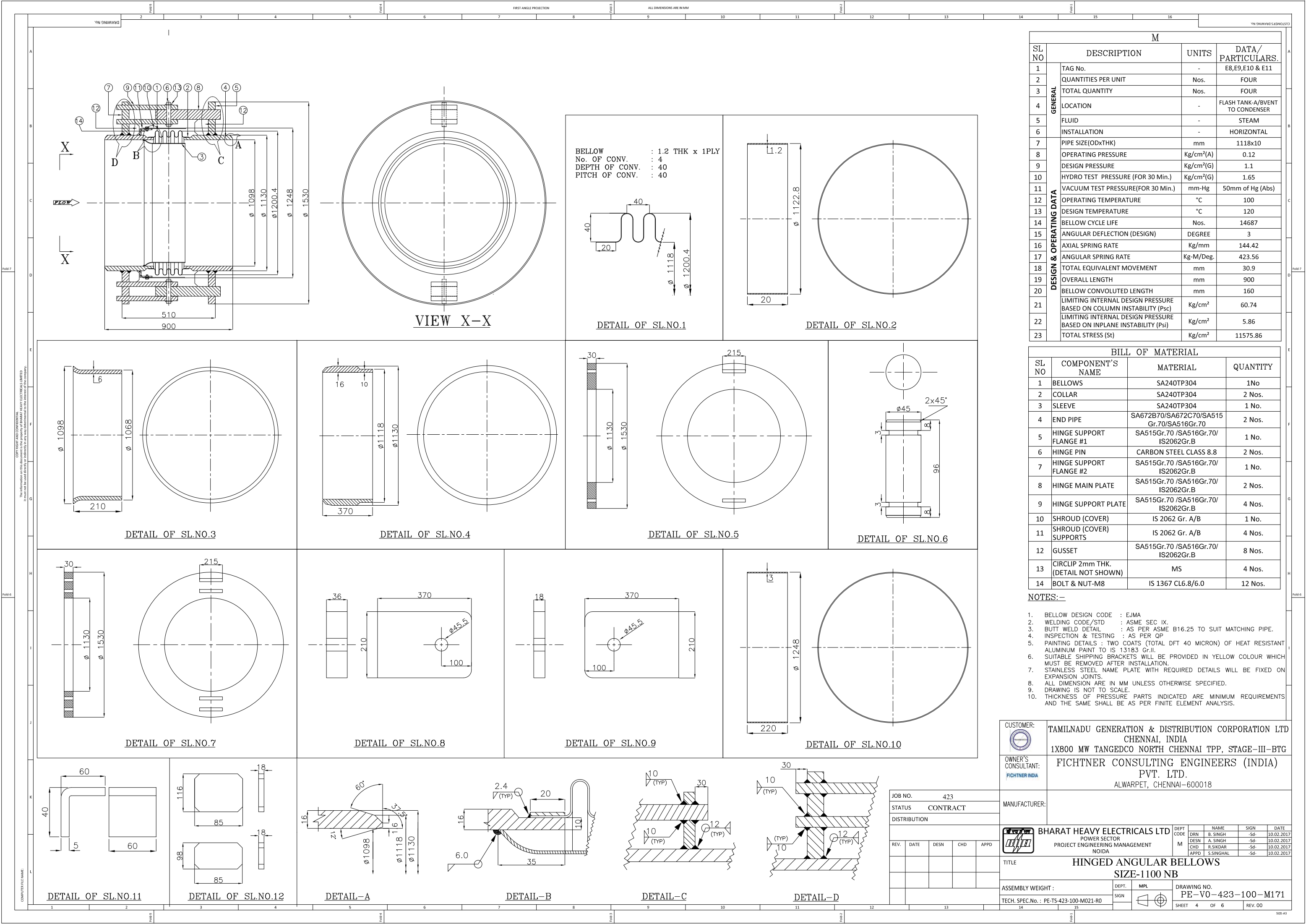
BELLOW DETAILS			
SL NO	DESCRIPTION	UNITS	DATA/ PARTICULARS.
1	TAG No.	-	E7 & E12
2	QUANTITIES PER UNIT	Nos.	TWO
3	TOTAL QUANTITY	Nos.	TWO
4	LOCATION	-	FLASH TANK-A/B VENT TO CONDENSER
5	FLUID	-	STEAM
6	INSTALLATION	-	VERTICAL
7	PIPE SIZE(ODxTHK)	mm	1118x10
8	OPERATING PRESSURE	Kg/cm ² (A)	0.12
9	DESIGN PRESSURE	Kg/cm ² (G)	1.1
10	HYDRO TEST PRESSURE (FOR 30 Min.)	Kg/cm ² (G)	1.65
11	VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (Abs)
12	OPERATING TEMPERATURE	°C	100
13	DESIGN TEMPERATURE	°C	120
14	BELLOW CYCLE LIFE	Nos.	14687
15	ANGULAR DEFLECTION (DESIGN)	DEGREE	3
16	AXIAL SPRING RATE	Kg/mm	144.42
17	ANGULAR SPRING RATE	Kg-M/Deg.	423.56
18	TOTAL EQUIVALENT MOVEMENT	mm	30.9
19	OVERALL LENGTH	mm	900
20	BELLOW CONVULOTED LENGTH	mm	160
21	LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm ²	60.74
22	LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm ²	5.86
23	TOTAL STRESS (St)	Kg/cm ²	11575.86

