

ANNEXIURE – I

TECHNICAL SPECIFICATIONS

**EQUIPMENTS FOR MODIFICATION OF
EXISTING WET FLUX TYPE CGL (CMIFPE PROJ #2089)
TO PRODUCE 55% Al-Zn (GL) COATED COILS**

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CMI FPE PROJECT N°. - S.1920.1000.006

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CHAPTER- 1

TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATIONS :
A. Site Conditions

Ambient temperature	45 °C max
Average temperature	32 °C
Relative humidity	90% RH max.
Height above mean sea level	1000 m max

B. Material Specification

Material	Cold rolled low carbon steel, FH Oil content : 500 mg/m ² max both sides together Iron fines : 100 mg/m ² max both sides together.
UTS	250 to 700 N/ mm ²
Strip Thickness	0.14 mm (min) / 0.60 mm (max)
Strip Width	610 mm (min) / 1250 mm (max)

Incoming Coil Data

Weight	20000 kgs. (Max)
Inside Diameter	508 mm/ 610mm
Outside Diameter	1800 mm max. / 900 mm min.

Outgoing Coil Data

Weight	20,000 kgs. (Max.)
Inside Diameter	508 mm
Outside Diameter	1800 mm max. / 900 mm min.

Coating Range

55% Al-Zn coating (GL)
Zn (43.4%); Si (1.6%); Al (55%)
50 to 200 g / m² both sides together
(As per JIS G-3321-2010) or equal

Surface condition	Normal spangle Antifinger print coating
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C. Line Specification

Type	Non-Oxidation Furnace type Continuous metal coating Line for 55% AlZn Coating (GL).
Line direction	Right to left
Line Speed (*):	
Entry Section	150 mpm (max)
Process Section	120 mpm (max)
Exit Section	150 mpm (max)
Threading Speed	20 mpm
Furnace Capacity	16 Ton/hr.max for FH 10 Ton/hr.max for CQ
Dragout rate from pot	1800 kg/hr max (on 200 gm/m2 coating weight)

CHAPTER- 2

UTILITY SUPPLY CONDITIONS

Fuel Gas:

Type	LPG gas
Low caloric value:	26500 kcal/Nm ³
Fluctuation range of LCV:	± 2%
Supply pressure:	0,3MPa

Recirculated cooling water:

Pressure:	0,5 MPa AVT SOFT floor level
Inlet temperature:	33°C
Outlet temperature:	45°C
Total hardness:	35 ppm as CaCO ₃
pH:	6,8-7,8
Alkalinity:	160 ppm
Fe:	0.5 ppm
SO ₄ :	90 ppm
Cl:	< 20 ppm
Suspended solids:	< 20 mg/l

Demineralized water / RO water.

Pressure:	0.35 - 0,5 MP at floor level
Temperature:	30°C
Total hardness:	< 2 ppm as CaCO ₃
pH:	7-8
Cl:	< 1 mg/l
Suspended solids:	< 5 mg/l

Compressed air:

Pressure:	0.4 - 0,6 MPa
Quality:	Industrial
Temperature:	ambient.
Dew point at 0.5 MPa	< 3°C

Compressed air for instrumentation:

Pressure:	0,4-0.60 MPa
Quality:	dried and oil free
Dew point at 1 bar :	-60°C .
Dust particles: 95%	<5 microns

Purging N2

- Purity	at least 99.95 %
- H2 content	0.5% max
- O2	5 ppm max
- Dew point	(-) 60 deg C
- Pressure	1800 mm WG

Hydrogen-H2

- Pressure	2500 mm WG
- Purity	99.999%
-Dew point@Top	(-) 60 deg C
-Oxygen(O2)	< 2 ppm

Protective Gas (HNX)

- N2H2 mixture :	
- H2 content	15% normal / 25 % max
- O2	5 ppm max.
- N2	balance.
- Dew point	(-) 60 deg C

Power supply

Low voltage	AC 415V +/-10%, 3 phases
Frequency	50 Hz +/- 3%
Control voltage	220 VAC, 48 VDC, 24 VDC, 12VDC

Utility Requirements (approx. figures subject to confirmation during detail design stage)

Parameter	Installed	(*) Consumption
LPG gas	140 Nm ³ /hr	7 Nm ³ /Ton for FH 8.5 Nm ³ /Ton for CQ
Recirculating water	200 m ³ /hr	
Emergency cooling water	45 m ³ / hr for 0-1 hr. 15 m ³ /hr for 1-4 hr.	
DM water	2 m ³ / hr	
Steam	1200 kg/hr	
N ₂	265 Nm ³ / hr.	
H ₂	42 Nm ³ / hr	

Note (*) : consumption figures are based on Reference size 0.25 mm x 960 mm, 108.8 mpm, 12.3 ton/hr FH grade.

CHAPTER- 3

PRODUCTION CAPACITY

The line proposed is for continuous operation 3 shifts of 24 hours per day

Calendar hours = 24 hrs/day x 365 days/yr = 8760 hours

Annual maintenance = 15 days x 24 hrs/day = 360 hours

Weekly maintenance = 8 hrs / week x 50 weeks = 400 hours

Net available time = 8760-360-400 = 8000 hours

Working factor = 0.9

Speed factor = 0.9

Production time available = 8000 x 0.9 x 0.9 = 6480 hours approx.

PRODUCT MIX

Strip Thickness	Width	Grade	% of Annual Production	Ton/yr	Ton/hr	Hours
0.20	960	FH	55%	38500	10.9	3532
0.25	960	FH	28%	19600	12.3	1593
Subtotal			83%	58100		5125
0.25	960	CQ	7%	4900	7.7	636
0.30	960	CQ	10%	7000	7.7	909
Subtotal			17%	11900		1545
Total			100%	70,000		6670

SPEED Vs GAUGE CHART
FH Grade

Thickness	Speed	Width (mm)				
(mm)	(mpm)	800	960	1050	1150	1250
0.14	120	6.4	7.6	8.4	9.1	9.9
0.15	120	6.8	8.2	9	9.8	11
0.18	120	8.2	9.8	10.7	11.7	13
0.20	120	9.1	10.9	11.9	13.0	14
0.22	120	10	12	13.1	14.3	16
0.25	108.8	10.3	12.3	13.5	14.8	16
0.30	90.6	10.3	12.3	13.5	14.8	16
0.35	77.7	10.3	12.3	13.5	14.8	16
0.40	68	10.3	12.3	13.5	14.8	16
0.45	60.4	10.3	12.3	13.5	14.8	16
0.50	54.4	10.3	12.3	13.5	14.8	16
(*) 0.60	45.3	10.3	12.3	13.5	14.8	16

(*) – Not recommended due to low line speed.

CQ Grade :

Thickness	Speed	Width (mm)				
(mm)	(mpm)	800	960	1050	1150	1250
0.14	120	6.4	7.6	8.4	9.1	9.9
0.15	113.3	6.5	7.7	8.5	9.3	10
0.18	94.4	6.5	7.7	8.5	9.3	10
0.20	85	6.5	7.7	8.5	9.3	10
0.22	77.3	6.5	7.7	8.5	9.3	10
0.25	68	6.5	7.7	8.5	9.3	10
0.30	56.7	6.5	7.7	8.5	9.3	10
0.35	48.6	6.5	7.7	8.5	9.3	10

CHAPTER- 4

SCOPE OF SUPPLY / EQUIPMENT LIST

DIVISION LIST OF SCOPE OF SUPPLY :

BE: Basic Engineering DE: Detail Engineering SU: Supply
ER: Erection SC: Supervision of Erection & Supervision of commissioning
S : Seller (CMI FPE) P : End User (CSL)

Item No.	Qty. Nos.	Description	BE	DE	SU	ER	SC	Remarks
		<u>General</u>						
1.		Civil foundation for supplied equipments	S	P	P	P	P	Only Load data and foundation bolt plan by Seller
2.		Embedded steel work, trench and pit covers, permanent floor plating, manhole covers, hand-railing, fencing, electrical panel supports	P	P	P	P	P	
3.		Effluent & waste piping and effluent disposal	P	P	P	P	P	
4.		Unloading, Storage and protection of delivered equipment	P	P	P	P	P	
5.		Ventilation and air conditioning system for ECR, operation pul-pits.	S	P	P	P	P	Heat load will be provided
6.		Shop lighting, equipment and general lighting Pot cellar lighting.	P	P	P	P	P	
7.		Fire alarm or extinguishing equipments	P	P	P	P	P	
8.		Cranes & other material handling equipments	P	P	P	P	P	
9.	Lot	Hydraulic oils, flushing oils, lubricating oils, grease, including their first fill	S	P	P	P		
10.	Lot	Process consumables like 55% Al-Zn ingots, electricity, fuel gas, protective gas(N ₂ H ₂) in required proportion, chemicals, input metal coils , computer stationary, cotton waste, etc.	S	P	P			
11.	Lot	Utility services like compressed air, cooling water, DM water, fuel gas, N ₂ & H ₂ gas, Electricity etc up to battery limit	S	P	P	P	P	Battery limit is +1.5 m above nearest building column

Item No.	Qty. Nos.	Description	BE	DE	SU	ER	SC	Remarks
12.	set	Necessary skilled & unskilled personnel to start and run the line in test and operating conditions	S	P	P			
13.	set	Site office with required furniture, lighting and free telecommunication facilities like telephones, e-mails, Sanitation facility for the Supervisory personnel during the time of erection and commissioning	P	P	P	P		
14.	set	Maintenance tools.	P	P	P			
15.	set	<u>Special tools</u> -Threading needle with chain – 1 set -Hearth roll removal rig – 1 no. -Turn buckles for inductor removal– 4 set (8 nos) -Screw jacks for inductor removal – 2 nos -Inductor handling trolley inside pot cellar – 1 no.	S	S	S			New
16.	set	Roll shop equipments, Roll stands.	P	P	P			
17.	set	Laboratory equipments / instruments.	S	P	P			
18.	set	Any modification or rectification or relocation of existing line equipment for incorporating the new supplied equipment	S	S	P	P	S	
19.		Site preparation for installation of new supplied equipments	P	P	P			
		<u>Line Equipment</u>						
1.		Entry Section						
1.1.	1 No	Deflector roll D1 (Degreasing section by-pass roll)	S	S	S	P	S	New
1.2.	1 set	Hot Air dryer	S	S	S	P	S	New
1.3.	1 set	Bridle B1	S	S	S	P	S	New
1.4.	1 set	Steering system No.S1	S	S	S	P	S	New
1.5.	Lot	Strip support rolls	S	S	S	P	S	New

Item No.	Qty. Nos.	Description	BE	DE	SU	ER	SC	Remarks
1.6.	1 no	Deflector roll no.D2	S	S	S	P	S	New
1.7.	1 no	Deflector roll no.D3 with snubber roll and Load cell	S	S	S	P	S	New
2.		<u>Process Section</u>						
2.1.	1 set	Furnace support structure with staircase, hand-rails	S	S	P	P	S	New
2.2.	1 set	<u>Non-Ox Furnace</u> Entry seal and Tunnel Section Preheat section (non-ox) Throat section Radiant tube heating section – LPG fired Soaking section SCH section Jet cool section Calm Zone Exit section with furnace bridle, down chute and snout. N ₂ H ₂ gas mixing station N ₂ H ₂ heater Gas analysers LPG leakage detector portable type -2nos	S	S	S	P	S	New
2.3.		Ceramic pots	S	S	S	P	S	Refer Appendix-II for details. Erection includes refractory lining work at site
2.4.	1 set	Ingot feeding arrangement at Pre-melt pot	S	S	P	P	S	New
2.5.	1 set	Pot cellar ventilation system	S	S	S	P	S	New
2.6.		Pot equipments						
2.6.1.	1 set	Sink roll assembly with roll scrapper	S	S	S	P	S	New
2.6.2.	1 set	Deflector roll assembly with roll scrapper	S	S	S	P	S	New
2.6.3.	1 set	Jet wiper assembly (Air knife)	S	S	S	P	S	New
2.6.4.	1 set	Edge baffle arrangement	S	S	S	P	S	New
2.6.5.		<u>Jet Blower with ducting</u>	-	-	-	-	-	

