Developing a Mixture-Based Specification for Flexible Base

Texas A&M Transportation Institute

Aggregate Production Facility*	Specification for	
	Production Control	Placement Control
Large Fixed	• Quality Monitoring	QC/QA
Large Portable	• QC/QA • Quality Monitoring	QC/QA
Small Portable	Method (Item 247)	Method (Item 247)

* Contractors Choice to Use Quality Monitoring or QC/QA for Production

Discussion Items for Method Specification

Item 247

- Addition of High Quality Base
- Control of Fine Fraction of Base Course
- In-place Density Measurements (Timing)
- Others

Discussion Items for QC/QA Specification (See Draft)

- Addition of High Quality Base
- Control of Fine Fraction of Base Course
- In-place Density Measurement
- Pay Factors for Production
- Pay Factors for Placement
- Use of Contractor's Test Results for Acceptance/Pay Factors
- Other

Discussion Items for

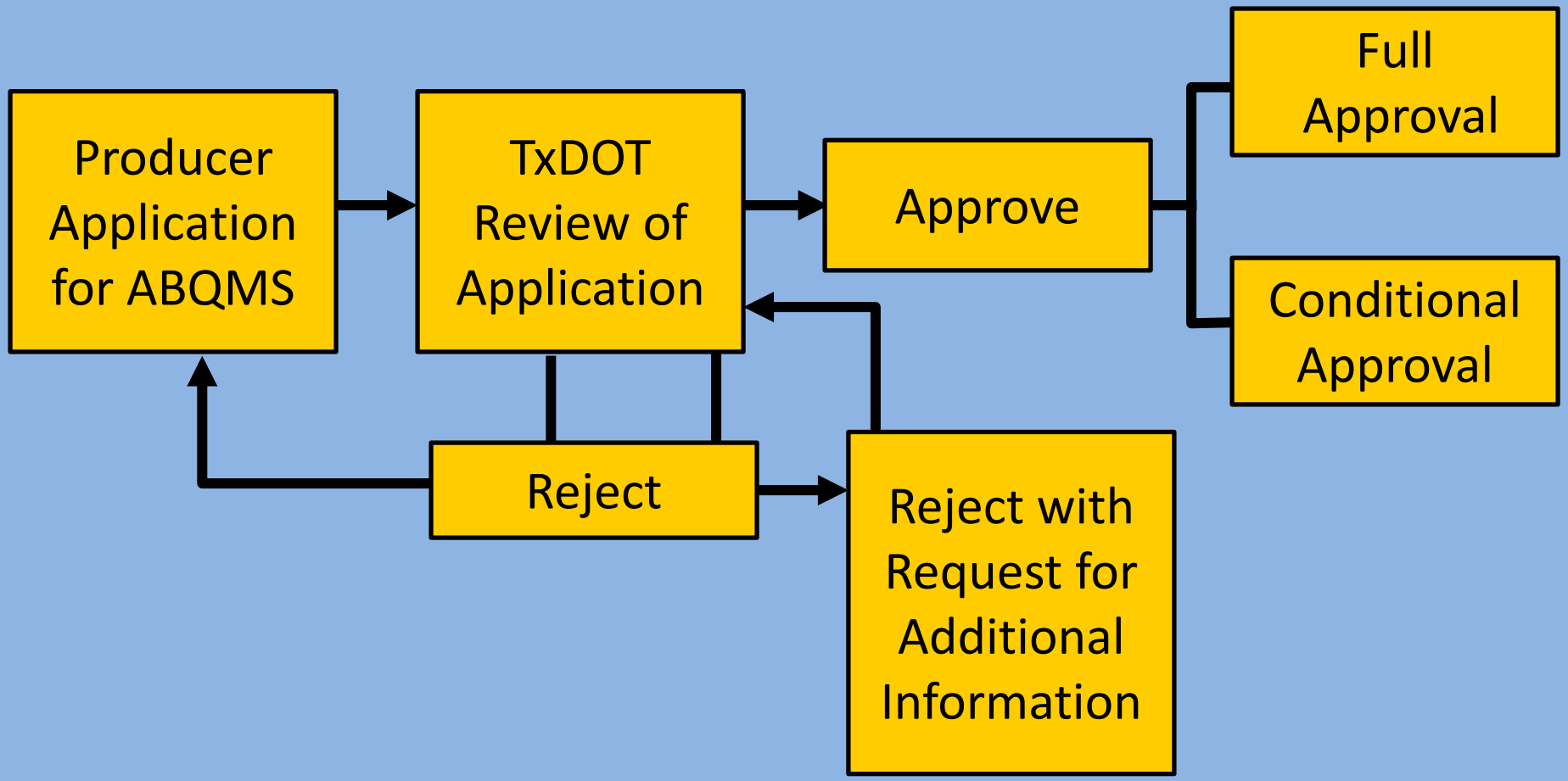
Quality Monitoring System (QMS)

