

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 01A
SEC. REV. NO.: 02
SEC REV DATE : 17.01.98
PAGE : 1 OF 1

01A. RECORD OF REVISION :

Date	Revision No.	Section Revised		
		Modified	Added	Deleted
30.10.93	00	-	-	-
11.06.94	01	3,4,5,6,7	1,2,8	.
17.01.98	02	2,4,5,6,7	01A	8
31.07.98	03	4,6	-	-

PREPARED BY

SECTIONAL INCHARGE (CERALIN)

APPROVED BY

FUNCTIONAL CHIEF (E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

DOCUMENT NO. : E&D:306
SECTION NO. : 01
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 1 OF 1

CERALIN DESIGN DOCUMENT

1. Table Of Contents

Section No.	Description	Sec. Rev. No.	Section Rev.Date	No. of Pages
01	Table of contents	03	31.07.98	1
01A	Record of Revision	03	31.07.98	1
02	Distribution list	01	17.01.98	1
03	Scope & Purpose	01	11.06.94	1
04	Ceralin Casing Design	03	31.07.98	8
05	List Of Instruments	02	17.01.98	1
06	Layout Details	03	31.07.98	8
07	Inspection Procedure For Pipe Casing	02	17.01.98	2

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE(CERALIN)

FUNCTIONAL CHIEF(E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

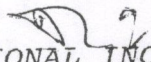
CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 02
SEC. REV. NO.: 01
SEC REV DATE : 17.01.98
PAGE : 1 OF 1

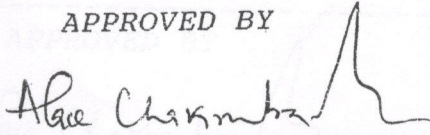
2.0 DISTRIBUTION LIST :

Controlled Copy No.	Copy Distributed To
Master Copy	Functional Chief (E&D, TEC)
01	Management Representative
02	Functional Chief (MMX)
03	Section I/c Product Design (Ceralin)
04	Area Incharge Recieving & Final Inspection & Testing
05	Functional Chief (ICD)
06	Functional Chief (PPC)

PREPARED BY


SECTIONAL INCHARGE (CERALIN)

APPROVED BY


FUNCTIONAL CHIEF (E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

DOCUMENT NO. : E&D:306
SECTION NO. : 03
SEC. REV. NO.: 01
SEC REV DATE : 11.06.94
PAGE : 1 OF 1

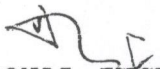
CERALIN DESIGN DOCUMENT

3.0 SUBJECT & PURPOSE :

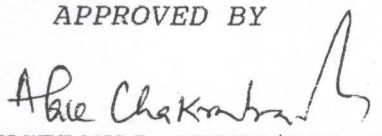
SUBJECT : Design & Inspection procedures for the
manufacture of fabricated casings &
Ceralin tiles for PF bends.

PURPOSE : To outline procedure for design of ceralin
tiles & to provide information & guidance to
various manufacturers of MS casings with end
rings.

PREPARED BY


SECTIONAL INCHARGE (CERALIN)

APPROVED BY


FUNCTIONAL CHIEF (E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

DOCUMENT NO. : E&D:306
SECTION NO. : 04
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 1 OF 8

CERALIN DESIGN DOCUMENT

4.0 CERALIN CASING DESIGN :

- OBJECTIVE : This procedure essentially provides information for the process of manufacture of mitred segments, stipulates conditions for acceptance of tack/full welded segments in the form of casings on Layout & details the method for tile design.
- SCOPE OF SUPPLY : 1) The casing size, various dimensions connection details, and quality shall be as per the latest drawings to be enclosed alongwith the detailed purchase order.
2) Contractual obligations, if any, other than those specified in the procedure will be mutually agreed upon.
- APPLICABLE CODES : All welders have to be qualified as per welding procedure E&D :330 prior to taking up welding on jobs.
- MATERIAL : 1) The material used for the mitred segments shall conform to IS-2062 Gr.A
2) The material for ceralin tile should be as per Technology Document No. E&D : 308
- CASINGS :
a) ROLLING : The following checks to be made prior to OF SHELLS rolling.
i) Thickness of plate conforming to drawing dimensions. Tolerances on thickness will be as per IS-1852 (1985) Cl.7.3
ii) Visual defects on plates such as dents and burrs to be removed suitably.
iii) Edges must be straight and if necessary to be ground. The plates of appropriate size to be chosen such that

PREPARED BY

SECTIONAL INCHARGE (CERALIN)

APPROVED BY

FUNCTIONAL CHIEF (E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 04
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 2 OF 8

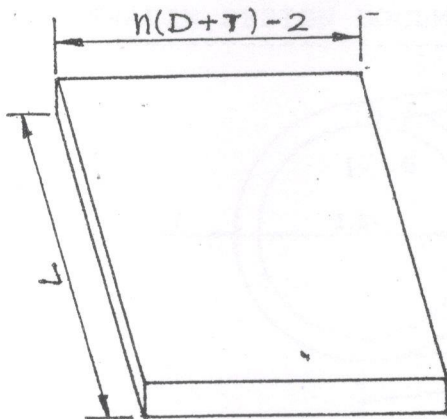


FIG - 1

(All dimensions in mm)

The desired rolling diameter is obtained and Maximum segments can be cut to minimize wastage of material.