Item No.	Qty. Nos.	Description	BE	DE	SU	ER	SC	Remarks
	1no	Jet blower (positive displacement type)	P	P	P	P	S	Existing to be used
	1no	Jet blower (Multistage turbo blower)	S	S	S	P	S	New
	1 set	Ductings and duct supports	S	S	P	P	S	New
	1 set	Air knife globe valves (2 nos) and SS braided flexible hoses (2 nos)	S	S	S	P	S	New
2.6.6.	1 set	Covers over openings around pot and pot cellar	S	S	P	P	S	New
2.6.7.	2 no	5 Ton Hoist for Pot Inductor handling	S	P	P	P	S	New
2.6.8.	1 set	Pot equipment handling crane with rails and support structure	S	S	P	P	S	New
2.7.		<u>After Pot Cooling tower (APC)</u>						
2.7.1.	1 lot	Tower structure modification	S	S	P	P	S	New augmented structure
2.7.2.	1 set	5 ton maintenance crane above cooling tower structure	S	P	P	P	S	New
2.7.3.	2 set	<u>Strip Cooling pendants</u> Movable vertical up-leg cooling pendants mounted on common motorised trolley with Fan and ductings.	S	S	S	P	S	New
2.7.4.	1 set	Deflector Roll No.5 with roll scrapper and strip clamp at cooling tower	S	S	S	P	S	Only new roll with new roll scrapper and new strip clamp arrangement.
2.7.5.	1 no	Tinsel scrapper	S	S	S	P	S	New
2.7.6.	1 no	Roller table	S	S	S	P	S	New
2.7.7.	1 no	Roll Scrapper for Deflector Roll No 6 at cooling tower with strip clamp	S	S	S	P	S	Existing roll with new roll scrapper and strip clamp arrangement.
2.8.	1 set	Water Quench tank	S	S	S	P	S	New
2.9.	1 set	Air Dryer	S	S	S	P	S	New
2.10.	1 set	Steering System no S2	S	S	S	P	S	New
2.11.	1 set	Deflector Roll No D4 with load cell	S	S	S	P	S	New
2.12.	1 set	Coating weight gauge with support rolls	S	S	S	P	S	New

Item No.	Qty. Nos.	Description	BE	DE	SU	ER	SC	Remarks
2.13.	1 set	Roller table	S	S	P	P	S	Existing table modification
2.14.	1 Set	Bridle B2 (New chrome plated rolls and new gear boxes)	S	S	S	P	S	Existing Bridle no.3 to be relocated Existing motors and drive to be used.
3.		Chemical treatment section						
3.1.	1set	Chemical coater no.1 (squeeze roll type)	S	S	S	P	S	New (stand-by)
3.2.	1 set	Chemical coater no.2 (Roll coater)	S	S	S	P	S	New
3.3.	1 set	Chemical supply system (common for Coater no1 & Coater no2)	S	S	S	P	S	New
3.4.	1 set	Chemical Dryer	S	S	S	P	S	New – LPG fired
3.5.	1 set	Air cooling pendant with fan and ducting	S	S	S	P	S	New
3.6.	1 set	Bridle B3 (with water cooled rolls)	S	S	S	P	S	New
3.7.	1 no	Water cooled roll no.D5	S	S	S	P	S	New
3.8.	1 no	Deflector roll at entry of Exit accumulator	S	S	S	P	S	New
3.9.	1 no	Strip clamp no.4 frame modification	S	S	P	P	S	Existing with Modification
3.10.	1 set	Gearboxes for Bridle no.4	S	S	S	P	S	New
4.		Auxiliary Systems						
4.1.	set	Electrical Controls	Refer Appendix-I for details					
4.2.	set	Hydraulic system	S	S	S	P	S	For the new equipments
4.3.	set	Interconnecting piping (for utility services) including fittings and supports within battery limit	S	S	S	P	S	For the new equipments
4.4.	set	Foundation bolts, wedges and packing plates	S	S	S	P	S	For the new equipments
4.5.	set	Bridging tables and access platforms for maintenance	S	S	P	P	S	For the new equipments

Item No.	Qty. Nos.	Description	BE	DE	SU	ER	SC	Remarks
4.6.	1 set 1 set 3 set 3 set 1 set 6 no 2 no 2 no 1 no	<u>Operating spares :</u> Sink roll rig (beam, arms, roll) Deflector roll rig (beam, arms, roll) Sink roll bushes Deflector roll bushes Air knife Applicator roll for Chemical coater Pickup roll for Chemical coater Squeeze roll for Chemical coater Inductor for ceramic pot	S	S	S			New
4.7.	set	Drawings and documents	S	S	S			
4.8.	set	N2 Plant	S	P	P	P	P	Seller will provide the basic data
4.9.	set	H2 plant	S	P	P	P	P	Seller will provide the basic data
4.10.	set	Touchup painting at site after Erection			P			

Note : -Proposed reuse of the existing equipments depends on the actual working condition of the equipment.

CHAPTER- 5

DESCRIPTIVE SPECIFICATIONS FOR ADDITIONAL EQUIPMENT

1. ENTRY EQUIPMENT

1.1. Deflector Roll No.D1

This is used to deflect the strip towards upwards to deflector roll no.D2 in order to by-pass the degreasing section. This is a tubular steel construction supported in antifriction bearings carried in plummer blocks which are mounted on fabricated steel frame.

Roll : 320 mm Ø x 1500 mm barrel length. Chrome plated .

1.2. Hot Air Dryer

This consists of a fabricated box construction with number of air headers with slit opening. The headers are chevron type and on both sides of the strip. One strip support roll will be provided at the entry side. A forced draft fan with flexible joint & inlet damper and Steam-Air heat exchanger will be provided to supply the hot air to the dryer.

Fan -10000 m³/hr

Heat exchanger-250000 kcal/hr

1.3. Bridle no.B1

This device is used to maintain required strip tension in the degreasing section. This consists of horizontal configuration of rolls and drive arrangement.

Bridle Rolls : 2 nos, 320 mm dia x 1500 mm barrel length, neoprene coated, mounted in antifriction bearings housings fixed to the stand.

Stands : Fabricated steel construction, machined.

Drive : Individual rolls are driven by AC variable speed motors through reduction gear boxes.

Snubber roll : 200 mm dia x 1400 mm barrel length, neoprene coated. Actuated by pneumatic cylinder.

1.4. Steering System no.S1

This is an arrangement for centering the strip before it enters the non-oxidising furnace. This consists of a fixed vertical frame on which another pivoted frame with steering rolls is mounted, which swings under the controlled movement of a hydraulic cylinder.

This is an electro-hydraulic system in which inductive sensor continuously monitors the exact position of moving strip, transmit a continuous electronic signal to signal processor to a servo valve. Servo valve is integrated with electro-hydraulic power unit to direct the flow of oil to the hydraulic cylinder which positions the guide providing accurate alignment of the strip.

Type : Two (2) rolls Off set pivot guide.

No. of Rolls : 2 Nos. 320 mm Ø x, 1600 mm barrel , tubular steel construction and chrome plated .supported at each end with antifriction bearings and plummer blocks.

1.5. Strip support rolls

These are suitable number of support rolls used to support the strip on its way above degreasing section towards furnace section

Roll size : 110 mm dia x 1500 mm barrel. Chrome plated.

1.6. Deflector Roll No.D2

Roll : 320 mm Ø x 1500 mm barrel length. Chrome plated .

This is a tubular steel construction supported in antifriction bearings carried in plummer blocks which are mounted on fabricated steel frame. This is used to deflect the strip upwards into Deflector roll No.D3 located before the furnace.

1.7. Deflector Roll No.D3 with snubber roll and load cell arrangement

This is a tubular steel construction supported in antifriction bearings carried in plummer blocks which are mounted on fabricated steel frame. This is used to deflect the strip horizontally into Non-Ox furnace.

Roll : 320 mm Ø x 1500 mm barrel length. Chrome plated .
Snubber roll : Dia 200mm x 600 mm barrel, Chrome plated
Actuated by pneumatic cylinder
Drive – AC geared motor.

Load cell arrangement-

Load cells will be provided at this roll to measure strip tension in the furnace.

2. *PROCESS SECTION*

2.1. Furnace supporting structure

The structure will be made using standard rolled sections. All the support structure is built up from steel columns, joist and bracing section welded or bolted together.

To allow thermal expansion of the furnace, it is fixed below the exit section and allowed to expand on roller support towards the entry side.

The structure includes:

Main and secondary supporting structures

Access stairs

Handrails

Walkways platforms

2.2. Non-Oxidising Furnace

Description :

This furnace is a “horizontal” shaped construction designed for processing Cold rolled strip. This non-oxidising furnace is designed for the production capacity of 16 MT/hr for FH & 10 MT/hr for CQ.

Strip Tensions

Recommended strip tension in the furnace section ranges from 0.5 to 1 Kg/Sq mm. The operating tension will be determined during the commissioning in accordance with the strip characteristics and set to the running conditions of the line.

Thermal Cycles-

For FH (Full Hard) quality

Heating under non oxidizing atmosphere from atmospheric temperature to 500°C in a direct fired non ox section.

Heating the strip to temperature of 550°C in radiant tube heating furnace

Maintaining strip temp in jet cooling zone to 540°C till dipping inside the pot.

For CQ (Commercial Quality)

Heating the strip under non oxidizing atmosphere from atmospheric temperature to 650°C in a Direct Fired non-ox section.

Heating the strip to temperature of 650°C to 720°C in Radiant tube furnace section and maintaining at 720°C in the Soaking Section protective atmosphere.

Cooling down in jet cooling zone to 560°C till dipping inside the pot.

Brief Description Of The Furnace Equipment :

The entry of the strip into the furnace is through entry seal followed by unfired tunnel section. The flue gases flow through the entry tunnel section in opposite direction of the strip travel giving some heat to raise the strip temperature to 150-180°C.

The strip is heated up to the required temperature as per the heat cycle mentioned above in the open flame gas fired pre-heat section at the same time cleaning it.

The strip is further heated to the processing temperature by means of [gas fired](#) radiant tube heating section. In this chamber the products of combustion are physically separated from the furnace atmosphere

The strip is then soaked in Electric heated soaking section under protective atmosphere.

The strip is further cooled in the Jet cooling section to coating temperature under protective atmosphere.

The protective gas is injected continuously at the Calm zone and travels counter-flow to the strip. Venting arrangement will be provided at the exit section in order to prevent the back flow of zinc vapor towards Jet cool section It consists of a N2 H2 mixture with 15% H2.(normal , max. up to 30%)

The hot gases leaving the furnace are passed through a recuperator before exhausting out of the building through a stack. In the recuperator the heat of the exhaust gases is

utilized to heat the combustion air being used for the burners increasing the fuel efficiency of the furnace.

