



QUALITY ASSURANCE PLAN

A Document to Ensure the final products are of utmost Quality.



KUMAR INDUSTRIES



(AN ISO 9001:2015 CERTIFIED COMPANY)

KUMAR INDUSTRIES

STANDARD MANUFACTURING QUALITY PLAN

FOR

HOT DIP GALVANIZED SOLAR TRANSMISSION LINE TOWERS & SUBSTATION STRUCTURES

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STANDARD MANUFACTURING QUALITY PLAN



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Section: Raw Material Inspection

Sr. No.	Component /Operation & Description of Test	Sampling Plan With Basis	Ref, Document & Acceptance Norm	Testing Agency	Remarks
1	Raw Material Structure Steel (Angle, Channel, Joists, Beam Sections, Plates & bars)	Steel Shall be Procure from main Producer/PGCIL/IS Approved Re-Rollers or as mutually agreed by the client			
1.1.1	Physical Properties				
a)	Test For Yield stress	One Sample for 50 Mt or part there of as per IS:2062	IS:2062, Grades, A<20mm thick 250N/mm ² mins20 to40mm thick- 240N/mm ² mins> 40mm thick- 230/mm ² min	KI/Re-Rollers/ Third Party independ ent lab	Verification of Manufacturer's Test Certificate & KI Records, Duly Co-related at the time of final inspection/CIP at Re-roller's works
b)	Test For ultimate Tensile strength	One Sample for 50 Mt. or part thereof as per IS:2062	IS:2062, Grades – A, 410N/mm ² min	KI/Re-Rollers	Verification of manufacturer's Test Certificate & KI Records Duly Co-related at the time of final inspection/CIP Re-roller's works
c)	Percentage for elongation Test	One sample For 50Mt or part there Of as per IS:2062	IS:2062, Grades- A23% mins IS:2062	KI/Re-Rollers/ Third party independent lab	Verification of Manufacturer's Test Certificate & KI , Records, duly co-related at the time of final inspection/CIP at re-roller's Works



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d)	Bend Test	One sample For 50 Mt or Part there of as per IS:1599 & IS :2062	IS: 2062, Grade A. Piece Shall withstands bending through 180 ⁰ to an internal dia not >3t, with bath modes parallel out cracking. (At room temp.) for Grades A3t	Main Producer KI/Re-roller's/Th ird Party Independent Lab	Verification of Manufacturer's Test Certificate RATNA Records, Duly co-related at the time of final inspection /CIP at re-roller's works
1.1.2	Chemical Composition	One sample Form each consignment of 50Mts or Part thereof as per IS:228 & IS:2062	IS:2062, Grade-A, As Annexure-1, Given Below Page(no. 19)	Main Producer KI/Re-roller's/Th ird Party Independent Lab	Verification of Manufacturer's Test Certificates from main producers/ KI third party lab records, duly co-related at the time of final inspection (when manufacturer's TC not available)/CIP AT re-rollers works
1.1.3	Visual inspection for surface defect	IS:2500 level II AQL 1.5 as per table-1 enclosed in page no. 17	IS:2500 level II, Material should be free form surface defects like laminations, rough/jagged & imperfect edges, cracks, piping & other harmful defects (removal of minor surface defects as IS:2062 Clause 7 acceptable	Re-rollers/ KI	Records Review at the time of Final inspection/CIP at the re-roller's works



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1.1.4	Dimensional checks with root radii	IS:2500 level II AQL-1.5 as per Table-1 enclosed In Page no. 17	IS: 808, IS: 1730 as a client's specn.	Re-rollers/ KI	----do----
1.1.5	Tolerances for Angle (Flange & Length) Equal Angles i) Up To 45 mm Leg length ii) >45 to 100mm length iii) >100mm leg length	----do----- ----do----- -----do----- -----do-----	IS:808,IS:1852 1.5 mm as a client's specn ± 2.0mm ± 2.0% of leg length difference between leg length of equal angles shall be limited to 75% of total tolerance (plus & minus	Re-rollers/ KI Re-rollers/ KI Re-rollers/ KI Re-rollers/ KI	----do----- ----do----- ----do----- ----do-----
1.1.6	Diameter tolerance for round bars	IS:2500 LEVEL II AQL 1.5 as per table-1enclosed in page no. 17	IS: 2062 Gr. A 1732 & IS 1852 Up to 25mm ±0.5mm > 25to 35 mm ±0.6mm >35 to 50 mm ±0.8 mm >50 to 80mm ±1.0 mm >80mm to 100 mm ±1.3mm >100mm±1.6% of dia	Re-rollers/ KI	Records review at the time of final inspection/CIP at the re-roller's works



