

QUALITY CONTROL MANUAL FOR ROAD WORKS

901. GENERAL

- 901.1 All materials to be used, all methods adopted and all works performed shall be strictly in accordance with requirements of these specifications. The contractor shall set up a field laboratory at locations approved by the Engineer and equip the same with adequate equipment and personnel in order to carry out all required tests and Quality Control work as per Specifications and/or as directed by the Engineer. The internal layout of the laboratory shall be as per Clause 121 and/or as directed by the Engineer-in-charge. The list of equipment and the facilities to be provided shall be got approved from the Engineer-in-charge in advance.
- 901.2 The contractor's laboratory should be manned by a qualified materials Engineer/Civil Engineer assisted by experienced technicians and the set up should be got approved by the Engineer-in-charge.
- 901.3 The contractor shall carry out quality control tests on the materials and work to the frequency stipulated in subsequent paragraphs. The absence of clear indications about method and or frequency of tests for any item, the instructions of the Engineer shall be followed.
- 901.4 For satisfying himself about the quality of the materials and work 10% of quality control tests will also be conducted by the Engineer (by himself, by his Quality Control Units or by any other agencies deemed fit by him), generally to the frequency set forth herein under. Additional tests may also be conducted where in the opinion of the Engineer-in-charge need for such tests exists.
- 901.5 The Contractor shall provide necessary co-operation and assistance in obtaining the samples for tests and carrying out the field tests as required by the Engineer from time to time. This may include provision of labour, attendants, assistance, in packing and dispatching and any other assistance considered necessary in connection with the tests.
- 901.6 for the work of embankment, sub-grade and pavement, construction of subsequent layer of same or other material over the finished layer shall be

done after obtaining permission from the Engineer. Similar permission from the Engineer shall be obtained in respect of all other items of works prior to proceeding with the next stage of construction.

- 901.7 The Contractor shall carry out modifications in the procedure of work, if found necessary, as directed by the Engineer during inspection. Works failing short of quality shall be rectified / redone by the Contractor at his own cost, and effective work shall also be removed from the site of works by the Contractor at his own cost.
- 901.8 The cost of laboratory building including service, essential supplies like water, electricity, sanitary services and their maintenance and cost of all equipment, tools, materials, labour and incidentals to perform tests and other operations of equality control according to the Specification requirements shall be deemed to be incidental to the work and no extra payment shall be made for the same. If, however, there is a separate item in the Bill of Quantities for setting up of a laboratory and installing testing equipment, such work shall be paid for separately.
- 901.9 For testing of samples of soil / soil mixes, granular materials, and-mixes, bituminous materials and mixes, aggregates, corpos etc. samples in the required quantity and form shall be supplied to the Engineer by the Contractor at his own cost.
- 901.10 For cement, bitumen, mild steel, and similar other materials where essential tests are to be carried out the manufacture's plants or at laboratories other than the site laboratory, the cost of samples, sampling, testing and furnishing of test certificates shall be borne by the Contractor. He shall also furnish the test certificates to the Engineer.
- 901.11 For testing of cement concrete at site during construction arrangements for supply of samples, sampling, testing and supply of test results shall be made by the Contractor as per the frequency and number of test specified in the Handbook of quality Control for construction of Roads & Runways (IRC-SP-11) and relevant IS Codes or relevant clauses of these Specifications, the cost of which shall be borne by the Contractor.

901.12. The method of sampling and testing of materials shall be as required by the "Handbook of Quality Control for construction of Roads and Runways" (IRC : SP-11) and these MOST specifications. Where they are contradicting, the provision in these Specifications shall be followed. Where they are silent sound-engineering practices shall be adopted. The sampling and testing procedure to be used shall be as approved by the Engineer and his decision shall be final and binding on the Contractor.

901.13 The materials of embankment construction shall be got approved from the Engineer. The responsibility for arranging and obtaining the land for borrowing or exploitation in any other way shall rest with the Contractor who shall ensure smooth and uninterrupted supply of material in the required quantity during the construction period.

Similarly, the supply of aggregates for construction of road pavement shall be from quarries approved by the Engineer. Responsibility for arranging uninterrupted supply of materials from the source shall be that of the Contractor.

901.14 Defective Materials

All materials which the Engineer / his representative has determined, as not conforming to the requirements of the Contract shall be rejected whether in place or not, they shall be removed immediately from the site as directed-Materials, which have been subsequently corrected, shall not be used in the work unless approval is accorded in writing by the Engineer. Upon failure of the Contractor to comply with any order of the Engineer / his representative given under this clause, the Engineer his representative shall have authority to cause the removal of rejected material and to deduct the removal cost thereof from any payments due to the Contractor.