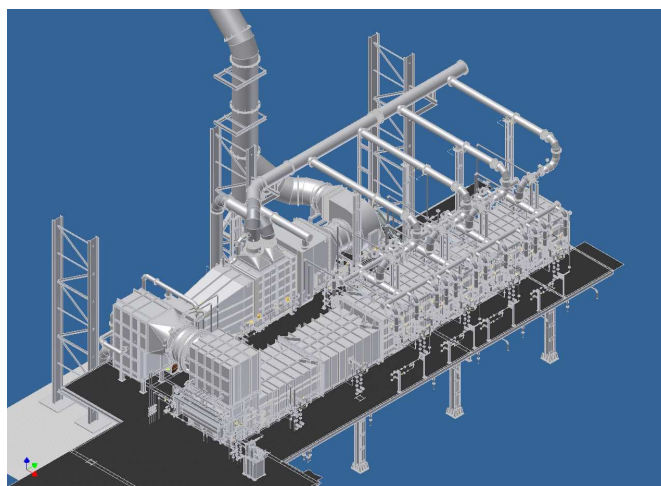
Furnace is fed with various controlled atmosphere gases.

- N₂H₂ mixture,
- N₂ for furnace normal purging,
- N₂ for emergency purging

Specification Of The Furnace Equipment :

The Furnace composed of
 Entry Section
 Preheat section (Non-Ox)
 Throat section
 Radiant tube heating section
 Radiant tube soaking section
 SCH Section
 Jet cool section
 Calm Zone
 Exit section with Furnace bridle and snout

Entry Tunnel section:



The entry of the strip into a Tunnel Section is through the entry seal and followed by Preheat section.

The entry seal mechanism consists of one driven seal roll at bottom side. The top side is a ceramic pad with vertical movement to facilitate opening of seal to pass the threading needle during initial strip threading operation. A single AC variable speed geared motor drives the seal roll.

The entry seal is followed by unfired tunnel section. This fabricated steel casing with roof, wall and bottom. The tunnel is lined from inside with HTZ module lining. The Bottom is lined with refractory bricks.

In the tunnel the flue gases from the direct fired preheat section and the protective gases, passes over the incoming strip whereby heating the strip up to 150-180°C. One thermocouple will be provided at the outlet of the tunnel to measure the flue gas temperature.

The heat released during the post combustion is also used to preheat the strip thus increasing the furnace efficiency. A flue damper is provided to control the outgoing flue gas and maintain the positive pressure inside the furnace. The furnace pressure of the order 5-8 mm WG will be maintained to avoid the infiltration of atmospheric Oxygen into the furnace. The dew point of furnace is (-) 20/ (-) 40°C at furnace bridle. The flue gases are taken out of the furnace from the flue duct provided at top of the tunnel. Suitable number of water-cooled rolls driven by AC variable speed motor supports the strip inside the tunnel.

Length of the Tunnel	:	6000 mm
Inside height of Tunnel:		976 mm
Entry Seal roll	:	200 mm dia
		Matl : Centrifugally cast HF alloy
Threading Roll	:	1 nos; 150 mm dia x 1500 mm barrel length
Hearth Roll	:	1 no.150 mm dia
		Matl : Centrifugally cast HH2 alloy. Water cooled.
Drive	:	2.2 kw AC variable speed geared motor.
Insulation	:	Roof & wall – Ceramic fiber.
		Bottom – Refractory.

Preheat Section (Non-Ox section)

Description:

The cold rolled and oiled strip has a surface residue which remains from cold mill treatment, transportation and storage. These surface impurities and oxides are finally removed in the direct fired heating section. The rate of reduction depends upon strip temperature, the amount of surface oxides present and the time in direct fired section.

This consists of steel shell of 6 mm thick plates at roof and wall and 8 mm thick at bottom. It's roof & walls are lined with ceramic fiber of 305 mm thickness while the hearth is lined with refractory bricks.

The reducing atmosphere in the furnace is achieved by burning the fuel gas at less air – fuel ratio than required for complete combustion so that hydrogen and carbon-monoxide are present in the products of combustion to react with the oxides on the strip surface.

The zone temperature is maintained between 1200°C to 1250°C depending on strip thickness. The Skin temperature will be about 50-60°C above the atmospheric temperature when inside furnace temperature is about 1250°C. The strip temperature at the exit of the preheat section is measured using infrared pyrometer located in the throat section. The burners are controlled using the strip temperature feedback. Combustion air and gas will be controlled separately using control valve. Air control valve with pneumatic actuator will be used as control cum shut-off valve. Adjustable port type gas control valve with modulating motor will be provided. The gas line will have a separate shut-off valve per zone.

UV flame sensors will be provided. The preheating section is designed for a strip temperature of 650°C to provide both cleaning and heating capabilities to meet incoming strip conditions.

Total length	:	6050 mm
Inside height	:	1220 mm
Nos. Of burners	:	6
Type of burners	:	Nozzle mix gas burners with pre-mixed pilot.
Turn down ratio	:	1: 7
Threading Roll	:	1 nos; 150 mm dia x 1500 mm barrel length
Hearth Roll	:	1 nos.150 mm dia x 1500 mm barrel length
		Matl : Centrifugally cast HH2 alloy. Water cooled.
Drive	:	2.2 kw AC variable speed geared motor each.
Insulation	:	Roof and wall 300 mm ceramic fiber insulation of 210 kg/m ³ density. Additional 25 mm cold face insulation
		Bottom - Refractory

Throat section

A throat section with a length of 1730 mm is provided at entry to the Radiant tube section to separate the preheat and radiant tube section. This helps in containing the furnace atmosphere in the radiant tube section.

Infrared pyrometer	:	1 No
Roll in throat	:	150 mm dia, Non water cooled
Drive	:	2.2 kw AC variable speed geared motor.

Recuperator:

The flue gases coming out of the preheat section passes through recuperator. This is a shell and tube type multi-tubular design. The shell is fabricated from mild steel lined from inside with ceramic fiber modules. Alloy steel tube suitable for the operating temperature will be used. One pneumatically actuated steel damper is installed after recuperator to control the furnace pressure.

A post combustion burner with a connected heat of 20,000 Kcal/hr is installed after the damper.

A separate blower is provided to supply air for post combustion, primary and secondary dilution of flue gases.

The flue gas temperature is controlled at 850°C before recuperator.

The flue gas coming out of the recuperator is cooled to 300-350°C, using secondary dilution air, before exhaust blower. The exhaust blower is driven by variable speed motor. Blower shaft & impeller is of suitable material. One pressure transmitter is provided in the flue duct to maintain the pressure by controlling speed of the flue exhaust blower. One thermocouple at the entry side and one at exit side of the recuperator will be provided to measure the flue gas temperature. The combustion air will be heated to 400-450°C in the recuperator. Combustion air piping will be of suitable material from recuperator to preheat burners. RTD will be provided to measure the combustion air temperature at the exit from the recuperator.

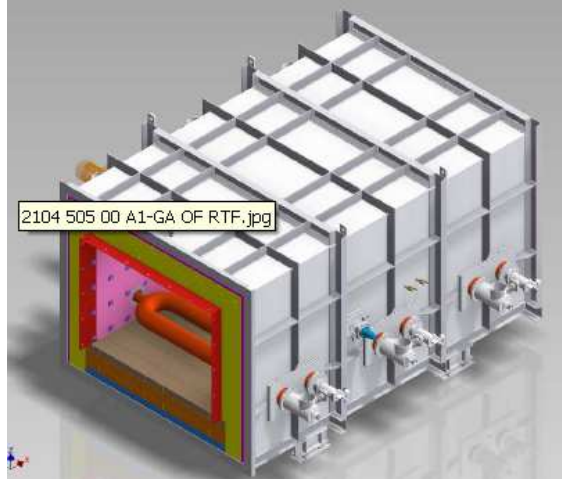
Radiant tube heating section (RTF)

Function

To heat the strip with respect to the annealing cycle.

Description:

A Horizontal radiant tube final heating section is provided with two independent temperature controlled zones. Each zone is provided with six 'U' shaped centrifugally



cast HP Alloy radiant tubes and gas burners with recuperator. 150 mm OD alloy steel variable speed driven rollers are provided at regular interval to support the strip. Two maintenance doors will be provided in this section..

The radiant tube heating section is designed to heat maximum tonnage 550°C for FH & 720°C for CQ cycle. This section, operating with 15% Hydrogen & 85% Nitrogen protective atmosphere, provides additional cleaning time as well as a softer control to

the strip temperature. The % of H₂ can be varied up to 30% as per the incoming strip conditions.

The roof and side walls of this section are fiber lined and the hearth is brick lined.

Temperature control:

Strip temperature is measured using the IR pyrometer mounted after radiant tube heating section and the control signal is distributed to individual zones in cascading manner. Zone temperature is controlled using the thermocouple mounted in each zone. One zone safety thermocouple is provided per zone. One radiant tube safety thermocouple is installed in a representative tube of the zone.

Premixed lance type pilot will be provided with each radiant tube burner. Ionization type pilot flame detection is considered. Single electrode will be used for both ignition and flame sensing.

Main data:

No. of zones	:	2
Total length	:	7.320 m

Insulation :

Roof & Wall	250 mm fiber blanket insulation 128 kg/m ³ .
Bottom	Refractory insulation bricks and calcium silicate blocks.

Zone temperature 900 °C

Hearth rolls 2 nos. of 150 mm dia

Roller drive 2.2 kW AC vector controlled geared motor to individual rollers.

No of radiant tubes 12

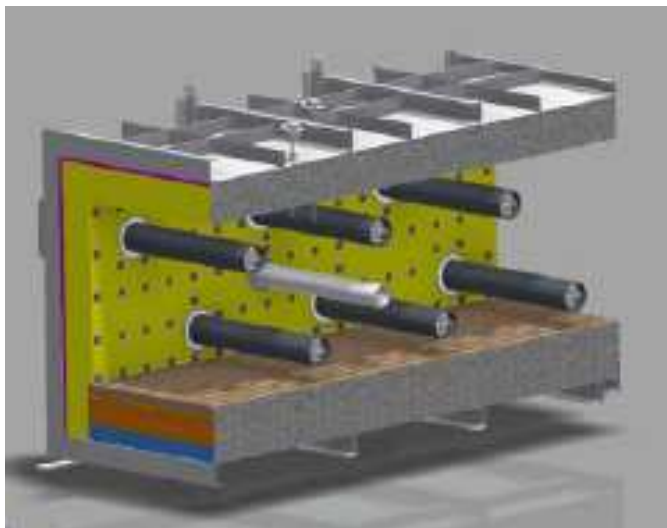
Radiant tube thickness 6.50 mm(min)

Radiant tube material HP or Gx 40 NiCr Nb 35-25 centrifugally cast heat resistant alloy.

