

SPECIFICATION OF ASPHALT MIXES

1 INTRODUCTION

These notes have been based on Part A – Contracting Environment, of the *Austrroads Framework for Specification of Asphalt*. The notes should be read in conjunction with the specification clauses contained in AGPT04B/07 : Guide to Pavement Technology - Part 4B: Asphalt , the AAPA National Asphalt Specification, relevant road agency specification or Australian Standard.

The contracting environment under which road agencies operate is a dynamic situation. Contract documents have evolved from largely method-based specifications to a range of options involving various end result and performance outcomes. This evolution has also included changes to increase the levels of accountability for contractor performance and transfer of service delivery and performance risk from the public to the private sector. The private sector is also becoming more involved in management of road system elements through design and construct contracts, design construct and maintain contracts, and performance-specified maintenance contracts.

Advances in asphalt technology have also brought changes in criteria applied to the selection of asphalt mix types and design requirements for particular applications. These notes aim to indicate where the different elements involved in the service delivery of asphalt pavements and surfacings relate to different forms of contracting environment, with particular reference to the current status of performance-related asphalt specifications.

2 PERFORMANCE SPECIFICATIONS

While there is no generally agreed terminology for describing different forms of performance specification and performance contracts, the following distinctions are used in this document.

Method specification

Method and materials, or prescription elements are used where the characteristics of the completed work are not measurable or no practical or timely acceptance test is available. Traditional specifications evolved from the transfer of construction activity from direct labour to contractors, and thus used to describe the work in the same manner as conveying information to employees. Some prescriptive elements, particularly related to materials factors, still remain in many roadmaking specifications.

Performance-related specification

One that describes the desired level of materials and construction (M&C) factors that have been found to correlate with fundamental engineering properties that predict performance. These factors are amenable to acceptance testing at the time of construction. Most road agency specifications in current use have been built around a performance-related model, using performance-related design standards and verification that the designed material is manufactured and placed to appropriate standards.

Performance-based specification

One that describes desired levels of fundamental engineering properties (e.g. resilient modulus, deformation resistance, fatigue) that are predictors of performance and can be used in models to predict pavement performance or distress from the combination of those properties, in association with external factors such as traffic, environment and underlying materials. Generally these properties are not amenable to timely acceptance testing. In the accompanying specification, fundamental engineering properties are applied as optional asphalt design requirements. Further options are also provided for verification of design properties on manufactured asphalt.

Performance specification

One that describes how the finished product should perform over time. A distinction is made here between a performance specification and an *end product specification*. An end product specification describes how a product should perform at the completion of the contract (i.e. it does not have an extended contract period to reflect the life of the product). End product criteria may include

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performance measures such as ride quality or surface characteristics. Other end product measures may also be included in all specification types, but recognition must still be given to limitations in current technology for predicting long term performance (e.g. skid resistance, durability, rutting or structural performance). Continued improvement in performance prediction models is an important element of R&D for both road agencies and contractors.

Performance contract

A contract that defines obligations and outcomes in terms of performance indicators for the product or service and is of sufficient duration to enable measurement of the contractor's performance over time and provide assurance of the quality and longevity of the product or service.

The key requirements desirable for performance contracts are:

A partnership approach

Creation of an economic framework that encourages the contractor to meet long term performance objectives

Selection of appropriate key performance indicators (KPIs)

An understanding of sharing of risk, including:

- effectiveness of design/performance prediction models
- variations in predicted traffic volumes
- variations in climatic conditions
- performance of underlying pavement or subgrade

Application of Quality Systems

Requirements for Key Performance Indicators include:

- Safety
 - Surface texture
 - Skid resistance
 - Conspicuity
 - Water spray
- Ride Quality
 - Roughness
 - Surface defects (cracking, patching, etc.)
 - Rutting
- Environmental
 - Noise
 - Environmental sustainability (recycling, etc)
- User Costs
 - Response times for remedial work
 - Vehicle delays
 - Appearance
 - Effectiveness of remedial work
- Future Agency costs
 - Remaining life of surfacing
 - Future maintenance and rehabilitation costs.

