

BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL**TRANSFORMER ENGINEERING DEPARTMENT**

FORM NO: TRE-2003A

Sheet 1 of 5 sheets

ANNEXURE TO INDENT-CUM-ENQUIRY - **240654222**

DTD:

DESCRIPTION OF EQUIPMENT : HOT DIP GALVANIZED RADIATORS FOR
2 NO. 144 MVA, 400/11.5-11.5 KV STATION TRANSFORMER
& 1 NO. 125 MVA, 420 KV, 3-PH SHUNT REACTOR

WORK ORDER NO. : 63258-A-512-01 & 63259-A-517-01

CUSTOMER : NTPC SINGRAULI

SPECIFICATION OF REACTOR HOT DIP GALVANIZED RADIATORS**1. Dimensions and types of Radiators**

Sl. no.	Description	Item-1	Item-2 (Swan Neck Type)
01	Valve center	3000 ± 2.0 mm ✓	2400 ± 2.0 mm ✓
02	Width of Elements	520 ± 5.0 mm	520 ± 5.0 mm ✓
03	Nominal Thickness of elements	1.20 mm	1.20 mm ✓
04	Nominal height of oil channels	12 mm	12 mm
05	Number of elements	28 x 3000mm ✓	4x2400mm + 26x3000mm ✓
06	Nominal pitch of elements	55 mm ✓	55 mm ✓
07	Size of header pipes	80 NB pipe wall thickness = 4.2 mm (min) ✓	80 NB pipe wall thickness = 4.2 mm (min) ✓
08	Nominal size of bracing rods	10 mm Dia round rods ✓	10 mm Dia round rods ✓
09	Min. S.A. of each radiators	93.91 m ² ✓	98.08 m ² ✓
10	Nominal no. of flutes	9 Minimum ✓	9 Minimum ✓
11	Typical drawing	TR 20081 R (Refer sheet 2)	34694300046

2. Scope.

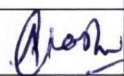

This specification covers the requirements of hot dip galvanized and painted steel minimum 9-flute radiators used for oil cooling in Power transformers/shunt Reactors by natural or forced circulation of oil and air. Hot dip galvanized surface of the radiator is over coated with paint for long-term protection against corrosion.

3. Applicable standards

- The radiators covered in this specification shall generally be in line with applicable standard.
- The requirements of hot dip galvanized coatings in accordance with IS: 2633.

4. Design and construction

- The radiator consists of mainly two parts:
 - Cooling elements with oil channels,
 - Header pipes with mounting flanges
- The cooling elements are fabricated from sheet metal, and have a large number of hollow oil channels (flutes) with their ends connected to header pipes by welding. Edges of the cooling elements shall be sealed at both sides by electrical resistance welding (ERW). The header pipes shall be closed at one end and open at the other end. Mounting flanges shall be welded to the open end of headers. Cooling elements and mounting flanges shall be welded to the header pipes by MIG welding.

REV	DATE	ALT CKD	REV-	DATE	ALT- CKD-	REV 00	NAME	SIGN	DATE
						PREP	A JOSHI		20/02/26
						CKD	P PRAJAPAT		23/04/26
DWI/TCB/TRE/010									

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FORM NO: TRE-2003A

Sheet 2 of 5 sheets

- c) The radiators shall be installed by their mounting flanges with header pipes at top and bottom and cooling elements always in vertical position. The connection of radiators to the transformer or cooling circuit shall be made by leak tight bolted joints, using synthetic rubber gaskets as oil seal. Hot oil from the transformer will flow into radiators through header pipes and get circulated in cooling elements. External air circulation through the spaces between adjacent cooling elements enables the heat transfer.
- d) The following attachments shall be welded to the radiator at specified locations, unless otherwise specified.
- (1) Air release plug for venting air while oil filling
 - (2) Drain plug for removing oil or emptying the radiator
 - (3) Lifting lugs for lifting and shifting the radiator
 - (4) Bracing lugs (fixing plates) for tie bars to keep the radiators properly aligned after installation
 - (5) Stiffeners (bracing rods) to prevent distortion and for noise reduction.
 - (6) Additionally, oil-sealing gaskets shall be provided with the air release and drain plugs.
- e) Materials:
 Unless otherwise specified, the following materials shall be used for the fabrication of radiators.
- (1) Cooling elements: Cold rolled steel sheet with nominal thickness 1.20 mm
 - (2) Header pipes: Steel pipe
 - (3) Attachments: Steel
 - (4) Oil sealing gaskets: PTFE (Teflon) washers for air release & drain plugs

4. Hot dip galvanizing of Radiator external surface:

Hot dip galvanization shall be carried out in accordance with EN ISO 1461 (Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods) and ISO 14713 (Protection against corrosion of iron and steel in structures — Zinc and aluminum coatings — Guidelines). Minimum thickness of galvanized coating shall be 55 µm.

It shall also conform to IS 2629:1985 & IS 1986

a) Surface preparation

All fabrication activities and leak testing shall be completed on radiators before the preparation of external surfaces for hot dip galvanizing. Weld spatter, slag, flux, sharp edges etc. shall be removed from the surface by chipping, wire brushing or grinding. The header pipe openings shall be closed tightly with metal plugs/blanking plates to prevent entry of molten zinc inside. Mounting flanges shall be fully galvanized except the areas that come in contact with gaskets during installation.

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FORM NO: TRE-2003A

Sheet 3 of 5 sheets

b) Galvanizing procedure

- (1) The zinc used for hot dip galvanizing shall be 99.9% pure. Total impurities in the molten zinc, other than iron and tin shall not exceed 1.5% (by mass). The radiator shall be dipped in molten zinc bath and kept immersed until it reaches the bath temperature. To prevent distortion and warping, special jigs and fixtures shall be used for dipping.
- (2) Hot-dip galvanized coatings shall conform to EN ISO 1461. Galvanized surface shall be free from nodules, blisters (raised portions without solid metal beneath), sharp points, uncoated areas, flux residues, lumps and zinc ash. Excessive build-up of zinc at edges of cooling fins shall be avoided.
- (3) Minimum thickness of galvanized coating shall be **55 µm**.
- (4) As per EN ISO 1461, occurrence of darker or lighter grey areas (e.g. a cellular pattern of dark grey area) or some surface unevenness, wet storage stain (white or dark corrosion products – primarily basic zinc oxide that is formed during storage in humid conditions after galvanizing) shall not be a cause for rejection, provided the coating thickness remains above the specified minimum value.

