

## STANDARD FIELD QUALITY PLAN FOR SUBSTATION

Sl. No.	Description of activity	Items to be checked	Tests/checks to be done	Ref. documents	Check/testing		Counter check/test by MeECL	Accepting authority in MeECL
					Agency	Extent		
1.	Column foundation	Materials						
		1.Cement	1. Source approval	Source meeting MeECL specification /approved vendor	Contractor	As proposed by contractor	To verify the proposal based on the supply made and factory test results.	Line -in-charge
			2. Physical tests	As per document at annexure-I of this FQP at page 6,7 & 8.	Samples to be taken jointly with MeECL and tested at MeECL approved lab	Review of all MTC's and one sample for every 500 MT	100% review of lab test results	Line -in-charge
			3. Chemical Tests & composition of cement	-do-	Contractor to submit MTC	100% review of MTC by contractor	100% review of manufacturer's Test certificate(MTC)	Line- in-charge
		2.Reinforcement steel	1. Source approval	To be procured from main producers only.	Contractor	As proposed by contractor	To review the proposal based on the documents.	Line- in-charge.
			2. Physical and chemical analysis test	As per annexure-2 of this FQP at page 9	Contractor to submit MTC	All MTC's	100% review of MTC	Line- in-charge
		3. Coarse aggregates	1. Source approval	Source meeting MeECL specification	Contractor	Proposed by the contractor, indicating the location of the quarry and based on the test results of Joint samples tested in MeECL approved lab.	To review the proposal based on the documents	Line- in-charge
			2. Physical tests	As per document at Annexure-3 of this FQP at page 10	Samples to be taken jointly and tested in MeECL approved lab.	One sample per lot of 200 cum or part thereof	100% review of lab. test results	Line- in-charge

Sl. No.	Description of activity	Items to be checked	Tests/checks to be done	Ref. documents	Check/testing		Counter check/test by MeECL	Accepting authority in MeECL		
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		4. Fine aggregate	1. Source approval	Source meeting MeECL specification	Contractor	Proposed by the contractor, indicating the location of the quarry and based on the results of Joint samples tested in MeECL approved lab.	To review the proposal based on the documents.	Line- in-charge		
			2. Physical test	As per annexure-4 of this FQP at page 11	Samples to be taken jointly and tested in MeECL approved lab.	One sample per lot of 200 cum or part thereof	100% review of lab test results	Line -in-charge		
		5. Water	1. Cleanliness (water shall be fresh and clean)	MeECL specification	Contractor	100% visual check at field	Verification at random	Site engineer		
			2. Suitability of water for concreting	MeECL specification	Contractor	100% visual check at field	Verification at random	Site engineer		
		<i>Concrete Works</i>								
		a. Before concreting								
		1.Bottom of excavated earth	Depth of foundation	Approved drawings	Contractor	100% at field	100% check by MeECL	Junior engineer/ Engineer		
		2.Reinforcement steel		Bar bending schedule	- do -	- do -			- do -	
		b. During concreting								
		1. Workability	Slump test	Range 25 mm to 55 mm refer document at Annexure-5 of this FQP at page 12	Contractor	100% at field	20% check at random	Junior Engineer/ Engineer		

Sl. No.	Description of activity	Items to be checked	Tests/checks to be done	Ref. documents	Check/testing		Counter check/test by MeECL	Accepting authority in MeECL	
					Agency	Extent			
		2. Concrete strength	Cubes compressive strength	CPWD specification as referred in document at annexure-5 of this FQP at page 12 & 13	Casting of cubes at site. Cubes to be tested at MeECL approved Lab. for 28 days strength	One sample of 3 cubes in each tower locations	100% review of lab test results. Cubes at 20% location are to be taken in presence of MeECL officials	Section -in-charge	
			1. Sequence of erection	As per Approved Drawings./ MeECL specification	Contractor	100% at field	100% check	Site engineer	
			2. Check for completeness	-do-	-do-	-do-	-do-	-do-	
			3. Tightening of nuts and bolts	-do-	-do-	-do-	-do-	-do-	
			4. Check for verticality	-do-	-do-	-do-	-do-	-do-	
			5. Tack welding for bolts & nuts	MeECL specification	Contractor	100% at field	100% Check	-do-	
2	Stringing	1. Field activity							
		a. Before stringing	Readiness for stringing	Stringing procedures as per MeECL specification	Contractor	Readiness certificate to be submitted by the contractor	Review of certificate	Line in-charge	
		b. During stringing	Conductor/Earth-wire)						
			1. Scratch/cut check (visual)	Approved drawings/ MeECL specification	Contractor	100% at Field	100% record & Field check 20%	Site engineer	
		c. After stringing	Check for,						
			1. Sag/tension	Sag tension chart/ tower spotting data	-do-	-do-	100% record & field check 20%	Site engineer	
	2. Electrical clearances	As per approved drawings./ MeECL specifications	-do-	-do-	-do-	-do-			