The dimension of plates may be $(D+T) - 2\text{mm} \times L\text{mm} \times T\text{mm}$ where D = Internal dia, T = Thickness of plate, L = Length suitably chosen. $(D+T)$ = Mean diameter.

The diagonals to be checked for equality and if necessary the edges to be gas cut and ground to the desired dimensions.

- Edge preparations shown in Fig-2 to be carried out by suitable grinding machines.

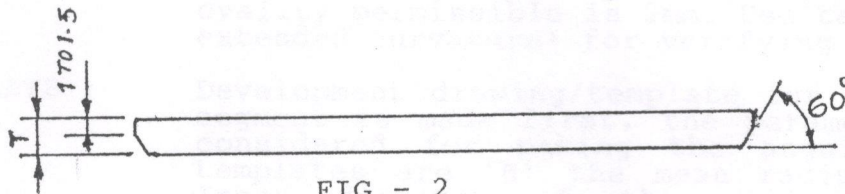


FIG - 2

Rolling to desired dimensions in the manner shown in Fig-3

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE (CERALIN)

FUNCTIONAL CHIEF (E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 04
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 3 OF 8

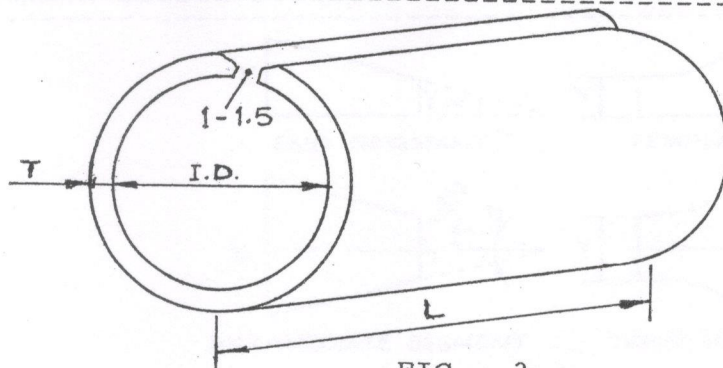


FIG - 3

At this stage the circumference compatibility with the corresponding length of development template of segment profile is to be checked and difference; if any, to be corrected to match with the template.

Welding is carried out as per welding procedure E & D : 330. On completion of welding, the pipe is to be re-rolled in order to correct for ovality and the maximum ovality permissible is 2mm. Use templates (extended curvature) for verifying ovality.

b) TEMPLATE :

Development drawing/template for the type of segment is made first. the parameters to be considered for making the angular segment templates are 'R' the mean radius of bend. Inner diameter of the casing (ID) the corresponding angle for the segment and the pipe thickness (T). The possible types of segments can be categorized under any of the following shown in Fig. 4.

For angles α , $\beta/2$, γ & ϕ the corresponding values of X & Y are calculated as

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE (CERALIN)

FUNCTIONAL CHIEF (E&D & TEC)

PHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 04
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 4 OF 8

