

BHEL		SQP:NP:01/04	Page 1 of 17
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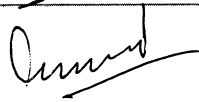

BHARAT HEAVY ELECTRICALS LIMITED

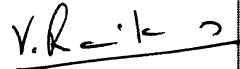
TIRUCHIRAPPALI 620 014 INDIA

STANDARD QUALITY PLAN FOR SQP:NP:01/04

DUCTS & HOPPERS

Page 1 of 17

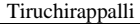
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QUALITY CONTROL (AMITROY)	
QUALITY ASSURANCE (BIKRAMADITYA ROY)	

REV.NO.	DATE	APPROVED BY	SIGNATURE
01	15. 07.96	Sr.Manager/ Q A	V.Ragavendran
02		DGM/QA	C.R.RAJU
03	1.12.2005	DGM/QA	C.R.RAJU
04	18.07. 2011	AGM/QA	 V.Ravikumar

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Rev. No.	Clause No.	Details of revision
00	--	This document consolidates all requirements of various previous SQPs.
01	--	Totally revised incorporating all amendments issued and latest TDC numbers.
02	--	SIP nos updated.
	3.2 in Note 3	Tolerances for depth of section revised in line with AWS D1.1 (2002 edition)
	4.1.3 & 4.1.4 in Note 4	Modified to incorporate Amendment A3 to rev.01
	4.2.4	deleted under Fillet welds and included under Butt welds as 4.1.7
	4.3.4 in Note 4	Added to incorporate Amendment A4 to rev.01
	5.1 (Vi) in Note 5	Added to incorporate Amendment A2 to rev.01
	5.2.3 in Note 5	Out of straightness revised in line with AWS D1.1 (2002 edition)
	5.2.5	Revised in line with AWS D1.1
	P5 in Note 6	Modified to incorporate Amendment A1 to Rev 01
03	2.2	Additional inputs added.
	3.1	Additional character added in trial assy.
	Note cl. No.1	New norms added for spliced joints with extra clarity.
	Note cl. No 2.5,3.1,	
	3.2, 3.3	Extra input added.
	Note cl. No.4.0,4.1.4	Inspection tolerance for
	4.1.7	Ducts/Hopper/Transition/Flanges added during trial assy.
	Note cl. No.5	Pre-qualification for welding.
04	1.0	S-TEN1 Material added.
	Note:3	Trial assy for duct assy classified based on the Note sheet approved by ED Applicable for OS, Non-NTPC). For ACF vendors, it will be reviewed and extended.




STANDARD QUALITY PLAN

BOILER DUCTS & HOPPERS

QP NO. : SQP:NP: 01 REV.: 04
DATE : 18/07/2011
PAGE : 3 of 17

SL. NO.	COMPONENT AND OPERATION	CHARECTERISTICS	CL.	TYPE OF CHECK	Quantum of Check	REF.DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD		Agency **			REMARKS
								D	M	TPI	C	

[illegible]

 Tiruchirappalli		QUALITY ASSURANCE		STANDARD QUALITY PLAN				QP NO. : SQP:NP: 01 REV.: 04			
				BOILER DUCTS & HOPPERS				DATE : 18/07/2011 PAGE : 4 of 17			
SL. NO.	COMPONENT AND OPERATION	CHARECTERISTICS	CL	TYPE OF CHECK	Quantum of Check	REF.DOCUMENT/ ACCEPTANCE STD.	TYPE OF RECORD	Agency **			REMARKS
							D	M	TPI	C	

2.2	Welding qualifications	New qualification OR Pre qualification Procedure (as below)*	Review of Documents	100%	SIP:NP:07	R		QC	V		Before commencement of elding,
WPS document is to be prepared by contractor (on form E-1 (Front) as per Annexe E of AWS D1.1 M: 2004 Edition Page 334 as applicable for the welding process to be used) and submitted to A I A / QC (BHEL) for review & approval .. (See Notes - 5 for guidance on welding parameters)											
2.3	Weld Inspection	Personnel	Review of Documents	100%	SIP:NP:07	R		QC	V		
		Weld size & shape Weld quality	Visual LPI	100% 10% #	Drawing / SIP:NP:06 BHE:NDT:PB:PT1	- R		QC QC	V		# 100% for SS
3.0	FINAL INSPECTION	Leak test *	Kerosene leak test	100%	SIP:NP:05	R		QC			*For single side welds
3.1	Trial Assembly	Orientation , Dimensions Match marks	Measurement	100%	Drawings Note - 3	R		QC			
3.2	Painting and Preservation	Paint finish coat thickness	Visual Measurement	-- Random	SIP:PP:22	-		QC			
3.3	Identification	WO No., DU No. Match marks Flow direction for aerofoil	Visual		Drawings Fig: 1,2,3 (as applicable)	-		QC			

NOTES

- 1 The following are the norms applicable for splicing through additional joints:. Any deviation from the same shall have the approval of Engineering.

For **stiffeners** up to 4 Meter length : Not permitted.

For stiffeners above 4 Meter length, permitted within 1/5th and 1/3rd of length from ends.

Duct walls : As below

<u>Area in Square meters:</u>	<u>Maximum No of joints.</u>
Up to and including 2.....	NIL
Above 2 upto and including 5.....	2
Above 5 upto and including 10.....	4
Above 10 upto and including 15.....	6
Above 15 upto and including 20.....	8
Above 20 upto and including 25.....	10
Above 25.....	15

- Welds joints shall be back gouged and 100% LPI tested before welding from second side.
- Welds joint to stiffener distance shall be 50 mm and above .
- Weld joints shall be ground flush at stiffener seating locations.
- Joints parallel to the bend shall be at least 100 mm away from the bend.

- 2 For aerofoil of flow meter no vertical joints are permitted in the inlet region (leading edge of flow meter).Joint can be permitted beyond 250mm from tapping points on downstream side. Refer figure 1.

- 2.1 If required horizontal joints, shall be permitted beyond 250mm from the tapping points.