Quality Assurance Program for Aggregate Base (Flexible Base)

Purpose of ABQMS

- Establish List of Qualified Producers
- Producers Responsible for Process Control/Quality Control
- Reduce TxDOT Sampling and Testing
- Expedite Aggregate Base Acceptance
- Share Responsibility (Producer/TxDOT) for Quality and Uniformity
- Reduce Cost and Time for Process Control, QC/QA Sampling and Testing and Acceptance
- Reduce Risk to Producer and TxDOT
- Other

Process


Producer Application for ABQMS
TxDOT Review of Application
Approve
Full Approval
Conditional Approval
Reject
Reject with Request for Additional Information

Producers Application

- Request Acceptance – ABQMS
- Quality Control Plan
- Quality Control Test Data

Quality Control Plan

- Project Personnel
- Production
- Material Delivery and Storage
- Loading and Transportation

Project Personnel

For Project Personnel Include:

- List of Individuals Responsible for Quality Control Sampling and Testing
- Organizational Structure
- Person Responsible for Mixture Design
- Person with Authority to Take Corrective Action
- Provide Copies of Current Certificates for All Personnel
- Provide Contact Information for All Personnel

Production

- Pit or Quarry Mining Plan
- Materials Haul/Transfer from Pit/Quarry to Materials Production Facility
- Method for “Charging” Materials into the Production Facility
- Material Production Facility Process Details (Materials Flow through the Plant-screens, Belts, Crushers, Washers, etc.

Production (Cont'd)

- Stockpile Location(s) from Plant Belts and Re-establish Stockpiles
- Post Production Blending
- Sampling Equipment and Location
- Production Process Control Plan (Contractor's Option)
- Production Quality Control Plan

Material Delivery and Storage

- Location of Stockpile Site at Quarry/Pit or Project
- Vehicles Used for Transportation
- Stockpiling Procedures to Avoid Contamination and Segregation
- Stockpile Quality Control/Quality Assurance Plan
- Producers/Contractors Process Control Plan for Stockpiling Operation (Contractor's Option)

Loading and Transportation

- Loading and Transportation Equipment for Movement of Coarse Base Materials from Quarry/Pit or Project Stockpile to Placement Site
- Loading and Transportation Procedures to Avoid Contamination and Segregation

Also See TxDOT Draft “Aggregate Base Quality Assurance Program”

2.1 Aggregate

Type

- A – Crushed Stone
- B – Crushed/Uncrushed Gravel
- C – Crushed Gravel
- D – Crushed Stone/Crushed Concrete
- E – As Shown on Plans

Grade

- Grades 1 to 5 (Table 1)

2.1.3 – Material Grade
(Table 1: Material Requirements)

Property	Test Method	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Master gradation sieve size (cumulative % passing)						
2 ½ in	TEX-110-E	-	0	0	As shown on the plans	100
1 ¾ in		100	90-100	90-100		95-100
7/8 in		65-90	-	-		65-90
3/8 in		50-70	-	-		35-65
No. 4		35-55	25-55	25-55		25-50
No. 40		15-30	15-40	15-50		10-30
No. Y						
Liquid limit, % max[1]	TEX-104-E	35	40	40	As shown on the plans	35