5. Internal oil resistant coating

- a) The radiators shall be coated inside with oil resistant primer/low viscosity varnish after completion of external galvanizing. Prior to internal coating the radiator shall be mechanically vibrated to dislodge loose metal particles sticking on the surface. The header pipes shall be scrubbed inside with a long wire brush and cleaned rust, weld spatter and other metal particles.
- b) The internal coating shall be compatible with hot transformer oil. The coated film shall be thin as thick coatings can get dislodged from the surface during forced oil circulation and clog the channels (flutes). The coating thickness to be 15-25 microns.
- c) After circulation, excess material shall be fully drained off. The coated film shall be dry, before packing the radiators for dispatch.

6. External painting on galvanized surface

Type of paint, no. of coating & Total DFT shall be as per ISO 12944-5:2018, Table D.1, System no. G5.05 of priming and painting with high quality full glossy outer finish paint (RAL 5012 Blue), kindly note the ISO 12944-5:2018, Table D.1, System no. G5.05 data as below for your ready reference, for details ISO 12944-5:2018 to refer:-

Table D.1 — Paint systems on hot dip galvanized steel for corrosivity categories C5

System No.	Corrosivity category	Priming coat			Subsequent coat(s)	Paint system			Durability ^a			
		Binder type	No. of coats	NDFT in µm		Binder type	No. of coats	NDFT in µm	l	m	h	vh
G5.01	C5	EP, PUR	1	80 to 120	EP, PUR, AY	1 to 2	120	X				
G5.02		AY	1	80	AY	2	160	X				
G5.02		EP, PUR	1	80	EP, PUR, AY	2	160	X	X			
G5.03		AY	1	80	AY	2 to 3	200	X	X			
G5.04		EP, PUR	1	80	EP, PUR, AY	2 to 3	200	X	X	X		
G5.05		EP, PUR	1	80	EP, PUR, AY	2 to 3	240	X	X	X	X	

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TRANSFORMER ENGINEERING DEPARTMENT

FORM NO: TRE-2003A

Sheet 4 of 5 sheets

Total DFT of primer and finish coats shall be **240 microns (min)** as per ISO 12944-5:2018, Table D.1, System no. G5.05 .

7. Inspection & Testing

a) Inspection:

(1) The supplier shall furnish all test certificates as per attached approved QAP applicable for NTPC SINGRAULI SHUNT REACTOR (63259A51701) & STATION TRANSFORMER (63258A51201).

The radiators shall be inspected & tested at manufacturer's works in presence of customer representative & BHEL/ BHEL authorized inspection agency. An advance notice of at least 15 days should be given to arrange for inspection. Radiator shall be dispatched only after material inspection dispatch clearance received from BHEL.

b) Routine tests:

The following tests shall be conducted on radiators as routine tests and the test reports submitted with the supply of material.

- (1) Leak test: Leak test shall be conducted on all radiators before galvanizing. The radiator shall be pressurized internally by filling compressed air at 2.0 kg/cm² (min.) and dipped in water at ambient temperature. Emanation of air bubbles, however small, will indicate leakage. The radiator (under pressure) shall be kept immersed in water continuously for 1 hour (min.) without leakage.
- (2) Coating thickness: Coating thickness shall be measured after galvanizing as well as after painting. The measurement shall be made with Elcometer, operating on magnetic principle. Minimum ten measurements shall be made at various locations on cooling elements and header pipes. Extended probe shall be used for measuring on surfaces between cooling elements. The measured thickness shall conform to the specified values.
- (3) Verification of dimensions: Overall dimensions and mounting distance shall be verified with respect to drawing before packing the radiators for dispatch.
- (4) Visual inspection: All radiators shall be visually inspected before packing. Overall appearance, finish and workmanship shall be satisfactory.

c) Type tests:

Test Reports of following type tests will be required to furnish for each type of radiators i.e each radiator of Item-1 and Item-2 as per spec, further test reports shall not be earlier than 5 years of bid submission date. If valid test report will not be available with supplier, each type of radiators i.e each radiator of Item-1 and Item-2 shall be subjected to the following type tests.

- (1) Vacuum test: The radiator shall be evacuated to 760 mm Hg (Vacuum value depend on test location) and held under vacuum for 1 hour continuously at ambient temperature. Deflections shall be measured on outermost cooling elements at center with the under vacuum and after breaking vacuum. The permanent deflections on cooling elements shall not exceed 0.5mm.

BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL
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FORM NO: TRE-2003A

Sheet 5 of 5 sheets

(2) Oil seepage test: The radiator shall be filled with hot transformer oil at $105\pm 5^{\circ}\text{C}$ to a pressure of 1 kg/cm^2 (min.) and kept under pressure and temperature for 12 hours. There shall not be any leakage or seepage of oil from the radiator during this period.

9. Marking and packing:

- a) Manufacturer's identification and Sr. no. of the radiator shall be marked on all radiators.
- b) The radiators shall be stacked one above the other and packed in wooden boxes/crates. The header pipe opening shall be closed leak-tight with steel blanking plates using gaskets. Plastic sheet covering shall be provided externally on the packing case.
- c) The packing wood shall be chemically treated and protected against fungus attack. The packing cases shall be strong, sturdy and suitable for re-packing, after the radiators are taken out for testing of transformer. The radiators and packing cases shall not get damaged during handling, transport and storage. The packing cases shall be covered with plastic sheets.
- d) Size of radiator, make shall be legibly marked on the packing cases for identification.