- 2.2 The weld reinforcement on outside surface of aerofoil shall be ground flush so as to avoid any resistance to flow.

- 2.3 For despatchable rectangular / square wall of size 2M x 2M or smaller, smallest dimension of any piece shall be 300mm. For despatchable rectangular /square wall of size greater than 2M x2M, the smallest dimension shall be 500 mm. However in case of transition, hopper and chimney walls, for triangular and trapezium shapes the smallest dimension can be Zero.

- 2.4 "T" joints can also be permitted in layout / cutting plan.

- 2.5 Butt welds on divider plate & guide vanes and aerofoil shall be free from abrupt projection. Weld reinforcement upto 2 mm is permitted.

3.0 Trial Assembly

- 3.1 To ensure correct matching during site erection/assembly, Trial assembly will be carried out at vendor works as below

- 3.2** .Trial Assembly is waived off for the following duct shapes.

- a) Straight duct with out internal Truss
- b) Straight duct with internal Truss.

- c) Elbow duct with out guide vane.
- d) Elbow duct with out internal truss.
- e) T-Duct with equal opening
- f) T-Duct with unequal openings.
- g) Bend duct with out truss.
- h) Transition duct on one plane only.

Dimension check on layout can be ensured a close tolerance Of 2mm.

3.3; Trial assembly of Elbow duct, Tee bend & Y- ducts with Guide Vanes ,Truss and partition plates are to be inspected/assembled as follows.

- a) The ducts with a height less than 6mtr shall be trial assembled completely .However the duct above 6 mtr can be assembled except the roof and the roof wall shall be trial assembled and checked on the ground.

3.4 Economiser out let ducts shall be trial assembled .A portion of the roof which may be difficult to assemble . A portion of roof height above 6 mtr , which is difficult to assemble can be checked on layout/ ground with prior written approval from BHEL/QC.

3.5 All other ducts such as T Duct,Hopper ,Transition non-symmetrical on axis or having bent plate corner arrangement and Aerofoil/Ventury ducts (flow meter duct) shall be fully trial assembled.

3.6 The schematic diagrams of the ducts of different configuration are enclosed for reference in the annexure –A.

3.7 Wherever trial assembly is waived off the tolerance as indicated in Note 4.1.8 of the this SQP (latest)shall be followed.

3.8 Chimney shells shall be trial assembled with suitable identification

3.9 Safety and stability is to be fully considered for trial assembly position and supporting during trial assembly.

3.10 During trial assembly, all segments shall be assembled together using temporary bolts, tack welds or other suitable means and held in position. For large and very odd shaped ducts, multiple stages of trial assembly is permitted after obtaining approval from Engineering and Quality.

3.11 All critical dimensions shall be checked and recorded during trial assembly. The tolerances given in the drawing shall be followed.

3.12 Before dismantling the assembly, the match marks shall be clearly punched, stenciled and bordered with white paint as shown in figure 2.

3.13 The manufacture and checking of duct walls shall be done on floor reasonably leveled and free from significant undulations.

3.14 All sides of ducts (top, bottom,& vertical sides) individually shall be assembled on level surface.

3.15 All profiled items (walls,shapes,angles&vanes) are to be checked by temp plate/layout. Other walls shall be checked by direct measurement.

3.16 After stiffener / flange welding the maximum gap between the temp plate and the bent wall profile (at the mid region) shall be 2mm.

3.17 All the profiled items are to be stiffened with stiffeners for retaining the profile

during transportation. Where profiling is shown in drawing such walls shall be checked on lay out.

- 3.18 The bent portion /corner angles to be welded to such walls shall be checked with templates/layout for profile prior to fit up on walls.
- 3.19 The vendors would also be informed that should there be any deviations noted during the site assembly , the vendors will be responsible for rectifying the same at site.

4.0 INSPECTION AND TOLERANCES (DUCTS / HOPPERS / TRANSITIONS) – when trial assembled as per Clause 3.0

- Length / width / diameter : ± 2 mm / meter (limited to 5 mm) of nominal dimensions
- Diagonals : @ of 1.5 mm / meter (limited to 5 mm) of nominal value.
- Circularity(at duct ends): @ of 2mm / meter (limited to 10 mm) of nominal diameter.
- Square ness (duct end) : @ 2mm/Mtr (limited to 10 mm) of nominal dimension –Fig 3
- Length : Limited to ± 5 mm variation (length up to 5 meters) and ± 10 mm for length above 5 meters.
- Flatness of flange face : Within 2 mm.
- Twist (in sections) : @ of 3 mm / meter (limited to 10 mm)
- Arm length of elbows : Within 2 mm. Refer figure 3.
- Center offset (figure 2.) : @ of 3 mm / meter (limited to 10 mm) between duct. openings
- Waviness (Duct walls) : @ of 6 mm / meter (limited to 10 mm).
- Height (Hopper/Chimney): ± 5 mm
- Stiffener shift on walls : ± 10 mm
- Guide vane shift : ± 5 mm
- Elbow arm length : ± 2 mm / meter (limited to 3 mm) - Fig: 3 b
- Center offset in transition : 3 mm / meter height (limited to 10 mm max) - Fig :3c (on top, bottom openings)
- Flow meters profile : 2 mm gap (maximum) with a template.(Fig:1)

4.1 Flow meters tolerances:(Unless otherwise specified in drg.)

- 4.1.1 Profile : 2 mm gap (maximum) with a template.(Fig:1)
- 4.1.2 Throat distance : within ± 2 mm.
- 4.1.3 The position of metering holes w.r.t. leading edges shall be within ± 2 mm.
- 4.1.4 Out of straightness of aerofoil(across the flow direction) shall be within 1mm/metre limited to 3mm max on the curvature side (flow entry)
- 4.1.5 Metering tubes shall be assembled separately outside maintaining the distance of tapping points and matched with tapping points on aerofoils.
- 4.1.6 Assembled tubes shall be kerosene leak tested for leak tightness and fitted with profile.