901.15 Imported materials :

At the time of submission of tenders, the Contractor shall furnish a list of material/ finished products manufactured, produced or fabricated outside India, which he proposes to use in the work. The Contractor shall not be entitled to extension of time for acts or event occurring outside India and it shall be the

Contractor's responsibility to make timely delivery to the job site of all such materials obtained from outside India.

The materials imported from outside India shall conform to the relevant Specifications of the Contract. In case where material / finished products are not covered by the Specifications in the Contract, the details of Specifications proposed to be followed and the testing procedure as well as laboratories / establishments where tests are to be carried out shall be specifically brought out and agreed to in the Contract.

The Contractor shall furnish to the Engineer a certificate of compliance of the tests carried out. In addition, certificate mill test reports clearly identified to the lot of materials shall be furnished at the Contractor's cost.

CONTROL OF ALIGNMENT, LEVEL AND SURFACE REGULARITY

General

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer, subject to the permitted tolerances described herein-after.

Horizontal Alignment:

Horizontal alignments shall be reckoned with respect to the center line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of +10 mm there from. The corresponding tolerance for edges of the roadway and lower layers of pavement shall be +25mm.

902.3 SURFACE LEVELS :

The levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the Engineer beyond the tolerances mentioned in Table – 900.1.

TABLE - 900.1
TOLERANCES IN SURFACE LEVELS

1.	Sub-grade	+ 20 mm
		- 25 mm
2.	Sub-base	+ 10 mm
	(a) Flexible pavement	- 20 mm
	(b) Concrete pavement	+ 6 mm
	(Dryclean concrete or Rolled Concrete)	- 10 mm
3.	Base-course for flexible pavement	
	(a) Bituminous course	- 6 mm
		+ 6 mm
	(b) Other than bituminous	+ 10 mm
	(i) Machine laid	- 10 mm
		+ 15 mm
	(ii) Manually laid	+ 15 mm
4.	Wearing course for Flexible pavement	
	(a) Machine laid	+ 6 mm
		- 6 mm
	(b) Manually laid	+ 10 mm
		- 10 mm
5.	Cement concrete pavement	+ 5 mm
		- 6 mm

* This may not exceed -8 mm at 0-30 cm from the edges.

Provided, however, that the negative tolerance for wearing course shall not be permitted in conjunction with the positive tolerance for base course, if the thickness of the former is thereby reduced by more than 6 mm for flexible pavements and 5 mm for concrete pavement.

For checking compliance with the above requirement for sub-grade, sub base and base courses, measurements of the surface levels shall be taken on a grid of points placed at 6.25 m longitudinally and 3.5 m transversely. For any 10 consecutive measurements taken longitudinally or transversely not more than one measurement shall be permitted to exceed the tolerance as above this one measurement being not in excess of 5 mm above the permitted tolerance.

For checking the compliance with the above requirement for bituminous wearing course and concrete pavements, measurements of the surface levels shall be taken on a grid of points spaced at 6.25 m along the length and at 0.5 m from the edges and at the center of the pavement. In any length of pavement, compliance shall be deemed to be met for the final road surface, only if the tolerance given above is satisfied for any point on the surface.

902.4

SURFACE REGULARITY OF PAVEMENT COURSES :

The longitudinal, profile shall be checked with a 3 metre long straight edge/moving straight-edge as desired by the Engineer at the middle of each traffic lane along a line parallel to the center line of the road.

The maximum permitted number of surface irregularities shall be as per Table – 900.2.

TABLE – 900.2
MAXIMUM PERMITTED NUMBER OF
SURFACE IRREGULARITIES.

	Surfaces of Carriageways And paved Shoulders				Surfaces of laybye, service areas and all bituminous base course			
Irregularity	4 mm		7mm		4 mm		7 mm	
Length (m)	300	75	300	75	300	75	300	75
National Highway/ Expressways*	20	9	2	1	40	18	4	
Roads of Lower Category*	40	18	4	2	60	27	6	3

*Category of each section of road as described in the contract.

The maximum allowable difference between the road surface and underside of a 3 m straight-edge when placed parallel with, or at right angles to the center line of the road at points decided by the Engineer shall be :

For pavement surface (bituminous and cement concrete)	3 mm
For bituminous base courses	6 mm
For granular sub-base/base courses	8 mm
For sub-bases under concrete pavement	10 mm

902.5 RECTIFICATION :

Where the surface regularly of sub-grade and the various pavement courses fall outside the specified tolerances, the contractors shall be liable to rectify these in the manner described below and to the satisfaction of the Engineer.