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1.1.7	Out of squareness for Angle	IS:2500 level II AQL- 1.5 as per table-1 enclosed in page no17	IS:2062 Gr.A IS:1852 <u>+1°</u>	Re-rollers/ KI	----do----
b	Permissible ovality for bars	----do----	IS:2062 Gr.A IS:1852 <u>+1°</u>	Re-rollers/ KI	----do----
1.1.8	Camber for Angle Section	-----do-----	IS2062, IS 1852 as a client's specn. Max 0.2% of length	Re-rollers/ KI	Records review at the time of final inspection/CIP at the re-roller's works
a)	For flange less than 100mm	-----do-----	--do--		
b)	For flange 100mm and above	-----do-----		Re-rollers/ KI	
1.1.9	Weight tolerance for angle sections 3mm thick >3mm thick	One sample for 20Mt/section or part thereof	IS:808, IS1852 5% <u>5%</u> -3% Over weight specified as in IS:808	Re-rollers/ KI	Records review at the time of final inspection/CIP at the re-roller's works
1.1.10	Weight Tolerance plates	One sample for 20Mt/section or part thereof	IS1730, IS 1852 <u>± 5%-2.5%</u> Over weight specified as is 1730	Re-rollers/ KI	Records review at the time of final inspection/CIP at the re-roller's works



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1.1.11	Weight tolerance for bars	One sample for 20MT/section or part thereof	IS: 1732, IS: 1852 as a client's specn. Up to 10mm $\pm > 10$ to16mm $\pm 3\%$ Over weights specified as in IS1732	Re-rollers/ KI	----do----
1.1.12	Thickness tolerance for plates	IS:2500 level II, AOL-1.5 as per table-1 enclosed in page no. 17	IS: 1732 IS: 1852 as client's specn. <8mm thick +12.5%, -5.0% 8mm to12mm $\pm 7.5, 5.0$ Over 12mm ± 5.0	Re-rollers/ KI	----do----
1.2	Zinc (to be procured from main manufacturer Hindustan zinc ltd. Or binani zinc ltd, or imported or sources approved by customers				
1.2.1	Chemical composition	One sample for 50Mt or part thereof	IS:209(Grade 99.95%) the molten metal in galvanizing bath shall not contain less than 98.5% by mass of zinc	Manufacturer/ third party independent lab	Verification of manufacturer's test certificate & records of KI duly correlated at the time of final inspection
		One sample every month	The molten metal in the galvanizing bath shall not contain less than 98.5% by mass of Zinc	Third party independent lab	--do--



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Section: In Process Inspection

Sr. No.	Component /Operation & Description of Test	Sampling Plan With Basis	Ref, Document & Acceptance Norm	Testing Agency	Remarks
2.0	<u>In process inspection</u>	100%	IS:802 part II IS:7215, Customer approved, Drg. & shop sketches	KI	Records review at the time of final inspection
(A)	Fabrication of structure parts.				Records review at the time of final inspection
a)	Straightening				
b)	Cropping(Cutting)	1 st piece and every 50 th piece	Length tolerance(±)2mm. the cut surface to be clean reasonably square & free from distortion	KI	Records review at the time of final inspection
c)	Stamping	1 st piece and every 50 th piece	Letter size as per customer specification	KI	Records review at the time of final inspection
d)	Punching/Drilling	1 st piece and every 50 th piece	Punching to be done for thickness Up to 15m and drilling to be done for thickness more than 15mm. holes near bends to be punched/drilled after bending hole should be perpendicular to surface	KI	Records review at the time of final inspection



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Sr. No	Component /Operation & Description of Test	Sampling Plan With Basis	Ref, Document & Acceptance Norm	Testing Agency	Remarks
i) i) ii) iii) iv)	Edge security For 13.5 mm dia hole For 17.5 mm dia hole For 21.5 mm dia hole For 25/25.5mm dia hole	1 st piece and every 50 th piece	Shared 20mm min. rolled 16mm min. sheared 23mm min. rolled 20mm mins sheared 28mm min. rolled 25mm min as per approved	KI	Records review at the time of final inspection
f)	Drilling & punching Hole to hole distance	1 st piece and every 50 th piece	Tolerance cumulative & between consecutive holes shall be within \pm 2mm & 1mm respectively	KI	Records review at the time of final inspection
g)	Notching, flange cut corner cut & bevel cut	1 st piece and every 50 th piece	+5mm on specified length of cut. Operation by shearing up to 8 mm thick and by gas cutting for material above 8mm thick	KI	Records review at the time of final inspection
h)	Heel cutting	1 st piece and every 50 th piece	Customer approved drgs./shop sketches for members greater than 12mm thick, gas cutting to be adopted followed by surface grinding	KI	Records review at the time of final inspection