4.1.7 FLANGES Inside dimensions (rectangular / square / circular flanges) – when trial assembled

<u>Nominal dimension</u>	<u>1000 & less</u>	<u>above 1000 upto 3000</u>	<u>above >3000</u>
Permissible deviation in mm	- 0.0 to +1.0	- 0.0 to +2.0	- 0.0 to +4.0
Diagonals variation	: @ of 1.5 mm / meter (limited to 5 mm)		
Circularity in circular flange	: @ 2mm / meter (limited to 10 mm) of the nominal dimension..		
Center line of bolt holes	: Shall be parallel within ± 2 mm. (in opposite faces)		
Pitch of holes	: Individual - within ± 1 mm. Cumulative (rectangular flanges) - with in ± 2 mm.		
Holes size	: With in ± 1 mm. (Only drilling permitted)		

4.1.8 INSPECTION AND TOLERANCES (DUCTS / HOPPERS / TRANSITIONS) – Loose walls
Wherever trial assembly is not required as per clause 3.0

- Length / width : ± 2 mm / meter (limited to 3 mm) of nominal dimensions
- Diagonals : @ of 1.5 mm / meter (limited to 5 mm) of nominal value.
- Flatness of flange face : Within 2 mm.
- Waviness (Duct walls) : @ of 6 mm / meter (limited to 10 mm).
- Stiffener shift on walls : ± 5 mm
- Center offset in transition: 3 mm / meter height (limited to 10 mm max) - Fig :3c
(on top, bottom openings)
- Corner angle tolerance : $+ / - 2$ mm from nominal value
- Flange face to face : $+ 0 / - 2$ mm from nominal value.

4.1.9 FLANGES Inside dimensions (rectangular / square) – Loose walls

Wherever trial assembly **is not required** as per clause 3.0

<u>Nominal dimension</u>	<u>1000 & less</u>	<u>above 1000 upto 3000</u>	<u>above >3000</u>
Permissible deviation in mm	- 0.0 to +1.0	- 0.0 to +2.0	- 0.0 to +4.0

- Diagonals variation : @ of 1.5 mm / meter (limited to 4 mm)
- Pitch of holes : Individual - within ± 1 mm.
Cumulative - with in ± 2 mm.
- End holes : To be slotted (2 x D)
- Holes size : With in ± 1 mm. (Only drilling permitted)

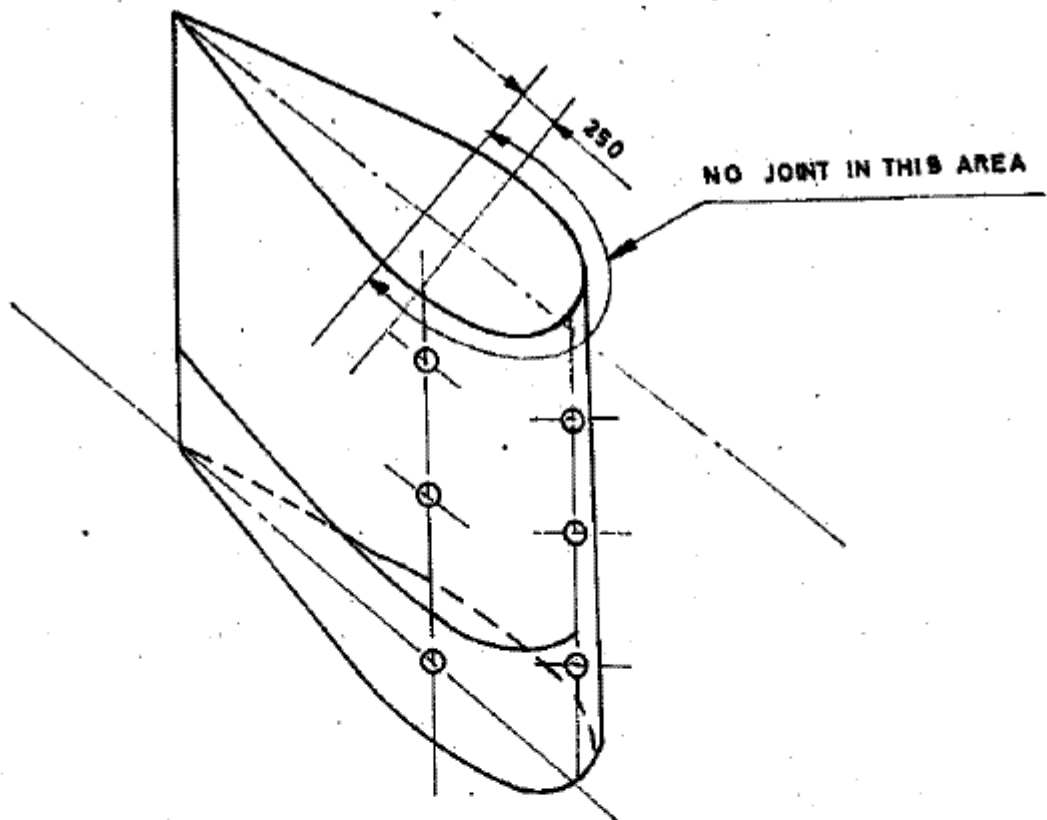
5.0 Guide lines for Pre qualification of WPS (Refer Clause 2.2). Refer to AWS D1.1 for further clarity.) as applicable for welds given in the drawing)

<u>WPS content</u>	<u>Requirements</u>
Electrode selection	E 60xx, or E 70xx for Plate T ≤ 20 mm E 70xx (with 10 deg C Pre heat for joints) for T > 20 mm
Weld groove/ fit up	As per Drawing
Weld width , depth	to be less than drawing weld face width, depth
Weld sizes (Groove , Fillet welds):	As per drawing but not less than the base metal thickness of thinner part T (T = thicker part if E 60xx is used)
Electrode dia (maximum) :	Dia 3.15mm (for Root pass), dia 4mm , (for balance passes)
Maximum current:	As per the recommendation of the electrode manufacturer
Maximum root pass thickness:	3 mm (for Horizontal welding), 4 mm (for Vertical welding and down hand welding)
Maximum filling pass thickness	4 mm .
Maximum fillet weld size when completed in single pass (for each welding position)	Within drawing weld size.