- (i) **Sub-Grade** : Where the surface is high, it shall be trimmed and suitably compacted. Where the same is low, the deficiency shall be corrected by scarifying the lower layer and adding fresh material and recompacting to the required density. The degree of compaction and the type of material to be used shall conform to the requirements of clause 305.
- (ii) **Granular Sub-base** : Same as at (i) above, except that the degree of compaction and the type of material to be used shall conform to the requirements of clause 401.
- (iii) **Lime/Cement Stabilized Soil Sub-base** : For lime/ cement treated materials where the surface is high, the same shall be suitably, trimmed while taking care that the material below is not disturbed due to this operation. However, where the surface is low, the same shall be corrected as described herein below.

For cement treated material, when the time elapsed between detection of irregularity and the time of mixing of the material is less than 2 hours, the surface shall be scarified to a depth of 50 mm supplemented with freshly mixed materials as necessary and recompacted to the relevant specification. When this time is more than 2 hours, the full depth of the layer shall be removed from the pavement and replaced with fresh material to specification. This shall also apply to lime treated material except that the time criterion shall be 3 hours instead of 3 hours.

- (iv) **Water Bound Macadam/Wet Mix Macadam Sub-base** : Where the surface is high or low, the top 75 mm shall be scarified, reshaped with added material as necessary and recompacted to clause 404. This shall also apply to wet mix macadam to clause-406.
- (v) **Bituminous Constructions** : For bituminous construction other than wearing course, where the surface is low, the deficiency shall be corrected by adding fresh material over a suitable tack coat if needed and recompacting to specifications. Where the surface is high, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications.

For wearing course, where the surface is high or low, the full depth of the layer shall be removed and replaced with fresh material and compacted to specifications. In all cases where the removal and replacement of a bituminous layer is involved, the area treated shall not be less than 5 m in length and not less than 3.5 m in width.

(vi) **Dry Clean Concrete Sub-base/Rolled Cement Concrete** : The defective length of the course shall be removed to full depth and replaced with material conforming to Clause 601 or 603, as applicable. The area treated shall be at least 3 m long, not less than 1 lane wide and extend to the full depth. Before relaying the course, the disturbed sub grade or layer below shall be corrected by leveling, watering and compacting.

(vii) **Cement concrete pavement** : The defective areas having surface irregularity exceeding 3 mm but not greater than 6 mm may be rectified by bump cutting or scrubbling or grinding using approved equipment. When required by the Engineer areas which have been reduced in level by the above operation(s) shall be retextured in an approved manner either by cutting grooves (5 mm deep) or roughening, the surface by backing the surface. If high areas in excess 6 mm or low areas in excess of 3 mm occur, exceeding the permitted numbers and if the contractor cannot rectify the slab shall be demolished and reconstructed at the Contractor's expense and in no case the area removed shall be less than the full width of the lane in which the irregularity occurs and full length of the slab. If deemed necessary by the Engineer, any section of the slab which deviates from the specified levels and tolerances shall be demolished and reconstructed at the contractor's expense.

903. **QUALITY CONTROL TESTS DURING CONSTRUCTION:**

903.1 **GENERAL :**

The materials supplied and the works carried out by the Contractor shall conform to the specifications prescribed in the preceding clauses.

For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control tests, as described hereinafter. The testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to carry out additional test as frequently as he may deem necessary, to satisfy himself that the materials and works comply with the appropriate

specifications. However, the number of tests recommended in Table 900-3 and 900-4 may be reduced at the discretion of the Engineer if it is felt that consistency in the quality of materials can still be maintained with the reduced number of tests.

The procedures for the various quality control tests are indicated in the respective sections of these specifications or for certain tests within this section. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Engineer-in-charge.

903.2 Tests on Earthwork for Embankment, Sub-grade Construction & Cut Formation.

903.2.1 BORROW MATERIAL :

Grid the borrow area at 25 m c/c (for closer, if the variability is high) to full depth of proposed working. These pits should be logged and plotted for proper identification of suitable sources of material. The following tests on representative samples shall be carried out.

- (a) Sand Content : (IS:2720 (Part-5)) : 2 tests per 3000 cubic metres of soil.
- (b) Plasticity Test (IS:2720 (Part-5)) : Each type to be tested, 2 tests per 3000 cubic metres of soil.
- (c) Density Test [IS:2720 (Part-8)] : Each soil type to be tested, 2 tests per 3000 cubic metres of soil.
- (d) Deleterious Content Test [IS:2720 (Part-27)] : As and when required by the Engineer-in-charge.
- (e) Moisture Content Test : [IS:2720 (Part-2)] : One test for every 250 cubic metres of soil.
- (f) CBR Test on materials to be incorporated in the sub grade on soaked/unsoaked samples [IS:2720 (Part-16)] : One CBR test for every 300 Cu.M. at least or closer as and when required by the Engineer.