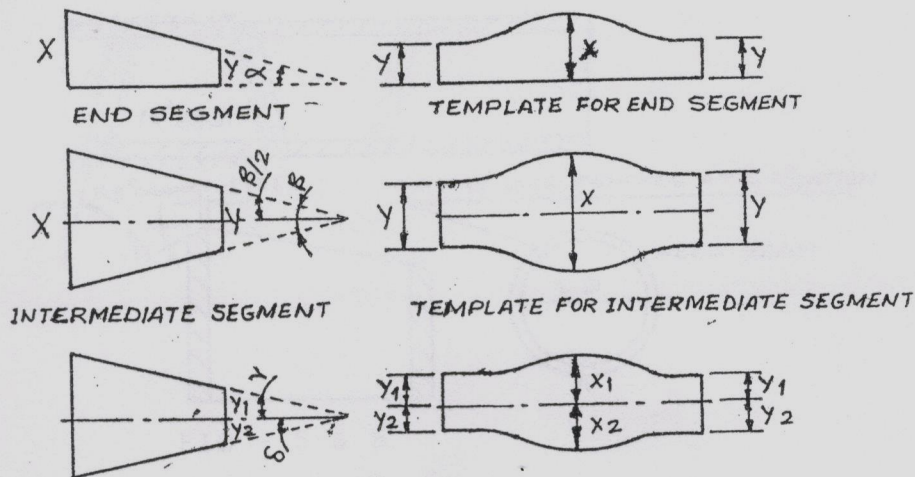


FIG - 4

$$X = \{(R+OD/2) \tan \alpha\} - 1$$

$$= \{2(R+OD/2) \tan \beta/2\} - 2$$

$$= (R+OD/2) \tan \gamma + \tan \delta - 2$$

$$X = x_1 + x_2 = \{(R+OD/2) \tan \gamma + (R+OD/2) \tan \delta\} - 2$$

$$Y = \{(R-OD/2-2) \tan \alpha\} - 1$$

$$= \{2(R-OD/2-2) \tan \beta/2\} - 2$$

$$= \{(R-OD/2-2) (\tan \gamma + \tan \delta)\} - 2$$

$$Y = Y_1 + Y_2$$

$$= \{(R-OD/2-2) \tan \gamma + (R-OD/2-2) \tan \delta\} - 2$$

The dimensions broadly shown are then transferred into a thin metal sheet of thickness <1mm or sufficiently thick brown paper for making the working template. They can be suitably identified by inscribing the angle, the radius of bend and the corresponding OD.

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE (CERALIN)

FUNCTIONAL CHIEF (E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 04
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 5 OF 8

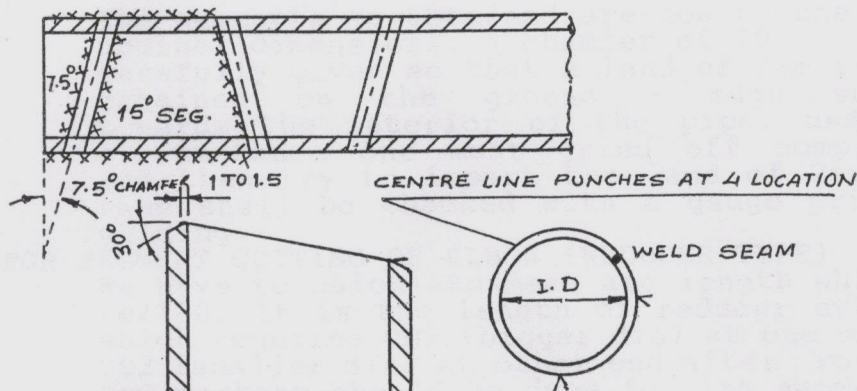


FIG - 5 & 6

c) i) CUTTING OF SEGMENT AND EDGE PREPARATION

The template cut to the desired dimensions is now wrapped around the pipe, care should be taken to align the pipe such that the longitudinal seam location is not at any of the four location as shown in Fig.5 and the segment boundaries are traced out with the help of a scribe and punch mark, made at regular intervals (about 1/2" to 1"). This line makes the nominal dimension desired. The template is now laterally shifted by 2mm and one more line is scribed parallel to the previous punchy marked line. This line is for gas cutting of segment and is shown in Fig.6.

After cutting of the segments the edges are to be ground to the nominal dimensions as per the punch-marked nominal dimensions boundary line.

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE (CERALIN)

FUNCTIONAL CHIEF (E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 04
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 6 OF 8

The segments so obtained are now to the nominal dimensions. a chamfer of 30° is carefully given so that a land of 2mm is retained on the ground - edge surface towards the interior of the pipe, under no circumstance one must grind off completely and then try to impart the land of 2mm. The same shall be checked with a gauge prior to welding.

- c)ii)PROCEDURE FOR SEGMENT CUTTING OF ELBOW (REDUCER TYPE)
We have to calculate mean arc length which is $\frac{r\theta}{180}$. It is the length of reducer cylinder which requires OD1 (bigger dia) at one end and OD2 (smaller dia) at other end after rolling. Now marking should be done for 1st segment at 7.5° and similarly for 2nd, 3rd to 7th segment. The cutting, edge preparation and welding should be done as per normal procedure.

- d). WELDING OF SEGMENTS/END RINGS
welding in general shall be in accordance with welding procedure E & D : 330 and D.P. Test on weld surfaces in accordance with E & D : 331 and the welding rods used shall be chosen only from the list of BHEL approved welding rod brands as specified in E&D :330.

Welding of segments to be carried out on a layout drawn on a levelled plate having appropriate end fixture. The end fixtures shall be in the form of rugged square (or rectangular/plates secured/welded rigidly) to form a right angle as shown in Fig.7.