Capacity of burner 50,000 kcal/hr

Total heat input 6,00,000 kcal/hr

Soaking Section



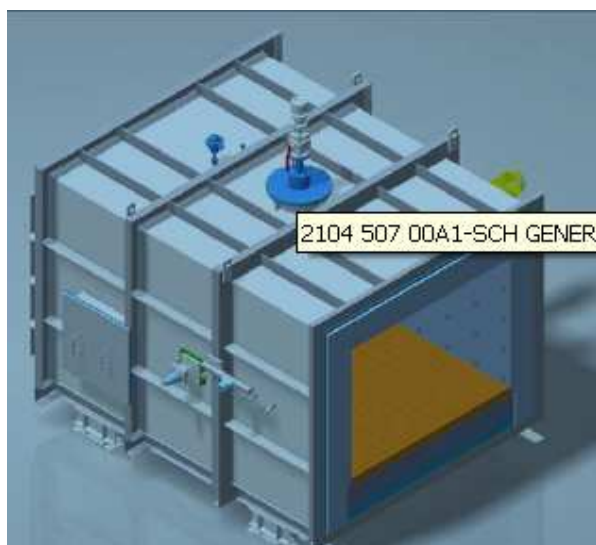
Description :

This is a horizontal section .Electrical radiant tube are provided to heat this section. Side walls and roof are lined with ceramic fiber whereas the hearth is lined with refractory bricks. Skin temperature will be 40-50°C above ambient. Support rollers are provided at the pass line. Thyristerised controls are provided for heaters for smooth operation and power saving. One IR pyrometer will be provided at the end of soaking zone to monitor the temperature of the outgoing strip.

Thermocouple is provided to control the zone temperature.

Length	7.32 m
Inside height	1256 mm
Inside width	1685 mm
Insulation	
Roof & Wall	250mm fiber blanket insulation of 128kg/m ³ density.
	Bottom Refractory
Zone temperature	750 °C
Hearth rolls	2 nos. of 150 mm dia
Roller drive	2.2 kW AC vector controlled geared motor coupled to individual rollers.
Connected power	150 kW
Type of heater	Electric radiant tube type
Nos. of heaters	6, 25 kW each
Heater control	Thyrister
Nos. of zones	2 (75 kW each)

Static cool/hold section



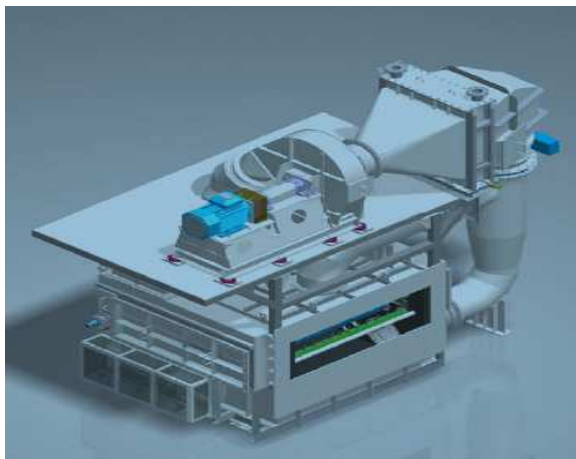
Description:

A Horizontal single zone static cool/hold section is provided after the Radiant tube heating section. This section serves as a holding zone and avoids heat loss to the Jet cooling zone from heating zone. The wall and the roof are lined with ceramic fiber while the hearth is lined with insulation bricks.

Main data:

Length	1250mm
Inside width	1685 mm
Lining:	
Side wall & roof	250 mm fiber insulation
Bottom	230 mm Hot face insulation bricks backed By 75 mm cold face insulation bricks.
Roller	1 No. 150 mm dia HH2 alloy roller
Roller drive	Geared motor
Other	One radiation pyrometer is provided to monitor the strip temperature after soaking

Jet cool section



One Jet cooler section follows the SCH section. This section is ceramic fiber lined on walls and roof and brick lined on the hearth. Door openings have been provided for the removal of scales.

Protective N₂H₂ gas is sucked through a water cooled heat exchanger by a variable speed fan and impinged onto the strip, thus cooling the strip to the required temperature.

The fan speed is controlled automatically to get the required strip temperature..

Electric radiant tube heaters are provided in the Jet cool section to maintain the zone temperature in case of full hard cycle specially for thinner strips. The glow heaters are provided as a safety device.

Jet cool section: “**PATENTED BLOW STAB DESIGN**” for efficient cooling.

Length	2.5 m
Inside width	1800mm
Nos. of cooling units	1

Insulation:

Side wall & roof	100 mm thick RT128 grade Ceramic fiber blankets covered by 0.5mm thick SS304 sheet.
Bottom	75mm insulation bricks backed by 75mm calcium silicate blocks
Fan operating temp.	150°C

Heat Exchanger	One radiator type gas to water heat exchanger
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Dia. of Roll	150 mm
Roller material	centrifugally cast HH2 grade heat resistant alloy.
No. of rolls	1
Roller drive	2.2 kW AC vector controlled geared motor.

coupled to individual roller.

No of glow heaters	2
Power per glow heaters	0.5kW
Heaters	Radiant tube type electric heaters.
Heater capacity	25 kW
No of heaters	1 No

Calm Zone

This is a vestibule consisting of baffles and a motorized damper arrangement. Section is lined with ceramic fiber on roof and side walls and refractory bricks on bottom. 150 mm OD alloy steel variable speed driven roller is provided to support the strip. One IR pyrometer is installed in this section to monitor the strip temperature at the end of calm zone. A small amount of protective atmosphere is admitted in this section, such that the exit section remains less turbulent. Protective gas flows towards the exit and escapes through the vent provided in the zone. The zinc fumes thus prevented from going towards the Jet Coolers. Electric radiant tube heaters are provided to maintain the temperature of the zone. Hot N2 purging connection is provided in the section. N2H2 heater will be provided.

Main data:

Number of control zones	1
Chamber width	1888 mm inside
Total length	3900 mm

Insulation:

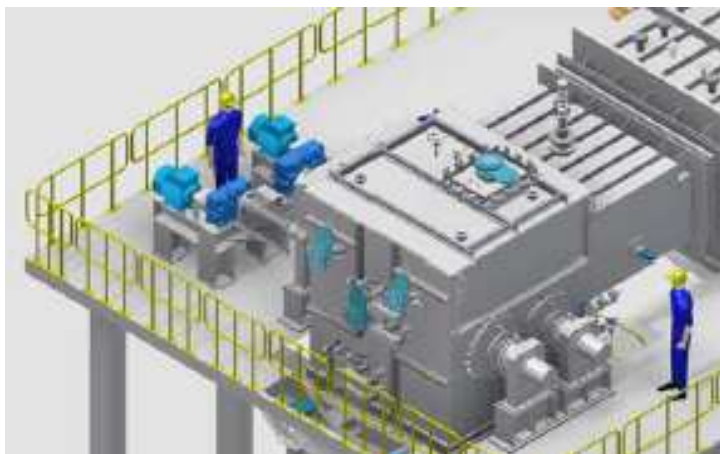
Side wall & roof	250 mm thick RT128 grade Ceramic fiber blankets covered by 0.5mm thick SS304 sheet.
Bottom	Refractory bricks

Hearth Rolls

Dia. of Roll	150 mm
Roller material	centrifugally cast HH2 grade heat resistant alloy.
No. of rolls	1
Roller drive	2.2 kW AC variable speed motor
No of glow heaters	4
Power per glow heaters	0.5kW

Heaters	Radiant tube type electric heaters.
Heater capacity	25 kW each
No of heaters	6
Total power	150 kW

Exit section with Furnace bridle



Description:

The section consists of Furnace Bridle. The rolls are supported on bearings located outside the furnace shell. Radiant tube heaters are provided along the path of the strip in the section to maintain the strip temperature. An infrared pyrometer is installed to sense the strip temperature and control the heaters,

The strip going out of furnace is kept in the protective gas atmosphere. Tubular Electric heaters are provided in the section to account for the heat loss through walls.

Main Data:

Length	2.8m
Inside width	1888 mm

Electric radiant tubes:

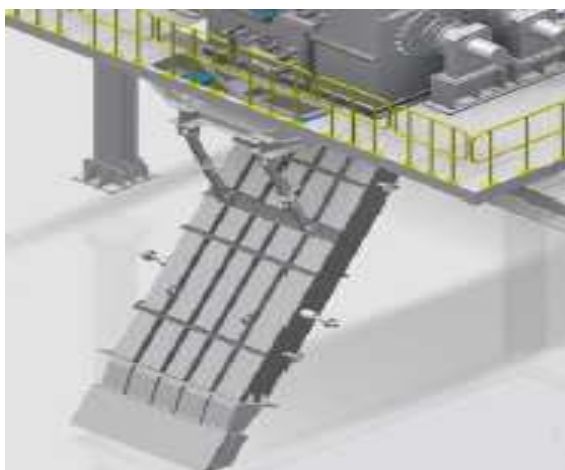
No of radiant tubes	3
Heater capacity	25kW
Total capacity	75kW

Bridle rollers:

No of Bridle rolls	2
Roll dia	500 mm
Roll material	AISI 309 / HH2
Bridle Rollers drive	AC vector controlled motor through gearbox coupled to individual roller with pneumatic caliper type brake.

Insulation:	
Side wall & roof	200 mm thick RT128 grade Ceramic fiber blankets
Bottom	75 mm Hot face bricks backed by 75 mm cold face bricks.
No of glow heaters	4
Power per glow heaters	0.5kW
Temp. Control	Zone température control mode. One thermocouple is provided to control the heater.

Down Chute & snout:



A chute is provided to protect the strip from outside atmosphere. Glow heaters are provided in the chute as safety a measure to avoid explosion. Glow heaters are made from Ni/Cr Wire.

3 nos. 25 kw each radiant tube electric heaters are mounted on either side of strip pass in the chute. This avoids zinc fumes from solidifying in this region.

A snout made up of ferrite free SS316L is provided at the end of chute. The snout is immersed in molten zinc bath thus to avoid air ingress into the furnace.

The snout is attached to the Down Chute

No of glow heaters	2
Power per glow heaters	0.5kW
Snout (End portion of the Down Chute)	50mm thick SS 316L(ferrite free)

Process Control System:Preheat Zone

Strip temperature control is governed by strip temperature measured by a pyrometer at the exit of the section. Firing rates of 0-100 % are through metered air and gas valves . Zone has differential pressure transmitters on burner air and gas supplies to perform mass flow calculations. Gas leads air on increase in firing rate and lags on decrease. There is a thermocouple (T/C) for each zone temperature and a low select between each T/C and the pyrometer to limit individual chamber temperature to 1250 deg C. Zone off condition, opens nitrogen solenoid valve and closes air and gas solenoids for that zone. ZTC and STC will be provided

RTH Zones 1-2

Temperature control of zones 1-2 is governed by strip temperature measured by a pyrometer at the end of the radiant tube section. There are six burners per zone. Each zone is provided with control valve with orifice plate and differential pressure transmitter for air and gas. Firing rate of 0-100% are through cross connected regulators in each zone. Air leads gas on increase in firing rate and lags on decrease. There is a thermocouple for each zone temperature and a low select between each T/C and the pyrometer to limit individual chamber temperature to 900 °C. Zone over temperature T/C pn each zone shuts off gas solenoid at 925°C and give alarm. ZTC & STC will be provided.

Soaking Section

Soaking section is controlled on strip temp control mode. The operator monitors the strip temperature using pyrometer at the end of soaking section.

Jet Cooling Zone :

Temperature control is driven by pyrometer at exit section. The speed of the variable speed fan is adjusted such that the outlet temperature of the strip maintained at set level.

Pressure Control :

Furnace delta pressure transmitter controls pre heater pressure damper to maintain furnace pressure at about + 4 mm WG. Alarms are generated at high or low pressures.