M			
SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	1No
2	COLLAR	SA240TP304	2 Nos.
3	SLEEVE	SA240TP304	1 No.
4	END PIPE	SA672B70/SA672C70/SA515 Gr.70/SA516Gr.70	2 Nos.
5	HINGE SUPPORT FLANGE #1	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	1 No.
6	HINGE PIN	CARBON STEEL CLASS 8.8	4 Nos.
7	HINGE SUPPORT FLANGE #2	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	1 No.
8	SQ GIMBAL RING	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	1 Nos.
9	HINGE SUPPORT PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	8 Nos.
10	SHROUD (COVER)	IS 2062 Gr. A/B	1 No.
11	SHROUD (COVER) SUPPORTS	IS 2062 Gr. A/B	4 Nos.
12	GUSSET	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	8 Nos.
13	CIRCLIP 2mm THK. (DETAIL NOT SHOWN)	MS	8 Nos.
14	STIFFNER	MS	4 Nos.
15	BOLT & NUT-M8	IS 1367 CL6.8/6.0	12 Nos.

NOTES:—

1. BELLOW DESIGN CODE : EJMA 9 th EDITION 2011 ADDENDA.
2. WELDING CODE/STD : ASME SEC. IX.
3. BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
4. INSPECTION & TESTING : AS PER OP NO. PE-OP-410-100-M021B-R00.
5. PAINTING DETAILS : TWO COATS (TOTAL DFT 40 MICRON) OF HEAT RESISTANT ALUMINUM PAINT TO IS 13183 GR.II.
6. SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
7. STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
8. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
9. DRAWING IS NOT TO SCALE.
10. THICKNESS OF PRESSURE PARTS INDICATED ARE MINIMUM REQUIREMENTS AND THE SAME SHALL BE AS PER FINITE ELEMENT ANALYSIS.

CUSTOMER:	 TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD CHENNAI, INDIA 1X800 MW TANGEDCO NORTH CHENNAI TPP, STAGE-III-BTG		OWNER'S CONSULTANT: FICHTNER INDIA		FICHTNER CONSULTING ENGINEERS (INDIA) PVT. LTD. ALWARPET, CHENNAI-600018		
MANUFACTURER:							
	 BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA		DEPT CODE M	NAME	SIGN	DATE	
				DRN	B. SINGH	-Sd-	10.02.2017
				DESN	A. SINGH	-Sd-	10.02.2017
				CHD	R.SIKDAR	-Sd-	10.02.2017
				APPD	S.SINGHAL	-Sd-	10.02.2017
TITLE GIMBAL BELLOWS SIZE-1100 NB							
ASSEMBLY WEIGHT :			DEPT. MPL	DRAWING NO. PE-V0-423-100-M171			
TECH. SPEC.No. : PE-TS-423-100-M021-RO			SIGN		SHEET 3 OF 6 REV.00		