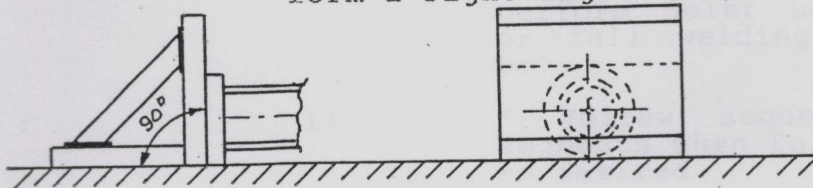


FIG - 7

PREPARED BY

SECTIONAL INCHARGE (CERALIN)

APPROVED BY

FUNCTIONAL CHIEF (E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 04
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 7 OF 8

On the outer side of the bend layout, suitable angle bars are welded at 90 to the levelled plate so that they form guides for proper positioning of the segments and also prevent distortion during welding of two segments.

To obtain a fully welded bend casings the following steps must be followed.

- Step 1 : Draw the appropriate layout as shown in the sheets from 11-14
- Step 2 : Align the end fixture at the two bends of the layout and position them rigidly
- Step 3 : Weld the two end segments onto the end rings taking care for concentricity of casing and end rings and for face perpendicularity, with respect to pipe axis.
- Step 4 : Now position these end segments integral with end rings on layout and clamp them by end rings to the end fixtures.
- Step 5 : Proceed with aligning other intermediate segments simultaneously from both ends to minimize errors in assembly and perform joint welding * (by tack or full welding as the case may be).

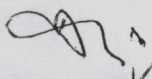
NOTE :

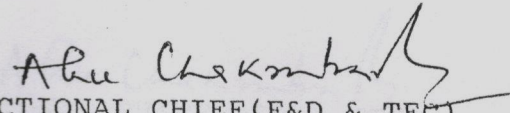
i)

* Follow sequential welding of segments when fully welded segments as desired.

PREPARED BY

APPROVED BY


SECTIONAL INCHARGE(CERALIN)


FUNCTIONAL CHIEF(E&D & TFC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 04
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 8 OF 8

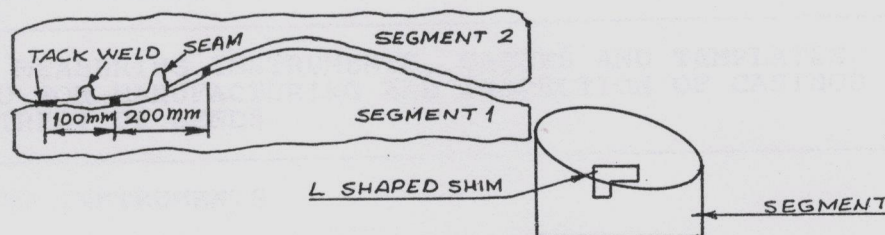


FIG - 8

- ii) For tack-welded segments the tacks to be given should not be more than 20 mm and spaced at 200mm. And care should be taken not to tack weld at the marking of aligning center punch marks.
- iii) For tack welded segments suitable shims shall be placed to maintain the gap and configuration. as shown in Fig.8
- iv) Suitable corrective measures in respect of fixture rigidity and welding process may be warranted from dimensional inspection on layout of the finished job after adequate ageing (i.e. one day) and the same shall accordingly be carried out by the fabricator so that post operational deviations in dimension are within the permissible limits (as per casing drawing).

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE (CERALIN)

FUNCTIONAL CHIEF (E&D & TECT)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

DOCUMENT NO. : E&D:306
SECTION NO. : 05
SEC. REV. NO.: 02
SEC REV DATE : 17.01.98
PAGE : 1 OF 1

CERALIN DESIGN DOCUMENT

5.0 LIST OF INSTRUMENTS :

LIST OF MEASURING INSTRUMENTS, GAUGES AND TEMPLATES
REQUIRED FOR MANUFACTURING AND INSPECTION OF CASINGS
FOR (MITRED) PF BENDS

1.0 MEASURING INSTRUMENTS

- Spring divider and spring calipers
- Bar compass
- Measuring tapes (calibrated) 3-5 meters
- Measuring scales(metallic) upto 1 meter
- Vernier caliper to check ID/OD/Thickness of flanges
- Combination square set 1 no.