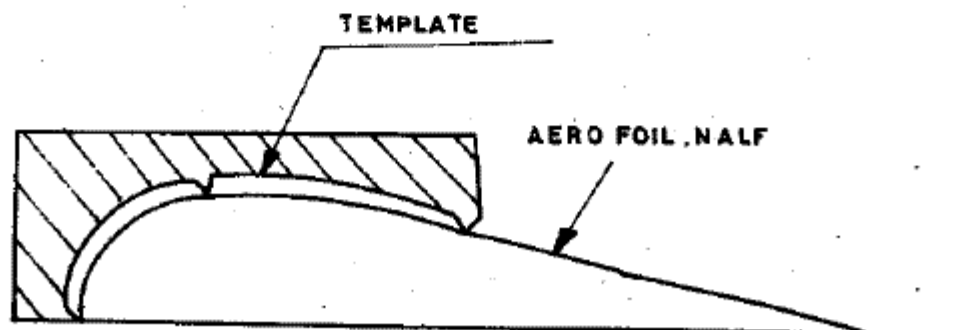
6.0 Surface preparation ,Painting and Identification

- 6.1.1 Temporary cleats, bridge-on pieces shall be removed carefully so as to avoid damage to parent material . Temporary tack welds shall be ground smooth. The completed assembly shall be thoroughly cleaned to remove spatter, slag, rust, oil or grease.

Fig. 1 : Splicing detail of Aerofoil and Profile Template

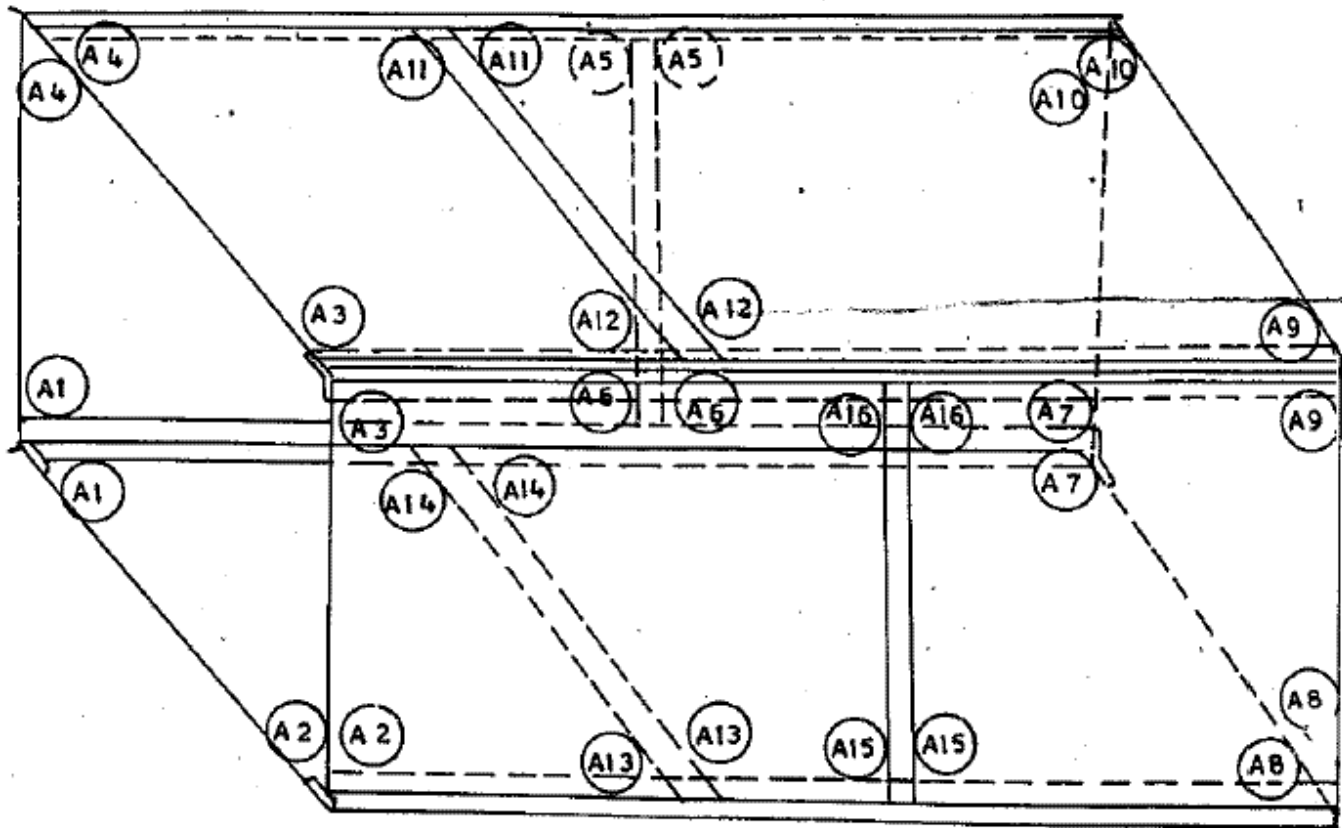


1. NO VERTICAL JOINT IS PERMITTED IN THE LEADING END MARK.
2. HORIZONTAL JOINT SHALL BE 250 MM AWAY FROM TAPPING POINTS.
3. FORMATION OF PLUS JOINTS SHALL BE AVOIDED



4. TEMPLATE SHALL BE MADE FROM 5MM. PLATE
5. VARIATION IN GAP BETWEEN TEMPLATE AND AERO FOIL SHALL BE LESS THAN ± 2.00 MM