- 10.**
- a) The bidder should submit signed Compliance of technical specification.
 - b) 2 copies of drawing showing the mounting details, description, leaflets & test reports (including type test) should be furnished alongwith the offer for approval.
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Form No. 2038

उत्पाद मानक

परिणामित्र

शाप/आ.का निर्देश

PRODUCT STANDARD

TRANSFORMER

SHOP/ENGG. INSTRUCTIONS

TR10005P

7 पृष्ठों में 1

PAGE 1 OF 7

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PAGE 1 OF 7

शीर्षक :
TITLE :**PAINTING INSTRUCTIONS**

1	2	3	4	5	6	7	8	9	10
SR NO	PARTS	SUR. FACE	PAINT	NO.OF COATS	HOW APPL- IED	PAINT SPEC.	DRY PAINT FILM TK. MICRON	PROCESS SPEC.	REMARKS
1	i. TRANSFORMER/ REACTOR TANK & COVER, TOP TANK BOTTOM TANK ii- TURRETS iii- INSPECTION COVERS, CONSERVATOR HEADERS	IN SIDE OUT SIDE	CHEMICAL & THERMAL RESISTANT EPOXY ENAMEL WHITE/ CREAM SHADE i. CHEMICAL & THERM. RESIST EPOXY PRIMER. ii. CHEM & THERM. RESISTANT EPOXY ENAMEL LIGHT GREY SHADE 631 OF IS:5	2 2 2	SPRAY OR BRUSH SPRAY OR BRUSH SPRAY OR BRUSH	BP 56179 AA 56105 BP 56179	TOTAL DFT 50 Min. 50 Min. 50 Min. TOTAL DFT. 100 Min.	TR10206P	EPOXY PAINTING
2	END FRAME, CLAMP PLATE, T.G & T.C BRACKETS & OTHER STEEL PARTS GOING INSIDE TRANSFORMER TANK		CHEMICAL & THERMAL RESISTANT EPOXY ENAMEL WHITE/CREAM SHADE	2	SPRAY OR BRUSH	BP 56179	TOTAL DFT 50 Min.	TR10206P	
2 (A)	E/F, CLAMP PLATE, CROSS BEAM. T.G & T.C BRACKET, OTHER STEEL PARTS GOING INSIDE TANK UPTO 400 KV CLASS FOR TRANS. & REACTORS		OIL RESISTANT FULL GLOSSY WHITE PAINT	2	SPRAY OR BRUSH	BP 56183	TOTAL DFT 40 Min.	TR10211P	
3	BARE COPPER GOING INSIDE TRANS. TANK		ONE 50% OVERLAP WOUND LAYER OF CREPE KRAFT PAPER TO AA21117 TYPE B						
4	i. TRANSF. TANKS UPTO 400 KV CLASS ii. REACTOR TANKS UP TO 400 KV CLASS iii. SPARE COIL TANK iv. CONSERVATOR, RELIEF VENT, RAD. HEADER. v. CABLE BOX COMPOUND FILLED. vi. TURRETS	IN SIDE OUT SIDE	OIL RESISTANT FULL GLOSSY WHITE PAINT i. ANTI CORROSIVE PRIMER PAINT. ii. HIGH QUALITY FULL GLOSSY OUTDOOR FINISHING PAINT LIGHT GREY SHADE 631 OF IS: 5	2 2 2	SPRAY OR BRUSH SPRAY OR BRUSH SPRAY OR BRUSH	BP 56183 AA 56101 AA 56126	TOTAL DFT 40 Min. 40 Min. 40 Min TOTAL DFT 80 Min	TR10211P	

पुनः Rev.21
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17/11/21

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दिनांक : DATE :

23-03-1986

पुनः Rev.22
दि. Dt.

26/08/23

NOTE TO SHOP REVISED

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7 पृष्ठों में 2 | PAGE 2 OF 7

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PAGE 2 OF 7

1	2	3	4	5	6	7	8	9	10
SR NO	PARTS	SUR. FACE	PAINT	NO.OF COATS	HOW APPLIED	PAINT SPEC.	DRY PAINT FILM TK. MICRON	PROCESS SPEC.	REMARKS
5	PIPE WORK	IN SIDE OUT SIDE	---AS IN SL.NO.4--- ---AS IN SL.NO.4---	- 2 2	FLOODING SPRAY OR BRUSH SPRAY OR BRUSH	BP 56183 AA 56101 AA 56126	40 Min. 40 Min. TOTAL DFT. 80 Min. 40 Min. TOTAL DFT. 80 Min.	TR10210P	
6	ROLLER ASSY. A-FRAMES, BREATHERS, STEEL PARTS, OUTSIDE TRANSFORMER TANK	OUT SIDE	---AS IN SL.NO.4---	2 2	SPRAY OR BRUSH SPRAY OR BRUSH	AA 56101 AA 56126	40 Min. 40 Min. TOTAL DFT. 80 Min.	TR10211P	
7	RADIATORS	OUT SIDE	i. SELF ETCH PRIMER ii. ANTI CORROSIVE PRIMER iii. HIGH QUALITY FULL GLOSSY FINISHING PAINT.	1 2	SPRAY OR BRUSH FLOODING FLOODING OR SPRAY OR BRUSH	AA56103 AA56101 AA56126	5 Min. 40 Min. 40 Min. TOTAL DFT 85 Min.	TR10205P	
8	ALL BLANKING DURING SHIPPING	IN SIDE OUT SIDE	---AS IN SL.NO.4--- POST OFFICE RED FINISHING PAINT	2 2	SPRAY OR BRUSH SPRAY OR BRUSH	BP 56183 AA 56126	TOTAL DFT 40 Min. TOTAL DFT 40 Min	TR10211P	
9	INSTRUMENT TRANSFORMER CT/CVT TANK	INSIDE EXCEPT SECONDARY TERMINAL BOX INSIDE SECONDARY TERMINAL BOX OUT SIDE	---AS IN SL.NO.4--- i. ANTI CORROSIVE PRIMER PAINT. ii. NON YELLOWING FULL GLOSSY WHITE PAINT ---AS IN SL.NO.4---	2 2 2	SPRAY OR BRUSH SPRAY OR BRUSH SPRAY OR BRUSH	BP 56183 AA56101 AA56127 AA56101 AA56126	TOTAL DFT. 40 Min. 40 Min. TOTAL DFT. 80 Min. 40 Min. TOTAL DFT. 80 Min.	TR10211P	