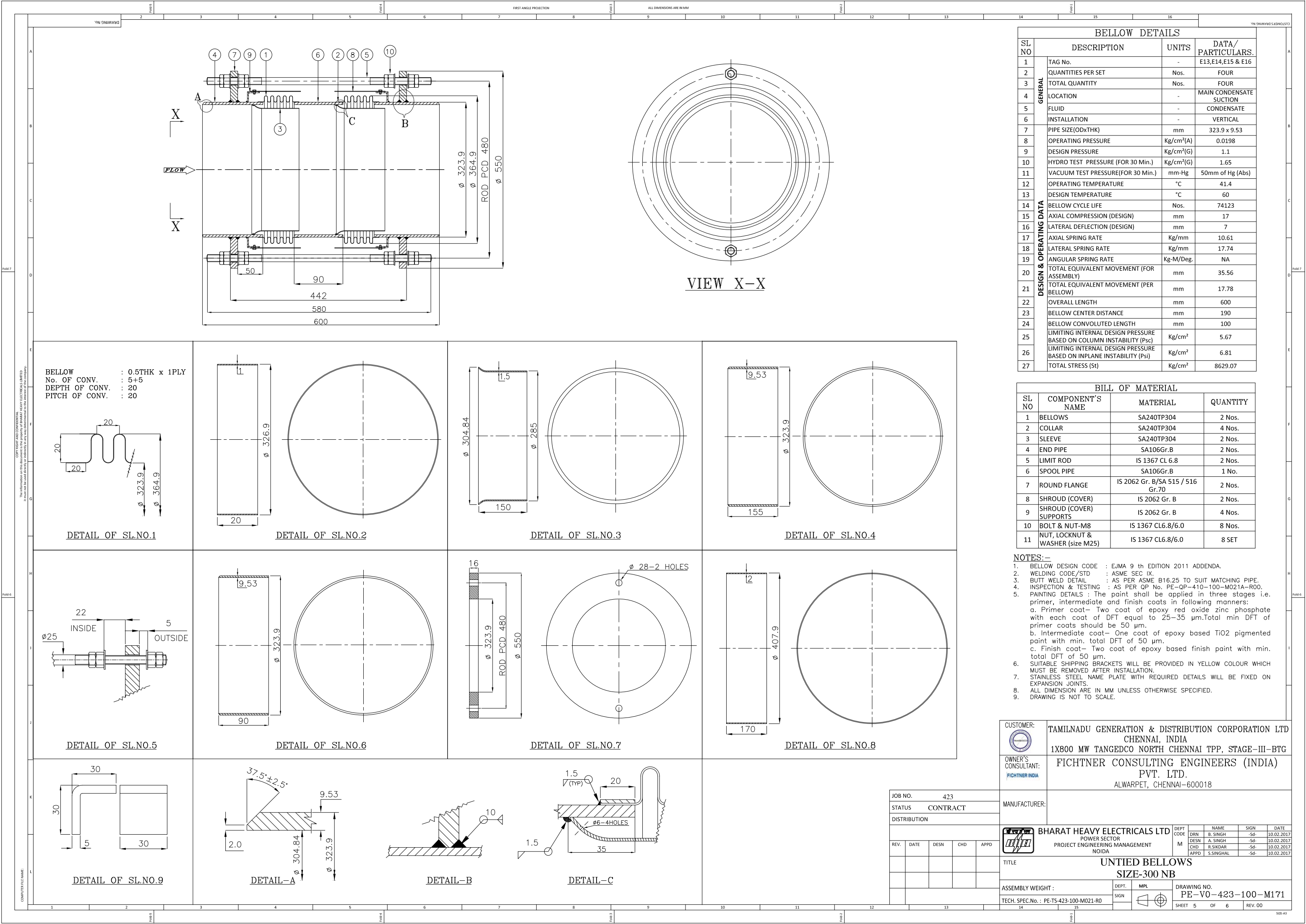


M			
SL NO	DESCRIPTION	UNITS	DATA/PARTICULARS.
1	TAG No.	-	E8,E9,E10 & E11
2	QUANTITIES PER UNIT	Nos.	FOUR
3	TOTAL QUANTITY	Nos.	FOUR
4	LOCATION	-	FLASH TANK-A/BVENT TO CONDENSER
5	FLUID	-	STEAM
6	INSTALLATION	-	HORIZONTAL
7	PIPE SIZE(ODxTHK)	mm	1118x10
8	OPERATING PRESSURE	Kg/cm²(A)	0.12
9	DESIGN PRESSURE	Kg/cm²(G)	1.1
10	HYDRO TEST PRESSURE (FOR 30 Min.)	Kg/cm²(G)	1.65
11	VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (Abs)
12	OPERATING TEMPERATURE	°C	100
13	DESIGN TEMPERATURE	°C	120
14	BELLOW CYCLE LIFE	Nos.	14687
15	ANGULAR DEFLECTION (DESIGN)	DEGREE	3
16	AXIAL SPRING RATE	Kg/mm	144.42
17	ANGULAR SPRING RATE	Kg-M/Deg.	423.56
18	TOTAL EQUIVALENT MOVEMENT	mm	30.9
19	OVERALL LENGTH	mm	900
20	BELLOW CONVOLUTED LENGTH	mm	160
21	LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm²	60.74
22	LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm²	5.86
23	TOTAL STRESS (St)	Kg/cm²	11575.86

BILL OF MATERIAL			
SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	1No
2	COLLAR	SA240TP304	2 Nos.
3	SLEEVE	SA240TP304	1 No.
4	END PIPE	SA672B70/SA672C70/SA515 Gr.70/SA516Gr.70	2 Nos.
5	HINGE SUPPORT FLANGE #1	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	1 No.
6	HINGE PIN	CARBON STEEL CLASS 8.8	2 Nos.
7	HINGE SUPPORT FLANGE #2	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	1 No.
8	HINGE MAIN PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	2 Nos.
9	HINGE SUPPORT PLATE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	4 Nos.
10	SHROUD (COVER)	IS 2062 Gr. A/B	1 No.
11	SHROUD (COVER) SUPPORTS	IS 2062 Gr. A/B	4 Nos.
12	GUSSET	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	8 Nos.
13	CIRCLIP 2mm THK. (DETAIL NOT SHOWN)	MS	4 Nos.
14	BOLT & NUT-M8	IS 1367 CL6.8/6.0	12 Nos.

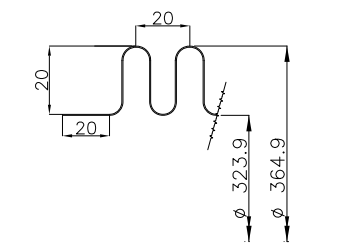
- NOTES: -
- BELLOW DESIGN CODE : EJMA
 - WELDING CODE/STD : ASME SEC IX.
 - BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
 - INSPECTION & TESTING : AS PER QP
 - PAINTING DETAILS : TWO COATS (TOTAL DFT 40 MICRON) OF HEAT RESISTANT ALUMINUM PAINT TO IS 13183 Gr.II.
 - SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
 - STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
 - ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
 - DRAWING IS NOT TO SCALE.
 - THICKNESS OF PRESSURE PARTS INDICATED ARE MINIMUM REQUIREMENTS AND THE SAME SHALL BE AS PER FINITE ELEMENT ANALYSIS.

CUSTOMER:	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD CHENNAI, INDIA 1X800 MW TANGEDCO NORTH CHENNAI TPP, STAGE-III-BTG				
OWNER'S CONSULTANT:	FICHTNER CONSULTING ENGINEERS (INDIA) PVT. LTD. ALWARPET, CHENNAI-600018				
MANUFACTURER:					
JOB NO. 423		STATUS CONTRACT			
DISTRIBUTION					
REV.	DATE	DESN	CHD	APPD	
TITLE HINGED ANGULAR BELLOWS SIZE-1100 NB					
ASSEMBLY WEIGHT :		DEPT. MPL	DRAWING NO. PE-V0-423-100-M171		
TECH. SPEC.No.: PE-TS-423-100-M021-RO		SIGN	SHEET 4 OF 6 REV. 00		