Nitrogen flow control :

The N2 supplied shall be divided in two streams.

One stream supplies purging nitrogen to roller, pyrometers, sight holes, spot lights, UV scanners etc. The flow is set manually using rotameter. Pressure switch is used to indicate the supply failure. Purge flow meters are used to set N2 to the pyrometers.

Other stream of N2 is used to quench the preheat section during line stop and purge during zone stop. Each zone is provided with two NC and one NO solenoid valves arranged in parallel. During line stop this valves operates in sequence and send preset

amount of N2 to preheat zones through combustion air piping. During the power failure the NO valve operates and the N2 flows to the zones.

HNX flow control :

N2H2 flow is manually set using a Rota meter. An auto shut-off valve is provided on this line to stop N2H2 during power failure and furnace shut down conditions.

N2H2 is distributed to snout; furnace bridle and control cool section.

Pressure switch are used to generate alarms during supply failure.

H2 percentage will be indicated on HMI.

HNX admitted to furnace bridle and snout area is preheated to 500°C to avoid fume condensation at this point

Cooling water:

Cooling water is monitored using temperature switches, flow switches.

Motor control:

All motors are started/ stopped from MMI.

Control loops :

All control loops are operated via the MMI. Manual override is available on all loops via the MMI.

HMI Functions :

All furnace equipment control, monitoring, reporting and alarming will be done through the HMI.

Analysis system:

One portable analyzer will be provided with both O₂ & CO, CO₂, gas efficiency measurement facilities for non-ox region.

One fixed online dew point analyzer will be provided to monitor dew point of the furnace atmosphere at Furnace bridle, Jet cool section, RTF and incoming HNX. The selection of samples is manual.

Two number of portable type LPG leakage detectors will be supplied.

Gas mixing station

End User will supply H2 and N2 at TOP and it will be mixed at gas mixing station supplied by Seller for desired H2 % in HNX

Gas mixing station will consists of H2 analyser, H2 shut-off valve, mixing tank and control valve for H2. H2% can be varied from HMI.

2.3. Ceramic pots (GL Pots)

Basic conditions & Technical Specification :

Strip thickness:	0.14 mm-0.60 mm
Strip width:	610 mm-1250 mm
Line speed:	120 mpm
Coating range:	60 to 200 g/m ² both sides together
Max through put:	16 T/hr
Max alloy drag out rate:	1800 kg/hr for GL
Electric supply:	AC415V \pm 10%, 50Hz \pm 3%, 3 phase
Enter temperature of strip:	GL: 540-550°C
Bath temperature:	GL: 600°C

Detail Technical specification-

Refer Appendix-II for details.

2.4. Ingot feeding arrangement at Pre-melt pot

One ton ingot loading arrangement consisting of mono-rail electric hoist supported on a structure shall be provided to feed 55% Al-Zn ingot in the Pre-melt pot. Ingot shall be suspended from this hoist and immersed inside the Premelt pot manually at a controlled rate.

Capacity of hoist = 2 Ton.

2.5. Pot cellar ventilation system

The pot cellar will be ventilated by supply of fresh air by forced draft centrifugal fan.

The ducting with necessary opening shall be provided at the bottom of the cellar.

The hot suction fan shall be provided to suck the hot air from top of the pot cellar and expel it outside the building through exhaust duct.

COATING SECTION**2.6. Pot Equipments****2.6.1. Sink roll assembly with roll scrapper**

Qty : 1 set
Sink roll : 450 mm O.D.x 50mm thk x 1600 mm barrel length.
Material – Ferrite free SS 316L

Consists of sink roll suspended by roll arms from mild steel frame. The shell thickness of the roll and thickness of the roll support arms will be suitable for high temperature stability required for GL coating

Pneumatically actuated Scrapper arrangement will be provided at the sink roll to clean the sink roll periodically.

Arms for sink roll are of Ferrite free SS 316L material Bushes are of Stellite-6 material.

2.6.2. Deflector roll assembly with roll scrapper

Deflector roll : 235 mm O.D. x 1600 mm barrel length.
Material – Ferrite free SS 316L

A Similar arrangement of suspension like sink roll has been provided to deflector roll to suitably adjust the vertical pass line of coated strip. Arms for deflector roll are of ferrite free SS 316L material Bushes are of ferrite free SS 316L. The Shell thickness of the roll and thickness of the roll support arms will be suitable for high temperature stability required for coating. Pneumatically actuated Scrapper arrangement will be provided at the deflector roll to clean the roll periodically.

2.6.3. Jet wiper assembly (Air Knife)

The purpose of jet wiper assembly is to meter the molten metal coating by means of a precisely shaped and directed jet of pressurized air, leaving a uniform coating of the correct thickness.

It consists of two single lip type air knives one each on either side of the strip coming out of the pot. The jet wiper assembly is suspended from a horizontal frame supported on the foundation at both ends over the pot. Both the air knives can be moved Up / Down together and In / Out independently and jointly. All the movements are through mechanical actuators operated by variable speed AC motor with encoder. The speed of the motors and hence the linear movement of air knives is controlled by frequency controller. The position display will be available in HMI screens in the pull pit. Air knife tilting arrangement is through actuator and is performed manually.

The air jet pressure control system consisting of pressure transducers for top and bottom Air Knife Control valve for top and bottom knife will be provided.

2.6.4. Edge Baffle :

Edge baffle arrangement will be provided to prevent the edge over-coating.

2.6.5. Jet Blower with ducting

One new multistage turbo blower will be supplied & Existing positive displacement type blower will be used as stand-by. Blower is used to supply the air at suitable flow and pressure for molten metal wiping at the jet nozzles. One blower will be working and other will be remain as stand-by.

1 No Turbo blower (working)+ 1 No existing positive displacement blower (stand-by)
Capacity = 3150 Cfm @ 9.2 psig, Driven by variable speed AC motor.

Modification in existing ducting from the jet blower to the Jet wiper assembly will be done by End User .

Two number of globe valves and two SS braided flexible hoses will be supplied new.

Note : *Site modification needed for above will be done by End User under Seller's supervision.*

2.6.6. Cover over openings around pot and pot cellar.

A fabricated steel cover, gratings shall be provided around the Ceramic pot and pot cellar.

2.6.7. Hoist For Pot Inductor Handling

Two manual hoists, one located below the furnace support structure and one at APC tower for Inductor handling shall be provided by End User based on basic engineering from Seller.

Capacity : 5 Ton

2.6.8. Pot equipment handling crane with rails and support structure.

EOT crane with double hook (7.5 Ton + 7.5 Ton capacity) moving perpendicular to line above the pot , shall be provided with steel supporting structure. The rails are common between moving cooling pendant trolley and this pot equipment crane. When the moving cooling pendant is shifted offline to operator side, the pot equipment crane gets access for pot rolls. This crane travels towards drive side in auxiliary shed to unload the pot rolls for necessary maintenance work.

2.7. AFTER POT COOLING SECTION

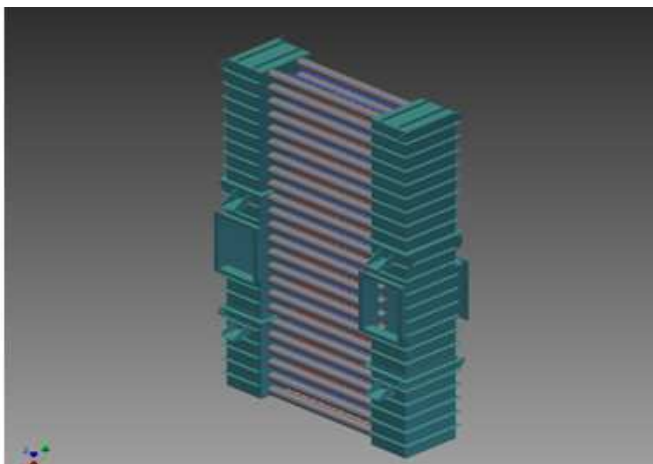
2.7.1. Tower structure modification

The augmented structure for the cooling tower shall be provided to support air cooling pendants, two deflector rolls and roller table.

2.7.2. 5 Ton maintenance crane

End User shall provide one 5 ton capacity crane at the top of the APC tower for maintenance purpose.

2.7.3. After Pot Strip Cooling Pendants



After exiting from ceramic pot , the strip will be rapidly cooled by up-leg coolers such that the strip temperature shall be approximately 250°C at the first deflector roll.

The final strip temperature of strip shall be approx. 250°C before entering the water quench tank.

The strip cooling equipment consists of two cooling pendants with blowers arranged on a fabricated steel structure . These are arranged on vertical up-leg before the first deflector roll of the APC tower.

The cooling section on vertical up-pass is a movable one, first cooling pendant is slot type and second cooling pendant is BLOW STAB type both provided with a pair of plenums, fed with cold air by means of a centrifugal type blowers .This mobile section is supported on a transfer carriage which can be moved out of the pass line on operator side in order to clear the pot area and allow the access to the coating equipment by the pot equipment handling crane. Quick disconnect coupling connection will be provided between pendant and fans for both the up leg coolers.

The second vertical cooler is **CMI patented “BLOW STAB” designs** consisting of air suction duct sucking the air from outside the shed , air blowers, duct from blower to cooler, two equalizing ducts at low air velocity, one set of tubes spaced along the strip width. Cooling is achieved by air stream blown through the holes and impinged on the strip. The fans of coolers are driven by AC variable speed motors. Necessary dampers are provided. The BLOW-STAB design not only provides very efficient cooling but also a stabilization of strip in vertical pass line which helps in better metal coating control at the air knife wiper.

2.7.4. **Deflector rolls no.5 with roll scrapper and strip clamp at cooling tower**

This roll is mounted on cooling tower at the end of Up pass.

New Roll : 500 mm Øx1500 mm barrel, chrome plated

Existing Snubber roll : 250 mm Ø x1500 mm barrel plain steel roll, chrome plated has been mounted with AC geared motor. This arrangement is provided for threading the strip from pot.

New pneumatically actuated roll scrapper arrangement is provided at this roll to clean the roll surface from any zinc pickups.

A pneumatically actuated strip clamp will be provided as a safety device to grip the strip in case of tension loss due to strip breakage.

Note : Relocation and Site modification needed for above will be done by End User under Seller's supervision.

2.7.5. **Tinsel Scrapper**

This is a pressure pad arrangement with wooden pads pressed on both sides of the strip using pneumatic pressure. The arrangement is provided to remove only the loose metal coating flakes from the strip so that they do not stick to the subsequent rolls.

2.7.6. **Roller table**

This is a fabricated steel table with suitable nos of support rolls provided between Deflector roll No.5 and Deflector roll No.6 on a horizontal pass in order to support the strip.

Roll : 100 mm Ø x 1500 mm barrel , chrome plated.

2.7.7. Roll scrapper for Deflector rolls no.6 and strip clamp at cooling tower

New pneumatically actuated roll scrapper arrangement is provided at the existing toll roll to clean the roll surface from any pickups.

This roll is mounted on cooling tower at the beginning of down pass.

A pneumatically actuated strip clamp will be provided as a safety device to grip the strip in case of tension loss due to strip breakage.

Note : *Relocation and Site modification needed for above will be done by End User under Seller's supervision.*

2.8. Water Quench tank

The strip coming down from Deflector roll no.D6 is finally cooled by quenching it in the cooling water. The tank is a vertical fabricated mild steel construction.