Fig-2 : Match marking after trial assembly

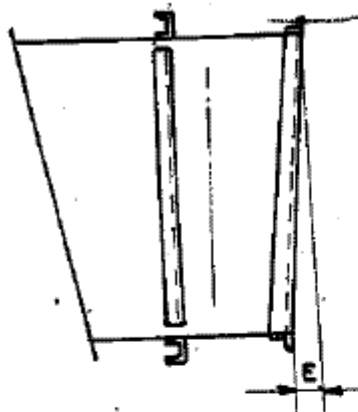


(X) FARSIDE

(X) NEAR SIDE

Fig. 3a,3b and 3c :Tolerances

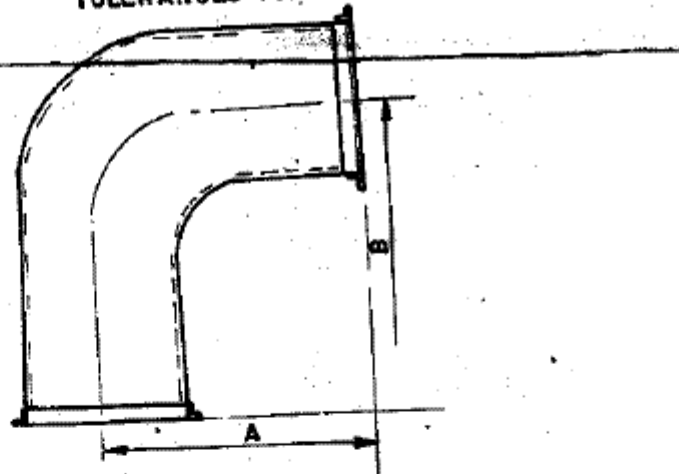
END OUT OF SQUARENESS



END OUT OF SQUARENESS
'E' SHALL NOT EXCEED 2MM
PER METRE OF DIAMETER OR
THE DEPTH OF THE SECTION

3a

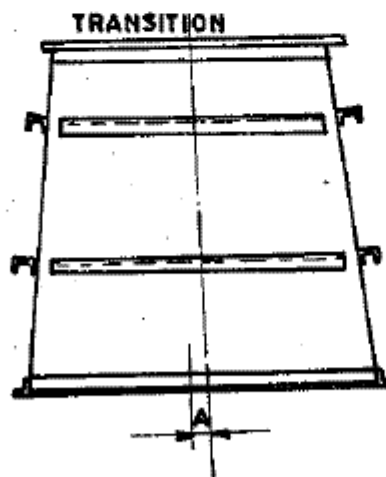
TOLERANCES FOR ELBOW



TOLERANCE ON A : $\pm 2 \text{ MM/M}$ NOT
EXCEEDING 3MM

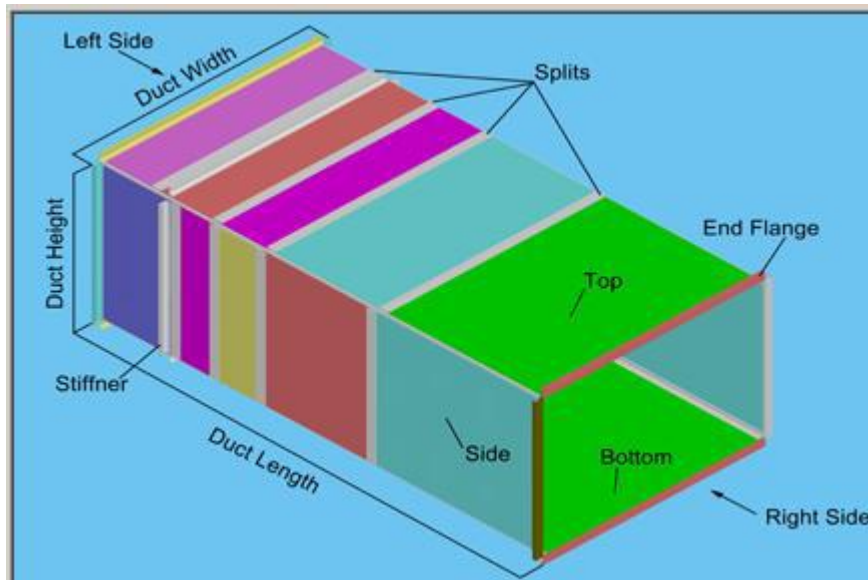
3b

TOLERANCE ON B : 2MM/M NOT
EXCEEDING 5MM

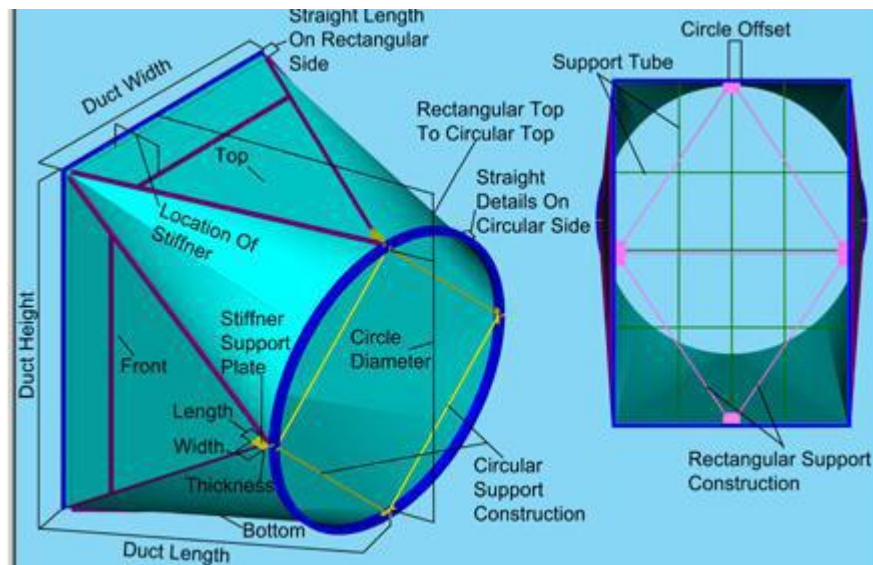


3c. AXES SHIFT 3MM M/OF NOMINAL HEIGHT
NOT EXCEEDING 5MM.