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7

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दिनांक : DATE : 23-03-1986									

1	2	3	4	5	6	7	8	9	10
SR NO	PARTS	SUR. FACE	PAINT	NO.O F COAT	HOW APPLIED	PAINT SPEC.	DRY PAINT FILM TK. MICRON	PROCESS SPEC.	REMARKS
10	MARSHALLING BOX/ KIOSK	IN SIDE	i. ANTICORROSIVE PRIMER PAINT. ii. NON YELLOWING FULL GLOSSY WHITE PAINT	2 2	SPRAY OR BRUSH	AA56101 AA56127	40 Min. 40 Min. TOTAL DFT. 80 Min.	TR10211P	
11	MARSHALLING BOX/ KIOSK AIR FILLED CABLE BOX	OUT SIDE	----SAME AS IN SL.NO.4----	2 2	SPRAY OR BRUSH	AA56101 AA56126	40 Min. 40 Min. TOTAL DFT. 80 Min.	TR10211P	
12	PANELS MOUNTED INSIDE M.BOX/KIOSK	OUT SIDE	----SAME AS IN SL.NO.4----	2 2	SPRAY OR BRUSH	AA56101 AA56126	40 Min. 40 Min. TOTAL DFT. 80 Min.	TR10211P	
13	MARSHALLING BOX/ KIOSK PARTS INCLUDING PANELS EXPOSED TO CHLORINE CONTAMINATED ATMOSPHERE	IN SIDE	i. CHEMICAL & THERMAL RESISTANT EPOXY PRIMER PAINT. ii. CHEMICAL & THERMAL RESISTANT EPOXY ENAMEL WHITE SHADE	2 2	SPRAY OR BRUSH	AA56101 AA56127	40 Min. 40 Min. TOTAL DFT 80 Min.	TR10211P	
14	NON FERROUS PARTS EXPOSED TO CHLORINE CONTAMINATED ATMOSPHERE	OUT SIDE	i. CHEMICAL & THERMAL RESISTANT PRIMER PAINT. ii. CHEMICAL & THERMAL RESISTANT EPOXY ENAMEL PAINT LIGHT GREY SHADE 631 OF IS:5	2 2	SPRAY OR BRUSH	AA56105 BP56179	50 Min. 50 Min. TOTAL DFT 100 Min.	TR10206P	
15	RADIATORS (EPOXY PAINTING)	OUT SIDE	i. SELF ETCH PRIMER ii. CHEMICAL & THERMAL RESISTANT EPOXY PRIMING PAINT. iii. CHEMICAL & THERMAL RESISTANT EPOXY ENAMEL PAINT LIGHT GREY SHADE 631 OF IS:5	1 1 2	SPRAY OR BRUSH	AA56103 AA56105 BP56179	5 Min. 25 Min. 50 Min. TOTAL DFT 80 Min.	TR10208P	
			----SAME AS IN SL.NO.1----	2 2	SPRAY OR BRUSH	AA56105 BP56179	50 Min. 50 Min. TOTAL DFT 100 Min.		

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PAGE 5 OF 7

1	2	3	4	5	6	7	8	9	10
SR NO	PARTS	SUR. FACE	PAINT	NO.OF COATS	HOW APPLIED	PAINT SPEC.	DRY PAINT FILM TK. MICRON	PROCESS SPEC.	REMARKS
20	i. TRANSFORMER TANK & COVER, TOP & BOT. TANK ii. TURRETS iii. INSPECTIONS COVERS, CONSERVATOR, HEADERS, A-FRAMES, P/W ETC.	IN SIDE OUT SIDE	CHEMICAL & THERMAL RESISTANT EPOXY WHITE PAINT i. CHEMICAL & THERMAL RESISTANT EPOXY ZINC PHOSPHATE PRIMER ii. POLYURETHANE FINISHING PAINT.	*	SPRAY OR BRUSH	TRE/168 TRE/166 TRE/165	TOTAL DFT 50 Min 50 Min. 50 Min. TOTAL DFT. 100 Min.	TR10265P	POLYURETHANE PAINTING
	END FRAME, CLAMP PLATE, CROSS BEAM, T.G & T.C. BRACKETS, OTHER STEEL PARTS GOING INSIDE TRANS. TANK	IN SIDE	CHEMICAL & THERMAL RESISTANT EPOXY WHITE PAINT FLUSHED WITH VARNISH	*	SPRAY OR BRUSH	TRE/168	TOTAL DFT. 50 Min.		
	RADIATOR	OUT SIDE	i. CHEMICAL & THERMAL RESISTANT EPOXY ZINC PHOSPHATE PRIMER ii. POLYURETHANE FINISHING PAINT.	*	SPRAY OR BRUSH	TRE/166 OR AA56105 TRE/165 OR AA56142	50 Min. 50 Min. TOTAL DFT 100 Min.		
21	i. TRANSFORMER TANK & COVER, TOP TANK, BOT. TANK ii. TURRETS iii. INSPECTIONS COVERS, CONSERVATOR, HEADERS, A-FRAMES, P/W ETC.	IN SIDE OUT SIDE	OIL RESISTANT FULL GLOSSY WHITE PAINT i. CHEMICAL RESISTANT HIGH BUILD EPOXIED PRIMING PAINT. OR CHEMICAL & THERMAL RESISTANT EPOXY PRIMER ii. POLYURETHANE FINISHING PAINT SHADE 631 OF IS:5	2 1 2 1 OR 2	SPRAY OR BRUSH	BP56183 AA56109 AA56105 AA56142	40 Min. 50 Min. 50 Min. TOTAL DFT. 100 Min.	TR10211P TR10229P	