Distinctions between each of the above different forms of specification are not precise, as contract documentation for different elements within a particular project may include various features of method, performance-related, performance-based and end result criteria, as outlined in the following discussion. Care must be exercised to ensure that a mixture of specification elements does not introduce conflict.

3 OWNERSHIP OF RISK IN ASPHALT SERVICE DELIVERY

3.1 General

The implementation of performance measures in asphalt contracts involves a shift of risk from the public to the private sector. An appreciation of the management of risk for the various elements involved in the service delivery of asphalt surfacing is an important factor in the development of performance specification requirements.

The elements of asphalt service delivery are broadly categorised as:

- Pavement design/selection of asphalt mixes
- Selection of component materials and asphalt mix design
- Manufacture
- Placement
- Monitoring of pavement performance.

Asphalt must also be supplied in a Quality Systems environment.

Application of the above elements to the allocation of risk to variations in contracting environment is shown broadly in Figure 1.

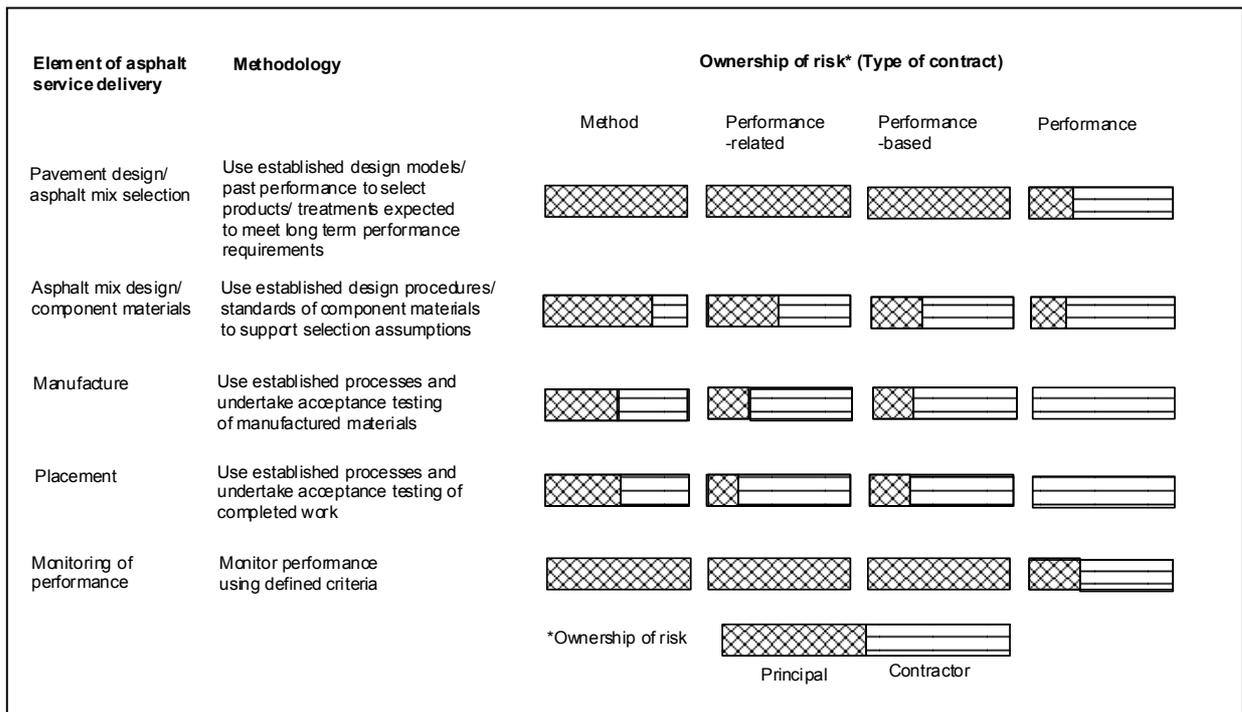


Figure 1 Ownership of Risk

3.2 Quality Systems

A major change in contract documentation in Australia came with the introduction of Quality Systems in the late 1980s. Under Quality Assured contracts, many of the prescription and procedural elements were removed from specifications on the basis that these would form part of the Contractor's Quality System and Quality Plan. Specification elements were changed to emphasise design and/or end result standards and acceptance testing criteria. All contracts for road works in Australia are now undertaken under some form of Quality Assurance contract.

