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ARAB ENGINEERING BUREAU

7 ASPHALT PLANTS

7.1 ASPHALT BINDERS DELIVERY, HANDLING AND STORAGE

- 1 Before loading, the bitumen manufacturer shall examine the shipping container and remove all remnants of previous cargos that may contaminate the material to be loaded.
- 2 The manufacturer shall furnish with each shipment two (2) copies of the delivery ticket containing the following:
 - (a) Consignees' details.
 - (b) Net liters.
 - (c) Net weight.
 - (d) Type and amount of anti-stripping agent (if any).
 - (e) Identification number (truck, car tank, etc.)
 - (f) Destination.
 - (g) Date.
 - (h) Loading temperature, and the recommended delivery temperature range.
 - (i) Specific gravity.
- 3 The bitumen manufacturer shall deliver a signed Certificate of Compliance to cover the quality and quantity of material and the condition of container for each shipment. Test results shall be provided with the shipment.
- 4 Bituminous materials furnished without a Certificate of Compliance should not be introduced into the work until the Contractor has had sufficient time to sample and test the delivered materials.
- 5 The delivery tanker shall be insulated with a rock wool or similar material. Burner tubes shall be designed so that the bituminous material is evenly heated with no hot spots within the tanker. Temperature gauges shall be calibrated and positioned such that the maximum temperature in the tanker shall be indicated. The temperature of unmodified and modified bitumen during delivery shall be maintained in accordance with the manufacturer recommendations. Tankers shall be designed to enable the safe sampling of the bitumen from the top of the tanker or from a sampling valve. Sampling shall not take place whilst the tank is under pressure.
- 6 The Contractor shall obtain acceptance samples of bituminous material according to ASTM D140 at the applicable point of acceptance.
- 7 For bituminous material used in direct application on the road, samples shall be taken from each shipping container at the time of discharge into distributors or other conveyances on the project.
- 8 For bituminous material initially discharged into storage tanks on the project, samples shall be taken from the line between the storage tank and the distributor or the asphalt plant after each delivery. Samples shall be taken after a sufficient period of circulation has taken place to ensure samples are representative of the material in the storage tank.
- 9 The manufacturer of bituminous materials shall test all materials produced and the test results retained for reference. Each shipment of bituminous material delivered to the asphalt plant shall be sampled. The samples shall be numbered consecutively and identified by project, type and grade of bituminous material, date of delivery and use. Samples testing recommended frequency could be as mentioned in sec 06 part 05 and as the Engineer approval.

- 10 Each bitumen delivery and storage tank and its associated delivery pipe and control valve must be independently and uniquely identified with the tank number.
- 11 Storage tanks must also display the grade of bitumen held in the tank.
- 12 Adequate and reliable means of gauging the bitumen tank contents and ullage must be available at the discharge point.
- 13 Vent pipes must be fitted in bitumen tanks and located where they do not pose a risk to any personnel or delivery vehicles and must be kept clear at all times.
- 14 It is recommended that bitumen tanks should be fitted with a correctly designed drain valve to enable the safe emptying of the tank for cleaning and maintenance. In the absence of a drain valve, a specific risk assessment must be carried out prior to any uplift of product.
- 15 Samples must not be taken from the bitumen delivery vehicle or hoses at the delivery site unless equipment is fitted to do so safely.
- 16 If there is a requirement to take bitumen samples a purpose designed valve should be permanently fitted to the tank (or corresponding pipework).

7.2 ASPHALT PLANTS PRODUCTION CONTROL

7.2.1 Factory Production Control (FPC)

- 1 The Organization shall establish and operate a permanent factory production control system to ensure delivery of the quality requirements of the project specification whilst maintaining a regime of continuous improvement and ensure the competence and training of staff and operators. The Organization shall document and maintain the FPC system in which procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials or components, equipment, the production process and the product.
- 2 A sample of checklist for plant inspection, which includes the minimum items to be covered as a part of quality management system (QMS) for QS inspection, Engineer inspection and producer internal audit system, is provided in Appendix "C".

7.2.2 Factory Production Control Quality Plan

- 1 The Organization shall establish and maintain FPC documentation for each asphalt production site used to supply the works.
- 2 The FPC documentation shall include a means for identifying and detailing the specific processes that directly affect the quality of the asphalt. This shall particularly address:
 - (a) Producer's organizational structure relating to conformity and quality.
 - (b) Document control.
 - (c) Control procedures for constituent materials and purchaser supplied product.
 - (d) Process control
 - (e) Requirements for the handling and storage of the product.
 - (f) Plant calibration and maintenance.
 - (g) Quality control laboratory calibration and maintenance.
 - (h) Requirements for inspection and testing of processes and products.
 - (i) Procedures for handling non-conformity.

7.2.3 Organizational Structure

- 1 The responsibility, authority and inter-relation of all personnel who manage, perform and verify work affecting conformity and quality shall be defined in the quality plan, particularly for personnel who have authority to:
 - (a) Initiate action to prevent the occurrence of product non-conformity.
 - (b) Identify and record any product quality problems.
- 2 The producer shall identify a person with appropriate authority, knowledge and experience to supervise Factory Production Control and to ensure that the requirements of the quality plan are implemented and maintained. The person identified may exercise such supervision over a group of plants.
- 3 The management structure shall be documented. Names, affiliations, and positions of principal staff shall be listed. The organization chart shall clearly define relationships with other partner organizations where applicable.

7.2.4 Internal Audits

- 1 The Organization shall carry out internal audits to verify which activities comply with the planned arrangements and to determine the effectiveness of the Factory Production Control system. Audits shall be scheduled on the basis of the status and importance of the activity. The audits and follow up action shall be carried out in accordance with documented procedures. The results of the audits shall be documented and brought to the attention of the personnel having responsibility in the area audited. The management personnel responsible for the area shall take timely corrective action on the non- conformities found by the audit and shall keep a record of the action taken.
- 2 The frequency of such audits shall be that each area of process is audited at least annually.

7.2.5 Management Review

- 1 The system shall be reviewed at least annually by management to ensure its continuing suitability and effectiveness.