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10

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NOTE TO SHOP REVISED

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PRODUCT STANDARD

TRANSFORMER

SHOP/ENGG. INSTRUCTIONS

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7 पृष्ठों में 6

PAGE 6 OF 7

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PAGE 6 OF 7

1	2	3	4	5	6	7	8	9	10
SR NO	PARTS	SUR. FACE	PAINT	NO.OF COATS	HOW APPLIED	PAINT SPEC.	DRY PAINT FILM TK. MICRON	PROCESS SPEC.	REMARKS
22	i. TRANSFORMER TANK & COVER, TOP & BOT. TANK ii. TURRETS iii. INSPECTIONS COVERS, CONSERVATOR, HEADERS, A-FRAMES, P/W ETC.	IN SIDE	CHEMICAL & THERMAL RESISTANT EPOXY WHITE PAINT	*	SPRAY OR BRUSH	TRE/168	TOTAL DFT 50 Min		POLYURETHANE PAINTING
		OUT SIDE	i. CHEMICAL & THERMAL RESISTANT EPOXY ZINC PHOSPHATE PRIMER ii. EPOXY HB MIO ii. POLYURETHANE FINISHING PAINT.	*	SPRAY OR BRUSH	TRE/166 TRE/167 TRE/165	50 Min. 75 Min. 50 Min. TOTAL DFT. 155 Min.	TR10257P	
	END FRAME, CLAMP PLATE, CROSS BEAM, T.G & T.C. BRACKETS, OTHER STEEL PARTS GOING INSIDE TRANS. TANK		CHEMICAL & THERMAL RESISTANT EPOXY WHITE PAINT		SPRAY OR BRUSH	TRE/168	TOTAL DFT. 50 Min.		
	RADIATOR	IN SIDE OUT SIDE	FLUSHED WITH VARNISH i. CHEMICAL & THERMAL RESISTANT EPOXY ZINC PHOSPHATE PRIMER ii. POLYURETHANE FINISHING PAINT.	*	SPRAY OR BRUSH	TRE/382/03 TRE/166 TRE/165	50 Min. 50 Min. TOTAL DFT 100 Min.		

NOTE TO DO :

- EPOXY PAINTING TO BE CALLED WHEN SPECIFICALLY ASKED FOR BY THE CUSTOMERS.
 - EPOXY PAINTING HOWEVER TO BE CALLED WHEN EQUIPMENTS ARE TO BE INSTALLED IN CHEMICAL ATMOSPHERE OR NEAR SEA SHORES.
 - SHADE OF FINISHING PAINT IS TO BE COVERED ON MID/DRAWINGS ALONG WITH RESPECTIVE S.NO. OF THIS STD.
- (*) NUMBER OF COATS SHALL BE GIVEN TO ACHIEVE DFT AS PER COLUMN 08.

NOTE TO SHOP :

- PAINTING TO BE TOUCHED UP WHERE EVER REQUIRED BY TRANSFORMER SHOP BEFORE SHIPMENT.
- INSIDE SURFACE OF THE TANK IS THE SURFACE WHICH IS IN CONTACT WITH THE OIL. REMAINING SURFACE SHALL BE CONSIDERED AS OUTSIDE SURFACE.

पुनः Rev.21
दि. Dt.

17/11/21

SHEET RE-AFFIRMED.

Rashmi Nitin NKM

वितरण

DISTRIBUTION.

सं

स्वीकृत किया :

APPROVED : Sd / SRR, sd/SNA

पुनः Rev.22
दि. Dt.

26/08/23

NOTE TO SHOP REVISED

KDS NM

TRE/TRM/FTM
TRX/TTG/QC-TCB
/QA-TCB/JHANSI

11

जारी किया ISSUED
टीआरई मानक / TRE STD.

तैयार किया : PREPD.:
SD /-SJ

दिनांक : DATE :

23-03-1986

बीएचईएल



Form No. 2038

उत्पाद मानक

परिणामित्र

शाप/आ.का निर्देश

PRODUCT STANDARD

TRANSFORMER

SHOP/ENGG. INSTRUCTIONS

TR10005P

7 पृष्ठों में 7

PAGE 7 OF 7

REF TR10005P

COMP. DRG

APPROVED VENDORS FOR TRE SPECIFICATION PAINTS :

PAINT MAKE	INTERNAL SURFACE	EXTERNAL SURFACE		
	TRE / 168	TRE/166	TRE/167	TRE/165
ASIAN	APCODUR CF699 WHITE	APCODUR RAPID RECOAT ZP PRIMER GREY	APCODUR RAPID RECOAT HB MIO	APCOTHANE CF678
AKZO NOBEL	INTERLINE 1012 WHITE	INTERGUARD 251	INTER GUARD 966	INTERTHANE 990
JOTUN	PENGAURD HB WHITE	PENGUARG HSP ZP	PENGUARG MID COAT MIO	HARD TOP XP
CHING	CHING EP EMC 182 WHITE	CHING EP PRIMER EMD 183	CHING EP MIO EMD 30	CHING EP TOP COAT ADD47

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TR10005P

PAGE 7 OF 7

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दि. Dt.
17/11/21

SHEET RE-AFFIRMED.

Rashmi *Nitin* *NKM*
RASHMI NITIN NKM

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स्वीकृत किया :
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TRX/TTG/QC-TCB
/QA-TCB/JHANSI

12

जारी किया ISSUED
टीआरई मानक / TRE STD.
तैयार किया : PREPD.:
SD /-SJ

दिनांक : DATE :