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A general outline of the application of Quality Assurance in road works contracts is provided in Austroads *Quality Assurance in Contracts*, 1994, Publication No. AP-115/94. Further guidance to contract surveillance activity is provided in Austroads *Guide to Field Surveillance of Quality Assurance Contracts*, 1995, Publication No. AP-38/95.

In practice, the state road authorities have instituted detailed procedures for the management of QA Contracts. These can include one or more of the following:

Prequalification of Contractors

Detailed technical audit of Contractors' Quality Systems and Quality Plans

Surveillance of contract activity

Audit/verification of quality of materials and testing

Selection of test lots and random sampling schemes.

Specific guidelines for the above activities are not provided in this document, as procedures will vary between road agencies, type and size of project, and approach to management of risk.

3.3 Pavement design and selection of asphalt type

For new and reconstructed pavements, structural design is undertaken using established design models. Selection of rehabilitation treatments is generally based on the condition of the existing pavement, level of improvement required and expectations of performance based on experience and performance models. In all cases, selection of wearing course is based on the surface characteristics required (texture, noise, water spray etc.), traffic, and operating environment.

Guidelines for pavement design, selection of rehabilitation treatments and selection of surfacing types is provided in a range of manuals, guides and publications such as the AGPT04B/07 : Guide to Pavement Technology - Part 4B: Asphalt, Austroads Pavement Design Guide, Austroads Rehabilitation Guide and Austroads Guide to the Selection of Pavement Surfacing.

Apart from performance contracts, the risks associated with long term performance arising from pavement design models and selection of type and thickness of asphalt mix are accepted by the Principal. In the case of a design and construct contract, the Principal may pass some of the risk associated with interpretation of design criteria to the designer but will still generally specify or approve the design models to be used.

Under performance contracts, the Principal may require the contractor to accept the risks associated with design and selection of treatment but must also be satisfied that the contractor is capable of providing the performance required. Management of that risk is undertaken through procedures for contractor prequalification, contract acceptance and auditing and surveillance of quality systems.

3.4 Selection of Component Materials and Asphalt Mix Design

Established design procedures, engineering properties and quality standards for component materials are used to support the assumptions made in structural design models.

The basis for quality standards of components is largely covered by Australian Standards or Austroads Guides. These cover issues of durability and certain performance attributes, e.g. resistance to polishing of aggregates, performance attributes of polymer modified binders. Selection of component material types and specification standards are generally defined by the Principal, although some scope may be provided for selection by the contractor where certain performance-based design criteria must be met.

Similarly, mix design procedures and design criteria are generally specified by the Principal to satisfy the structural design and other assumptions relating to prediction of long term performance.

Under contracts established on performance-related and performance-based specification criteria, asphalt mix design is almost always undertaken by the contractor, but the Principal generally accepts the risks associated with selection of design models and may undertake verification or checking of design data prior to commencing works under the contract.

3.5 Manufacture

Under method specifications, the only manufacturing risks carried by the contractor are those associated with efficiency of organisation and adherence to procedures.

Under quality assured contracts, the contractor must ensure that procedures are adequate to meet the performance-based and/or performance-related acceptance testing criteria defined by the Principal. The contractor is responsible for selection of the processes and management of control procedures to meet those criteria while the Principal generally accepts that the specified acceptance testing criteria correlate with the engineering properties required. Under performance contracts, that responsibility and risk shifts to the contractor.

3.6 Placing

As with manufacture, contractor risk under method specifications is largely confined to efficiency of organisation and adherence to procedures, although some end result criteria may also be included.

Quality assured specifications are largely based on acceptance testing of end result criteria, primarily compacted density and geometric standards. End result criteria may also be applied to ride quality and some performance-related/performance-based criteria. In this form of contract, the contractor is responsible for both selection of processes and their control.

3.7 Monitoring of Performance

Monitoring of performance is generally only applicable to performance contracts, although it may also be applied to verification and refinement of assumptions used in design models and selection criteria.