7.2.6 Document Control

- 1 The producer shall establish and maintain documented procedures to control all documents and data that relate to the requirements of these specifications.
- 2 The producer shall maintain all documents related to daily production quality records, test methods, practices, procedures, and specifications.
- 3 Records relating to Factory Production Control shall be maintained and accessible by the Organization and shall be produced if requested by the Engineer or any authorized audit body.
- 4 Management review, internal audits, 3rd party assessment, and inspection and testing of finished asphalt shall be kept for a minimum of ten years. All other quality records shall be kept until at least five years after the completion of the project, or longer as the Organization requires.

7.3 PRODUCT REALISATION

7.3.1 Constituent Materials

- 1 Adequate supplies of constituent materials shall be available to ensure that the planned rates of production and delivery can be maintained.
- 2 The specification and tolerances for incoming constituent materials shall be established and communicated to suppliers by appropriate traceable and confirmable means.

- 3 The control procedures shall verify that suppliers of incoming materials are capable of providing the required quality of materials.
- 4 Different material types or grades shall be transported and stored in such a manner as to avoid intermingling, contamination or deterioration which may adversely affect the quality of the product.
- 5 The general requirements of this clause shall be translated into more detailed plant specific requirements within the FPC and include the following:
 - (a) Procedures for the control of aggregates delivered to a depot or plant site.
 - (b) Requirements for labelling of storage bays and silos.
 - (c) Requirements for heating, temperature control and insulation of binder tanks, pipes and pumps.
 - (d) Requirements for controlling delivery of binders into the correct tanks, including stirrers/agitators and labelling of tanks, and the selection of the correct tanks for use.
 - (e) Requirements for the control of additives.
 - (f) Requirements for the manufacture of polymer modified binders at site by the Organization or its supplier, where applicable.

7.3.2 Customer Supplied Product

- 1 Any constituent material supplied by the customer for inclusion in the asphalt shall be handled, stored and maintained free of contamination by the Organization.

7.3.3 Process Control

- 1 The FPC quality plan shall include the following items of process control:
- 2 A description of the flow of materials and the processes carried out on them from receipt at the plant to delivery to the job site. This shall incorporate a flow diagram.
- 3 A statement of the production control processes necessary to maintain and regulate the quality of material in conformity with the specification. This will include the procedure for the control of batching instructions.
- 4 A schedule for monitoring the performance of the process, which is shown in Table A-1 in Appendix "A", resulting in a record of plant performance against stated tolerances.
- 5 A detailed method statement for the production of polymer modified binder including storage and quality control, and the procedure for the handling of nonconforming product.

7.3.4 Handling, Storage and Delivery

- 1 The FPC quality plan shall contain procedures to ensure that the asphalt mixture is handled, stored, discharged and delivered at the specified temperature range, minimizing segregation and degradation.
- 2 The asphalt mixture shall be identifiable and traceable with regard to its production data and can be referenced from information on the delivery ticket from its manufacture to its point of installation. The quality plan shall however make clear the point to which the Organization's responsibility for handling storage and delivery extends.
- 3 The quality plan shall describe the characteristics of any hot storage system and define its mode of operation. The Organization shall ensure thorough checks, inspections and records that such systems are used correctly and that bituminous mixtures maintain their suitability for use.

- 4 Bituminous materials shall not be heated during the process of its manufacture or during construction so as to cause damage to the materials as evidenced by the formation of carbonized particles.

7.3.5 Plant Calibration and Maintenance

- 1 The FPC quality plan documentation shall identify those items of measuring equipment which require calibration and the frequency of such calibration which shall comply with the requirements of QCS 2024, or its revisions, and the contract specification.
- 2 Calibration procedures shall be provided, including the permitted tolerances for the equipment to remain in service. The quality plan shall state the required accuracy of all plant calibrations and shall identify any that require traceability to national reference standards (e.g. mass or weight).
- 3 The plant shall be maintained to ensure that it continues to be capable of producing asphalt to the required specifications and tolerances. Table A-2 gives guidance with regard to schedules for calibration and checks.
- 4 The FPC quality plan documentation shall identify those items and areas of the plant where constant use and wear will affect the quality of production including, but not limited to, the dryer drum, hot elevator, screen deck and meshes, hot bins, weighing and mixing apparatus, and state the inspection and maintenance schedules for these items in order to maintain them to the condition necessary to ensure the quality of production.
- 5 A maintenance schedule shall be available and maintenance records shall be kept.

7.3.6 Plant Quality Control Laboratory

- 1 The asphalt plant shall have a quality control testing laboratory capable of conducting the following tests:
- (a) Sieve analysis (ASTM C117, C136, and D5444).
 - (b) Specific gravity for coarse and fine aggregates (ASTM C127, C128).
 - (c) Theoretical maximum specific gravity and density of asphalt mixtures (ASTM D2041).
 - (d) Quantitative extraction of asphalt binder from asphalt mixtures (ASTM D2172).
 - (e) Bulk specific gravity and density of compacted asphalt mixtures (ASTM D1188, D2726).
- 2 The asphalt plant laboratory shall have the following:
- (a) Efficient quality management system.
 - (b) Qualified laboratory manager.
 - (c) Qualified technicians.
 - (d) Calibrated equipment.
- 3 The asphalt plant laboratory shall have a database includes but not limited to the following:
- (a) Production data.
 - (b) Testing data.
 - (c) Materials type and materials traceability to source data.
- 4 The plant laboratory shall keep records of materials and asphalt mixtures properties on a daily basis.

- 5 The laboratory shall maintain a position description for each technical operational position shown on the laboratory's organization chart. Position descriptions shall identify the position and include a description of the duties, required skills, and education and experience associated with the position.
- 6 The laboratory shall maintain technical staff training records, qualifications, work experience, licensure, certifications, and current position for each supervisory technical staff member.
- 7 The laboratory shall maintain a procedure which describes the methods used for laboratory personnel training to perform tests in accordance with standard procedures. Records of laboratory personnel training shall be maintained.
- 8 The laboratory shall maintain a procedure describing the method used to evaluate staff competency to ensure that each test covered by the scope of this standard is performed in accordance with standard procedures. This description shall include the frequency of competency evaluations for each technician and indicate what position or employee is responsible for evaluating staff competency and maintaining records. The procedure shall ensure that each technician receives a performance evaluation for each test that technician performs.
- 9 The laboratory shall calibrate, standardize, and check all significant equipment associated with tests which the laboratory performs.
- 10 The laboratory shall have a procedure for the storage, retention, and disposal of test samples.