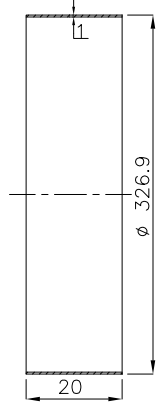


VIEW X-X

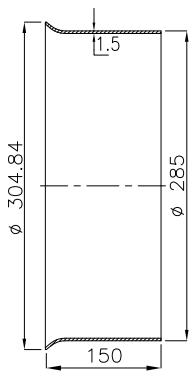
BELLOW : 0.5THK x 1PLY
No. OF CONV. : 5+5
DEPTH OF CONV. : 20
PITCH OF CONV. : 20



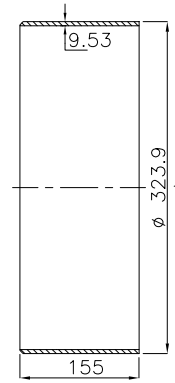
DETAIL OF SL.NO.1



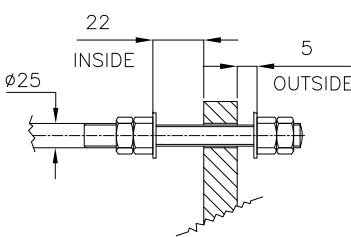
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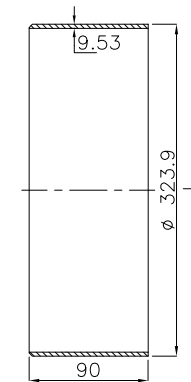
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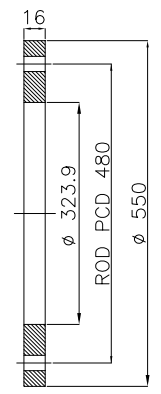
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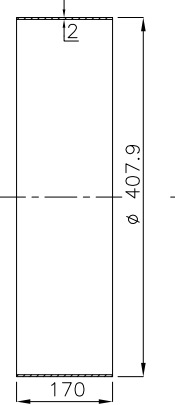
DETAIL OF SL.NO.5



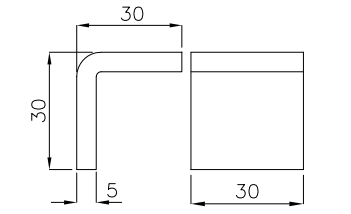
DETAIL OF SL.NO.6



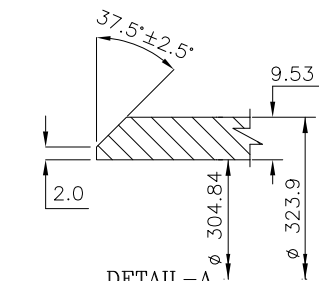
DETAIL OF SL.NO.7



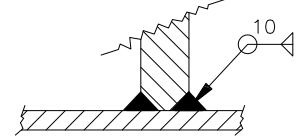
DETAIL OF SL.NO.8



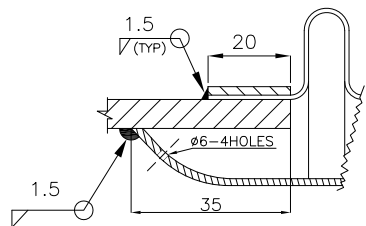
DETAIL OF SL.NO.9



DETAIL-A



DETAIL-B



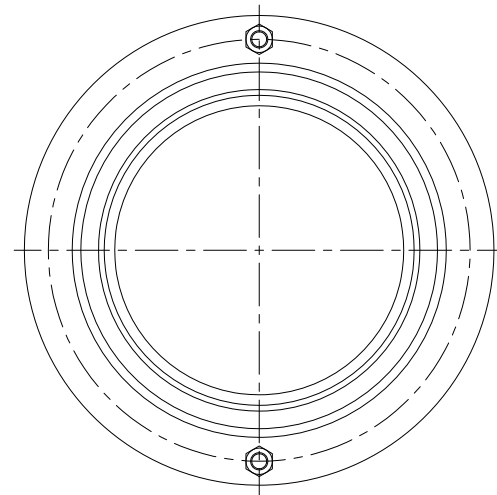
DETAIL-C

BELLOW DETAILS			
SL NO	DESCRIPTION	UNITS	DATA/PARTICULARS.
1	TAG No.	-	E13,E14,E15 & E16
2	QUANTITIES PER SET	Nos.	FOUR
3	TOTAL QUANTITY	Nos.	FOUR
4	LOCATION	-	MAIN CONDENSATE SUCTION
5	FLUID	-	CONDENSATE
6	INSTALLATION	-	VERTICAL
7	PIPE SIZE(ODxTHK)	mm	323.9 x 9.53
8	OPERATING PRESSURE	Kg/cm ² (A)	0.0198
9	DESIGN PRESSURE	Kg/cm ² (G)	1.1
10	HYDRO TEST PRESSURE (FOR 30 Min.)	Kg/cm ² (G)	1.65
11	VACUUM TEST PRESSURE(FOR 30 Min.)	mm-Hg	50mm of Hg (Abs)
12	OPERATING TEMPERATURE	°C	41.4
13	DESIGN TEMPERATURE	°C	60
14	BELLOW CYCLE LIFE	Nos.	74123
15	AXIAL COMPRESSION (DESIGN)	mm	17
16	LATERAL DEFLECTION (DESIGN)	mm	7
17	AXIAL SPRING RATE	Kg/mm	10.61
18	LATERAL SPRING RATE	Kg/mm	17.74
19	ANGULAR SPRING RATE	Kg-M/Deg.	NA
20	TOTAL EQUIVALENT MOVEMENT (FOR ASSEMBLY)	mm	35.56
21	TOTAL EQUIVALENT MOVEMENT (PER BELLOW)	mm	17.78
22	OVERALL LENGTH	mm	600
23	BELLOW CENTER DISTANCE	mm	190
24	BELLOW CONVOLUTED LENGTH	mm	100
25	LIMITING INTERNAL DESIGN PRESSURE BASED ON COLUMN INSTABILITY (Psc)	Kg/cm ²	5.67
26	LIMITING INTERNAL DESIGN PRESSURE BASED ON INPLANE INSTABILITY (Psi)	Kg/cm ²	6.81
27	TOTAL STRESS (St)	Kg/cm ²	8629.07