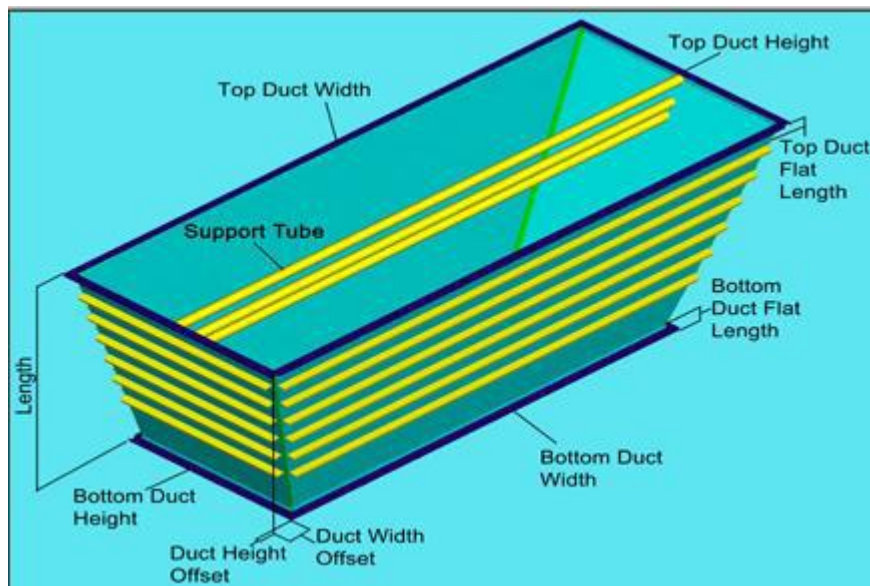
ANNEXURE-A



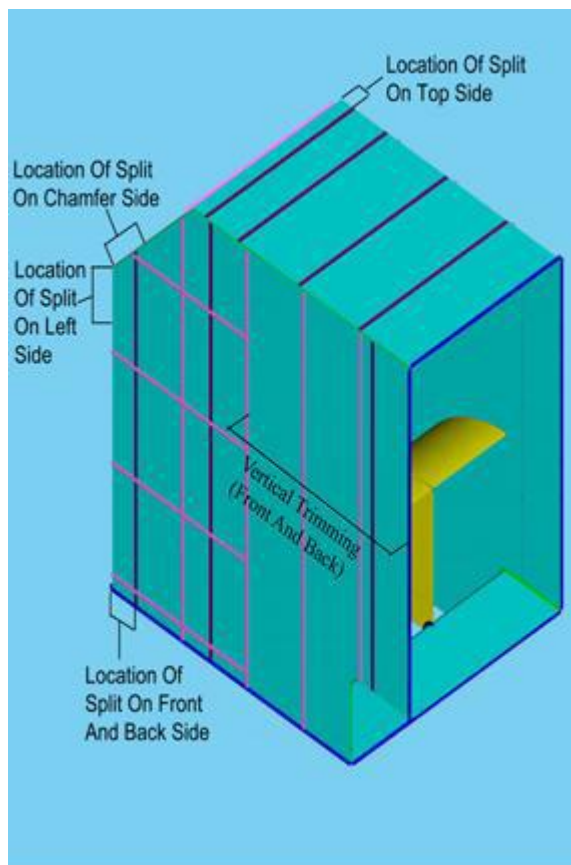
Straight Duct



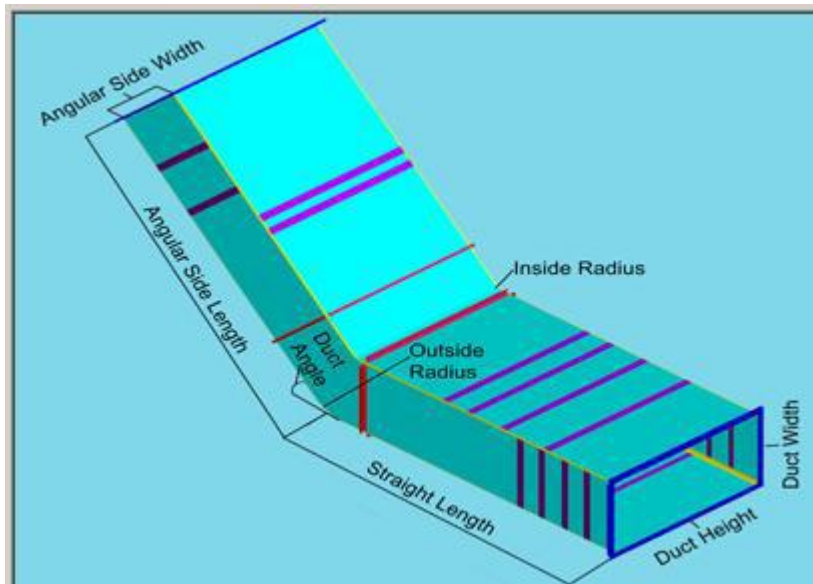
