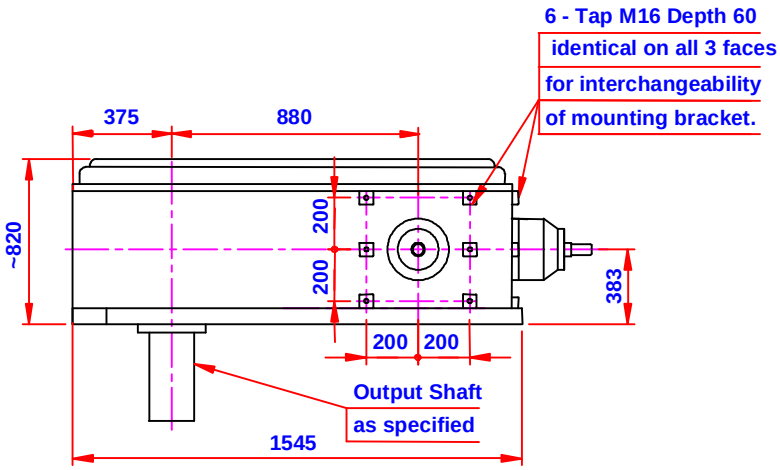
01	**Item : Main Drive Speed Reducer 9APB (3 Input, Down Shaft Output, 3 ORC)**	
02	Application Used for driving the rotor of Regenerative Air Preheater in coal fired power stations. Two input shafts are required to connect them to the main Electric Motor drive and to the standby Electric Motor. A third input shaft is also required to connect to the emergency compressed Air Motor drive. All the input shafts should have over-running clutch built-in as a part of the speed reducer. A pinion is mounted on the output shaft of the reducer, which engages to a Pin rack provided in the rotor of the air heater. All the drive motors are mounted in brackets, which are to be attached to the speed reducer casing.	
03	Prime Movers	a) Main / Standby - Electric motor 3 Ph, 50 Hz. b) Emergency - Air motor of lower speed & lower KW
04	Input RPM	1450
05	Output RPM	14.74
06	Transmitting Power	a) Continuous – 37 KW b) Peak – 111 KW c) Motor Rating - 37 KW
07	Peak Input Torque	74 Kg-m
08	Conditions of service a) Duration : continuous - 24 hours daily b) Nature of load : smooth c) Starting torque : 50 Kg-m d) Momentary Max over load : 400 % e) Ambient Temperature : 55°C f) Environment : Dusty and Humid g) Direction of rotation of high speed shaft : Must be capable of rotating in either direction (clockwise or counter-clockwise)	
09	Coupling method a) High speed shaft - Electric motor by fluid coupling & Air motor by flexible coupling. b) Low speed shaft - Pinion mounted (Pitch circle dia of pinion - 1270 mm, Pressure angle - 20°)	