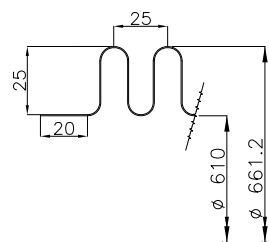
BILL OF MATERIAL			
SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	2 Nos.
2	COLLAR	SA240TP304	4 Nos.
3	SLEEVE	SA240TP304	2 Nos.
4	END PIPE	SA106Gr.B	2 Nos.
5	LIMIT ROD	IS 1367 CL 6.8	2 Nos.
6	SPOOL PIPE	SA106Gr.B	1 No.
7	ROUND FLANGE	IS 2062 Gr. B/SA 515 / 516 Gr.70	2 Nos.
8	SHROUD (COVER)	IS 2062 Gr. B	2 Nos.
9	SHROUD (COVER) SUPPORTS	IS 2062 Gr. B	4 Nos.
10	BOLT & NUT-M8	IS 1367 CL6.8/6.0	8 Nos.
11	NUT, LOCKNUT & WASHER (size M25)	IS 1367 CL6.8/6.0	8 SET

- NOTES:-
- BELLOW DESIGN CODE : EJMA 9 th EDITION 2011 ADDENDA.
 - WELDING CODE/STD : ASME SEC IX.
 - BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
 - INSPECTION & TESTING : AS PER QP No. PE-QP-410-100-M021A-R00.
 - PAINTING DETAILS : The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manners:
a. Primer coat- Two coat of epoxy red oxide zinc phosphate with each coat of DFT equal to 25-35 µm.Total min DFT of primer coats should be 50 µm.
b. Intermediate coat- One coat of epoxy based TiO2 pigmented paint with min. total DFT of 50 µm.
c. Finish coat- Two coat of epoxy based finish paint with min. total DFT of 50 µm.
 - SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE REMOVED AFTER INSTALLATION.
 - STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
 - ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
 - DRAWING IS NOT TO SCALE.

CUSTOMER:	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD CHENNAI, INDIA 1X800 MW TANGEDCO NORTH CHENNAI TPP, STAGE-III-BTG			
OWNER'S CONSULTANT:	FICHTNER CONSULTING ENGINEERS (INDIA) PVT. LTD. ALWARPET, CHENNAI-600018			
MANUFACTURER:	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA			
JOB NO. 423		STATUS CONTRACT		
DISTRIBUTION		REV. DATE DESN CHD APPD		
TITLE		DEPT. MPL		
ASSEMBLY WEIGHT :		DRAWING NO.		
TECH. SPEC.No.: PE-TS-423-100-M021-R0		PE-V0-423-100-M171		
SHEET 5 OF 6		REV. 00		



BELLOW : 0.6THK x 1PLY.
No. OF CONV. : 5+5
DEPTH OF CONV. : 25
PITCH OF CONV. : 25



Technical drawing of a rectangular plate. The width is labeled as 20 and the height as 613.2. A label '1' is positioned at the top center of the plate.

Diagram of a rectangular plate with a horizontal centerline. The top edge is labeled '10' with a downward arrow, and the bottom edge is labeled '150'.

Technical drawing of a rod with the following dimensions and labels:

- Top dimension: 24
- Inner diameter dimension: $\varnothing 610$
- Label: ROD PCD 750
- Outer diameter dimension: $\varnothing 830$

Technical drawing of a rectangular plate. The width is 185 mm and the height is 695 mm. A dimension line at the top indicates a thickness of 2 mm.

Technical drawing of a stepped block. The drawing shows a side view of a block with a total width of 50 and a total height of 40. The block has a vertical section on the left and a horizontal section on the right. The vertical section has a width of 5 and a height of 40. The horizontal section has a width of 50 and a height of 5. The dimensions are labeled as follows: 50 (total width), 40 (total height), 5 (width of vertical section), and 50 (width of horizontal section).

DETAIL-A

A diagram of a beam of length 12 units, fixed at the left end. A triangular load is applied to the beam, starting at 0 at the left end and increasing linearly to 12 at the right end. The load is represented by a shaded area under a line that slopes upwards from left to right. A reaction force of 12 is shown at the right end, acting vertically upwards.

JOB NO.		423	
STATUS		CONTRACT	
DISTRIBUTION			
REV.	DATE	DESN	CHD

BILL OF MATERIAL			
SL NO	COMPONENT'S NAME	MATERIAL	QUANTITY
1	BELLOWS	SA240TP304	2 Nos.
2	COLLAR	SA240TP304	4 Nos.
3	SLEEVE	SA240TP304	2 Nos.
4	END PIPE	SA672B70/SA672C70/SA515 Gr.70/SA516Gr.70	2 Nos.
5	LIMIT ROD	CS (CL. 6.8 & 6.0)	2 Nos..
6	SPOOL PIPE	SA672B70/SA672C70/SA515 Gr.70/SA516Gr.70	1 No.
7	ROUND FLANGE	SA515Gr.70 /SA516Gr.70/ IS2062Gr.B	2 Nos.
8	SHROUD (COVER)	IS 2062 Gr. A/B	2 Nos.
9	SHROUD (COVER) SUPPORTS	IS 2062 Gr. A/B	4 Nos.
10	BOLT & NUT-M8	IS 1367 CL6.8/6.0	8 Nos.
11	NUT, LOCKNUT & WASHER (SIZE M30)	IS 1367 CL6.8/6.0	8 SET