23-03-1986

पुनः Rev.22
दि. Dt.
26/08/23

NOTE TO SHOP REVISED

KDS *NM*
KDS NM



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PRODUCT STANDARD

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SHOP/ENGG. INSTRUCTION

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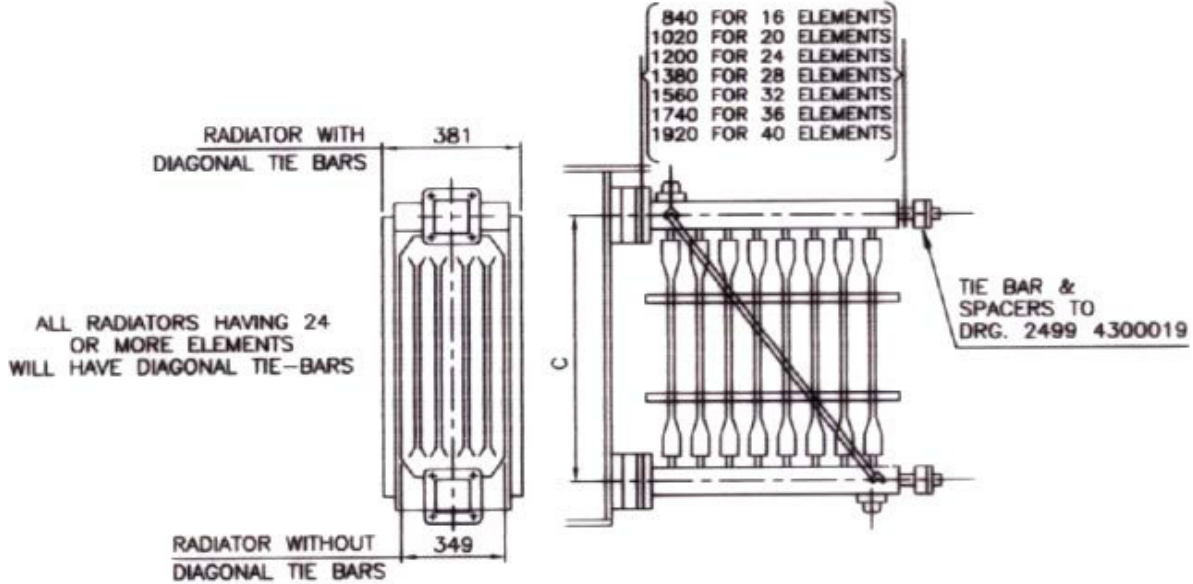
2 पृष्ठों में 1

PAGE 1 OF 2

REF. C600717 (R 26)

COMP. DRG.

Title : RADIATORS
(A). 5 FLUTE ELEMENTS



"C" VALVE CENTRES	OIL QUANTITY IN LITRES							SURFACE AREA IN SQ. METERS						
	NUMBER OF ELEMENTS							NUMBER OF ELEMENTS						
	16	20	24	28	32	36	40	16	20	24	28	32	36	40
1300 mm	57.00	70.50	85.00	99.00	112.00	-	-	13.39	16.73	20.07	23.40	26.74	-	-
1600 mm	67.00	83.50	100.00	116.50	133.00	-	-	16.70	20.87	25.03	29.20	33.37	-	-
2020 mm	85.00	105.00	125.50	146.00	166.50	-	-	21.34	26.66	31.99	37.31	42.64	-	-
2325 mm	95.00	118.00	141.00	165.00	188.00	211.00	-	24.71	30.87	37.04	43.21	49.37	55.54	-
2630 mm	-	131.50	157.00	183.00	209.00	235.00	261.00	-	35.08	42.09	49.10	56.11	63.12	70.13
2935 mm	-	-	173.00	202.00	230.00	258.50	287.00	-	39.29	47.14	54.99	62.84	70.69	78.54
3500 mm	-	-	203.00	237.00	269.00	302.00	335.00	-	47.08	56.49	65.90	75.30	84.71	94.11

"C" VALVE CENTRES	WEIGHTS FOR RADIATOR (WITHOUT OIL) IN KGS.						
	NUMBER OF ELEMENTS						
	16	20	24	28	32	36	40
1300 mm	169.00	208.00	257.50	297.00	337.00	-	-
1600 mm	204.00	251.50	310.00	359.00	407.00	-	-
2020 mm	253.00	313.00	385.00	446.00	506.00	-	-
2325 mm	288.00	357.00	439.00	509.00	578.00	647.50	-
2630 mm	-	404.50	494.00	572.00	650.50	729.00	807.00
2935 mm	-	446.00	548.00	635.00	722.00	809.00	896.00
3500 mm	-	528.40	648.00	751.70	854.40	957.20	1061.00

NOTES :-

- FOR GENERAL ARRANGEMENT REFER DRG. NO. 04994300007.
- RADIATORS UP TO 32 ELEMENTS SHALL BE PREFERRED.
- THIS DRG. REPLACES DRG. C600717 (R-2-6) & THE WEIGHTS AND OIL QUANTITY IS COMPLETELY REVISED.

TR20081R

PAGE 1 OF 2

पुनःRev.
05
दि. Dt.
10/06/21

SHEET REAFFIRMED.

Rashmi *Nitin* *NKM*
RASHMI NITIN NKM

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स्वीकृत किया :

APPROVED : Sd/- BSB , SNA

पुनःRev.
04
दि. Dt.
10/07/14

SHEET REAFFIRMED.

ARVIND S.K.G. A.DEOTA

TRE/TRM/FTM
TRX/TTG
QC-TCB/QA-TCB
JHANSI

13

तैयार किया PREPD.

Sd/- TRS

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दिनांक DATE

16.04.90



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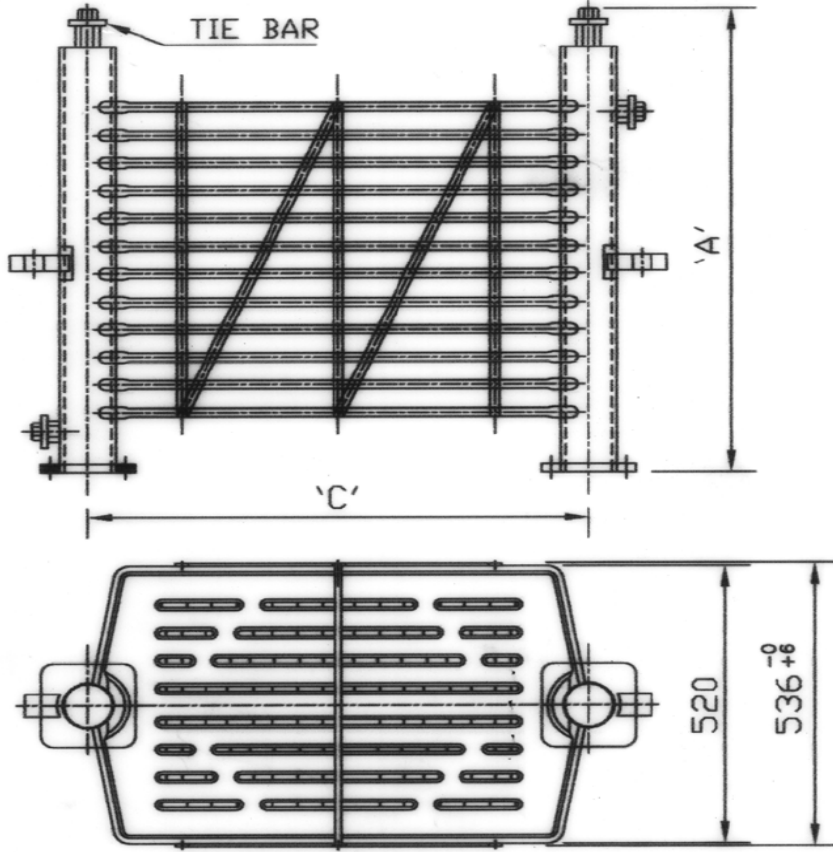
REF. C600717 (R 26)

COMP. DRG.