2.0 GAUGES

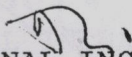
- To check chamfering and weld dimensions
- Angle templates
- Profile templates for checking ovality

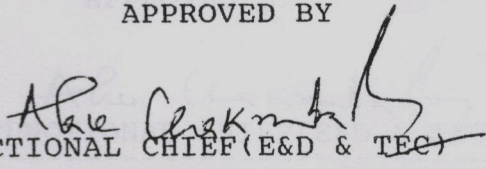
3.0 OTHER AIDS

- Straight edge (upto 3 meters length) 1 no.
- Precision squares (1 meter height) 2 nos.
- Spirit level (600mm length vertical and horizontal) 2 nos.
- Plumb line.
- Filler gauge

PREPARED BY

APPROVED BY


SECTIONAL INCHARGE(CERALIN)


FUNCTIONAL CHIEF(E&D & TEC)

INDIARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

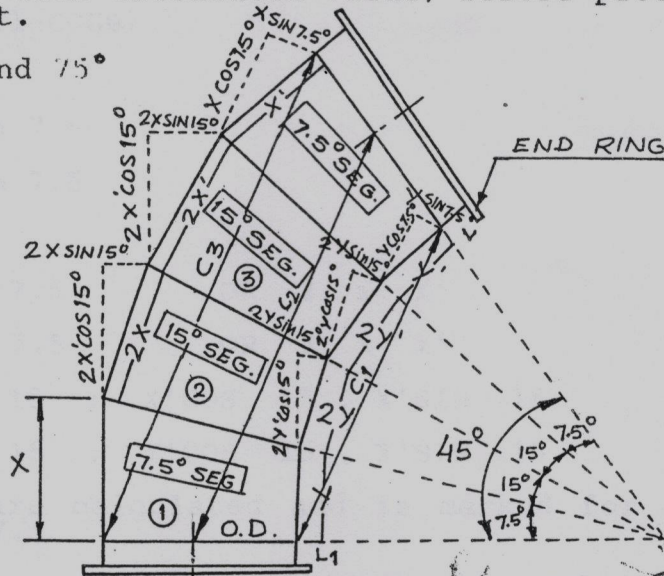
DOCUMENT NO. : E&D:306
SECTION NO. : 06
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 1 OF 8

6. LAYOUT DETAILS :

The following points shall be followed for drawing the layout and use in manufacture and inspection of the casings.

- Check the Bed level before drawing the layout.
- Use sharp punch for punching the points.
- Use coloured paint for marking the Center punch marks by circling it.
- Never use scales or measuring tapes for marking.
- Use vernier and divider for drawing the layout.
- The points, shall be clearly punched and ensure that the dimensions tallied with calculated value, before proceeding to the next segment.

LAYOUT FOR 30°, 45°, 60° and 75°



R= Mean radius of the Bend
OD= Outside diameter of the casing.

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE (CERALIN)

FUNCTIONAL CHIEF (E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 06
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 2 OF 8

The chord C1, C2, C3 is calculated using the formula

$C1 = a + b - 2ab \cos \theta$ where $\theta = 30, 45, 60, 75$
Here $a=b=R$

$$C1 = a + a - 2a \cos \theta \\ = 2a (1 - \cos \theta)$$

$$C1 = 2(R - OD/2) (1 - \cos \theta)$$

$$C1 = 2(R - OD/2) (1 - \cos \theta)$$

$$C2 = 2R (1 - \cos \theta)$$

$$C3 = 2(R + OD/2) (1 - \cos \theta)$$

FOR 7.5 SEGMENT :

$$X' = (R + OD/2) \tan 7.5$$

$$Y' = (R - OD/2) \tan 7.5$$

FOR 15 SEGMENT :

$$2X' = 2(R + OD/2) \tan 7.5 \quad \text{OR} \quad 2 \times X'$$

$$2Y' = 2(R - OD/2) \tan 7.5 \quad \text{OR} \quad 2 \times Y'$$

$$2X' \cos 15, 2X' \sin 15 ; X' \cos 15, X' \sin 15$$

$$2Y' \cos 15, 2Y' \sin 15 ; Y' \cos 15, Y' \sin 15$$

The above values are calculated and is marked for segment Nos 1,2,3,4,5 and 7.

The chord lengths C1,C2.C3. is cross-checked before proceeding for assembly of segments on the layout.

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE(CERALIN)

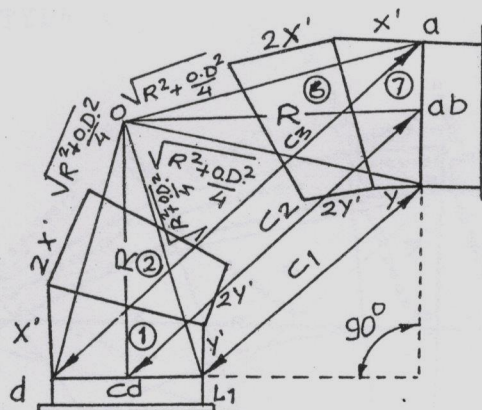
FUNCTIONAL CHIEF(E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 06
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 3 OF 8

FOR 90 LAYOUT:



The following steps shall be followed for drawing.