Transition from rectangular to Circular



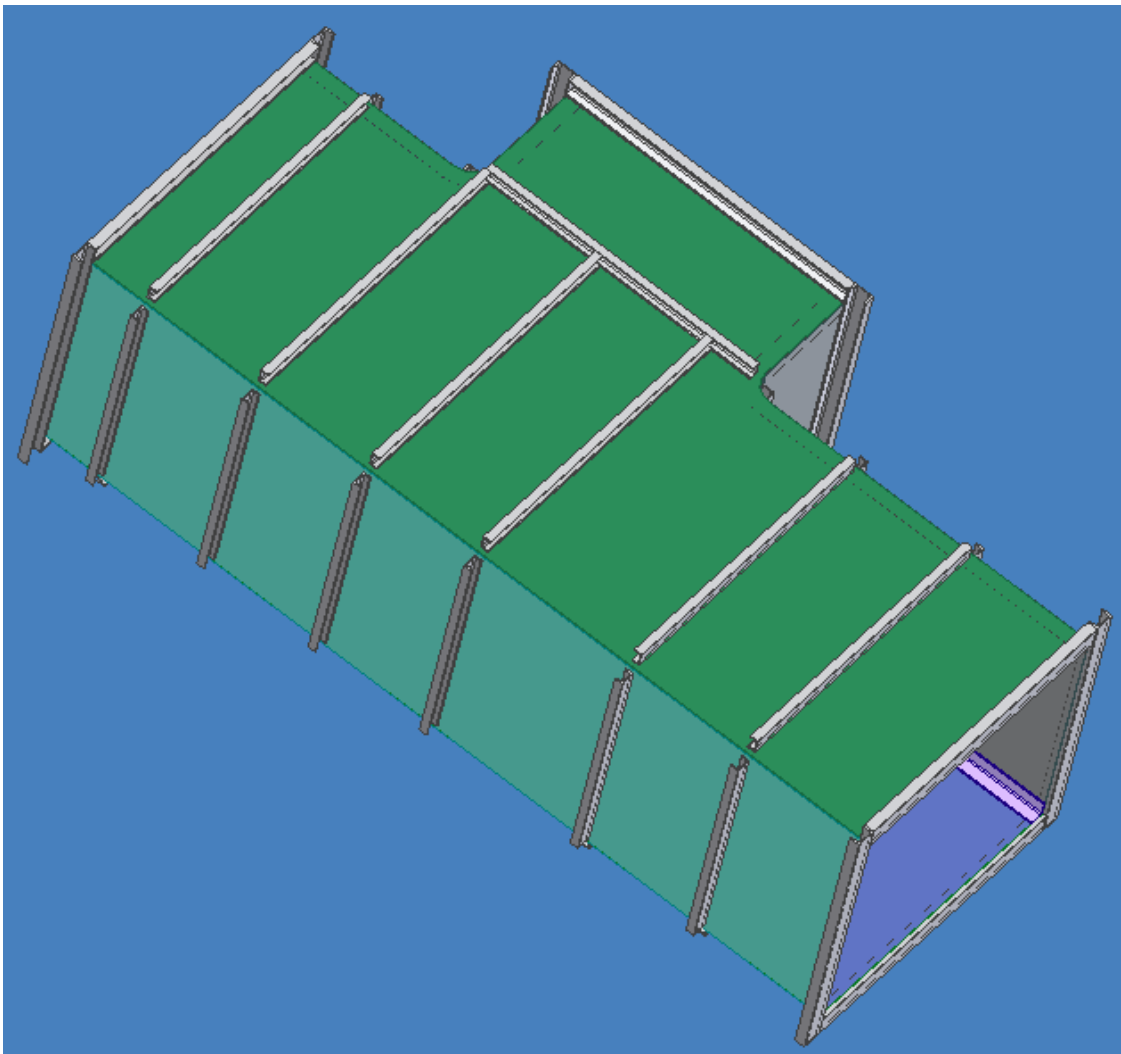
Transition in multiple planes



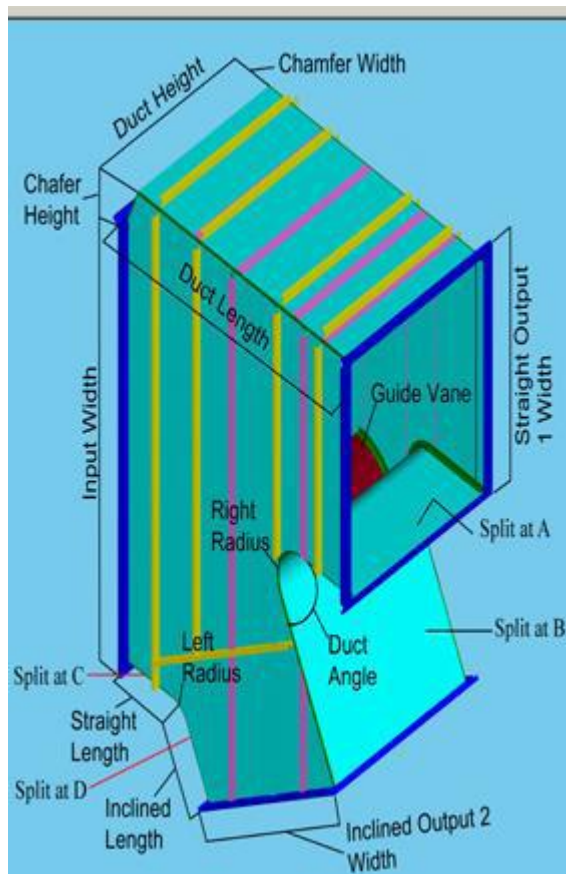