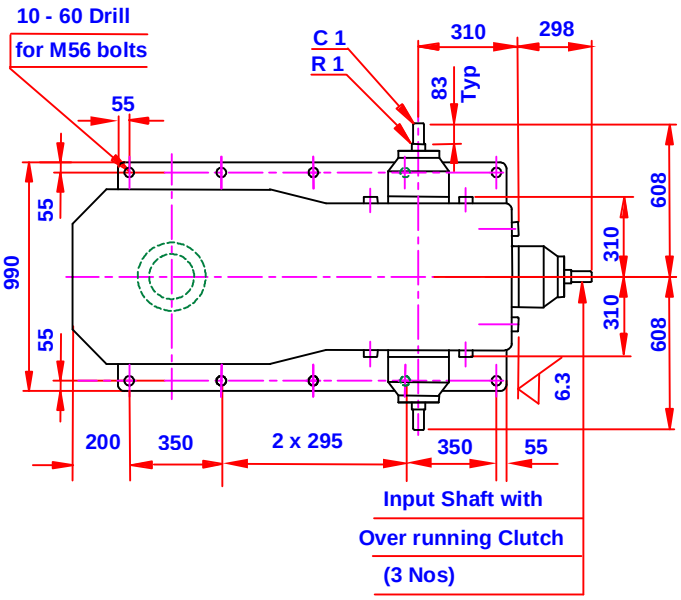
10	General arrangement of Assembly, Input shaft details & Output Shaft details	As per sketch in page **03 of 03**
11	PAINTING a) All external surfaces, which require painting, shall be cleaned by power tool before applying paint. b) 2 coats of Red Oxide Zinc Chrome (IS : 2074) primer paint shall be applied to have a dry film thickness of 50 microns. c) Finally, 3 coats of synthetic enamel (IS : 2932) finish paint of colour Smoke Grey shade no : 692 of IS : 5 shall be applied to have a dry film thickness of 60 microns. d) Total dry film thickness shall be 100 microns (minimum) after final coat.	
12	GENERAL a) Dimensions mentioned in the sketches are not to be exceeded. b) Speed reducers have to satisfy AGMA specifications for durability of 120,000 hours life at rated KW. c) Service factor 1.25 d) Bearings to have minimum B-10 life of 50,000 hours at rated KW. e) Lubrication arrangement shall be provided for all bearings and gear meshes above oil level. f) **At 400% of motor rating, tooth stress should not exceed 70% of yield point of tooth material.** g) Over Running Clutches shall be mounted in all the input shafts such that when one input shaft is driven the other two input shafts shall not rotate. h) The Over Running Clutch shall be without Oil Seal and shall be suitable for Sump Oil Lubrication. It shall be of '**Daido**', '**Formsprag**' or '**Renold'** Make only. i) Double seal is required at high speed shafts and at low speed shaft. j) In the event of first order on a vendor, the first lot of speed reducers will be subject to test at our works. The procedure before each starting is to obtain full backlash inside the reducer plus 1 degree backlash between the tooth of pinion on the low speed shaft and a stop. The motor is then turned on. This is to be done 500 times without fracture of speed reducer components. k) The casing of the speed reducer shall be of fine-grained Cast Iron per IS 210 FG 260 or equivalent. l) All input and output shafts shall be supplied with keys. m) 3 copies of O & M manual to be supplied along with Reducer. n) Only latest revision shall be referred for all the standards specified.	
13	a) Vendor shall submit the Dimensional drawing indicating Materials of Construction of all the parts and Weight, for our approval. b) In the event of first order on a vendor, the vendor shall submit (i) Gear calculations as per AGMA, (ii) Tooth stress calculations at 400% rated power and (iii) Quality Plan, for our approval.	
14	INSPECTION a) Inspection by BHEL. b) Necessary Material Compliance Certificate and No-load Run Test certificate (indicating Noise level, Vibration, and Temperature Rise) shall be submitted.	