Mark the Point 'O' suitably on the levelled bed.

Draw a line from the point 'O' "O to ab" = R and drop a perpendicular at 'O' and bisect "O to cd = R and cross check for 90 using 3,4,5 rule i.e. 3 + 4 = 5

Drop a perpendicular at 'ab' and mark 'ab to a' = OD/2 and 'ab to b' = OD/2, and check $oa = ob = \sqrt{R + (OD) / 4}$ Similarly, at 'cd': cd to c = OD/2 and

$$oc = od = \sqrt{R + (OD) / 4}$$

From the point cd, draw the segment No.1(7.5), and build up the segment No.2,3 (15) as shown in the figure.

From the point ab, draw the segment No.7(7.5), and build up the segment No.6,5 (15) as shown in the figure.

Join the points from segment No.3 and segment No.5 and check for the segment No.4 calculated values. If not tallying with the actual verify the points at segment No.1 2 3 4 5 6 & 7.

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE(CERALIN)

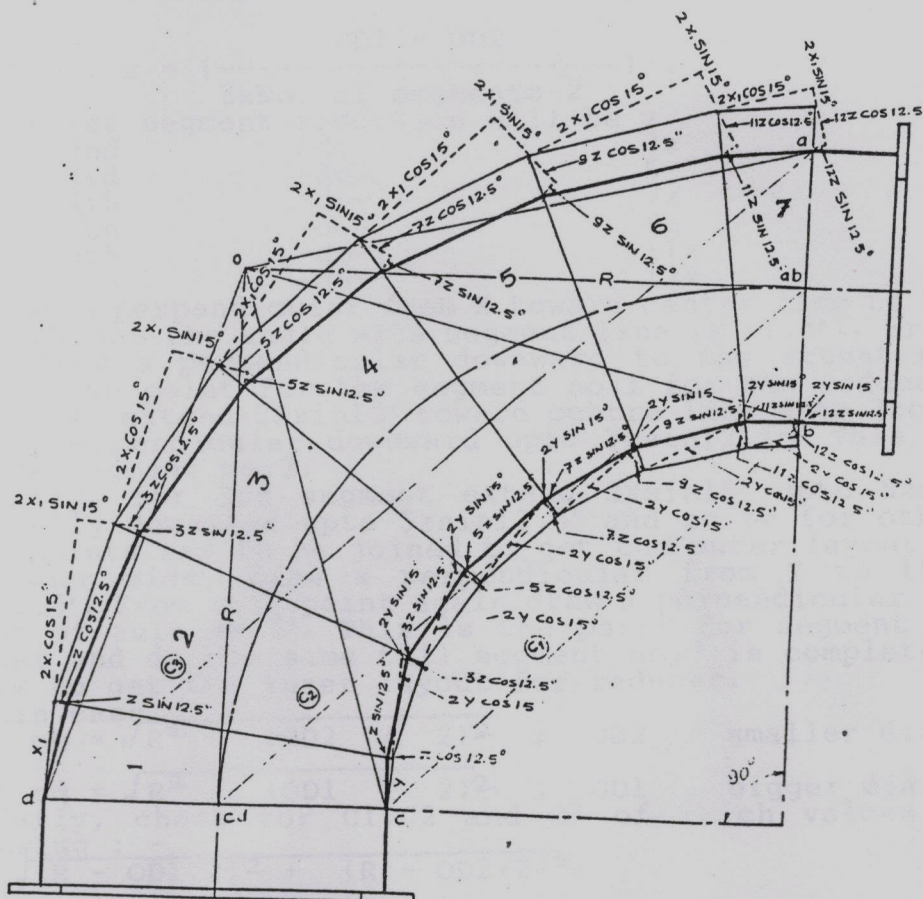
FUNCTIONAL CHIEF(E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 06
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 4 OF 8

FOR 90° LAYOUT (REDUCER TYPE):



PREPARED BY

SECTIONAL INCHARGE (CERALIN)

APPROVED BY

FUNCTIONAL CHIEF (E&D & TECH)

C-22
C-27

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

DOCUMENT NO. : E&D:306
SECTION NO. : 06
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 5 OF 8

CERALIN DESIGN DOCUMENT

Draw a layout for OD1 (bigger dia).