2.1.3 – Material Grade
(Table 1: Material Requirements, Cont'd)

Property	Test Method	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Plasticity index, max[1]	TEX-106-E	10	12	12	As shown on the plans	10
Plasticity index, min[1]		As Shown on Plans				
Wet ball mill, max[2]	TEX-116-E	40	45	-	As shown on the plans	40
Wet ball mill, % max Increase passing the No. 40 sieve		20	20	-	As shown on the plans	20

2.1.3 – Material Grade
(Table 1: Material Requirements, Cont'd)

Property	Test Method	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Sulfate content, max ppm	TEX-145-E					
Min. compression strength, psi	TEX-117-E				As shown on the plans	
lateral pressure, 0 psi		45	35	-		-
lateral pressure, 3 psi		-	-	-		90
lateral pressure, 15 psi		175	175	-		175

2.1.4 – Recycled Materials (Table 2: Requirements for Recycled Portland Cement Concrete (RPCC))

Property	Test Method	Requirement
Gradation Cumulative Percent Passing, Maximum 2 in	Tex-110-E	100
Deleterious Materials, Percent Maximum	Tex 413-A	1.5
Sulfate, ppm Maximum	Tex-145-E	3000

2.1.4 – Recycled Materials (Table 3: Requirements for Reclaimed Asphalt Pavement)

Property	Test Method	Requirement
Gradation Cumulative Percent Passing, Maximum 2 in	TEX-110-E	100
Decantation, Percent Maximum	TEX-406-A	5.0
Deleterious Materials, Percent Maximum	TEX-413-A	1.5

Quality Control Test Data

- Supply Information in Aggregate Base Data Management System
- Sampling and Test Plan

Test	Test Method	Initial Production Frequency, Tons		Normal Production Frequency, Ton		Loadout Frequency, Ton	
		Sublot	Lot	Sublot	Lot	Sublot	Lot
Gradation	TEX-110-E	1,000		2,000		6,000	
Atterberg Limits	TEX-104-E TEX-106-E	1,000		2,000		6,000	
Wet Ball Mill	TEX-116-E	1,000		2,000		6,000	
Sulfate Content	TEX-145-E	1,000		2,000		6,000	
Compressive Strength	TEX-117-E	2,000		2,000		10,000	

Initial Production – 6,000 to 10,000 Ton
1 Sample per Sublot

TxDOT Verification Test*

Test	Test Method	Initial Production Frequency, Tons	Normal Production Frequency, Tons	Loadout Frequency, Tons
Gradation	TEX-110-E	3,000	10,000	10,000
Atterberg Limits	TEX-104-E TEX-106-E	3,000	10,000	10,000
Wet Ball Mill	TEX-116-E	3,000	10,000	10,000
Sulfate Content	TEX-145-E	3,000	10,000	10,000
Compressive Strength	TEX-117-E	3,000	10,000	10,000

* Tests Can Be Performed by TxDOT at Any Time

TxDOT Approval Process

- PWL Based on Job Mix Formula and Allowable Variations
- PWL Based on Specification Tolerances
- Other

4.12.2.4 Operational Tolerances
(Table 7: Allowable Material Property (Production) Differences and Specification Limits)

Property	Test Method	Allowable Difference from Current JMF Target	Allowable Difference between Contractor and Engineer Test Results	Specification Limits for Pay Factor Determination
Gradation Accumulative Percent Passing				
2 ½ in	Tex-110-E			
1 ¾ in		5	5	
7/8 in		5	5	
3/8 in		5	5	
No. 4		5	5	Plus or minus 5
No. 40		3	3	
No. Y				Plus or minus

4.12.2.4 Operational Tolerances
(Table 7: Allowable Material Property (Production) Differences and Specification Limits, Cont'd)

Property	Test Method	Allowable Difference from Current JMF Target	Allowable Difference between Contractor and Engineer Test Results	Specification Limits for Pay Factor Determination
Liquid Limit	Tex-104-E	5	5	
Plasticity Index	Tex-105-E Tex-106-E	4	4	
Wet Ball Mill, Max	TEX-116-E	5	5	
Wet Ball Mill, % Increase Passing the No. 40 Sieve Percentage Points		4	4	