903.2.2 COMPACTION CONTROL :

Control shall be exercised on each layer by taking at least one measurement of density for each 1000 square metres of compacted area, or closer as required to yield the minimum number of test results for evaluating a day's work on statistical basis. The determination of density shall be in accordance with IS:2720 (Part-28). Test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of any one test but on the mean value of a set of 5-10 density determinations. The number of tests in one set of measurements shall be 6 (if non destructive tests are carried out, the number of tests shall be doubled) as long as it is felt that sufficient control over borrow material and the method of compaction is being exercised. If considerable

variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increased to 10. The acceptance criteria shall be subject to the condition that the mean density is not less than the specified density plus :

$$1.65 \frac{1.65}{(\text{No. of samples})^{0.5}} \text{ times the standard deviation}$$

However, if earthwork in shoulders (earthen) and in the sub grade, at least one density measurement shall be taken for every 500 square metres for the compacted area provided further that the number of tests in each set or measurements shall be at least 10. In other respects, the control shall be similar to that described earlier.

903.2.3 **CUT FORMATION** :

Tests for the density requirements of cut formation shall be carried out in accordance with clause – 903.2.2.

903.3 Test on sub base and bases (excluding bitumen bound bases) :

The tests and their frequencies for the different types of bases and sub bases shall be as given in Table – 900.3. The evaluation of density results and acceptance criteria for compaction control shall be on lines similar to those set out in Clause 903.2.2.

3.3.1 **ACCEPTANCE CRITERIA** :

The acceptance criteria for tests on the strength of cement/lime stabilized soil and distribution of stabilizer content shall be subject to the condition that the mean value is not less than the specified value plus :

$$1.65 \frac{1.65}{(\text{No. of samples})^{0.5}} \text{ times the standard deviation}$$

TABLE NO. 900-1

**Control tests and their minimum frequency for sub bases and bases
(Excluding bitumen bound bases).**

Sr. No.	Type of Construction	Test	Frequency (min)
1.	Granular	i) Gradation	One test per 200 m ³
		ii) Atterberg limits	One test per 200 m ³
		iii) Moisture content prior to compaction	One test per 250 m ²
		iv) Density of compaction layer	One test per 500 m ²
		v) Deleterious Constituents	As required
		vi) C.B.R.	As required
2.	Lime/Cement	i) Quality of lime/Cement	One test for each Consignment subject to a minimum of the test per 5 tonnes.
		ii) Lime/Cement content	Regularly, through procedural checks.
		iii) Degree of Pulverization	Periodically as considered necessary.
		iv) CBR or Unconfined Compressive strength test on a set of 3 specimens.	As required
		v) Moisture contents	One test per 250 Sq.M. prior to compaction
		vi) Density of compacted layer	One test per 500 m ²
		vii) Deleterious constituents	As required.
3.	Water Bound Macadam	i) Aggregate impact value	One test per 200 m ³

	ii)	Grading	One test per 100 m ³
	iii)	Flakiness Index and Elongation Index	One test per 200 m ³ of aggregate
	iv)	Atterberg limits of binding material.	One test per 25 m ³
	v)	Atterberg limits of portion of aggregate passing 425 micron sieve.	Binding material One test per 1.00 cubic metre of aggregate.
4. Wet Mix Macadam	i)	Aggregats Impact Value	One test per 200 m ³
	ii)	Grading	One test per 100 m ³ of aggregate
	iii)	Flakiness and Elongation Index	One test per 200 m ³ of aggregate
	iv)	Atterberg limits of portion of aggregate passing 425 micron sieve.	One test per 100 m ³ of aggregates
	v)	Density of compacted layer	One test per 500 m ³

903.4 TEST ON BITUMINOUS CONSTRUCTIONS :

903.4.1 The tests and their minimum frequencies for the difference types of bituminous works shall be as given in Table 900.4.