The strip will be cooled to a temp. Around 50°C as it passes through quench tank cooling system.

It consists of one dunk roll of 900 mm dia x 1500 mm barrel length is provided to dip the strip in the quench water .The bearings of the rolls are outside the tank.

Two pairs of rubber covered squeeze rolls of 200 mm dia are provided on the outgoing side of tank to remove excess water from the surface of strip.

Quench tank will be provided with dump valve and a connection point for fresh water filling.

Spray pump with suction strainer will spray the quench water onto the strip surface on entry side. Stand-by pump provided.

Soft water will be used for the quenching. The quench water will be cooled by Heat exchanger and is re-circulated in the quench tank. The plant cooling water from the cooling tower will be used in the heat exchanger to cool the quench water.

Fresh make up water will be added into the tank through makeup connection.

Tank will be provided with openings on the sides to have access for tinsel removal from the bottom.

2.9. Air Dryer

An air dryer with chevron type headers, slit opening on both sides and blower is provided to dry the strip

2.10. **Steering System no S2**

This consists of a fixed frame mounted on a Cooling tower support structure, on which another pivoted frame with steering rolls is mounted which swings under the controlled movement of a hydraulic cylinder.

This is a electro-hydraulic system in which sensor continuously monitors the exact position of moving strip, transmit a continuous electronic signal to signal processor to a servo valve. Servo valve is integrated with electro-hydraulic power unit to direct the flow of oil to the hydraulic cylinder which positions the guide providing accurate alignment of the strip.

Type : Offset pivot guide.
Strip wrap angle : 180°
Roll : 2 Nos, 320 mm Ø x 1600 mm barrel length, tubular steel construction, and chrome plated supported at each end with self-aligning roller bearings carried in plummer blocks.

2.11. **Deflector rolls no.D4 with load cell**

Roll : 320 mm Ø x 1500 mm barrel length. Plain steel roll.
Chrome plated

This is a tubular steel construction supported in antifriction bearings carried in plummer blocks which are mounted on fabricated steel frame.

Load cell is provided to measure the strip tension in the coating area.

2.12. **Coating weight gauge**

Coating Weight Gauge provides On-line and Non-contact measurement of Coating weight applied on the steel strips. The output signal is used to control the air knife pressure. The measurement principle is based on X-ray fluorescence. A Gamma-ray source irradiates the target material which causes it to emit X-ray photons by fluorescence. These photons are characteristic of every material and their number is in direct proportion to the emitter thickness till a saturation value. Therefore by selectively counting the Characteristic photons from the coated material the thickness of the coating is determined.

Design & Construction

The system uses a 30kV X-ray source. The X-ray is mounted inside a collimator to form a narrow spot on the target. The large area X-ray detector (Proportional Counter) is mounted in the same housing as of the emitter to detect the fluorescence

photons. The detector is coupled with a low-noise wide-bandwidth Charge Sensitive pre-amplifier. At the output of this amplifier a voltage window is applied to separate out pulses with energies of interest, which are then counted by a high-speed counter. The sensor automatically compensates for the change in detector gain due to ageing of the components or other factors by taking reference from the original 59.5 KeV gamma photons.

All the signal conversion and processing is done by electronics placed in the sensor housing and the measured values are transmitted digitally through RS485 serial interface to the Operator Panel.

The fluorescence photon count is also affected by the density of the air gap between the target material and the sensor. The density of the air in the column changes with temperature, which causes more or less attenuation of the emitted photons. To compensate for this effect the sensor utilises a thermister air gap sensor to exactly account for the air temperature change in each measurement.

The sensor is mounted on a heavy-duty scanner to move it across the width of the coated strip. The scanner is designed on maintenance free and sealed roller bearing Linear motion system. The movement is through an ac motor controlled by a variable frequency inverter.

The operator station is based on PC (Personal Computer) architecture with industry standard hardware and software, which allows for easy upgrades and local support. The software is designed for touch screen operation for easy and efficient operator interaction. All settings and operations can be done from the display touch screen with out using any additional key-pad.

Coating thickness gauge system consists of :

- One single beam scanning O frame with X-ray Fluorescence Sensor.
- Software Package for data presentation, reporting and system control.
- Scanner O frame Electronics panel & Auxillary logic Control panel for processing inputs /output (analog/digital).
- Personal Computer system.

Gauge Specifications :

One scanning O – frame with two X – ray fluorescent sensors (For measurement on both side of the strip)

X – ray Tube	: 30KV, 2 Watts
- Measurement Range	: 30 – 400 GSM per side
- Accuracy	: 0.5% or 0.25 GSM
- Precision	: 0.5% or 0.5 GSM with integration time of 2 sec.
- Air Gap	: 25mm
- Operating Temp.	: 0 - 50° C
- Passline Sensitivity	: max 1% for passline deviation of 2mm
- Display Change Time	: 50 sec – 1 min
- Sampling Time	: 10 msec
- Response Time	: 50 msec (programmable)

Support rolls will be provided before & after the gauge to support the strip to maintain a constant pass line.

2.13. Roller table

This is a fabricated steel table with suitable nos of support rolls provided between Deflector roll No.D4 and Chemical coater in order to support the strip.

Roll : 100 mm Ø x 1500 mm barrel , chrome plated.

2.14. Bridle B2

Existing Bridle no.3 located after chromating section will be relocated to a position before Chemical coater. This bridle regulates the strip tension in the pot area.
New gear boxes and new hard chrome plated rolls will be supplied.
Existing motors and drives will be re-used.

3. CHEMICAL TREATMENT SECTION

3.1. Chemical coater no.1 (Squeeze roll type) – Stand-by

Function

This is a stand-by horizontal squeeze roll coater used for application of chemical solution on the strip when the main roll coater is under roll replacement / maintenance.

One set of squeeze roll coating units will be provided. It consists of a fabricated steel frame . Squeeze roll is mounted on the fixed frame. The arm is closed with the two pneumatic cylinders. The chemical solution is sprayed on the strip on top and bottom side before the squeeze roll and the excess solution is wiped with squeeze rolls. The solution falls in a tray below the squeeze roll and returns by gravity to re-circulation tank.

One pneumatic pump with standby will be provided with necessary valves for recirculation tank to supply chemical to the spray headers mounted on the coater.

Squeeze rolls : Hypolon coated. 200 mm dia x 1500 mm barrel length

3.2. Anti-finger print Chemical coater no.2 (Roll coater)

Function

This is main working horizontal roll coater used for application of anti-finger print chemical solution on both sides of the strip.

Description

The chemical coater is composed of two heads that can apply a layer of chemical solution on the top and on the bottom side of the strip to provide antifinger print properties on the metal coating.

The horizontal chemical coater is mainly composed of:

- A fix frame supporting the two heads
- A top head for coating the front side of the strip
- A bottom head for coating the back side of the strip

The support frame

The supporting frame for the Top head & Bottom head is fixed.

Coating heads

Top head and Bottom head :

Each head consists mainly of -

Two rolls:

- The applicator roll
- The pick-up roll
- Two motors and two cordons which drive each roll

Each coating head is fitted with two rolls: one applicator roll and one pick up roll.

Each coating head is mounted on a slide and may be retracted or engaged onto the strip by means of a quick off system actuated by two hydraulic jacks. This helps to quickly retract or apply the heads without changing the settings between the rolls. This retraction occurs to avoid the strip weld to touch the applicator roll or just to stop the coating. The position of each head, “head retracted” or “head engaged” are monitored by two proximity sensors per head. In preparation of production mode, the rolls can rotate only in forward mode.

The applicator roll

The applicator roll is polyurethane rubber coated. When rubber starts exhibiting crack, the applicator roll is dismantled and rubber coating is machined; consequently

the applicator roll diameter is variable. The applicator roll takes the coating product from the pick-up roll and applies onto the strip.

The pick-up roll

The pick-up roll is chrome plated. The pick-up is used to calibrate the thickness of the coating to be applied on the strip. That is the pressure between the pick-up roll and the applicator roll and their peripheral speed that ultimately determine the thickness of the coating. The position of the pick-up roll in relation to the applicator roll is adjustable manually by a handle through reducing device, to obtain the necessary pressure between the pick-up roll and the applicator roll.

Rolls

Applicator rolls

Diameter	max	:	241 mm
	Min	:	210 mm (working range)
Barrel length		:	1450 mm
Coating		:	polyurethane
Coating thickness		:	25 mm
Material	Barrel	:	ASTM A 53/A
	Journals	:	ASTM A 53/A

Pick-up rolls

Diameter		:	241 mm
Barrel length		:	1450 mm
Material	Barrel	:	ASTM A 53/A
	Journals	:	ASTM A 53/A
Coating		:	hard chromium plating, 100 µm

The two motors and cardans

Each roll is driven by a variable speed gear-motor. The liaison between the motors and the rolls are made by cardan shaft. Speed measurement sensors are foreseen to verify the effective speed of each roll. Each cardan shaft is manually dismountable from the corresponding roll. A proximity Switch per cardan monitored when a cardan is dismounted.

Safety – ergonomy devices

Cardan shafts cover

The Cardan shafts are mechanically covered to protect the operators. The protection device is composed of two covers placed above and on the sides of the cardan shaft:

- A fix cover that covers the part of the cardan shaft which on motor side
- A movable cover that covers the part of the cardan shaft which on operator side.

The access to the Cardan shafts, the operator can slide the movable cover under the fix cover. The closed position of the movable cover is detected by one proximity sensor.

Rolls cover

The rolls are mechanically covered to protect the operators. The access to the rolls, the operator can take away the cover. The closed position of the movable cover is detected by one proximity sensor.

Emergency Stop

On the top coating head, there is an emergency stop push button. If this one is engaged, the system stops directly.

lubrication

The lubrication points are grouped on manifolds located at operator and motor sides and can be fed by hand grease pump, except:

- Gearmotors
- Cardanshafts
- Rolls bearings

Hydraulic power for this chemical coater will be derived from existing exit power pack of the line. Necessary valve stand will be provided.

3.3. Chemical recirculation system

This is a common system between Coater No.1 and coater No.2.

Chemical handling system

- Main chemical tanks (2 nos – 400 lit each)
- Air operated double diaphragm pump (1 w + 1 S)
- Pressure regulator, hose , suction rod & strainer
- Air operated agitator mounted on above chemical tank
- Chemical mixing tank with cover drain valve & hose
- Air operated agitator mounted on above chemical tank

3.4. Chemical dryer

Function

To heat the strip up to 110°C PMT.

Description

The required heat transfer rate is achieved by impinging hot air onto the strip with suitable velocity that doesn't affect the chemical coating.

Air is discharged from blowing ducts positioned at each side of the strip.

Load for the dryer will be provided by heating with LPG burner

The air temperature in the drying zone is ensured by thermocouples.

An external recirculation system, consisting in :

One recirculation fan;

One combustion air fan;
One direct flame burner;
A vapour exhausting duct
Combustion products and evaporated water are exhausted into the exhaust duct.

Technical data

Dryer type	Horizontal(hot air recirculation type)
IN Strip PMT	min. 40 °C
OUT Strip PMT	max. 110 °C

3.5. Air cooler (cooling pendent)

This is used for cooling the coated strip to around 75° C and that the chemical coating is dry or solidified before passing around the first roll after the cooler.

- Air cooler pendant is located in horizontal pass line of the strip
- Air blower of suitable capacity sucking the air from outside the building is used to cool the strip.