Speed Reducer 9APB – 3 Input, Output Downshaft, 3 ORC

GENERAL ARRANGEMENT

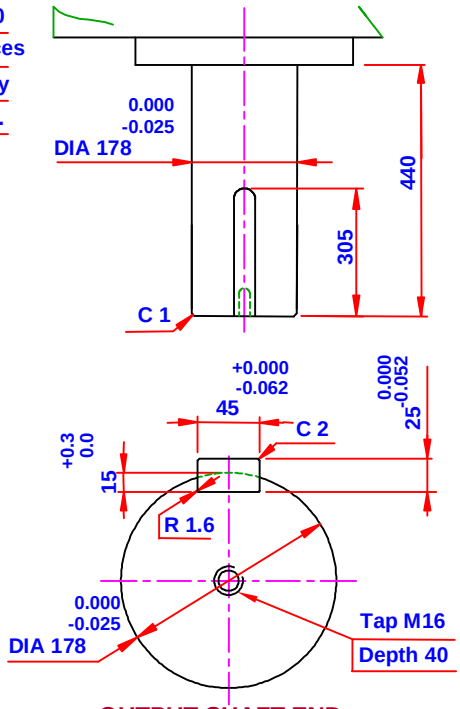


ELEVATION

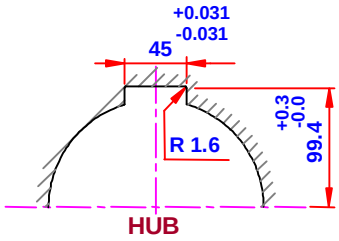


PLAN

OUTPUT SHAFT DETAILS

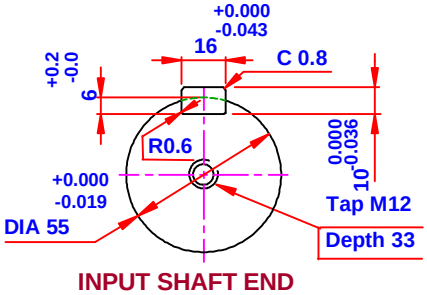


OUTPUT SHAFT END

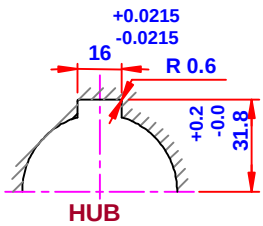


HUB

INPUT SHAFT DETAILS



INPUT SHAFT END



HUB

All dimensions are in mm

RANIPET	Quality assurance M/S BHEL BAP RANIPET TAMILNADU 632 406	STANDARD QUALITY PLAN		
		ITEM/SUB SYSTEM **Speed Reducer (Type I, II. III,4HR)**	**Doc No**	**SQP APH 111**
			Rev No.	**01**
			Date	**250210**
			Page No	**Page 1 of 5**

Sl No	Component /Description	Characteristics	Class	Type of check	Quantum of check	Reference document	Acceptance standard	Format of Records	Agency		Remarks
									Supplier	Customer	
1.0	Raw material Inspection										
1.1	Gear Case (C I)	Surface Defect	Major	Visual	100%	Vendor Drawing	As per relevant Standard	Inspection Report	W	V	Material specified as per BHEL appvd drawing
		Tensile Strength	-do-	Tensile Strength	Sample per heat	-do-	-do-	-do-	W	V	
1.2	Pinion shaft,Gears(Case hardenmed steel) and output shaft	Chemical	-do-	Chemical Analysis	-do-	-do-	-do-	-do-	W	V	
		SOUNDNESS	-do-	UT	100%	-do-	-do-	-do-	W	V	
		Microstructure	-do-	Microtest	100%	-do-	-do-	-do-	W	V	
2.0	Inprocess Inspection										
2.1	Gear Case	Shot blasting	-do-	Visual	100%	SA 2 ½	SA 2 ½	-do-	W	V	
		Primer Painting(zinc phosphate)	-do-	-do-	100%	1 coat	30 microns	-do-	W	V	

Prepared By	Reviewed by	Approved by

Sl No	Component /Description	Characteristics	Class	Type of check	Quantum of check	Reference document	Acceptance standard	Format of Records	Agency		Remarks
									Supplier	Customer	
		Dimensions	-do-	Measure ment	100 %	BHEL appvd drawing/ven dor drawing	BHEL appvd drawing/vend or drawing	-do-	W	V	
2.2	Pinion shaft & gears	Dimensions	-do-	-do-	-do-	-do-	-do-	-do-	W	V	
		Soundness	-do-	UT	100%	Relevant std	Relevant std	-do-	W	V	
		Surface Hardness	-do-	Hardness	100%	Relevant std	Relevant std	-do-	W	V	
		Case Depth	-do-	Case Depth	100%	Relevant std	Relevant std	-do-	W	V	
2.3	Output Shaft	Dimension	Major	Measure ment	100%	BHEL appvd drawing/ven dor drawing	BHEL appvd drawing/vend or drawing	-do-	W	W	
		Soundness	-do-	UT	100%	Relevant std	Relevant std	-do-	W	V	
		Surface Hardness	-do-	Hardness	-do-	-do-	-do-	-do-	W	V	
2.4	Pre Assembly Test	Blue match	-do-	Visual	-do-	-do-	25% min for Helical &40%for Bevel gear DIN 3990	-do-	W	W #	W#- NOTE 1
		Bearings	-do-	make	-do-	-do-	-do-	-do-	W	V #	
		Overrunning clutch	-do-	make	-do-	-do-	-do-	-do-	W	V #	
3.0	Final Inspection										