Segment wise reduction will be done by the following method.

$$\text{Reduction, } z = \frac{\text{OD1} - \text{OD2}}{2 \times \text{No. of segments} - 2} / 2$$

So, for 1st segment reduction will be z
2nd -do- 3z
3rd -do- 5z
4th -do- 7z
5th -do- 9z
6th -do- 11z
7th -do- 12z

Now draw a perpendicular from X toward centre line to the extent of $z \cos 12.5^\circ$ (as the angle with segment line is 12.5°). From that point again draw a perpendicular downward to the extent of $z \sin 12.5^\circ$. This is the point for the segment no.1 for the reducer. Similarly, extend $2X \sin 15^\circ$ toward centre line upto $3z \cos 12.5^\circ$, then drop a perpendicular downward upto $3z \sin 12.5^\circ$. This is the point for the segment no.2.

Similarly, for 3rd segment extend $2X \sin 15^\circ$ upto $5z \cos 12.5^\circ$. Then vertically downward upto $5z \sin 12.5^\circ$ and so on for other segments. These points are to be joined to get the outer layout for reducer. For inner side, draw a perpendicular from Y to the extent of $z \cos 12.5^\circ$. From that point again draw a perpendicular upward to the extent of $z \sin 12.5^\circ$. This is the point for segment no.1 for the reducer and do the same till segment no.7 is completed. Join the points to get the inner layout for reducer.

In this case,

$$oa = ob = \sqrt{R^2 + (\text{OD2} / 2)^2} ; \text{OD2} - \text{smaller dia}$$

$$oc = od = \sqrt{R^2 + (\text{OD1} / 2)^2} ; \text{OD1} - \text{bigger dia}$$

Similarly, check for C1, C2 and C3 of which values will be the following: -

$$C1 = \sqrt{(R - \text{OD1}/2)^2 + (R - \text{OD2}/2)^2}$$

$$C2 = \sqrt{2R^2}$$

$$C3 = \sqrt{(R + \text{OD1}/2)^2 + (R + \text{OD2}/2)^2}$$

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE (CERLIN)

FUNCTIONAL CHIEF (E&D & TECH)

221
C26

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

DOCUMENT NO. : E&D:306
SECTION NO. : 06
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 6 OF 8

CERALIN DESIGN DOCUMENT

FOR 20° LAYOUT:

FOR 5° SEGMENT:

$$C = (R+OD/2) \tan 5$$

$$D = (R-OD/2) \tan 5$$

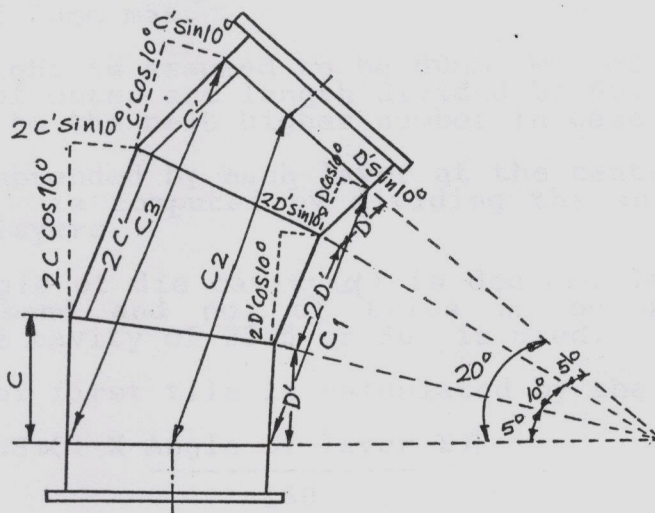
FOR 10° SEGMENT:

$$2C = 2(R+OD/2) \tan 5 \quad \text{OR } 2 \times C$$

$$2D = 2(R-OD/2) \tan 5 \quad \text{OR } 2 \times D$$

$$2C' \cos 10, 2C' \sin 10 ; C' \cos 10, C' \sin 10$$

$$2D' \cos 10, 2D' \sin 10 ; D' \cos 10, D' \sin 10$$



C1, C2, C3 are calculated as shown in sheet 12
For all other odd angles, approval of template and layout
calculations shall be obtained before manufacturing.

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE (CERALIN)

FUNCTIONAL CHIEF (E&D & TECH)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 06
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 7 OF 8

The design of ceralin tiles is made as per following procedure:

1. The various dimensions like radius (R) inside diameter (ID) tile thickness (t) & angle of bend (θ) are identified for the tender enquiry.
2. The outer arc length is completed within the following formula:

$$\text{Outer arc length} = (R + \frac{ID+t}{2}) \times \frac{2\pi\theta}{360}$$

This outer arc length is normally computed for tile thickness of 20mm max.