7.4 INSPECTION AND TESTING

7.4.1 General

- 1 All necessary facilities, equipment and personnel shall be available to carry out the required inspections and tests.
- 2 Inspection and testing shall be carried out at least as frequently as indicated in Tables A-3 to A-7. Sampling shall be randomised so as not to introduce undue bias in the assessment of compliance. Due care shall be taken to adequately cover both large and small volumes of material.
- 3 At least 10% of quality control tests related to constituent materials and finished mixtures shall be carried out by an approved third party laboratory. Third party testing schedule shall be liaised with the Engineer.
- 4 The results of all tests carried out on materials shall be recorded. Tests taken specifically for the resolution of problems arising from process control shall be kept separately and need not be used for the purpose of calculating compliance with the technical specifications.
- 5 All sampling and testing shall be carried out in accordance with the relevant standard procedures required by the specification.

7.4.2 Incoming constituent materials

- 1 Incoming constituent materials shall be inspected and tested using procedures detailed in the quality plan and to a schedule complying with this clause and the requirements of QCS 2024, or its revisions, and the contract specification.
- 2 The required inspections of materials in storage shall be maintained to establish that no deterioration has occurred.
- 3 Detailed requirements shall be as follows:
 - (a) Aggregates: see Table A-3.

- (b) Filler: see Table A-4.
- (c) Additive: see Table A-5.
- (d) Binders: see Table A-6.
- (e) Finished Asphalt Mixture: see Appendix "B".

7.4.3 Finished Asphalt Mixture

- 1 The finished asphalt mixture shall be inspected and tested using procedures detailed in the quality management system documentation and to a schedule complying with the requirements of QCS 2024 and the contract specification.
- 2 Appropriate statistical records shall be maintained in order to monitor and verify process capability and product characteristics.
- 3 Individual batch readings shall be recorded as part of the quality records. The plant pyrometer shall be calibrated in accordance with ASTM E2847 and checked daily against a calibrated laboratory thermometer, the record of which shall be maintained in the plant control cabin/office. The temperature of the finished asphalt shall be the average load temperature however no batch or part of the load shall exceed the maximum JSM temperature for the mix. Measurement shall be in accordance with QCS 2024.
- 4 As a regular audit check on the efficacy of the plant quality control laboratory, 10% of samples analysed for mix composition by the plant control laboratory shall have a duplicate sample analysed in an independent laboratory, which is ISO17025 accredited in related tests. The duplicate sampling may be done simultaneously as part of the Organization's other testing obligations conducted by an approved independent laboratory. The duplicate results shall be regularly reviewed and any differences falling outside the reproducibility limits published in the test standard applicable to the ASTM test methods employed shall be investigated.
- 5 The results of all tests carried out on materials shall be recorded. Tests taken specifically for the resolution of problems arising from process control shall be kept separately and need not be used for the purpose of calculating compliance with the technical specifications.
- 6 All sampling and testing shall be carried out in accordance with the relevant standard procedures required by the specification.
- 7 Sampling frequencies, operating compliance level (OCL) and test frequencies are provided in Appendix "B".

7.5 NON-CONFORMITY

7.5.1 General

- 1 The producer shall establish and maintain documented procedures to ensure that constituent materials or asphalt mixture which when identified by in-process inspection does not conform to specified requirements is prevented from use or installation. This control shall provide for identification, evaluation, separation from conforming product (when practical) and disposal of the nonconforming material or asphalt mixture.
- 2 The non-conformance process shall include:
 - (a) Constituent materials upon arrival at the plant or storage site.
 - (b) Constituent materials in storage.
 - (c) The manufacturing process.
 - (d) Handling, storage and delivery of the finished product.

7.5.2 Non-conformity of Material or Asphalt Mixtures

- 1 Where non-conforming constituent materials or finished asphalt mixtures are identified, the cause of the non-conformance shall be investigated and identified to effect appropriate corrective actions to prevent a reoccurrence. Such corrective actions shall be incorporated into the FPC quality plan.
- 2 Corrective actions may involve reworking the material, adjusting the process, redirection to another use where it may be acceptable, recycling for further use or rejection and disposal.
- 3 The FPC quality plan shall identify the action to be taken in process control when non-conforming product is identified from analysis.
- 4 The FPC quality plan shall state the process under which the installation contractor and the supervising agency will be notified of non-conforming analysis results.

7.6 INSPECTION, MEASURING AND TEST EQUIPMENT

- 1 The Organization shall control, calibrate and maintain suitable measuring and test equipment as required by this guidance document and QCS 2024.
- 2 To ensure the testing of incoming constituent materials and finished asphalt conforms to the relevant test method specification, the Organization, or where an independent laboratory is employed by the Organization to conduct its quality control testing, shall ensure within the FPC quality plan that the measuring and test equipment used is maintained in a known state of calibration and maintenance.
- 3 The equipment control procedures shall demonstrate the following:
 - (a) Accuracy and frequency of calibration, which should be in accordance with the relevant test standard.
 - (b) Equipment is used in accordance with a documented procedure.
 - (c) Equipment is uniquely identified.
 - (d) Calibration records to be maintained.

7.7 PLANT GENERALLY

- 1 The machinery and tools used in constructing the various items involved in asphalt works shall be in good working condition and free of oil and fuel leaks. The Contractor shall maintain and preserve them for the whole duration of the work. The Engineer shall approve the machinery and tools before works begin and the Contractor shall supply adequate quantities of such machinery in order to execute the work with due speed and precision. Equipment approved for use shall not be removed from the Site without the approval of the Engineer.
- 2 If required the Contractor shall furnish the Engineer with the manufacturer's catalogues, specifications and other published data for the equipment and machinery he proposes to use.
- 3 On first erecting an asphalt plant and at least once each three months thereafter, the plant shall be calibrated by a calibration service organisation approved by the QS. Production shall not be permitted if the weigh batch calibration does not comply with the requirements of ASTM D995-95.
- 4 The Engineer shall have the right to stop the use of any equipment or plant which he deems to be inferior to the quality required or detrimental to the permanent works and to instruct the removal of such equipment and to have it replaced by suitable equipment.