4 SPECIFICATION COMPONENTS

4.1 Recent changes in asphalt specification criteria

There has been significant world-wide technological development in the characterisation of asphalt in the last decade. Austroads has invested heavily in development of asphalt testing equipment, research and methods. Leadership and funding has come from Austroads, with support from AAPA, ARRB and Roding New Zealand (formerly BCA). There is now a desire to convert the investment into tangible specifications that move towards a greater emphasis on performance specified criteria in asphalt specifications.

An outcome of the initiatives to move towards performance specifications has been publication of the provisional guide to mix design and selection; APRG Report No 18 – Selection and Design of Asphalt Mixes. This report is a milestone in Australian asphalt technology. It implements outcomes of the Austroads R&D program and sets out procedures for the rational characterisation of asphalt performance properties in place of the empirical requirements on which most Australasian asphalt specifications have been based.

The most significant change it promotes is the adoption of gyratory compaction methods to replace Marshall and Hubbard-Field compaction techniques for the determination of volumetric properties. Another significant change is the use of performance-based tests (modulus, creep, wheel tracking, fatigue, etc) to replace Marshall or Hubbard-Field parameters for pavements in more heavily trafficked situations.

Road agency specifications tend to be in a transition stage from method-based to more performance-related specifications and may refer to either (or both) gyratory and Marshall compaction for determination of volumetric properties.

4.2 Specification Clauses

Figure 2 depicts main elements of asphalt specifications related to variations in contracting environment. Contracting environment has been described in the previous sections. Although four distinct forms of specification are shown, variations in contracting environment will result in some hybridisation in application of specification clauses to different forms of contract.

The main elements incorporated in most asphalt specifications are:

Scope

Scope in this context refers to pavement design and selection of asphalt type and layer thickness as described in Section 3.3. This is generally determined by the Principal, based on pavement design requirements or type of rehabilitation treatment, in conjunction with surface characteristics required and operating environment.

Quality systems

Depending on project type and performance risk, the Principal may undertake an audit of a Contractor's Quality System and/or Quality Plan as part of prequalification or contract acceptance procedures.

Method specifications rely on detailed specification of equipment and all stages of the process including quality of component materials, asphalt mix design, manufacturing processes and placing procedures, together with detailed inspection and supervision to ensure that procedures are adhered to.

Materials

Quality requirements for materials used in asphalt manufacture are generally included in all specification types as being relevant to durability and other long term performance characteristics.

Asphalt Mix Design

Asphalt mix design may be specified at a number of levels, varying from prescriptive, through basic volumetric criteria, to detailed performance characterisation.

In some cases the Principal may require details of mix designs to be submitted for approval prior to commencing work (this may be a specification hold point) or provision of samples for audit or verification.

The output of the asphalt mix design process is a job mix (or job mix formula) to be used as the manufacturing target.

Manufacture

Method specifications contain detailed requirements for mixing plants and mixing procedures. In QA specifications these form part of the Contractor's Quality System.

Assessment of asphalt manufacture may be at several levels:

Verification that the asphalt has been produced in accordance with the job mix (i.e. use of correct materials, grading and binder content)

Confirmation that the manufactured mix meets basic volumetric criteria on laboratory compacted samples of manufactured asphalt.

Confirmation that manufactured asphalt achieves other mix design performance criteria.

The use of statistical process control techniques for assessment of asphalt production is a desirable inclusion in specifications and/or the quality plan for manufacturing process control.