3. The tile height is assumed to be 60mm. No. of layer is taken as a ratio of outer arc length divided by 60. This is rounded off to the next higher number in case of fraction.
4. The angle subtended by each layer at the center of curvature of the bend is computed by dividing the angle of bend by the no. of layers.
5. Next the angle of die cavity (α) is decided depending on the radius of bend and no. of tiles to be used per layer normally die cavity of 22.5 or 30 is used.
6. The height of first tile is calculated by the formula:

$$(R + \frac{ID+t}{2} \cos \alpha) \times \frac{\text{Angle of layer} \times \pi}{180}$$

For the first tile height α is taken as 0 & for the subsequent heights the α is incremented by die cavity angle.

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE (CERALIN)

FUNCTIONAL CHIEF (E&D & TECH)

C-19
C-24

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

DOCUMENT NO. : E&D:306
SECTION NO. : 06
SEC. REV. NO.: 03
SEC REV DATE : 31.07.98
PAGE : 8 OF 8

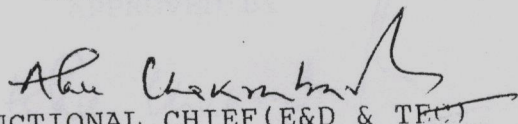
CERALIN DESIGN DOCUMENT

- 7.. For the height the taper is calculated by taking the difference of tile height and dividing it by 2. Then tapers should be rounded off and in general 3 or 4 Std. taper chosen.
8. These dimensions are used in marking top and bottom punches of Ceralin die.
9. Ceralin die is made as per drg. number.....
10. The casing design is made as per E&D : 306
11. The cement thickness is taken as 10mm.
12. The flanges are made as per customer requirement.
13. For safety in handing 3/4 Nos. lifting lugs are provided.

PREPARED BY

APPROVED BY


SECTIONAL INCHARGE(CERALIN)


FUNCTIONAL CHIEF(E&D & TECT)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 07
SEC. REV. NO.: 02
SEC REV DATE : 17.01.98
PAGE : 1 OF 2

7.0 INSPECTION PROCEDURE FOR PIPE CASING

1.0 layout is drawn on the levelled plates as per nominal dimensions .

2.0 The pipe is suitably positioned on this layout by packing plates at the bottom such that the center line is maintained uniformly. Refer section 05 of E&D : 306 for inspection aids.

3.0 Bends, & Elbows.

The radial and axial shifts at both the pipe ends are measured and recorded . The out of squareness and inner diameter at both ends are also measured.

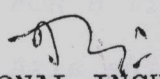
3.2 Straight pipes.

One end is matched squarely on the layout and measurement made at the other end.

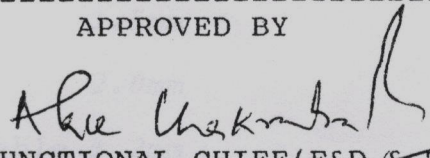
4.0 Acceptance criteria:

Acceptance of bends and elbows with radial shifts, axial shifts and out of squareness will be in accordance with the norms given in the table or as per drawing requirements for the fully welded casings/tack welded casings if specifically mentioned.

PREPARED BY


SECTIONAL INCHARGE (CERALIN)

APPROVED BY


FUNCTIONAL CHIEF (E&D & TEC)

BHARAT HEAVY ELECTRICALS LTD.
INSULATOR PLANT, JAGDISHPUR
SULTANPUR

CERALIN DESIGN DOCUMENT

DOCUMENT NO. : E&D:306
SECTION NO. : 07
SEC. REV. NO.: 02
SEC REV DATE : 17.01.98
PAGE : 2 OF 2

TABLE

4.1 FOR FULLY WELDED CASINGS :

	Bends/Elbows	Straight pipe
1. Radial shift	$\pm 5\text{mm}$	Not applicable
2. Axial shift	$\pm 5\text{mm}$	Not applicable
3. Out of squareness		
FOR C & A TYPE *	2.0mm	2.0mm
FOR B TYPE*	3.0mm	3.0mm
4. Axis shift	Not applicable $\pm 2\text{mm}$	

4.2 FOR TACK/FULLY WELDED SEGMENTED CASINGS :

	Bends/Elbows	Straight pipe
1. Radial shift	$\pm 3\text{mm}$	Not applicable
2. Axial shift	$\pm 5\text{mm}$	Not applicable
3. Out of squareness		
FOR C & A TYPE *	1.5mm	1.5mm
FOR B TYPE*	2.0mm	2.0mm
4. Axis shift	Not applicable $\pm 2\text{mm}$	

* These 'Types' refer to the terminal end rings.

PREPARED BY

APPROVED BY

SECTIONAL INCHARGE (CERALIN)

FUNCTIONAL CHIEF (E&D & TEC)