Prepared By	Reviewed by	Approved by

Sl No	Component /Description	Characteristics	Class	Type of check	Quantum of check	Reference document	Acceptance standard	Format of Records	Agency		Remarks
									Supplier	Customer	
3.1	Assembly	Verification pf arrangement	Critical	Visual	100%	BHEL appvd drawing/vendor drawing	BHEL appvd drawing/vendor drawing	-do-	W	W	
3.2	Mounting dimension(Air motor , electric motor, spare motor, distance between input drive/gear bpx to output shaft) etc	dimension	-do-	-do-	-do-	-do-	-do-	-do-	W	W	
3.3	No load test run	Leakage	Critical	Visual	100%	No leakage	No leakage	-do-	W	W	
		Reduction ratio	Major	Measurement	100%	BHEL appvd drawing/vendor drawing	BHEL appvd drawing/vendor drawing	-do-	W	W	
		Temperature rise(4 hrs)	-do-	-do-	-do-	Ambient temperature	30 degree over ambient temperature	-do-	W	W	
		Noise Level (85db max , 4hrs run)Maximum	Major	Measurement	100%	BHEL appvd drawing/vendor drawing	BHEL appvd drawing/vendor drawing	-do-	W	W	
		Vibration	-do-	-do-	100%	Relevant std	Relevant std	-do-	W	W	

Sl No	Component /Description	Characteristics	Class	Type of check	Quantum of check	Reference document	Acceptance standard	Format of Records	Agency		Remarks
									Supplier	Customer	
		Lube oil pump	Major	Make	100%	BHEL appvd drawing/vendor drawing	BHEL appvd drawing/vendor drawing	-do-	W	W $	W$ - NOTE 2
		Pressure gauge	Major	Make	100%	BHEL appvd drawing/vendor drawing	BHEL appvd drawing/vendor drawing	-do-	W	W $	
		Oil seals	Major	Make	100%	BHEL appvd drawing/vendor drawing	BHEL appvd drawing/vendor drawing	-do-	W	V	
4.0	Painting	Visual	Major	Visual	100%	2 coats of redoxide =50Microns &2 coats of synthetic enamel =60Micronst Total 100 microns Minimum.	2 coats of redoxide =50Microns &2 coats of synthetic enamel =60Micronst Total 100 microns Minimum.	-do-	W	W*	
5.0	Packing (polythene cover, wooden packing)	Visual	Major	Visual	100%	BHEL appvd drawing/vendor drawing	BHEL appd. drawing/vendor drawing	-do-	W	W@	

Prepared By	Reviewed by	Approved by

RANIPET	Quality assurance M/S BHEL BAP RANIPET TAMILNADU 632 406	STANDARD QUALITY PLAN		
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			Rev No.	**01**
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Sl No	Component /Description	Characteristics	Class	Type of check	Quantum of check	Reference document	Acceptance standard	Format of Records	Agency		Remarks
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NOTE: 1) W#-One number of each 50 nos will be dismantled to verify the record for Type I&II only. 2) W $ -NOT APPLICABLE FOR SPEEDCREDUCER TYPE III&4HR 3)Protecttion cover screws should not be of through hole type. W *Upto April 30st,Colour photos with coating thickness to be given .

Record of revision 01:Type 4HR also added in the scope.Dismantling requirement is restricted to Type I&II only.

W@Packing :one typical packing is to be shown to TPI

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