Sl. No.	Description of activity	Items to be checked	Tests/checks to be done	Ref. documents	Check/testing		Counter check/test by MeECL	Accepting authority in MeECL
					Agency	Extent		
			i) Ground clearance	-do-	-do-	-do-	-do-	-do-
			ii) Live metal clearance etc.	-do-	-do-	-do-	-do-	-do-
			3. Jumpering	-do-	-do-	-do-	-do-	-do-
3	Final Testing							
	a. Pre-commissioning of substation	a. Readiness of lines for pre-commissioning	1. Completeness of substation. 2. Megger test of substation	MeECL latest pre-commissioning procedures	Contractor	100%	100% joint checking	Project -in-charge
	b. Commissioning of line	Readiness of lines for commissioning	1. Digital photograph of each tower to ascertain the completeness of tower.	a. MeECL latest pre-commissioning procedures b. Pre-commissioning report	-do-	-do-	-do-	-do-
			2. Electrical Inspectors clearance		-do-	-do-	-do-	-do-

## ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CEMENT

<b>1. ORDINARY PORTLAND CEMENT</b>					
<b>Sl. No.</b>	<b>Name of the test</b>	<b>Ordinary portland cement 33 grade as per IS 269</b>	<b>Ordinary portland cement 43 grade as per IS 8112</b>	<b>Ordinary portland cement 53 grade as per IS 12269</b>	<b>Remarks</b>
a)	Physical tests				To be conducted in appr. Lab
(i)	Fineness	Specific surface area shall not be less than 225 sq.m. per Kg. or 2250 Cm <sup>2</sup> /gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 Cm <sup>2</sup> /gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 Cm <sup>2</sup> /gm.	Blaine's air permeability method as per IS 4031 (Part-2)
(ii)	Compressive strength	72+/- 1 hour : Not less than 16 Mpa (16 N/mm <sup>2</sup> ) 168+/-2 hour : Not less than 22 Mpa (22 N/mm <sup>2</sup> ) 672+/-4 hour : Not less than 33 Mpa (33 N/mm <sup>2</sup> )	72+/- 1 hour : Not less than 27 Mpa (27 N/mm <sup>2</sup> ) 168+/-2 hour : Not less than 37 Mpa (37 N/mm <sup>2</sup> ) 672+/-4 hour : Not less than 53 Mpa (53 N/mm <sup>2</sup> )	72+/- 1 hour : Not less than 23 Mpa (23 n/mm <sup>2</sup> ) 168+/-1 hour : Not less than 33 Mpa (33 N/mm <sup>2</sup> ) 672+/-1 hour : Not less than 43 Mpa (43 N/mm <sup>2</sup> )	As per IS 4031 (Part-6)
(iii)	Initial & final setting time	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	As per IS 4031 (Part-5)  -do-
(iv)	Soundness	Un-aerated cement shall not have an expansion of more than 10mm when tested by Le chatlier and 0.8% autoclave test.	Un-aerated cement shall not have an expansion of more than 10mm when tested by Le chatlier and 0.8% autoclave test	Un-aerated cement shall not have an expansion of more than 10mm when tested by Le chatlier and 0.8% autoclave test.	Le chatlier and Autoclave test as per IS 4031 (Part-3)