- 5 The Contractor shall immediately comply with such instructions without being entitled to any indemnities or extensions as a result of such instructions. The Contractor shall not be allowed to use any equipment or plant before obtaining the approval of the Engineer, and the Contractor shall undertake to follow sound technical methods in operation and to engage skilled and trained operators, mechanics and labour to carry out the works. The Engineer shall have the right to expel any operators, mechanics or labour and to instruct suitable replacement thereof at any time he deems such action is necessary.
- 6 The Contractor shall comply with any special plant requirements published by the concerned authority.

7.8 ASPHALT PLANT

7.8.1 General

- 1 All plant used by the Contractor for the preparation of asphalt hot mixes shall be batch type plants conforming to the requirements as detailed below.
- 2 The Engineer may permit the use of continuous drier drum type asphalt plants after a fully detailed technical submission by the Contractor itemising the differences from the specification. In such cases after approval of the technical submission the Contractor shall carry out a full scale laying trial with testing of the hot and laid mix and monitoring of the plant operation by the Engineers staff to assess the suitability of the proposed plant.
- 3 No laboratory verification or plant trial shall be carried out, unless an automatic compaction apparatus is available at the producer's laboratory.

7.8.2 Automatic Operation

- 1 The plant shall be designed, co-ordinated and operated so as to continually produce an asphalt mix within the job mix tolerances specified.
- 2 The plant shall be equipped and operated so that the proportioning of the hot aggregate, filler and bitumen, together with the dry and wet mixing cycles are all controlled automatically. Positive interlock shall be provided so that proportioning, mixing and discharge are accomplished by one operation without manual control of the separate phase.
- 3 The use of manual and semi-automatic plants for the production of asphalt is not permitted unless specific approval is given in writing by the Engineer.

7.8.3 Cold Bins System

- 1 The plant shall include a sufficient number of cold storage bins so that there is at least one bin for each different stockpile of material being used.
- 2 Intermixing of material from different stockpiles in one bin or on the ground before putting into the bin is prohibited.
- 3 The cold bins and loading equipment used shall be compatible to prevent overflow between the bins. Baffle plates shall also be used between bins to prevent overflow of one bin into another. Each cold bin shall include an accurate means for continuously feeding the required amount of mineral aggregate so that uniform production is achieved. The settings on the cold bins shall be approved by the Engineer and shall be checked and calibrated as often as he may deem necessary to ensure their continued accuracy. Change of settings shall be made only with the approval of the Engineer.

7.8.4 Drier

- 1 A drier of satisfactory design shall be provided. The drier shall be capable of uniformly drying and heating the aggregate to the moisture and temperature required without leaving any visible burned oil or carbon residue on the aggregate when discharged from the drier.

7.8.5 Dust Collector

- 1 The plant shall be provided with a dust collector designed to waste, or to return all or part of the material collected to the asphalt plant.
- 2 The asphalt plant shall have an efficient fugitive emission collection and control system to control dust or fume emissions from the drying, screening, weighing and mixing operations. The collection system shall be so designed to prevent the emission of dust and fumes into the atmosphere in accordance with the environmental standards of Qatar.
- 3 The collected dust from the drying process shall pass through a coarse collector which will pass the coarse particles, substantially greater than 0.075mm, back to the hot elevator or to a silo for the controlled return to the asphalt mix. The reclaimed dust substantially less than 0.075mm shall be collected and passed into a storage silo for the controlled return as mineral filler to the asphalt mix through the filler weighbox or sent to waste.
- 4 The plant shall be equipped with a filler silo for recovered filler. An additional dry storage silo shall be provided for imported mineral filler with a provision of a separate weighing hopper to proportion this filler into the mix.

7.8.6 Screens

- 1 Plant screens shall be capable of screening all aggregates to the specified sizes and proportions. They shall have capacities equal to or greater than the maximum rated capacity of the plant. They shall have an operating efficiency such that the aggregate deposited in any bins shall not contain more than 10 % oversize or undersize material. This screen tolerance shall not invalidate the job mix tolerances specified.

7.8.7 Hot Bins

- 1 The plant shall include at least three storage bins for hot aggregate of sufficient size to supply the pugmill when it is operating at full capacity. They shall be arranged to ensure separate and adequate storage of appropriate fractions of the aggregate. Each compartment shall be provided with an overflow pipe that shall be of such size and at such location as to prevent any backing up of material into other bins or against the screens. Bins shall be so constructed that samples can be readily obtained therefrom. The hot bins shall be equipped with continuous level indicators to provide information about the level of each ingredient of the JMF and to avoid shortage or overflow of aggregate from one bin to another.

7.8.8 Asphalt Binder Storage

- 1 Tanks for storage of asphalt binders shall be equipped for heating the material using positive and automatic control at all times, to a temperature within the specified range. The heating shall be accomplished by hot thermal oil, electricity or other approved means such that no direct flame shall come in contact with the bitumen or heating tank.
- 2 The circulating system for the asphalt binder shall be of adequate size to ensure proper and continuous circulation during the entire operating period. Suitable means shall be provided either by double jacketed steam or hot oil or other insulation for maintaining the specified temperature of the bituminous material in the pipeline, meters, weigh buckets, spray bars, and other containers and flow lines.

- 3 The storage tank capacity shall be sufficient for at least one day's operation. Circulation return lines to the asphalt storage tanks should be submerged to the same elevation in the storage tanks as the feeder line. Two or three vertical slots may be cut in the return line above the high level mark to break vacuum when reversing the pump.
- 4 The Contractor shall provide a sampling outlet in the asphalt binder feed line connecting the plant storage tanks to the asphalt binder weighing or metering box. The outlets shall consist of valves installed in such a manner that samples may be withdrawn slowly at any time during plant operation. The locations of the sampling outlets shall be readily accessible and free from obstructions. Drainage receptacles shall be provided for flushing the outlets before sampling.

7.8.9 Thermometric Equipment

- 1 An armoured thermometer reading from 38 °C to 204 °C shall be fixed in the bituminous feed line at a suitable location near the discharge valve. Similar devices shall be fixed in the heating and storage tanks.
- 2 The plant shall be further equipped with either an approved dial-scale, mercury-actuated thermometer, an electric pyrometer, or other approved thermometric instruments placed at the discharge chute of the drier and in the hot fines bin so as to register automatically or indicate the temperature of the heated aggregates. For better regulation of the temperature of the aggregates, replacement of any thermometer by an approved temperature recording apparatus may be required by the Engineer and he may further require that daily temperature charts be submitted to him by the Contractor.