3.6. Bridle B3

This is a new bridle used to maintain required strip tension in the chemical coating section. This consists of a horizontal configuration of rolls and drive arrangement.

Bridle Rolls	:	2 Nos. water cooled rolls. 600 mm dia x 1500 mm barrel lengths Tubular Steel construction, Hard chrome plated. Rolls are mounted in antifriction bearing carried in the plummer block fixed to the stand.
Stand	:	Stands are of fabricated steel and machined.
Snubber Roll	:	250mm dia x 600 mm Neoprene coated roll supported on welded steel arm actuated by pneumatic cylinders is provided on the entry roll
Drive	:	Gear boxes , couplings and pneumatic caliper brakes.

3.7. Water cooled roll no.D5

Roll	:	600 mm Ø x 1500 mm barrel length. Plain steel roll. Chrome plated, Water cooled.
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This water cooled roll is a tubular steel construction supported in antifriction bearings carried in plummer blocks which are mounted on fabricated steel frame.

3.8. Deflector roll at entry of Exit accumulator

Roll : 800 mm Ø x 1500 mm barrel length. Plain steel roll.
Chrome plated

This roll is a tubular steel construction supported in antifriction bearings carried in plummer blocks which are mounted on fabricated steel frame.

3.9. Strip clamp no.4 frame modification

Strip clamp no.4 frame to be modified to suit the new pass line.

Note : *Site modification needed for above will be done by End User under Seller's supervision.*

3.10. Gear boxes for Bridle No.4

New gearboxes for Bridle no.4 will be supplied

Note : *Site modification needed for above will be done by End User under Seller's supervision.*

4. AUXILLIARY SYSTEMS

4.1 Electrical Controls

The design manufacture and testing as well as documentation of the electrical equipment will be in accordance with IS (Indian Standards) which is mainly based on IEC (International Electro technical commission).

IEC is applicable wherever IS is not available.

Refer Attached Appendix I for details.

4.2 Hydraulic System

There will be two separate hydraulic systems for steering no.S1 & steering no.S2. Valve stand will be provided for Chemical coater functions. Each system will be completed with pump, tank, filters, pressure gauges, pressure & flow switches, temperature switches, heat exchanger (plate type), instrumentation and control for proper functioning of hydraulic actuators.

All control valves will be solenoid operated and will be manifold mounted where possible to reduce the amount of piping and simplify maintenance. All equipment utilizing hydraulic functions will be pre piped to separate header blocks mounted on the individual equipment.

Interconnecting piping for hydraulic system shall consists of piping within hydraulic power pack and piping between power pack and actuator via manifold blocks. The cylinders shall be provided with cushioned ends wherever necessary.

All hydraulic motors and cylinders shall be tested at 1.5 times the maximum working pressure.

The pipes shall be pickled and flushed. Flushing filter element shall be provided for flushing hyd. System including interconnecting piping.

4.3 Inter-Connecting Piping

For hydraulic system, it shall consists of piping within hydraulic power pack and piping between power pack and actuator via manifold blocks.

The pipes shall be pickled and flushed. Flushing filter element shall be provided for flushing hyd. System including interconnecting piping.

The End User will provide the other utilities like cooling water, compressed air etc..with pipeline at battery limit at the nearest building column at 1.5 m height from

the floor level with an isolation valve where the equipment requiring such utilities will be installed.

Based on detail engineering Seller will provide the interconnecting piping for new supplied equipments along with necessary pipe fittings and valves. This interconnecting pipe-work is from battery limits mentioned above up to the equipment . The interconnecting piping includes all pipe fittings, clamps. The piping will be routed through the trenches wherever envisaged.

4.4 Foundation Bolts

Foundation bolts, wedges, packing for the new supplied equipments will be provided.

4.5 Miscellaneous bridging tables and access platforms

Only Engineering for Necessary bridging tables for guiding and supporting the strip between equipments will be provided. Engineering for Access platforms for maintenance of the equipments wherever necessary will be provided.

Note: Pictures provided in the specifications are for reference purpose only, meant for better understanding and not to be treated as to the actual design.

CHAPTER- 6

EXCLUSION LIST

EXCLUSIONS

1. Obtaining environmental permit, building permit, utility tie-in permit, occupancy permit, permit for disposal of hazardous material etc.
2. Equipment to compensate the voltage and frequency fluctuations to suppress harmonics and to improve the power factor.
3. Chimneys / Stacks and exhaust ducts from blower/fan to respective chimneys
4. Strengthening of existing After pot cooling tower structure to support the extended new structure.
5. Modification of Building to increase the After pot cooling tower height and installation of crane.
6. All other auxiliary equipment for running of the plant.
7. Grouting material.
8. Removal and relocation of existing equipments as per proposed layout.
9. Onsite modifications in the existing equipments as proposed in scope of supply.
10. Erection of supplied equipment or any other equipment supplied by others.
11. Any required ceramic lining of pot or oil-proof impregnation of pits, trenches and foundations.
12. Pressure reducing station for steam.
13. Water cooling tower
14. Support structure for Non-Ox furnace, After pot cooling tower
15. Any other equipment or service not specified in the scope of supply.
16. Any rectification of existing mechanical equipments, Process , Electrical system which are not in direct relation to proposed modification are excluded.

CHAPTER- 7

PERFORMANCE GUARANTEE

General

- A The Seller guarantees and warrants that the equipments supplied will be strictly as per specifications and of first class workmanship and according to latest engineering practice and will show no defects due to faulty design, materials for a period of twelve (12) months from the date of commissioning Or eighteen (18) months from the date of receipt of last equipment at site, whichever is earlier. This excludes the fast wearing parts whose shelf life is less than the warrantee period. The Seller undertakes to repair and/ or replace, at his own cost and expense the equipments or part thereof which may show any defect in workmanship or materials or deficient in performance during guarantee period. The replaced and / or repaired parts will have additional guarantee period of twelve (12) months from the date of their commissioning. Twelve (12) months following the date of the commissioning, if the equipment shows no defect, the End User shall issue the certificate to the Seller releasing the equipment from the stipulated guarantee obligations. For any defect in the contract equipment , for which the Seller is proven not responsible , the Seller guarantees to give every assistance to repair or re-supply the equipment at the End User's cost. The due attention will be paid to the contract schedule.
- B The Seller also guarantees and warrants that the equipments and materials will be brand new, unused and comply in all respects with the quality specification and quantity as stipulated.
- C The Seller also guarantees that the specialists dispatched for the supervision work shall be competent and experienced.
- D The Seller guarantees that the equipment after erection at site shall be complete in respect of operation on commercial scale at the rate and capacity as specified.
- E End User confirms that the existing line is capable to run at line speeds mentioned in the line specifications above without any limitations from existing line equipments which are being reused. Seller's warranty and performance guarantee is based on this confirmation and is limited only to the newly supplied equipments as per the scope of supply mentioned herein.
- F The Seller will inspect each machine in the factory before they will be shipped to the Purchaser/End User. However the Purchaser/End User or their authorised representative will have the right of inspecting equipment during the time of manufacture in accordance with the agreed inspection procedure (as per QAP of Seller) with his own expenses.
- G Before the start of the performance tests the Seller will submit the detailed procedure and schedule for the same to the End User which will be mutually discussed and finalised.

- H After completion of erection, both the parties shall sign a certificate for the successful completion of erection. The commissioning work shall be carried out then without any delay. The End User shall provide the qualified personnel for operation, maintenance, testing and shall provide all raw materials (metal coils & process consumables) and utilities in the required quantities and quality as specified by Seller during detail engineering.
- I The No-load and Cold Tests shall be conducted after the successful erection to prepare the equipment and line for the Hot run and Performance Tests for the purpose of confirming the performance of the line. The details of conditions and procedures of tests will be discussed and agreed upon between the End User and Seller at later stage.

No-load and Cold Tests

A detailed programme of cold test will be prepared by the Seller and submitted to the End User sufficiently in advance to the commencement of cold tests.

The test shall include checking for completion of erection, equipment alignment, rotation, and vibration, checking of electrical interlocks, insulations, cabling interconnections. This also includes the calibration of instruments, pressure testing of pipelines, idle and no-load tests.

Hydraulic pump units will be operated and checked for proper pressure and operation of the pressure regulating equipment, coolers, filters etc. All solenoid valves and cylinders will be tested for operation and proper speed and stroke.

Motor operated equipment will be tested for proper rotation, speed and control from operator desk

Blowers will be tested for proper static pressure.

All equipment will be tested to operate at required speed and with the specified traverse and lift motion for all hydraulic equipment.

The furnace will be checked for gas tightness.

The test will be achieved in the following conditions.

- the entry seal and the exit snout will be completely shutoff with plates
- the test will be with cold air / nitrogen.

After closing of the furnace enclosure, the furnace will be pressurized under air or nitrogen and the leaks will be detected with soapy water and immediately corrected in order to reach good tightness.

Furnaces dry out.

Upon successful completion of No Load Test of the furnace section, operation of all furnace systems will be initiated in compliance with a schedule to be provided by the SELLER.

End User's personnel under the supervision and direction of the SELLER will start up the protective atmosphere, pilot and main gas combustion systems, cooling fans, heat exchangers, etc. and confirm that proper adjustment of instrumentation and controls has been achieved. All variable data such as fuel flow and pressure, atmosphere flow and distribution, nozzle pressure in cooling sections, temperature attained, etc. will be recorded during the dry out period. The SELLER shall prepare a tabulation of the data and establish optimum values for each parameter.

After the dry out has been completed the furnace will be inspected by SELLER representatives to detect any deterioration of refractory, distortion or damage to structure, or equipment problems. All defects attributable to the SELLER will be corrected by the SELLER at his own expense.

Automated functions will be tested to the maximum possible degree without strip. During cold run test period the automatic and semiautomatic operations of the line will be checked and adjustments and/or corrections will be made before completion of cold run test especially for equipment start, stop, acceleration, deceleration and sequencing. The instrumentation will be set sufficiently for normal operation of the line.

These tests will prepare the equipments and line for hot run and Performance tests.

Hot Run (commissioning) and Performance tests (PAT & FAT)

After the successful completion of cold tests the Seller will inform End User, the proposed date of commencement of hot run and Performance test. The requirements for the labour, materials, chemicals, power and utilities will be established and provided by the End User. The End User also shall make available their trained (trained by the Seller's supervisors during erection and cold tests) operators and maintenance people to follow the Hot run and performance tests.

For this test the input coil as per reference size or any other mutually decided size shall be used.

During hot run test the line functions like Heat cycle test in the furnace , air knife coating uniformity and adhesion test, coating pot temperature accuracy test, coating weight control, chemical coating test, will be tested observed and recorded.

If any equipment or part thereof fails due to Seller's responsibility during the hot run test, Seller will remedy the faults at his own expenses, including either repairing or replacing of the respective equipment or part thereof.

The commissioning will be considered as successfully done, as soon as the mutually selected coils have been continuously coated for 3 hours.(minor stoppages less than five(5) minutes will not be considered as interruption)

After completion of commissioning, Seller shall inform the End User the proposed date of the commencement of the Performance test / FAT (Final Acceptance tests) to demonstrate the specified performance guarantee parameters. These tests shall be carried out within three (3) months of the commissioning. If the test cannot take place during the period of three (3) months for the reasons which are not attributable to Seller, then the Seller shall be released from its obligation to perform the test fully or partly. In that case further assistance from the Seller will be agreed between both side representatives.