Elbow with guide vane



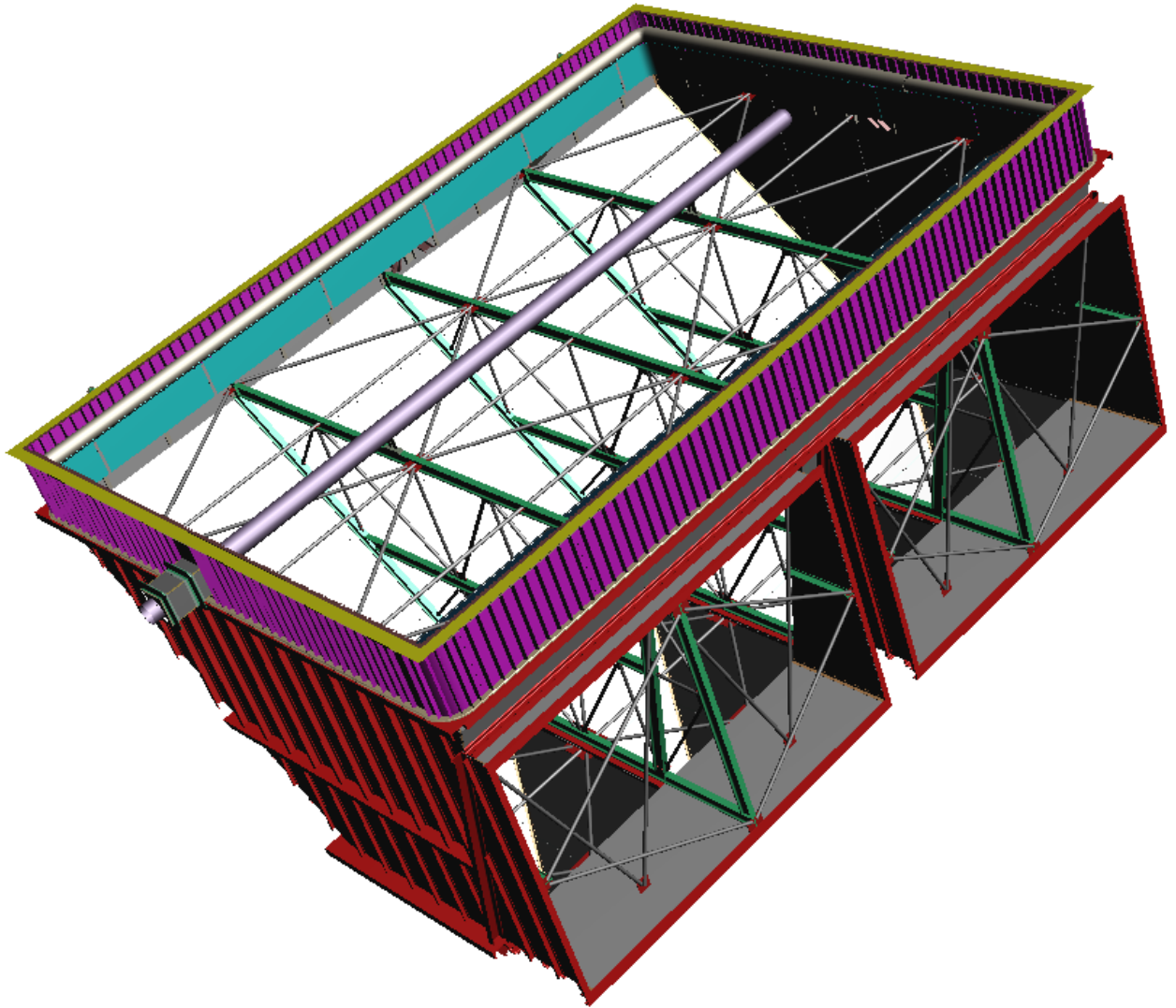
Bend Duct



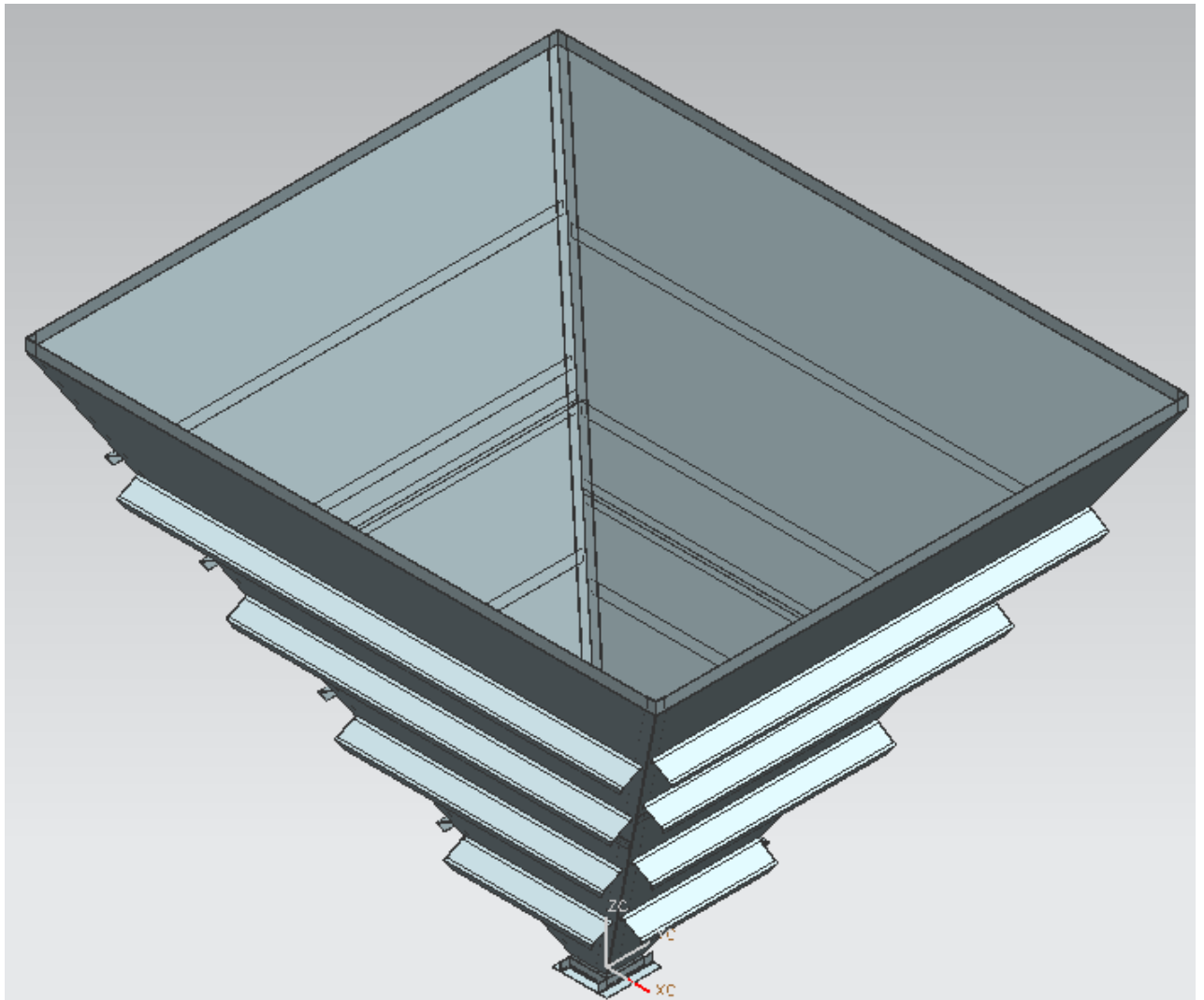
Tee Duct



Y duct



Eco Duct



Hopper Duct