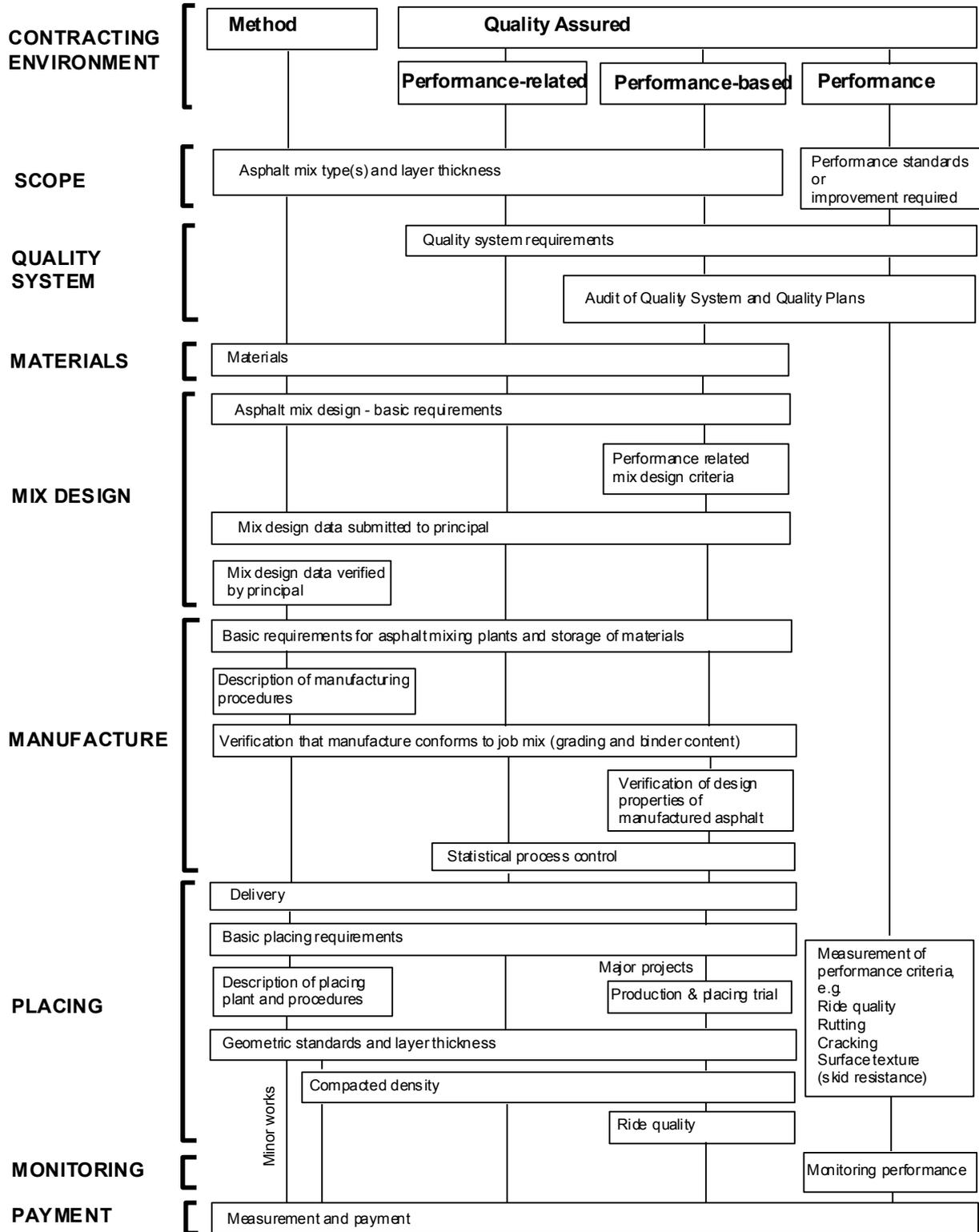


Figure 2 Specification Framework

Placing

Placing involves:

Delivery of asphalt

Use of appropriate equipment and procedures. In QA specifications this forms part of the Contractor's Quality System.

A production and placing trial may be used for major projects, particularly for newly established project plants.

Achievement of geometric standards (shape and thickness)

Achievement of an appropriate standard of compacted density. Acceptance on the basis of rolling procedures may be applied to some minor works.

Measurement of ride quality and other finished surface characteristics (e.g. texture, segregation) may be included where appropriate.

Performance monitoring

Measurement and monitoring of performance criteria (e.g. ride quality, rutting, cracking, surface texture or skid resistance) is generally only applied to contracts involving performance specified maintenance, although some criteria can be applied to defects occurring within the contract defects liability period.

Measurement and payment

Detailed requirements for measurement and payment may vary between road agencies specifications depending on the contract type.

REFERENCES

AGPT04B/07 : Guide to Pavement Technology - Part 4B: Asphalt

AAPA National Asphalt Specification, AAPA, Second edition, 2004

Road agencies (various) Standard specifications for asphalt

Australian Standard AS 2150 – Hot Mix Asphalt