7.8.10 Control of Mixing Time

- 1 The Plant shall be equipped with positive means to govern the time of mixing and to maintain it constant unless changed at the direction of the Engineer.

7.8.11 Pugmill

- 1 The batch mixer shall be an approved twin pugmill type, capable of producing a uniform mixture within the job-mix tolerances. It shall be so designed as to permit a visual inspection of the mix. The mixer capacity shall be not less than 600 kg per batch and shall be so constructed as to prevent leakage of contents.
- 2 The bitumen system shall deliver an even flow of binder into the mixer to ensure an even distribution of bitumen binder throughout the mix during the wet mixing cycle.
- 3 The mixer shall be fully enclosed with sufficient air extraction to prevent emissions of dust and fumes. The mixing cycle shall be controlled such that from charging of the mixer until the closing of the mixer door at the completion of the cycle there shall be no leakage of aggregate, filler or bitumen from the weighing hoppers. The system shall permit a dry mixing period, defined as the interval of time between opening of the weigh box gate and the start of application of bitumen, if required by the mixing process.
- 4 The wet mixing period is defined as the interval between the discharge of the bitumen binder into the mixer and the mixer gate is opened to discharge the mix, and shall be not less than 30 seconds. The wet mix time shall be capable of being incrementally set at intervals of not more than five seconds up to a wet mix time of three minutes. A mechanical batch counter shall register the completely mixed batches.

- 5 The mixer shall be equipped with a full set of mixer paddles in a suitable arrangement, in accordance with the manufacturer's specification, to produce a proper and uniformly mixed batch. All paddle arms and tips, and mixer liners shall be in good condition. Mixing shall cease if any mixer arms or tips are missing, and shall not resume until replaced and inspected.

7.8.12 Temporary Storage of Mix

- 1 Plants may be equipped with skips or elevators for delivering batched mix to hoppers or silos before discharging to hauling units. The skips or elevators shall not be sprayed with diesel or other solvents; where necessary they may be sprayed with a minimum amount of lime water, soap or detergent solution. Hoppers or silos shall be of such design that no segregation or loss in temperature of the mix occurs.

7.8.13 Safety Requirements

- 1 Adequate and safe stairways to the mixer platform and guarded ladders to other plant units shall be placed at all points required for accessibility to all plant operations. Accessibility to the top of truck bodies shall be provided by means of a platform or other suitable device to enable the Engineer to obtain mixture temperature data. To facilitate handling scale calibration equipment and sampling equipment, a hoist or pulley system shall be provided to raise or lower the equipment from the ground to platform or vice-versa. All gears, pulleys, chains, sprockets and other dangerous moving parts shall be thoroughly guarded and protected. Ample and unobstructed passage shall be maintained at all times in and around the truck loading space. This space shall be kept free from drippings from the mixing platform.
- 2 Accessibility to the top of loaded truck body shall be provided by means of a platform to enable obtaining asphalt mixture samples and temperature readings and to check truck body condition. All necessary safety measures shall be provided for accessing the top of loaded truck body.

7.8.14 Weigh-Box

- 1 The plant shall include means for accurately weighing each size of aggregate in a weigh-box or hopper, suspended on scales, ample in size to hold a full batch without hand raking or running over.
- 2 The weigh-box or hopper shall be so constructed that they will not be thrown out of alignment or adjustment. All edges, ends and sides of weighing hoppers shall be free from contact with any supporting rods and columns or other equipment that will in any way affect the proper functioning of the hopper.
- 3 There shall also be sufficient clearance between hoppers and supporting devices to prevent accumulations of foreign materials. The discharge gate of the weigh-box shall be so hung that the aggregate will not be segregated when dumped into the mixer and shall close tightly when the hopper is empty so that no material is allowed to leak into the batch in the mixer during the process of weighing the next batch.
- 4 Weighing boxes and hoppers shall be free hanging and placed on high precision load cells or strain gauges.

7.8.15 Scales or Meters

- 1 Scales or meters used for proportioning aggregates, mineral filler and bitumen shall be accurate to 1 % of the indicated quantity. Scales and meters shall be substantially constructed. Scales and meters that require frequent adjustment shall be replaced. Scales shall be constructed and located so as to prevent vibration in the dial pointer.

- 2 Weighing sequence of hot aggregates shall progress from coarse to fine.
- 3 Bituminous material shall be automatically proportioned by either weighing or metering. The minimum gradation shall be not more than 1 litre or 1 kg. Bituminous scales and weigh buckets shall be such that the required amount of bitumen is provided in a single weighing and delivered to the pugmill without loss due to overflow, splashing or spillage.
- 4 Bituminous weigh buckets shall be satisfactorily insulated to prevent loss of heat in the bitumen or accumulation of bitumen in the bucket. Bituminous metering devices shall be rotating positive displacement pumps and shall be capable of providing the designated quantity of material for each batch.
- 5 All scales and meters shall be approved by the Engineer and shall be checked and calibrated as detailed in Clause 5.3. Production shall not be permitted if the weight batch calibration does not comply with the requirements of ASTM D955-95.

7.8.16 Plant Control System

- 1 The asphalt plant operations shall be fully automated and connected to a centralized control system. Preferably, the plant operating software shall be capable to store the detailed production history.