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Title : RADIATORS (B). 9 FLUTE ELEMENTS



NO. OF ELEMENTS	DIMENSION "A"
12	816
14	926
16	1036
18	1146
20	1256
22	1366
24	1476
26	1586
28	1696

"C" VALVE CENTRES	WEIGHTS FOR RADIATOR (WITHOUT OIL) IN KGS.								
	NUMBER OF ELEMENTS								
	12	14	16	18	20	22	24	26	28
1200 mm	176.00	204.00	232.00	262.00	290.00	318.00	347.00	376.00	404.00
1600 mm	231.00	269.00	306.00	344.00	381.00	420.00	458.00	496.00	534.00
1800 mm	259.00	301.00	343.00	386.00	426.00	471.00	513.00	556.00	599.00
2400 mm	342.00	389.00	454.00	511.00	564.00	623.00	679.00	736.00	792.00
3000 mm	425.00	495.00	565.00	636.00	703.00	776.00	846.00	916.00	986.00
3500 mm	-	-	-	742.00	820.00	905.00	987.00	1069.00	1150.00

NOTES:-

1. FOR GENERAL ARRANGEMENT REFER DRG. NO. 04994300010.

SURFACE AREA IN SQ. METERS

NUMBER OF ELEMENTS

OIL QUANTITY IN LITRES

NUMBER OF ELEMENTS

"C" VALVE CENTRES

NUMBER OF ELEMENTS

"C" VALVE CENTRES	SURFACE AREA IN SQ. METERS										OIL QUANTITY IN LITRES																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
	12	14	16	18	20	22	24	26	28	30	12	14	16	18	20	22	24	26	28	30																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
1200 MM	59.00	68.50	78.00	87.50	97.00	-	-	-	-	-	16.20	18.89	21.57	24.26	26.96	-	-	-	-	-	39.45	44.36	49.02	53.70	58.44	63.17	67.90	72.63	77.36	82.09	86.82	91.55	96.28	101.01	105.74	110.47	115.20	119.93	124.66	129.39	134.12	138.85	143.58	148.31	153.04	157.77	162.50	167.23	171.96	176.69	181.42	186.15	190.88	195.61	200.34	205.07	209.80	214.53	219.26	223.99	228.72	233.45	238.18	242.91	247.64	252.37	257.10	261.83	266.56	271.29	276.02	280.75	285.48	290.21	294.94	299.67	304.40	309.13	313.86	318.59	323.32	328.05	332.78	337.51	342.24	346.97	351.70	356.43	361.16	365.89	370.62	375.35	380.08	384.81	389.54	394.27	399.00	403.73	408.46	413.19	417.92	422.65	427.38	432.11	436.84	441.57	446.30	451.03	455.76	460.49	465.22	469.95	474.68	479.41	484.14	488.87	493.60	498.33	503.06	507.79	512.52	517.25	521.98	526.71	531.44	536.17	540.90	545.63	550.36	555.09	559.82	564.55	569.28	574.01	578.74	583.47	588.20	592.93	597.66	602.39	607.12	611.85	616.58	621.31	626.04	630.77	635.50	640.23	644.96	649.69	654.42	659.15	663.88	668.61	673.34	678.07	682.80	687.53	692.26	696.99	701.72	706.45	711.18	715.91	720.64	725.37	730.10	734.83	739.56	744.29	749.02	753.75	758.48	763.21	767.94	772.67	777.40	782.13	786.86	791.59	796.32	801.05	805.78	810.51	815.24	819.97	824.70	829.43	834.16	838.89	843.62	848.35	853.08	857.81	862.54	867.27	872.00	876.73	881.46	886.19	890.92	895.65	900.38	905.11	909.84	914.57	919.30	924.03	928.76	933.49	938.22	942.95	947.68	952.41	957.14	961.87	966.60	971.33	976.06	980.79	985.52	990.25	994.98	999.71	1004.44	1009.17	1013.90	1018.63	1023.36	1028.09	1032.82	1037.55	1042.28	1047.01	1051.74	1056.47	1061.20	1065.93	1070.66	1075.39	1080.12	1084.85	1089.58	1094.31	1099.04	1103.77	1108.50	1113.23	1117.96	1122.69	1127.42	1132.15	1136.88	1141.61	1146.34	1151.07	1155.80	1160.53	1165.26	1169.99	1174.72	1179.45	1184.18	1188.91	1193.64	1198.37	1203.10	1207.83	1212.56	1217.29	1222.02	1226.75	1231.48	1236.21	1240.94	1245.67	1250.40	1255.13	1259.86	1264.59	1269.32	1274.05	1278.78	1283.51	1288.24	1292.97	1297.70	1302.43	1307.16	1311.89	1316.62	1321.35	1326.08	1330.81	1335.54	1340.27	1345.00	1349.73	1354.46	1359.19	1363.92	1368.65	1373.38	1378.11	1382.84	1387.57	1392.30	1397.03	1401.76	1406.49	1411.22	1415.95	1420.68	1425.41	1430.14	1434.87	1439.60	1444.33	1449.06	1453.79	1458.52	1463.25	1467.98	1472.71	1477.44	1482.17	1486.90	1491.63	1496.36	1501.09	1505.82	1510.55	1515.28	1519.91	1524.64	1529.37	1534.10	1538.83	1543.56	1548.29	1553.02	1557.75	1562.48	1567.21	1571.94	1576.67	1581.40	1586.13	1590.86	1595.59	1600.32	1605.05	1609.78	1614.51	1619.24	1623.97	1628.70	1633.43	1638.16	1642.89	1647.62	1652.35	1657.08	1661.81	1666.54	1671.27	1676.00	1680.73	1685.46	1690.19	