Sl. No.	Name of the test	Ordinary portland cement 33 grade as per IS 269	Ordinary portland cement 43 grade as per IS 8112	Ordinary portland cement 53 grade as per IS 12269	Remarks
b)	<b>Chemical composition tests</b>				Review of MTCC only
		a) Ratio of percentage of lime to percentage of silica, alumina & iron oxide 0.66 to 1.02	a) Ratio of percentage of lime to percentage of silica, alumina % iron oxide <b>0.66 to 1.02</b>	a) Ratio of percentage of lime to percentage of silica, alumina % iron oxide <b>0.66 to 1.02%</b>	
		b) Ratio of percentage of alumina to that of iron oxide <b>Minimum 0.66%</b>	a) Ratio of percentage of alumina to that of iron oxide <b>Minimum 0.66</b>	a) Ratio of percentage of alumina to that of iron oxide <b>Minimum 0.66%</b>	
		c) Insoluble residue, percentage by mass <b>Max. 4.00%</b>	c) Insoluble residue, percentage by mass <b>Max. 4.00%</b>	c) Insoluble residue, percentage by mass <b>Max. 4.00%</b>	
		d) Magnesia percentage by mass Max. 6%	d) Magnesia percentage by mass Max. 6%	d) Magnesia percentage by mass Max. 6%	
		e) Total sulphur content calculated as sulphuric anhydride (SO <sub>3</sub> ), percentage by mass <b>Not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5 respectively.</b>	e) Total sulphur content calculated as sulphuric anhydride (SO <sub>3</sub> ), percentage by mass <b>Not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5 respectively.</b>	e) Total sulphur content calculated as sulphuric anhydride (SO <sub>3</sub> ), percentage by mass <b>Not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5 respectively.</b>	
c)	<b>Total loss on ignition</b>	Not more than 5 percent	Not more than 5 percent	Not more than 5 percent	

Sl. No.	Name of the test	Pozzolana portland cement as per IS 1489			Remarks
2.	<b>POZZOLANA PORTLAND CEMENT AS PER IS 1489</b>				
a)	<b>Physical tests</b>	i) Fineness	Specific surface area shall not be less than 300 sq.m. per Kg. or 3000 Cm <sup>2</sup> /gm		
		ii) Compressive strength	168+/- 2 hour : Not less than 22 Mpa (22 N/mm <sup>2</sup> ) 672+/- 2 hour : Not less than 33 Mpa (33 N/mm <sup>2</sup> )		
		iii) Initial & final setting time	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes		
		iv) Soundness	Un-aerated cement shall not have an expansion of more than 10mm		Le chatlier and autoclave test as per IS 4031 (Part-3)
b)	<b>Chemical composition tests</b>				
		a) Magnesia percentage by mass Max. 6%			Review of MTCC only
		b) Insoluble material, percentage by mass $x + 2(100-x)/100$ where x is the declared % of pozzolana in the PPC			-do-
		c) Total sulphur content calculated as sulphuric anhydride (SO <sub>3</sub> ), percentage by mass <b>not more than 2.75 and 3.0 when tri-calcium aluminate percent by mass is 7 or less and greater than 7 respectively.</b>			-do-
c)	<b>Total loss on Ignition</b>	Not more than 5 percent			

## ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR REINFORCEMENT STEEL

Sl. No.	Name of the test	Mild and medium tensile steel as per IS 432	Cold twisted deformed bars Fe 415 as per IS 1786	Remarks
i)	Chemical analysis test	Carbon (for 20 mm dia and below) 0.23% Max. Carbon (for over 20 mm dia) 0.25%	Carbon 0.30% Max	
		Sulpher 0.055%	Sulpher 0.060%	
		Phosphorus 0.055%	Phosphorus 0.060%	
			Sulphur & Phosphorus 0.11%	
ii)	Physical tests	a) Ultimate tensile stress For all dia bars 410 N/Sq.mm. (min.)	a) Ultimate tensile stress 10% more than actual 0.2% proof stress but not less than 485 N/Sq.mm.)	Testing in approved lab.
		b) Yield stress (N/Sq.mm) min. For bars upto 20 mm dia 250 For bars above 20 mm dia 240 c) Percentage of elongation 23%	b) 0.2% of proof stress/yield stress (N/Sq.mm) min. For bars upto 20 mm dia 415 c) Percentage of elongation 14.5% (min.)	Testing in approved lab.
iii)	Bend & re-bend tests	Pass	Pass	Testing in approved lab.

## ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR COARSE AGGREGATES AS PER IS 383

3. Coarse aggregates											
i) Physical tests											
	a) Determination of particles size	a. IS sieve designation	%age passing for single-sized aggregate of nominal size					Percentage passing for grades aggregate of nominal size			
			40 mm	20 mm	16 mm	12.5 mm	10 mm	40 mm	20 mm	16 mm	12.5 mm
		63 mm	100	-	-	-	-	-	-	-	-
		40 mm	85 to 100	100	-	-	-	95 to 100	100	-	-
		20 mm	0 to 20	85 to 100	100	-	-	30 to 70	95 to 100	100	100
		16 mm	-	-	85 to 100	100	-	-	-	90-100	-
		12.5 mm	-	-	-	85 to 100	100	-	-	-	90 to 100
		10 mm	0 to 5	0 to 20	0 to 30	0 to 45	85 to 100	10 to 35	25 to 35	30 to 70	40 to 85
		4.75 mm	-	0 to 5	0 to 5	0 to 10	0 to 20	0 to 5	0 to 10	0 to 10	0 to 10
		2.36 mm	-	-	-	-	0 to 5	-	-	-	-
	b. Flakiness index	Not to exceed 25%									
	c. Crushing value	Not to exceed 45%									
	d. Presence of deleterious material	Total presence of deleterious materials not to exceed 5%									
	e. Soundness test (for concrete work subject to frost action)	12% when tested with sodium sulphate and 18% when tested with magnesium sulphate									

## ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FINE AGGREGATES AS PER IS 383

4.	Fine aggregates					
	i)	Physical Tests	IS sieve designation	Percentage passing for graded aggregate of nominal size		
a) Determination of particle size				F.A. Zone I	F.A. Zone II	F.A. Zone III
			10 mm	100	100	100
			4.75 mm	90-100	90-100	90-100
			2.36 mm	60-95	75-100	85-100
			1.18 mm	30-70	55-90	75-100
			600 microns 12.5 mm	15-34	35-59	60-79
			300 microns	5 to 20	8 to 30	12 to 40
			150 microns	0-10	0-10	01-0
	b)	Silt content		Not to exceed 8%	Not to exceed 8%	Not to exceed 8%
	c)	Presence of deleterious material	Total presence of deleterious materials shall not exceed 5%			
	d)	Soundness applicable to concrete work subject to frost action	12% when tested with sodium sulphate and 15% when tested with magnesium sulphate			

**ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CONCRETE WORK**

<b>1)</b>	<b>Concrete</b>	(a) Workability	Slump shall be recorded by slump cone method and it shall be between 25-55 mm.
		(b) Compressive strength	Three samples of 15 cm cube for 28 days compressive strength for all concrete works.

**Notes :**

- 1) **For nominal (volumetric) concrete mixes, compressive strength for 1:1.5:3 (sand: fine aggregates: coarse aggregates) concrete shall be 265 kg/Sq.cm. for 28 days and for 1:2:4 nominal mix, it shall be 210 kg/Sq.cm.**
- 2) **ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTHS FOR NOMINAL MIX CONCRETE :**
  - (a) the average of the strength of three specimen be accepted as the compressive strength of the concrete, provided the strength of any individual cube shall neither be less than 70% nor higher than 130% of the specified strength.
  - (b) If the actual average strength of accepted sample exceeds specified strength by more than 30%, the engineer-in-charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of the specified strength, it will be restricted to 30% only for computation of strength.
  - (c) If the actual average strength of accepted sample is equal to or higher than specified upto 30%, the strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.
  - (d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of engineer-in-charge.
  - (e) If the actual average strength of accepted sample is less than 70% of specified strength, the engineer-in-charge shall reject the defective portion of work represent by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall taken at the risk and cost of contractor. If, however, the engineer-in-charge so desires, he may order additional tests to be carried out to ascertain if the structure can be retained. All the charges in connection with these additional tests shall be borne by the contractor.

**General notes:**

- (1) This standard field quality plan is not to limit the supervisory checks which are otherwise required to be carried out during execution of work as per drawings/technical specifications etc.
- (2) Contractor shall be responsible for implementing/documenting the SFQP. Documents shall be handed over by the contractor to MeECL after the completion of the work.
- (3) Project -in-charge means over all in-charge of work. Line- in-charge means in-charge of the line. Section- in-charge means in-charge of the section.
- (4) In case of deviation the approving authority will be one step above the officer designated for acceptance in this quality plan subject to minimum level of Line- in-charge.
- (5) Acceptance criteria and permissible limits for tests are indicated in the annexures. However for further details/tests MeECL specification and relevant Indian standards shall be referred.
- (6) Tests as mentioned in this FQP shall generally be followed. However E.I.C. reserves the right to order additional tests wherever required necessary at the cost of the agency.
- (7) All counter checks/tests by MeECL shall be carried out by MeECL's officials at least at the level of Junior engineer.