APPENDIX “A”

Table A-1: Process control minimum inspection schedule

Control Area	Inspection/Test	Purpose	Minimum frequency
Aggregate stockpiles	As FPC quality plan	Identify contamination, intermingling, level ground for tipping, stock availability	Daily
Cold feed bins	As FPC quality plan	Ensure correct feeding to plant and maintenance of bins	Weekly
Aggregate dryer	As FPC quality plan	Maintenance inspection to ensure effective heating and drying	Monthly or as FPC quality plan
Dried heated aggregate	Aggregate temperature	Control for conformance	Continuously in production
Aggregate screens	As FPC quality plan	Identify mechanical and physical defects	Weekly or as FPC quality plan
Hot aggregate bins	As FPC quality plan	Identify mechanical and physical defects	Weekly
	Hot bin gradations	Check screening efficacy	
Weighing apparatus	As FPC quality plan	Identify mechanical and physical defect Check weighing efficacy against truck scale	Weekly
Bitumen	Tank temperature	Check storage conformance	Daily
	Binder properties	In accordance with storage recommendations	As FPC quality plan or in case of doubt
Temperature monitoring equipment for drying/heating and asphalt mix process	Test of accuracy comparison with calibrated reference thermometer	To ascertain the equipment is functioning correctly	Weekly
Asphalt mix	Mix temperature	Ensure temperature conformance	Each batch or continuously in production

Table A-2: Minimum plant calibration and check requirements

Item of Plant	Inspection/Test	Purpose	Minimum frequency
Weighing equipment	Visual inspection as described in procedures	To ensure that weighing equipment is functioning correctly	Daily
	Testing of weighing accuracy - calibration	To ensure accuracy within quality plan requirements	a) on installation ¹ b) every 3 months c) in case of doubt.
Admixture/additive dispensers	Organoleptic* inspection	To ensure that dispenser is functioning correctly	First batch of the day containing admixture
	Test for accuracy as described in procedures.	To ensure accuracy within quality plan requirements	a) on installation ¹ b) every 3 months c) in case of doubt.
Flow meters	Comparison of the actual amount with the metered amount by reconciliation	To ensure accuracy within quality plan requirements	a) on installation ¹ b) every 3 months c) in case of doubt.
Batching system (on batch plants)	Comparison of actual mass of constituents in the batch with the intended mass using the method prescribed in the quality plan	To ensure the batching accuracy in accordance with the quality plan	a) on installation ¹ b) every 3 months c) in case of doubt.
Proportioning system (cold feed)	Comparison of actual mass in a measured period of time with the intended mass using the method prescribed in the quality plan	To ensure the accuracy in accordance with the quality plan	a) on installation ¹ b) every 12 months c) in case of doubt.
Temperature monitoring equipment (infrared pyrometer)	Visual as described in procedures	To ensure the equipment is functioning correctly	Daily
	Test of accuracy comparison with calibrated reference	To ensure the equipment is functioning correctly	Weekly
	Test of accuracy - calibration	To ensure correct temperatures are recorded	a) on installation ¹ b) every 12 months c) in case of doubt.
Temperature monitoring equipment (contact probe or thermocouple for drying heating process)	Visual as described in procedures	To ensure the equipment is functioning correctly	Daily
	Test of accuracy - calibration	To ensure correct temperatures are recorded	a) on installation ¹ b) every 3 months c) in case of doubt.

Table A-3: FPC Inspection and test guidance for aggregate stockpiles

Inspection/Test	Purpose	Minimum frequency
Tests for aggregate properties	To check suitability for intended use	As required by QCS 2024, or its revisions
Tests for aggregate consistency by sieve analysis	To check consignment quality	Each size: Weekly Each consignment: in case of doubt
Inspection of delivery ticket	To check consignment is as ordered and from correct source	Each delivery

Table A-4: FPC inspection and test guidance for Filler

Inspection/Test	Purpose	Minimum frequency
Tests for filler properties	To check suitability for intended use	As required by QCS 2024, or its subsequent revisions
Tests for filler consistency	To check consignment or production quality Filler: Non plastic	Gradation: Weekly Plasticity: Weekly
Appropriate tests to determine specified properties	To confirm characteristics of product or check compliance with specification	Each delivery or weekly for reclaimed filler dust
Inspection of delivery ticket	To check consignment is as ordered and from correct source	Each delivery

Table A-5: FPC inspection and test guidance for additives

Inspection/Test	Purpose	Minimum frequency
Appropriate tests to determine intrinsic properties	To confirm characteristics of product or check compliance with	a) Source approval prior to initial use and b) as stated in the quality plan
Inspection of delivery ticket	To check that consignment is as ordered and from the correct source	Each delivery
Organoleptic* check of consignment	For comparison with normal appearance	Each delivery, if practicable; otherwise in accordance with quality

Table A-6: FPC Inspection and test guidance for bitumen binder

Inspection/Test	Purpose	Minimum frequency
Tests for bitumen properties	To check suitability for intended use	As required by QCS 2024 and project particular specification
Inspection of delivery ticket	To check consignment is as ordered and from the correct source	Each delivery or production batch
Temperature	To check that binder is within specified temperature limits	(a) Each delivery or production batch (b) Each tank recorded daily
Grade Properties (60/70)	To assess compliance with specification	1 per 450 tons of binder delivered in normal production
Grade Properties (PG76- 10)	To assess compliance with specification	1 per 450 tons of binder delivered in normal production Prior to production if stored for more than 3 days without further deliveries or production batches
Organoleptic* Check	For comparison with normal perceptible properties	Each delivery or daily survey of tanks

Table A-7: FPC minimum inspection/test frequencies for product quality control

Inspection/Test	Purpose	Minimum frequency
Organoleptic* check on mixed asphalt	For comparison with normal appearance with regard to grading, evenness of mixing and adequacy of binder coating	Every load
Suitability of delivery vehicles by visual	To check adequacy of insulation	a) Prior to first use b) In case of doubt.
Cleanliness of delivery vehicles by visual assessment	To avoid contamination To control use of release agent	Every load prior to loading
Mixed asphalt temperature	To assess conformity	a) As required under Table 1 b) Whenever samples
Grading and binder content	To assess conformity	In accordance with QCS 2024
Other characteristics included in technical specifications	To assess conformity	In accordance with QCS 2024

* **Organoleptic check:** a broader evaluation made with the senses: sight, touch, smell, hearing etc. rather than a visual inspection.