NOTES:-

1. BELLOW DESIGN CODE : EJMA 9 th EDITION 2011 ADDENDA.
2. WELDING CODE/STD : ASME SEC IX.
3. BUTT WELD DETAIL : AS PER ASME B16.25 TO SUIT MATCHING PIPE.
4. INSULATION & TESTING : AS PER QIP No. PE-QP-4-1-10A-M02-R00.
5. PAINTING DETAILS : The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manners:
 - a. Primer coat— Two coat of epoxy red oxide zinc phosphate with each coat of DFT equal to 25–35 µm.Total min DFT of primer coats should be 50 µm.
 - b. Intermediate coat— One coat of epoxy based TiO2 pigmented paint with min. total DFT of 50 µm.
 - c. Finish coat— Two coat of epoxy based finish paint with min. total DFT of 50 µm.
6. SUITABLE SHIPPING BRACKETS WILL BE PROVIDED IN YELLOW COLOUR WHICH MUST BE INSTALLED AFTER INSTALLATION.
7. STAINLESS STEEL NAME PLATE WITH REQUIRED DETAILS WILL BE FIXED ON EXPANSION JOINTS.
8. ALL DIMENSION ARE IN MM UNLESS OTHERWISE SPECIFIED.
9. DRAWING IS NOT TO SCALE.

CUSTOMER: 	TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD CHENNAI, INDIA 1X800 MW TANGEDCO NORTH CHENNAI TPP, STAGE-III-BTG
OWNER'S CONSULTANT: 	FICHTNER CONSULTING ENGINEERS (INDIA) PVT. LTD. ALWARPET, CHENNAI-600018

	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA		DEPT CODE M		NAME	SIGN	DATE
				DRN	B. SINGH	-sd-	10.02.2021
				DESN	A. SINGH	-sd-	10.02.2021
				CHD	S.SIKDAR	-sd-	10.02.2021
				APPD	S.SINGHAL	-sd-	10.02.2021

TITLE		UNTIED BELLOWS SIZE-600 NB			
ASSEMBLY WEIGHT :	DEPT.	MPL	DRAWING NO. PE-V0-423-100-M171		
TECH. SPEC.No.: PE-TS-423-100-M021-R0	SIGN		SHEET 6 OF 6		
			REV.00		

	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT : 1X800 MW NORTH CHENNAI STPP		
				CUSTOMER : TANGEDCO		
		ITEM : ME BELLWS (UPTO 2000 NB) SUB-SYSTEM: POWER CYCLE PIPING		QP NO. PE-QP-423-100-M021 REV.NO.: 00 DATE: 07/02/2017 PAGE: 1..... OF...5.		JOB NO. : 423
				SECTION : II		

No	COMPONENT & OPERATIONS	CHARACTERIST-ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT #	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C / N				D	M	C	-	
1.0 RAW MATERIAL														
1.1	MATERIAL FOR BELLOWS AND ASSEMBLY PARTS (SHEET/ PIPE / PLATES/ ROD / BAR)	CHEMICAL COMPOSITION	MAJOR	CHEMICAL ANALYSIS	ONE PER HEAT		BHEL DRAWING /APPROVED DRAWING / TECH SPEC	MTC (or) CHECK TEST CERTIFICATE	√	P	V	-	CORELATED TC TO BE REVIEWED BY BHEL QC.	
		MECHANICAL PROPERTIES		UTS, YS & PERCENTAGE OF ELONGATION	ONE PER HEAT				√	P	V	-		
		DIMENSIONAL CHECK		MEASUREMENT	100 %	100 %			-	P	V	-	REFER NOTE NO:3	
		SURFACE EXAMINATION	MINOR	VISUAL	100 %	100 %			-	P	V	-		
2.0 WELDING														
2.1	1) WELDING PROCEDURE	CORRECTNESS OF PROCEDURE	CRITICAL	VERIFICATION OF WPS	100 %		IS 7307 / ASME SEC IX	IS 7307 / ASME SEC IX	IS 7307 / ASME SEC IX	√	P	V	-	REFER NOTE NO: 4
	2) PROCEDURE QUALIFICATION	WELD SOUNDNESS		DESTRUCTIVE TESTS	IS 7307 / ASME SEC IX					√	P	V	-	
	3) WELDER PERFORMANCE QUALIFICATION	WELDERS' PERFORMANCE		DESTRUCTIVE TESTS / NDE	IS 7310 / ASME SEC IX					IS 7310 / ASME SEC IX	IS 7310 / ASME SEC IX	IS 7310 / ASME SEC IX	√	

	BHEL (PEM), NOIDA	LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** TPI: THIRD PARTY INSPECTION M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER(BHEL)/TPI T: CUSTOMER/CUSTOMER CONSULTANT P: PERFORM W: WITNESS & V: VERIFICATION. AS APPROPRIATE	DOC. NO.:		REV..... CAT.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER					
SIGNATURE			REVIEWED BY	APPROVED BY	APPROVAL SEAL	