4.12.2.4 Operational Tolerances
(Table 7: Allowable Material Property (Production) Differences and Specification Limits, Cont'd)

Property	Test Method	Allowable Difference from Current JMF Target	Allowable Difference between Contractor and Engineer Test Results	Specification Limits for Pay Factor Determination
Sulfate Content, ppm	Tex-145-E	500	500	
Min. Compression Strength, psi	Tex-117-E			
Lateral Pressure, 0 psi		10	8	
Lateral Pressure, 3 psi		15	12	
Lateral Pressure, 15 psi		20	15	
Optimum Moisture Content, %	Tex-113-E	0.3	0.3	
Max Dry Density, lbs per cu. ft.		1.0	1.0	

TxDOT Approval

Full Approval

- PWL >95% for All Properties
- Can Ship and Certify for Department Usage without TxDOT Acceptance Testing

TxDOT Approval

Conditional Approval

- PWL 90 to 95 for All Properties
- Other Factors
- Producer Ship Material
- Acceptance Based on TxDOT QA Tests
- Source on Conditional Approval
  - Increased Sampling Frequency
  - Pretesting Prior to Shipment
  - Restrict Base Production to Specific Layers on Pits or Locations in Quarry
- Length of Time Conditional Approval – 6 Months

Conditional Approval – Other Factors

- QC Program not Effective
- Poor Records
- Not Adhere to QC Plan
- Improper Sampling and Testing
- Does Not Certify Product
- Improper Certification and Accreditation
- Other

4.12.3 Placement Acceptance

- Lot Size
  - 4 Sublots per Lot
  - Area Placed by 4,000 Tons
- Pay Factor for Lot 1-1.00
- Rework or Remove and Replace Any Sublot in Lot 1 with Relative In-place Density Less than 98%

Special Areas

- Shoulder Ramps, etc.
  - In-place Density Requirement
  - Miscellaneous Area (Driveways, Mailbox Turnouts, etc.)
  - No In-place Density Requirement?

4.12.3.7 Placement Sampling

- Random Sampling (Engineer)

Property	Samples per sublot	Samples per lot
In-place density	4	
In-place moisture content	4	
Thickness	1	
Lab compacted moisture-density relationship		1

4.12.3.8 Placement Testing

(Table 9: Placement Testing Frequency, Allowable Differences and Specification Limits)

Property	Test Method	Minimal Contractor Testing Frequency	Minimal Engineer Testing Frequency	Allowable Difference from Current JMF Target	Allowable Difference between Contractor and Engineer	Specification Limits
Optimum Moisture Content, %	Tex-113-E	1 per lot	1 per 3 lots	0.3 (percentage points)	0.3 (percentage points)	
Maximum Dry Density, lbs per cu. ft				1.0	1.0	
In-place Density, % [1]	Tex-115-E	4 per sublot	1 per sublot		2.0 (percentage points)	100
In-place Moisture Content, % [1]					0.5 (percentage points)	± 1.5
Thickness, in.	Tex-140-E	1 per sublot	1 per sublot		0.5	– 0.5 + 0.5

4.12.3.9 Operational Tolerance/ Suspend Placement

Property	Out of Operational Tolerance		Suspend Production	
	JMF	Specification	Parameter	No. of Consecutive Sublots
In-place density/ moisture content		X	In-place density or moisture content individually	2
			Either in-place density or moisture content	3
Thickness		X	Thickness	2
Lab Compacted moisture-density relationship	X		Moisture content or dry density individually	2
			Either moisture content or dry density	3

4.12.3.11 Smoothness

- 1/4 inch in 16 ft. Longitudinally
- 1/4 inch over Entire Width of Cross Section
- IRI - ?

4.12.3.10 Irregularities

- Segregation, Bumps, Texture, Roller marks, Tears, Gouges, etc.
- May Require
  - Suspend Operations
  - Rework
  - Remove and Replace