1694.92	1700.65	1705.38	1710.11	1714.84	1719.57	1724.30	1729.03	1733.76	1738.49	1743.22	1747.95	1752.68	1757.41	1762.14	1766.87	1771.60	1776.33	1781.06	1785.79	1790.52	1795.25	1800.98	1805.71	1810.44	1815.17	1819.90	1824.63	1829.36	1834.09	1838.82	1843.55	1848.28	1853.01	1857.74	1862.47	1867.20	1871.93	1876.66	1881.39	1886.12	1890.85	1895.58	1900.31	1905.04	1909.77	1914.50	1919.23	1923.96	1928.69	1933.42	1938.15	1942.88	1947.61	1952.34	1957.07	1961.80	1966.53	1971.26	1975.99	1980.72	1985.45	1990.18	1994.91	1999.64	2004.37	2009.10	2013.83	2018.56	2023.29	2028.02	2032.75	2037.48	2042.21	2046.94	2051.67	2056.40	2061.13	2065.86	2070.59	2075.32	2080.05	2084.78	2089.51	2094.24	2098.97	2103.70	2108.43	2113.16	2117.89	2122.62	2127.35	2132.08	2136.81	2141.54	2146.27	2151.00	2155.73	2160.46	2165.19	2169.92	2174.65	2179.38	2184.11	2188.84	2193.57	2198.30	2203.03	2207.76	2212.49	2217.22	2221.95	2226.68	2231.41	2236.14	2240.87	2245.60	2250.33	2255.06	2259.79	2264.52	2269.25	2273.98	2278.71	2283.44	2288.17	2292.90	2297.63	2302.36	2307.09	2311.82	2316.55	2321.28	2326.01	2330.74	2335.47	2340.20	2344.93	2349.66	2354.39	2359.12	2363.85	2368.58	2373.31	2378.04	2382.77	2387.50	2392.23	2396.96	2401.69	2406.42	2411.15	2415.88	2420.61	2425.34	2430.07	2434.80	2439.53	2444.26	2448.99	2453.72	2458.45	2463.18	2467.91	2472.64	2477.37	2482.10	2486.83	2491.56	2496.29	2501.02	2505.75	2510.48	2515.21	2519.94	2524.67	2529.40	2534.13	2538.86	2543.59	2548.32	2553.05	2557.78	2562.51	2567.24	2571.97	2576.70	2581.43	2586.16	2590.89	2595.62	2600.35	2605.08	2609.81	2614.54	2619.27	2624.00	2628.73	2633.46	2638.19	2642.92	2647.65	2652.38	2657.11	2661.84	2666.57	2671.30	2676.03	2680.76	2685.49	2690.22	2694.95	2700.68	2705.41	2710.14	2714.87	2719.60	2724.33	2729.06	2733.79	2738.52	2743.25	2747.98	2752.71	2757.44	2762.17	2766.90	2771.63	2776.36	2781.09	2785.82	2790.55	2795.28	2800.01	2804.74	2809.47	2814.20	2818.93	2823.66	2828.39	2833.12	2837.85	2842.58	2847.31	2852.04	2856.77	2861.50	2866.23	2870.96	2875.69	2880.42	2885.15	2889.88	2894.61	2899.34	2904.07	2908.80	2913.53	2918.26	2922.99	2927.72	2932.45	2937.18	2941.91	2946.64	2951.37	2956.10	2960.83	2965.56	2970.29	2975.02	2979.75	2984.48	2989.21	2993.94	2998.67	3003.40	3008.13	3012.86	3017.59	3022.32	3027.05	3031.78	3036.51	3041.24	3045.97	3050.70	3055.43	3060.16	3064.89	3069.62	3074.35	3079.08	3083.81	3088.54	3093.27	3098.00	3102.73	3107.46	3112.19	3116.92	3121.65	3126.38	3131.11	3135.84	3140.57	3145.30	3150.03	3154.76	3159.49	3164.22	3168.95	3173.68	3178.41	3183.14	3187.87	3192.60	3197.33	3202.06	3206.79	3211.52	3216.25	3220.98	3225.71	3230.44	3235.17	3239.90	3244.63	3249.36	3254.09	3258.82	3263.55	3268.28	3273.01	3277.74	3282.47	3287.20	3291.93	3296.66	3301.39	3306.12	3310.85	3315.58	3320.31	3325.04	3329.77	3334.50	3339.23	3343.96	3348.69	3353.42	3358.15	3362.88	3367.61	3372.34	3377.07	3381.80	3386.53	3391.26	3395.99	3400.72	3405.45	3410.18	3414.91	3419.64	3424.37	3429.10	3433.83	3438.56	3443.29	3448.02	3452.75	3457.48	3462.21	3466.94	3471.67	3476.40	3481.13	3485.86	3490.59	3495.32	3500.05	3504.78	3509.51	3514.24	3518.97	3523.70	3528.43	3533.16	3537.89	3542.62	3547.35	3552.08	3556.81	3561.54	3566.27	3571.00	3575.73	3580.46	3585.19	3589.92	3594.65	3599.38	3604.11	3608.84	3613.57	3618.30	3623.03	3627.76	3632.49	3637.22	3641.95	3646.68	3651.41	3656.14	3660.87	3665.60	3670.33	3675.06	3679.79	3684.52	3689.25	3693.98	3698.71	3703.44	3708.17	3712.90	3717.63	3722.36	3727.09	3731.82	3736.55	3741.28	3746.01	3750.74	3755.47	3760.20	3764.93	3769.66	3774.39	3779.12	3783.85	3788.58	3793.31	3798.04	3802.77	3807.50	3812.23	3816.96	3821.69	3826.42	3831.15	3835.88	3840.61	3845.34	3850.07	3854.80	3859.53	3864.26	3868.99	3873.72	3878.45	3883.18	3887.91	3892.64	3897.37	3902.10	3906.83	3911.56	3916.29	3921.02	3925.75	3930.48	3935.21	3939.94	3944.67	3949.40	3954.13	3958.86	3963.59	3968.32	3973.05	3977.78	3982.51	3987.24