	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN				PROJECT : 1X800 MW NORTH CHENNAI STPP			
						CUSTOMER : TANGEDCO			
		ITEM : ME BELLWS (UPTO 2000 NB) SUB-SYSTEM: POWER CYCLE PIPING		QP NO. PE-QP-423-100-M021 REV.NO.: 00 DATE: 07/02/2017 PAGE: 2.... OF...5.		JOB NO. : 423			
						SECTION : II			

SL No	COMPONENT & OPERATIONS	CHARACTERIST -ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT #	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D*	**			
					M	C / N					M	C	-	
2.2	BUTT / GROOVE WELDS													
	1) BELLOWS AND PLATE FORMED PIPES	FITUP,SIZE OF WELD	MAJOR	VISUAL AND MEASUREMENT	100 %	-	APPD DRG / ASME SEC VIII – DIVISION 1	ASME SEC VIII – DIVISION 1	INTERNAL INSPECTION REPORTS	-	P	-	-	REVIEW OF FILM BY BHEL
		SOUNDNESS OF WELD	CRITICAL	PT FOR BELLOW LONG SEAM BEFORE FORMING	100 %		ASTM E 165	NO SURFACE DEFECT	INTERNAL INSPECTION REPORTS	-	P	V	-	
				RT FOR BELLOW LONG SEAM BEFORE FORMING	100 %		ASME SEC V / APPD. DRG	ASME SEC VIII – DIVISION 1	RT REPORT	√	P	V	-	
				RT FOR PIPE LONG SEAM					RT REPORT	√	P	V	-	
	2) SEGMENTAL FLANGES	SURFACE DEFECTS OF WELDMENTS	MAJOR	PT	100 %	100 %	ASTM E 165	NO SURFACE DEFECT	INTERNAL INSPECTION REPORTS	√	P	V	-	
INTERNAL DEFECTS OF WELDMENTS		MAJOR	RT	100 %		ASME SEC V	ASME SEC VIII – DIVISION 1	RT REPORT	√	P	V	-	REVIEW OF FILM BY BHEL	
i) FOR THICKNESS 40 MM & BELOW								UT	ASTM A388 &A435	ASTM A388 &A435	UT REPORT	√		P
		ii) FOR THICKNESS ABOVE 40 MM												
2.3	FILLET WELDS	SOUNDNESS OF WELDMENTS	MAJOR	PT	100 %		ASME SEC V	ASME SEC VIII – DIVISION 1	INTERNAL INSPECTION REPORTS	√	P	V	-	

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MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER					
SIGNATURE			REVIEWED BY	APPROVED BY	APPROVAL SEAL	

	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT : 1X800 MW NORTH CHENNAI STPP		
				CUSTOMER : TANGEDCO		
		ITEM : ME BELLWS (UPTO 2000 NB) SUB-SYSTEM: POWER CYCLE PIPING		QP NO. PE-QP-423-100-M021 REV.NO.: 00 DATE: 07/02/2017 PAGE: 3.... OF...5.		JOB NO. : 423
				SECTION : II		

SL No	COMPONENT & OPERATIONS	CHARACTERIST -ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT #	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
1	2	3	4	5	6	7	8	9	**				
					M C / N				D*	M	C		
3.0 INSPECTION & TESTS													
3.1	BELLWS CONVOLUTIONS	WORKMANSHIP	MAJOR	VISUAL	100 %	APPD. DRG		INTERNAL INSPECTION REPORTS	√	P	W	-	
		DIMENSIONS		MEASUREMENT					√	P	W	-	
		SURFACE DEFECTS (INSIDE & OUTSIDE OF LONG SEAM)		PT		ASTM E 165	NO SURFACE DEFECT		√	P	W	-	
		THINNING		MOCK UP PIECE (or) UT	ONE / TYPE	EJMA / TECH. SPEC	NOT TO EXCEED 15% OF ACTUAL RAW MATERIAL THICKNESS	INTERNAL INSPECTION REPORTS	√	P	W	-	REFER NOTE NO: 6
3.2	GIMBAL RING, HINGE PLATE, FLANGE, SHROUD,SLEEVE, PIN,TIE ROD,WASHER & NUTS	WORKMANSHIP & DIMENSIONS	MAJOR	VISUAL & MEASUREMENT	100 %	APPD. DRG		INTERNAL INSPECTION REPORTS	-	P	V	-	
3.3	SEGMENTAL FLANGE	STRESS RELIEVING	MAJOR	REVIEW OF HT CHART	100 %	ASME SEC VIII		SR CHART	√	P	V	-	
3.4	ROUTINE TESTS	1) LEAK TIGHTNESS	CRITICAL	1) VACUUM TEST	100 %	1) 50 mm Hg (A)	NO LEAKAGE OR PERMANENT DEFORMATION	TEST REPORTS	√	P	W	-	
				2)HYDROSTATIC PR. TEST		1) APPD. DRG / 1.5 TIMES OF DESIGN PRESSURE			√	P	W	-	
		2) DEFLECTION	CRITICAL	DEFLECTION TESTS	100 %	EJMA / TECH. SPEC / APPD. DRG	EJMA / TECH. SPEC / APPD. DRG	TEST REPORTS	√	P	W	-	

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MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER					
SIGNATURE			REVIEWED BY	APPROVED BY	APPROVAL SEAL	

	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT : 1X800 MW NORTH CHENNAI STPP		
				CUSTOMER : TANGEDCO		
		ITEM : ME BELLWS (UPTO 2000 NB) SUB-SYSTEM: POWER CYCLE PIPING		QP NO. PE-QP-423-100-M021 REV.NO.: 00 DATE: 07/02/2017 PAGE: 4.... OF...5.		JOB NO. : 423
				SECTION : II		