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Section: In Process Inspection

Sr. No	Component /Operation & Description of Test	Sampling Plan With Basis	Ref, Document & Acceptance Norm	Testing Agency	Remarks
i)	Bending	100% pieces	IS: 802 part-II, IS: 7215 customer approved drawings/shop sketches	KI	Records review at the time of final inspection
	i) MS Section	100% pieces	<u>Process</u> Cold Cold Hot Hot	<u>Section</u> Up to 75x75x6 Upto100x100x8 Abv 75x75x6 Abv 100x8	<u>Bend angle</u> Up to 10 Deg. Up to 5deg,above10° & 5°
	ii)MS Plates	100% pieces	Cold Hot	Up to 12 mm others	Up to 15 deg
j)	Welding i) Visual Examination ii) DP TEST	1 st piece and every 50 th piece 100% 100%	As per customer technical specn/Approved welding procedure welder's qualification	KI	Records review at the time of final inspection CIP at Black Stage. CIP Records review at the time of final inspection.CIP at random basis at Black stages on 25% of pieces
k)	Final inspection of fabricated parts	Random Basis	All parameters from(a) to (j) above are checked and records maintained before releasing the materials for Galvanizing	KI	Records review at the time of final inspection



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Sr. No.	Component /Operation & Description of Test	Sampling Plan With Basis	Ref, Document & Acceptance Norm	Testing Agency	Remarks
B)	<u>In process inspection of foundation Bolts</u>		IS:802part II/approved bills of materials		Records review at the time of final inspection
a)	Cutting & shearing	1 st piece and every 50 th piece	IS:802part II/approved bills of materials	KI	Records review at the time of final inspection
b)	Chamfering	1 st piece and every 50 th piece		KI	Records review at the time of final inspection
c)	Threading	1 st piece and every 50 th piece	IS1367, IS4218		Records review at the time of final inspection
3.0	Proto (Model & assembly as per requirement of Customer)	One structure of each type	Customers approved structural drawing & bill of materials. To be assembled & checked for dimensions, angle size by this to verify interchangeable of members etc.	KI	Records review at the time of final inspection CIP to be witnessed by the main contractor of customer & obtain proto corrected drawing & B.O.M. approved from customer.
4.0 4.1	Galvanizing	One sample daily	IS: 2629 Power grid spcn . KI Plant standards. Strength of solution Between 4% to 12%	KI	Records review at the time of final inspection



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Sr. No.	Component /Operation & Description of Test	Sampling Plan With Basis	Ref, Document & Acceptance Norm	Testing Agency	Remarks
a)	Degreasing in caustic soda solution or acid based cold degreaser		5% to 15% PH & SP, Gr. As per KI PLANT standards. IS: 2629 Power grid spcn. KI plant stds.40-180gms/Lt. IS:2629		
b)	Pickling i)acid content	One sample daily	KI plant stds. 40 ^o c to 180 gram/Ltr.	KI	Records review at the final inspection
	ii) iron content	One sample daily	IS: 2629/PGCIL spcn. KI plant stds. 100 to 120gm/liter(max)	KI	Records review at the final inspection
c)	Rinsing (only in absence of auto neutralization of pre-flux solution)	One sample daily	IS: 2629/PGCIL spcn. KI plant stds. 70 ^o c-110 ^o c	KI	Records review at the final inspection
d)	Pre-fluxing in Zinc chloride & ammonium chloride solution	One sample daily	IS: 2629/PGCIL/KI plants stds. 200 to 400gms/liter max. 1.16 to 1.32, 4 to 5	KI	Records review at the final inspection
e)	Preheating		IS: 2629 PGCIL specs. KI Plant stds. 70 ^o c to 110 ^o c	KI	Records review at the final inspection



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Section: In process Inspection