APPENDIX “B”

ARAB ENGINEERING BUREAU

MINIMUM SAMPLING FREQUENCIES AND TOLERANCES FOR THE FACTORY PRODUCTION QUALITY CONTROL OF FINISHED ASPHALT

General

- 1 This Appendix includes sampling frequencies and tolerances for mixture composition for use in the evaluation of conformity of mixed asphalt during production. It is consistent with QCS 2024 but is specifically intended as guidance for the Organization (Asphalt Producer) to maintain the quality control of the finished asphalt mixture at the point of manufacture and does not impede on the requirements of QCS 2024, or its revisions, or the contract specification. The sampling and frequencies are the minimum that should be considered for control but it is to discretion of the Organization to ensure sufficient samples, tests and assessments are made in order for the asphalt mixture conforms to specification requirements.
- 2 The properties of asphalt mix characteristics shall conform to the requirements of QCS 2024 and the contract specification. Should these not properties be found not to conform to the Job Mix Formula the design should be assessed.
- 3 The guidance provides for three levels of minimum frequency. The minimum frequency which shall be carried out for all production circumstances and higher frequencies which are appropriate where it is necessary to give a greater assurance of consistency where the measured level of conformity has decreased.
- 4 A guide to assessment of production quality control test conformity is given.

Testing tolerances and conformity assessment

- 1 Asphalt mixture composition Job Mix Tolerances shall be in accordance with QCS 2024, as indicated in Table B.1:

Table B.1: Job Mix Tolerances

Description	Base Course	Intermediate Course	Wearing Courses
Aggregate retained on 4.75mm sieve or larger	± 5 %	± 4 %	± 4 %
Aggregate passing 4.75mm sieve and retained on 850µm sieve	± 4 %	± 3 %	± 3 %
Aggregate passing 850µm sieve and retained on 75µm sieve	± 3%	± 2%	± 2%
Aggregate passing 75µm sieve	± 1.5 %	± 1.0 %	± 1.0 %
Binder Content	± 0.3 %	± 0.2 %	± 0.2 %

Operating Compliance Level

- 1 The Operating Compliance Level (OCL) shall be applicable to each single plant and shall be determined on an ongoing basis from the number of non-conforming compositional test results within the last 32 analyses of all asphalt mixtures tested. In addition, the OCL shall take into account the consistency of production with assessment of the mean deviation from target as detailed in Table B.2.
- 2 In the event of 5 or more of the previous 32 results being non-conforming, and/or variance of the mean deviation from target from the prescribed tolerances, the plant shall be subject to an immediate and comprehensive review of equipment and procedures.

Mean Deviation from Target

- 1 For each analysis the deviation from target shall be determined for each of the sieves sizes and binder content indicated in Table B.1. A running mean of the deviations for the last 32 analyses of each asphalt mixture shall be maintained.
- 2 Should the running mean of the deviations exceed the values stated in Table B.2, this shall be deemed to be non-conforming asphalt mixture in accordance with Clause 25.4.2 and the appropriate corrective quality control action taken. The Operating Compliance Level shall be lowered by one level for as long as the mean deviation stays outside tolerance.

Table B.2: Mean deviation from target tolerances

Description	Base Course	Intermediate Course	Wearing Course
Aggregate passing 19 mm	± 4	± 3	-
Aggregate passing 12.5 mm	-		± 3
Aggregate passing 9.5 mm	± 4	± 3	± 3
Aggregate passing 4.75 mm (Superpave)	± 3	± 2	± 2
Aggregate passing 2.36 mm (Marshall)	± 3	± 2	± 2
Aggregate passing 75 µm sieve	± 1.5	± 1.0	± 1.0
Soluble Binder Content	± 0.3	± 0.2	± 0.2

Test Frequency

- 1 The frequency for sampling shall be determined weekly and shall be maintained at the operating compliance level minimum frequency indicated in Table B.3.

Table B.3: Determination of Operating Compliance Level and Sampling Frequency

Number of nonconforming analyses in last 32	Operating Compliance Level	Minimum Sample Frequency
0 - 2	A	1 per 250t per mix or part thereof
3 - 6	B	1 per 200t per mix or part thereof
≥ 6	C	1 per 100t per mix or part thereof

- 2 New plants commencing production, plants restarting after relocating, a major repair or overhaul, or those recommencing commercial production after a period exceeding 3 months cessation shall operate under OCL until 32 results have accumulated after which the frequency shall revert to the OCL achieved.

APPENDIX “C”

Table C-1: Sample of plant inspection checklist

Aggregate Stockpiles		Yes	No
1	Are aggregate stockpiles separated by walls or clear space with signed labelling?		
2	Are the stockpiles free of significant contamination and segregation? (<i>Plant drain-out aggregate is acceptable if the aggregate size is similar and uncoated.</i>)		
3	Is the aggregate in good condition with no signs of degradation on the stockpile due to vehicle/plant movements?		
4	Is the truck tipping area at the stockpile level? (<i>Non-level surfaces can cause trucks to tip over.</i>)		
5	Do the aggregate delivery and test records conform to the approved mix designs?		
6	Have the aggregates been sampled and tested in accordance with requirements?		
Aggregate Cold Feed			
1	Has each aggregate size its own designated and labelled bin/hopper?		
2	Are bins/hoppers in good condition with no holes, with bin wall divider plates between each?		
3	Is aggregate overflow between hoppers being prevented by divider plates?		
4	If meshes (grizzlies) are fitted over the bins/hoppers, are they in reasonable condition and fit for purpose?		
5	Are the feeder gates, feeder belts and vibrators in good condition?		
6	Are there no-flow paddles/sensors on each feeder and are they working?		
7	Date of the last feeder calibrations:		
8	Is the aggregate collecting conveyor in good condition, with no holes or splits, or evidence of tracking (side movement) and the belt scrapers are in good order?		
Dryer			
1	Is there any significant aggregate spillage under the dryer conveyor, the dryer drum or around the base of the hot elevator?		
2	Are the dryer lifters and flights are in good condition without undue bending or deformation and none missing. (when dryer is cold and stopped)		
3	Is the drum exit chute temperature pyrometer, thermocouple or probe clean, working and in calibration?		
4	Date of last pyrometer, thermocouple or probe calibration:		
5	Has the drum exit chute temperature equipment been checked recently with a referenced laboratory probe?	Date:	
		Drum chute:	°C
		Laboratory probe:	°C