During the performance test / FAT, the line shall be running at steady state and will be operated under the Seller's supervision. Seller shall issue test procedures and check sheets which shall be mutually agreed.

Should one or several performance tests fail due to the Seller's fault within above mentioned period, the Seller shall be allowed for repeat of the corresponding failed test(s) within an additional period of 2 months. Should one or several performance tests fail due to the End User's fault within above mentioned period, the Seller shall repeat the corresponding failed test(s) within an additional period of 2 months. If this test cannot take place , fully or partly, one(1) month after the first request of the Seller, and if the delay is not attributable to Seller , then the Seller will be released from its obligation to perform the test fully or partly.

If the guaranteed figures are not reached even after the additional period of 2 months, for the reasons attributable to the Seller only, the Seller will submit to the End User proposal in order to obtain the guaranteed performance. In such case, the terms of commercial contract will apply.

The End User shall issue Final Acceptance Certificate (FAC) within 7 days after successful completion of last performance test / FAT .

In case the End User fail to issue the FAC within 15 days of the successful FAT without any special reason, it is automatically recognised that FAC has been issued. However the End User shall issue the FAC at earliest.

FURNACE PRODUCTION RATE GUARANTEE

Production guarantee test will be conducted at appropriate time for two mutually agreed sizes from the production chart.

Guaranteed_Hourly_Production Rate

The hourly production rate is based on the actual production during the period (test duration 4 hours), divided by the available time excluding scheduled and unscheduled delays.

Allowed production capacity deviation for all tests will be 5%

Calculation for production capacity :

$$\text{Production capacity} = (T * W * L * 7.85 * 10^{-6}) / \text{PRT}$$

T = Strip thickness in mm

W = Strip width in mm

L = Length of the strip (m) processed during the test.

PRT = TO – TB – TS

TO = Test duration i.e. 4 hours

TB = Time of interruption and failures which are attributable to End User

TS = Time of interruption and failures which are attributable to Seller

If TS > 36 minutes, the test is not valid and has to be repeated.

COATING WEIGHT GUARANTEE

Reading of coating weight shall be considered under following conditions

Line speed to be constant

Bath temperature variation shall be within $\pm 2^{\circ}\text{C}$.

Bath chemistry to remain constant

No strip vibration

Strip flatness 20 IU or better

Strip roughness < 0.5 μ

Reading during weld passage through airknife to be excluded.

Max coating shall be limited by maximum pot dragout rate.

OVERALL PERFORMANCE

At appropriate time in consultation with the End User, the Seller shall demonstrate performance at rated capacity for each selected size as above for 4 hours continuous steady state run after 30 minutes of initial running before test starts. If during a period of 4 hours an interruption of more than 20 minutes happens less than 1 hour after start of test, the test will be restarted.

Conditions for Performance tests:

- 1 The details of the test procedure shall be decided through consultation between the End User and the Seller after finishing the hot run test.
- 2 The operating staff has sufficient process experience and is well acquainted with the line and its operation.

- 3 Line operates according to specific line speed (m/min) under normal operating conditions.
- 4 The input coils confirming to the incoming material specifications mentioned in the technical specifications and of the specified reference size or equivalent shall be made available in the quantities required.
- 5 The coils shall not be abnormally contaminated by rust, oil, grease etc, shall have good flatness , tight and square wound, free from defects like edge cracks, waviness, centre buckle, spills, busters, holes, etc
- 6 In case of a narrower / wider width than the reference, prorata tonnage will be added to actual tonnage processed.
- 7 In case of lighter coils than the reference coil weight, the equivalent tonnage will be calculated on the basis of increasing the actual steady process time proportional to the coil weight and reference coil weight will be considered as coil weight for computing the equivalent tonnage processed.
- 8 If the materials develops defects, the processing from that coil will be discontinued. The time consumed in such cases shall be deleted from the total available hours with corresponding reduction in the tonnage to be processed for the campaign in question.
- 9 Stoppages on account of reason stated earlier or any other reasons beyond process cycle or beyond the Seller's control shall be deducted from the available time for computing the new figures for tonnage per hour.
- 10 Coils mutually acceptable should be made available prior to performance test.
- 11 The tests for production and quality shall be carried out simultaneously.
- 12 Any other delays, than caused by equipment, will not be considered as process delay for e.g. shift change hours etc.
- 13 Trained operating crew for the line and material handling should be made available.
- 14 In charge for the trials with adequate authority to be present during the trials.
- 15 Crane handling and material handling facilities as well as an uninterrupted supply of power and all the utility services as specified will be made available by the End User.
- 16 Any deviation coming from physical heterogeneity of the input material characteristic such as but not limited to chemical analysis, strip dimensions and emissivity will be taken into account to evaluate the performance test results.
- 17 For coating guarantee, line should operate at constant speed, without vibrations and

tension variations, Bath temperature $\pm 2^{\circ}\text{C}$, bath chemistry should be constant, Strip near weld should not be considered. Max coating shall be limited by maximum drag out rate specified.

GUARANTEE PARAMETERS

Subject to all technical specifications and test conditions described in the proposal / agreed in the contract Seller will demonstrate following parameters

<u>Guarantee Parameter</u>	<u>Guarantee Value</u>	<u>Tolerance limit</u>	<u>Definition and conditions</u>	<u>Test method</u>	<u>Remark</u>	<u>LD (more than tolerance value)</u>
Furnace Production rate 0.25mm x 960mm-FH 0.30mm x 960mm-CQ	12.3 Ton/hr 7.7 Ton/hr	- 5%	Definition of Ton/hr (=P) $P = 60 \times L_s \times t \times w \times 7.85 \times 10^{-6}$ Where, P= Ton/hr L_s =Center line speed (mpm) t= Strip thickness (mm) w = Strip width (mm)	1)The test shall be carried out under the steady state conditions. 2)At least one adjusting coil, size of which is same as the test coil, shall be used to prepare the proper line conditions for test.	Instantaneous value, excluding all scheduled and unscheduled delays.	-0.5% = 0.5% -1.0% = 1% -1.5% = 1.5%
Coating weight (both side together)	50 gm/m ² min 150 gm/m ² max	±5%		1)Coating weight shall be measured by Coating wt. gauge in tripple spots in certain time of stable condition of coating 2)Measurement under unstable conditions shall be excluded. 3)Shape of the input test coils shall be better than 20 I units checked and confirmed by both parties.	Within the limitation of max dragout rate specified	±5% = 0.5% ±10% = 1% ±15% = 1.5%

CHAPTER- 8

SUPERVISION OF ERECTION
AND SUPERVISION OF COMMISSIONING

The End User with his resources like erection tools, materials, utility services and people will perform the Erection work.

The End User will provide the semi-skilled / unskilled labor and material handling equipment including EOT crane and the utility services like electricity, water, compressed air, fuel gas required for erection.

The Seller & the End User before the start of erection work shall, jointly inspect the equipment foundations prepared by the End User based on the basic engineering provided by the Seller.

The mechanical testing, Cold trials, Hot trials, commissioning and performance testing shall be carried out by the End User using trained operators under the Seller's Supervision. The End User shall provide all the necessary facilities like input CR coils, utilities, all the consumables like GLingots, chemicals, Electricity, Fuel gas, steam etc. till the successful completion of performance tests.

The Seller shall provide the special tool & tackles and commissioning spares required during commissioning and performance tests.

The Seller shall provide a detailed schedule, program of erection and procedure for all cold, hot and other tests well in advance of executing the actual work.

CHAPTER- 9

TRAINING

To ensure a continuous and trouble-free operation of the supplied equipments , the training will be provided for the following categories.

1. Process
2. Operating technique
3. Maintenance technique
 - Mechanical
 - Electrical
 - System control programming

Qualification of trainees

- Mechanical engineer
- Electrical engineer

Training Program

The number of persons and period of training will be mutually agreed upon.

Mechanical	
Suggested Training Programme	SELLER
End User's site	On job training shall be provided at site for End User's operating & maintenance personnel , during erection & commissioning of the equipment.

Electrical

Training on hardware

The training on hardware and system software shall be completed before erection and commissioning of the plant. The training shall be organised at the End users factory for the electrical and automation system.

The training on AC drive systems, Automation, PLC, and Hardware / Software techniques shall be provided.

Training on application software

For application software training the End User's engineers who have participated in the earlier training courses on hardware and software techniques shall participate with SELLER engineers during the commissioning to familiarise themselves with the application software.

Commissioning training at site

The plant operational and maintenance personnel should work in close association with SELLER's personnel during the commissioning. This would enable them to take over the plant on commissioning.

CHAPTER- 10

LIST OF MAKES

LIST OF MAKES

SR.NO.	DESCRIPTION	MAKE
1.	Hydraulic Cylinder	Veljan / Dynaforce / IPH/ Canara Hydraulics
2.	Rotary Union (water)	Deublin/ Texuaan
3.	Pneumatic Cylinders	Duncan Engineering (Schrader)/ Rotex / Festo/Electropneumatic
4.	Pneumatic valves	Duncan engineering(Schrader) / ROSS controls / Norgren / Festo / SMC/Electropneumatic
5.	Bearings	SKF / FAG / NTN / INA / KOYO / NSK
6.	Load Cell	HAEHNE- Germany / Vhshay KELK
7.	AC Geared Motor	Essenpro / Power Build / Premium transmission
8.	Geared Coupling	Flex trans / Nu teck / Rath / GBM / Elecon
9.	Pneumatic Caliper Brake	Kateel Engineering /Caliper Brakes
10.	Gear Box	Essential power/ Elecon / Shanthi / NAW / Premium Transmission/ Power Build
11.	Universal Joints	Hindustan Hardy Spicer / Hilberk / Nuhydro
12.	Pump	Mather & Platt / Kirloskar Brothers
13.	Heat Exchanger for water quench tank	Neha / Alfa-Laval / Kelvoin (GEA)/ Trantor
14.	Heat exchanger for dryer	Neha
15.	Hydraulic System	Yuken/ Eaton / Hydac / Rexroth/Vickers
16.	Hydraulic Motor	Danfoss / M+S Hydraulics/ Dyna Automation / Dantal Hydraulics
17.	Modulating Motor	Honeywell
18.	Pressure Transmitter	Emerson, Honeywell, E & H, Yokogawa
19.	Flow Transmitter / Temp. Transmitter	Emerson, Honeywell, E & H, Yokogawa
20.	Steering System	EMG / CMI Automation
21.	Burners for NOX furnace	ESA (Pyronics) / Bloom / Eclipse
22.	Heating elements	Sandvik Asia/ Marathon heaters / SS environmental
23.	Thermocouples	General Instruments / Toshniwal / Unitech / Radix
24.	IR Pyrometer	Ircon / Land
25.	U V Flame Detector	Honeywell / Pyronics / Khromschroder
26.	Gas station	ESA manufacturing / GTS / Elster / Eclipse / Maxon
27.	Ceramic pots	Xi'an Zhongwei Electric Equipment – China, Xi'an Wisdom Electric Equipment Company – China.
28.	Fan	Batliboi / Vapcon /Laxmi / Howden (Flakt woods)
29.	Blower for Air-Knife (turbo blower)	Hoffman
30.	Gas Analysers	GE / Emerson
31.	Coating weight gauge	Jasch

Note : Seller retains the choice to select the suitable make from the above list and however try to match with the existing line (proj 2089).

CHAPTER- 11

PROJECT SCHEDULE