Sr. No.	Component /Operation & Description of Test	Sampling Plan With Basis	Ref, Document & Acceptance Norm	Testing Agency	Remarks
4.2	Dipping				
a)	(galvanizing) Zinc bath temperature continuous recording by graph & actual verifications by thermometer	Hourly check	IS: 2629 PGCIL/KI specn. Articles to remain immersed till the reaction takes place which is indicated by stoppage of bubbling withdrawal to be controlled so that zinc drains freely	KI	Records review at the final inspection
b)	Immersion time & withdrawal time				
c)	Quenching in running water	-----	-----	-----	-----
d)	Dichromating (PH value)	One sample daily	IS: 2629 KI plant stds. Standard strength of solution to be maintained at .0.2% to 1% of sodium dichromate and 0.5% of sulphur acid temp. of solution should be less than 65 ^o c (PH value 4 to 5)	KI	Records review at the final inspection



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Sr. No.	Component /Operation & Description of Test	Sampling Plan With Basis	Ref, Document & Acceptance Norm	Testing Agency	Remarks
4.3	Galvanizing Checking	100%	IS: 2629/ KI surface to be free from defect like bare/black spots, (except when small & suitable for patching) heavy ash & flux inclusions, lumps, pimples, runs etc.	KI	Records review at the final inspection
a)	Visual checking				
b)	Thickness of zinc coating by coat meter	3 sample/shift	IS:4759, Min 86Micrones	KI	Records review at the final inspection
	i)for Angle sections & plates			KI	
	ii) for anchor bolts	3 sample/shift	IS:2629, IS:4759, Min. 86 microns	KI	Records review at the final inspection
c)	weight for Zn coating for angles, sections & plates & anchor bolts	3 sample/shift	IS:4759, IS:6745/-<5mm thick 460gm/mtr ² > 5mm thk610 gm/mtr ²	KI	Records review at the final inspection
d)	uniformity of zinc	3 sample/shift	IS: 2629, IS2633/Materials to withstand 4 dips of one minute each without showing signs of copper deposits..	KI	Records review at the
e)	adhesion test of Zn coating(pivot hammer test)	3 sample/shift	IS: 2629 NO. Removal or lifting of coating in areas between hammer impressions. Coating should not peel off.		Records review at the time of final inspection



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Section: Final Inspection

Sr. No.	Component /Operation & Description of Test	Sampling Plan With Basis	Ref, Document & Acceptance Norm	Testing Agency	Remarks
5.0	FINAL INSPECTION & TESTING (Inspection engineer to check /ensure compliance to notes/general reqt. given on page 15 & 16 of MQP) Physical properties (i) UTS test (ii) Yield stress test. (iii) Percentage elongation test. (iv) Bend test	One sample for every 50Mt/section and part thereof	Please refer clause No. 1.1.1.(a), (b), (c), & (d)	KI	CIP
b) i)	Galvanizing Test Thickness of Zn coating	One sample for every 50Mt./ section and part thereof	IS:2629/4759/Please refer clause no. 4.3 (b)	KI in present of customer/ran dom representative	CIP
ii)	Weight of Zn coating	--do--	Please refer clause 4.3 © 610 gm/m2	--do--	CIP
iii)	Uniformity of Zn coating	--do--	Please refer clause 4.3(d) 4 dips of Cuso4 solution of 1.186	--do--	CIP
(iv)	Adhesion test of Zn coating (Hammer test as per IS)	--do--	Sp. Gravity/180C+/-20c (IS:2633) IS:2629 Refer clause 4.3 (e)	--do--	CIP



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(c)	Visual inspection for fabrication galvanizing	As per table II Page no.18	Please refer clause no. 4.3 (a)	--do--	CIP
(C)	Dimensional , physical check of foundation bolts	--do--	Power grid specn approved. Drgs. Please refer clause no.2a) to 2j) IS: 802 power grid spcn.	--do--	CIP
6.0	<u>Packing storing, bundling, handling</u>	100%	Packing list to be submitted along with dispatch. Documents.	KI	Pieces of light section to be wire bundled & heavy section to be supplied loose. Stacking to have proper ventilation and kept inclined. Damage to galvanization coating to be avoided while handling. KI to ensure sequential supplies & other details as per client specs.