Dust Collection			
1	Does the pre-skimmer or knockout box return the collected fine sand to the plant hot elevator?		
2	Is the bag house extracted dust:-	a: returned to a silo for re-use?	
		b: directly fed back into the asphalt plant?	
		c: wasted?	
3	Does the laboratory monitor the gradation of the coarse pre-skimmer or knockout box fines and bag house filler?		
4	Is there a dust emission monitoring system on the plant?		
5	Date of last certified plant stack emission test?		
6	Is the plant stack emission is visually clean with no obvious dust or smoke??		
Aggregate Screening			
1	Is there any spillage around the screen deck area?		
2	Did the last screen inspection indicate any defects?		
3	Date of last screen deck inspection:		
4	Are there any signs of damage or wear, especially adjacent to screen bearings or shafts?		
5	Is there any significant dust emission from the screen housing lids, covers or doors?		
6	Is there any evidence of holes, splits or tears in the screen meshes and is there any apparent and significant pegging or blockages?		
7	Are there any loose screen meshes that need tightening or support bars that are loose and need welding?		
8	Is there evidence of side seal seepage which could contaminate screened aggregate or wear other parts?		
Hot Aggregate Bins			
1	Is there any indication of hot bin oversize or undersize in hot bin drain-outs?		
2	Bin 1 Aggregate size X / X mm		
3	Bin 2 Aggregate size X / X mm		
4	Bin 3 Aggregate size X / X mm		
5	Bin 4 Aggregate size X / X mm		
6	Bin 5 Aggregate size X / X mm		
7	Bin 6 Aggregate size X / X mm		
8	Are the individual hot stone bin overflow chutes/pipes blocked or damaged?		
9	Are there holes or damaged seams or welds in the hot bin walls, especially in the corners and in the lower half of the bins?		
10	Do the hot stone bin doors stick or seize? Is there evidence of holes in or leakage from the doors?		

Weighing and Measuring Apparatus			
1	Are the calibrations of the aggregate, filler and bitumen weighing apparatus current and in date?		
2	Aggregate weighing apparatus calibration date:		
3	Bitumen weighing apparatus calibration date:		
4	Filler weighing apparatus calibration date:		
5	Mixed asphalt pyrometer calibration date:		
6	Has the mixed asphalt pyrometer been checked recently with a referenced laboratory probe?	Date: Pyrometer: Laboratory probe:	°C °C
Weighing efficacy:			
1	Do the printed batch weights equal the weight indicators and are total load batch weights similar to the truck scale net weight?		
2	Does the bitumen bucket/kettle pass the static load test? <i>(Hold a fully weighed batch of bitumen for at least 30 seconds and note any change in weight. Repeat when empty and note any major change in tare)</i>		
3	Does the aggregate and filler weighing apparatus pass the static load test?		
4	Is there any bitumen seepage or leakage from the charge and the discharge pipes, and the butterfly valve underneath on direct gravity discharge bitumen bucket/kettle systems?		
5	Is the bitumen bucket/kettle adequately insulated and heated? Seepage or leakage from the charge and the discharge pipes? Check the butterfly valve underneath for direct gravity discharge systems.		
Bitumen Storage and Pumping			
1	Where fitted, are breather vents clear on the bitumen weigh bucket/kettle and delivery pipe to the mixer?		
2	Are the bitumen tanks and are all tanks clearly labelled according to the grade of binder stored?		
3	Are stored binder tank temperatures compliant with specification or supplier recommendations?		
4	Where PMB is stored, are the stirrers operational and in good condition?		
5	Is there a supplier defined procedure for the storage and use of polymer modified binders?		
6	Are all tanks, pipes, pumps and flow meters properly insulated and the surrounds clean and in good order?		
7	Is there any evidence of excessive bitumen or oil seepage/leaks from pump(s), valves or manifolds?		
8	Are bitumen tank temperatures monitored and recorded daily by the plant staff?		
9	Are the bitumen binders tested for foaming when heated to 175°C?		
10	Is there a control or procedure for tank/binder grade selection according to asphalt mix recipe to avoid using the incorrect grade?		

Asphalt Mixing			
1	Are the weighing apparatus and mixer external surrounds in clean and good order with no apparent seepage or leakage of aggregate, filler or bitumen?		
2	Are inspection hatches secure and sealed to prevent dust emission?		
3	Are electric cables, hydraulic and air lines well maintained and in good order?		
4	Are all mixer arms, paddles and tips, liners and door seals present and in good condition?		
5	Is the aggregate weighing sequence, coarse size to fine size?		
6	Is there excessive overflow from the aggregate overflow chutes?		
7	Check the required batch weights on the mix card.		
8	Are batch deviations within acceptable guide tolerance?		
9	Batch aggregate component $\pm 1.5\%$ of total batch weight		
10	Bitumen deviation $\pm 0.1\%$ of total batch weight		
11	Mineral filler deviations $\pm 0.1\%$ of total batch weight		
12	Are the in-flight adjustments being made automatically by the plant control system?		
13	What is the delay time after aggregate discharge for bitumen:		sec.
14	What is the delay time after aggregate discharge for filler:		sec.
15	What is the total wet mixing time in seconds? <i>(From the complete discharge of the bitumen and filler to the emptying of the finished batch)</i>		sec.
16	On completion of the mixing cycle, does the mixer fully empty?		
17	On visually inspecting single batches of asphalt, is the appearance consistent from side to side and front to back, and not segregated?		
18	Does each batch conform to the mix temperature specification requirement?		
19	Does the plant indicated mixed asphalt temperature correspond with a laboratory check?		
20	Where used, is the skip hopper acceptably clean?		
21	Are the empty hot storage silos acceptably clean without cold asphalt sticking to the sides and corners?		
Loading			
1	Are all trucks acceptably clean prior to loading without any evidence of diesel being used as a release agent?		
2	Are all trucks equipped with load cover sheets or canvasses?		
3	Are the loaded trucks free of significant segregation?		

4	Is the asphalt temperature acceptably consistent and within range tolerance throughout the load front to back?		
5	Has the correct delivery ticket been issued to the driver with accurate asphalt description, truck reference or number, site address, driver name, and ticket number?		
6	Is the plant sampling technician equipped with all necessary PPE including safety helmet, steel-capped boots, overalls, gloves, hi-visibility jacket, and protective eye glasses?		
7	Are the plants sampling procedures being followed by the technician to ensure a representative sample? <i>(Ask for and retain a copy of the sampling procedures.)</i>		
8	Are plant sample details, including truck delivery details, are recorded on each plant sample?		
9	Request plant compliance rate for each product supplied to the project or contract for record purposes.		

END OF PART