903.4.2 **ACCEPTANCE CRITEIA :** The acceptance criteria for tests on density and Marshall stability shall be subject to the condition that the mean value is not less than the specified value plus -

$$1.65 \pm \frac{1.65}{(\text{No. of samples})^{0.5}} \text{ times the standard deviation}$$

TABLE NO. 900-4**Control Tests and their minimum frequency for Bitumen Work**

Sr. No.	Type of Construction	Test	Frequency (min)
1.	Prime Coat/ Tack Coat	i) Quality of binder	Two samples per lot to be Subjected to all or some tests as directed by the Engineer.
		ii) Binder temperature for application	As regular close intervals
		iii) Rate of spread of Binder	Two tests per day
2.	Seal Coat/ Surface Dressing	i) Quality of binder	
		ii) Aggregate Impact Value	One test per 50 M ³ of Value aggregate
		iii) Flakiness Index and Elongation Index	-do-
		iv) Stripping value of aggregates	Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates.
		v) Water absorption of aggregates.	-do-
		vi) Grading of aggregates	One test per 25 M ³ of aggregate.
		vii) Stone polishing Value	As required.
		viii) Temperature of Binder at application	At regular close intervals
		ix) Rate of spread of materials.	One test per 500 M ² of Work.
3.	Open graded Premix Carpet/ Mix Seal Surfacing	i) Quality of binder	Two samples per lot to be subjected to all or some tests as directed by the Engineer.

	ii)	Aggregate Impact Value	One test per 50 M ³ of aggregate.
	iii)	Flakiness Index and Elongation Index	-do-
	iv)	Stripping value of aggregate	Same as mentioned under Serial No.2
	v)	Water absorption of aggregates.	-do-
	vi)	Grading of aggregates	One test per 25 M ³ of Aggregate
	vii)	Stone polishing value	As required.
	viii)	Temperature of Binder at application.	At regular close intervals.
	ix)	Binder content	Two test per day
	x)	Rate of spread of Materials.	Regular control through checks on materials and layer thickness.
4.		Bituminous Macadam	
	i)	Quality of binder	Two samples per lot to be subjected to all or some tests as directed by the Engineer.
	ii)	Aggregate Impact Value	One test per 50 M ³ of Aggregate.
	iii)	Flakiness Index and Elongation Index, of Aggregate	-do-
	iv)	Stripping Value	Same as mentioned under Serial No.2
	v)	Grading of Aggregates	Two tests per day per plant. Both on the individual constituents and mixed aggregates from the dryer.
	vi)	Water absorption aggregates	Same as in Serial No.2
	vii)	Binder content	Periodic, subject to minimum of two test per day per plant.
	viii)	Control of Temperature of Binder and Aggregates for mixing and of the mix at the time of laying and rolling.	At regular close intervals.

		ix)	Rate of spread of materials layer thickness.	Regular control through checks on materials and
5.	Bituminous Penetration Macadam/ Built-up Spray Grout	i)	Quality of binder	Two samples per lot to be subjected to all or some tests as directed by the Engineer.
		ii)	Aggregate Impact Value	One test per 50 M ³ of aggregate.
		iii)	Flakiness Index and Elongation Index.	-do-
		iv)	Stripping Value	Same as mentioned under Serial No.2
		v)	Water absorption of aggregates	-do-
		vi)	Aggregates grading	One test per 1.00 M ³ aggregates
		vii)	Temperature of binder at application	At regular close intervals
		viii)	Rate of spreading of binder	One test per 500 M ² of area
6.	Dense Bituminous Macadam/ Semi Dense Bituminous Concrete/ Bituminous Concrete	i)	Quality of binder	Two samples per lot to be subjected to all or some tests as directed by the Engineer.
		ii)	Aggregate Impact Value	One test per 50 M ³ of Aggregate.
		iii)	Flakiness Index and Elongation Index	-do-
		iv)	Stripping Value	As in Sr.No.2
		v)	Water absorption of aggregates.	-do-
		vi)	Sand equivalent test	As required for bituminous Concrete

vii)	Stone Polishing Value	As required for Semi Dense Bituminous Concrete/ Bituminous Concrete.
viii)	Mix grading	One set of tests on individual constituents and mixed aggregate from the dryer for each 400 tonnes of mix subject to a minimum of two tests per plant per day.
ix)	Stability of mix	For each 400 tonnes of mix produced, a set of 3 Marshall specimens to be prepared and tested for stability, flow value, density and void content subject to a minimum of two sets being tested per plant per day.
x)	Water sensitivity of mix (Retention of Marshal Stability)	As required for Bituminous concrete.
xi)	Swell test on the mix	-do-
xii)	Control of temperature of binder in boiler, aggregate in the dryer and mix at the time of laying and rolling.	At regular close intervals.
xiii)	Control of binder content and gradation in the mix.	One test of each 400 tonnes of mix subject to a minimum of two tests per day per plant.
xiv)	Rate of spread of materials.	Regular control and through checks on the weight of mixed material and layer thickness.
xv)	Density of Compacted layer.	One test per 250 in 2 area.