SL No	COMPONENT & OPERATIONS	CHARACTERIST -ICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT #	ACCEPTANC E NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D *	**			
					M	C / N					M	C	-	
	ROUTINE TESTS	4) SPRING RATE (ONLY AXIAL)	CRITICAL	STIFFNESS TEST	ONE / TYPE		EJMA / TECH. SPEC/APPROVED PROCEDURE	EJMA / TECH. SPEC/APPROVED PROCEDURE	SPRING RATE CURVES REPORT	√	P	W	-	BELLOWS UNDER NORMAL CONDITION DEFLECTED TO THE VALUE AS SPECIFIED IN TECH SPEC./APPD. DRAWINGS REFER NOTE NO. 6
		5) CLEANLINESS	MAJOR	VISUAL	100 %	100 %	APPD. DRG	APPD. DRG	INTERNAL INSPECTION REPORTS	√	P	V	-	
		6) PAINT THICKNESS		MEASUREMENT						√	P	V	-	
		7)WORKMANSHIP		VISUAL						√	P	V	-	
		8) MARKING		VISUAL						√	P	V	-	
3.5	TYPE TEST	1) CYCLE LIFE (10000 CYCLES), SQUIRM TEST, YIELD & RUPTURE	CRITICAL	DESTRUCTIVE TEST	REFER NOTE NO:1		BHEL/CUSTOMER APPD. TEST PROCEDURES / DATA SHEETS / DRGS	BHEL/CUSTO MERAPPD. TEST PROCEDURES / DATA SHEETS / DRGS	TEST REPORTS	√	P	W	-	REFER NOTE NO: 1 & 5
3.6	ASSEMBLY	WORKMANSHIP & DIMENSIONS	MAJOR	VISUAL & MEASUREMENT	100 %	100 %	APPD. DRGS	APPD. DRGS	INTERNAL INSPECTION REPORTS	√	P	V	-	
4.0	PACKING	SOUNDNESS OF PACKING		VISUAL	100 %	100 %	TECH. SPEC	TECH. SPEC	INTERNAL INSPECTION REPORTS	√	P	V	-	PHOTOGRAPHS OF BELLOWS AFTER PACKING TO BE VERIFIED BY BHEL ENGGRING BEFORE ISSUING MDCC

	BHEL (PEM), NOIDA	LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** TPI: THIRD PARTY INSPECTION M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER(BHEL)/TPI T: CUSTOMER/CUSTOMER CONSULTANT P: PERFORM W: WITNESS & V: VERIFICATION. AS APPROPRIATE	DOC. NO.:		REV..... CAT.....	
MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER					
SIGNATURE			REVIEWED BY	APPROVED BY	APPROVAL SEAL	

	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN		PROJECT : 1X800 MW NORTH CHENNAI STPP
		ITEM : ME BELLWS (UPTO 2000 NB) SUB-SYSTEM: POWER CYCLE PIPING	QP NO. PE-QP-423-100-M021 REV.NO.: 00 DATE: 07/02/2017 PAGE: 5.... OF...5.	CUSTOMER : TANGEDCO
				JOB NO. : 423
				SECTION : II

NOTES:-

1. a) Life cycle test shall be carried out on one bellow of each group as mentioned in the technical specification.
b) Squirm & Yield – Rupture test shall also be carried out on one bellow (other than the bellow on which life cycle test has been carried out of each group as mentioned in the technical specification).
2. Test reports for final performance tests, material test certificates and stage inspection records as indicted in the quality plan shall be submitted to BHEL for their scrutiny and approval.
3. In case co related test certificates are not available, check testing shall be carried out by vendor at approved lab (NABL).
4. For qualified welders, WPS & PQR shall be reviewed by BHEL. In case welder is not qualified, witnessing will be done by main supplier i.e. BHEL.
5. If type tests as mentioned at cl.3.5 and note1 above, have been successfully done for earlier BHEL projects for the bellows of the same type in a group, then only TCs of same shall be reviewed and no type test needs to be carried out. But TC's of same type of bellows in specified group shall not be older than 5 years from project bid opening date which is 29th January 2016. However, type test clearance shall be taken from BHEL prior to offering to routine test. In case the type test is to be done, type test procedure approval shall be taken from BHEL.
6. Bellows of the same type would mean those having the same diameter, height, pitch, convolution profile & ply thickness.
7. All materials of construction shall be as per approved drawings / data sheet.

MANUFACTURER/ SUB-SUPPLIER	BHEL (PEM), NOIDA	LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** TPI: THIRD PARTY INSPECTION M: MANUFACTURER/SUB-SUPPLIER C: MAIN SUPPLIER(BHEL)/TPI T: CUSTOMER/CUSTOMER CONSULTANT P: PERFORM W: WITNESS & V: VERIFICATION. AS APPROPRIATE	DOC. NO.: REV..... CAT.....		
	MAIN-SUPPLIER				
	SIGNATURE		REVIEWED BY	APPROVED BY	APPROVAL SEAL

	COMPLIANCE SHEET BALL VALVES		SPECIFICATION NO. PE-TS-423-100-M004	
			SECTION : II	
	REV. NO.: 0		DATE: 10.02.2017	
	Sheet 1 of 1			

I hereby comply/not comply (*) to all the requirements of this technical specification in totality.

* In case the bidder does not comply to the technical specification, the deviations shall be explicitly listed in the technical deviation sheet of GCC. Deviations listed in technical deviation sheet shall only be considered.

Name of Bidder / Authorized Representative :-

Designation :-

Signature :-

Company Seal :-

Date :-