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Notes/General Requirement To be Checked/Ensured

- 1 Proper co-relation of test certificate w.r.t. the materials from the raw materials state to finished materials state shall be maintained.
- 2 In case steel section are purchased by **KI** from the re-rollers, the following conditions shall be fulfilled
 - i) The re-rollers have to be approved by client, copy of MQP shall be available at supplier's work and identification marks shall be ensured.
 - ii) **KI** shall ensure and certify that the billets from the main producer as per specification are: 2830 have been used for conversion, unless specifically agreed to otherwise.
 - ii) **KI** shall offer the steel section at the re-rollers works for inspection to re roller.. this shall be a CIP in such cases for tests specified in clause 1.1 of MQP. The rolled angle sections shall be duly co-related with corresponding billets Railway shall have the option of establishing the co-relation by review of records or by conduction chemical analysis on rolled products
- 3 Nuts & bolts and step bolts & nuts & other bought out items to be procured from power Grid approved sources & CIP at supplier's works.
- 4 Welding procedure and welder's performance qualification approval by RE is required in case welding is involved at any stage of fabrication/erection. DP test before galvanizing is necessary to detect any welding defect and incase any defect exist, same has to be ground off and repaired before galvanizing.
- 5 If holes are to be done near the bend lines, the same is to be done after bending
- 6 RE confirmed that sample pieces consumed in testing shall be replenished by **KI** at the time of Dispatch. If the materials meet the quality requirements, CIP/MICC shall be issued for total quantity offered without deducting the weights of materials consumed in testing.
- 7 All testing and measuring equipments are required to be calibrate the calibration certificate shall be reviewed by RE Representative at the time of finals inspection.
- 8 Copy of CIP/MICC/inspection reports issued to be sent to site along with the materials.
- 9 Client's specification means client's technical specification, approved Drawings, approved technical data sheets and LOA provision applicable for the specific contract.



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Notes/General Requirement To be Checked/Ensured

10	KI shall strip off galvanizing of rejected materials before re-galvanizing in case rejection is due galvanizing testing/defects.
11	KI shall dispose-off entire section rejected in physical testing by gas cutting or by machine cutting .
12	In case of any contradiction between technical specification/approved drawing and MQP, the details mentioned in the technical specification / drawing shall be final.
13	
14	
15	Client should progressive align their quality system to the requirement of ISO: 9000 series quality standard and in due course of time should get their quality systems certified to ISO: 9001.
16	The quality manual should also be submitted to client.
17	Inspection of angle section at black stage of tower structures irrespective of specific contract can be followed as detailed under: The contractor may raise inspection call for angle section at black stage at re-roller's works against any one of the on going contract. i) under specific instruction from the contractor, TE may fabricate the raw materials cleared under AT –A CIP for a particular contract, for any of your project under execution. ii) KI will maintain a separate register indicating splitting and swapping of materials between different projects awarded to same contractor, which can be reviewed by RE inspection engineer. Separate register for each contractor is to be maintained if KI is executive jobs for different contractor. iii)The final inspection after fabrication and galvanizing, however, will continue to be contract wise and CIP will be issued for each day Client shall ensure that the material bear the embossing of re-roller's identification.
16	RE shall get the universal testing Machine (UTM) calibrated From accredited Lab. Of national accreditation body For Laboratory (NABL).
17	Only steel plates below 6mm Size exclusively used fir plates/ packing washers produce as per IS: 1079 (Grade –O) Are also acceptable .However, if below 6mm thick plates are used as load bearing plates, gusset plates, splices etc. Same shall confirm to IS: 2062 or equivalent std. and chequered plates used for platform proceed as per IS (work tested)



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TABLE - 1
SAMPLING PLAN FOR
VISUAL & DIMENSIONAL CHARACTERISTICS OF STRUCTURAL STEEL
FOR RAW MATERIAL ONLY
SAMPLING PLAN AS PER IS: 2500, LEVEL II, AQL 1.5
NUMBER OF PIECES

Lot Size	Sample Size	Acceptance No	Rejection No
2 to 8	100 % Inspection	0	0
911-15	8	0	1
16-25	8	0	1
26-50	8	0	1
51-90	8	0	1
91-150	32	1	2
151-280	32	1	2
281-500	50	2	3
501-1200	80	3	4
1201-3200	125	5	6
3201-10000	200	7	8
10001-35000	315	10	11
35001-150000	500	14	15.
150001& Over	800	21	22



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Annexure – 1
Chemical Composition (Ladle Analyses) Indigenous

Element Grade	C % Max	M n % Max	S % Max	P % Max	Si V % Max	C E
IS : 2062						
Grade A- Fe – 410 WA	0.23	1.50	0.05	0.05	0.40	0.42
Grade – B Fe410 WB	0.22	1.50	0.045	0.045	0.40	0.41

Permissible Variation For Grade A & B Product Analysis for IS:2062

Element Grade	C % Max	M n % Max	S % Max	P % Max	Si % Max	CEV
IS : 2062	0.02	0.05	0.005	0.005	0.003	-