PennDOT Asphalt Balanced Mix Design Implementation

Neal Fannin P.E.

Pavement Materials Engineer

pennsylvania
DEPARTMENT OF TRANSPORTATION
www.dot.state.pa.us

BALANCED MIX DESIGN

PREVIOUS BULLETIN 27 CHANGES THAT ARE INCLUDED THE BMD CHANGE

- Gyration Levels: (SOL 481-21-02)
  - Old:
    - 50, 75, and 100 gyrations
  - New:
    - 75 and 100 gyrations

- VMA Change: (SOL 481-21-02)
  - Old:
    - 0.5% above AASTO M 323
  - New:
    - 1.0% above AASHTO M 323

- Minimum Asphalt (Feb. 11, 2015 - Memo)
  - Incorporated into the BMD change to Bulletin 27, so there is no more need for an SSP in every contract.

- Moisture susceptibility (SOL 481-16-06)
  - (Mandatory anti-strip) Requirements:

WHAT CHANGES ARE BEING MADE?

- Adding Performance Testing: **(No required limits yet)**
  - Hamburg Wheel Track Testing (HWT, AASHTO T 324):
    - Rutting
  - Cracking Tolerance Index (CT-Index, ASTM D8225):
    - Cracking
  - Delta Tc (ΔTc, AASHTO PP 78):
    - Only for JMFs over RBR of 0.35 and above
    - High RAP/RAS/Recycled mixtures cracking.

- Incentives:
  - N_{design} Air Voids:
    - Possible 3.0% to 4.1% allowed limit.
  - AASHTO T 283 Testing:
    - Possible waiving of TSR testing and anti-strip requirements.
  - PG grade bumping:
    - Possible to meet all performance requirements.

TABLE 9 - PERFORMANCE TESTING LIMITS

FOR INFORMATION ONLY – WITH INCENTIVE

TABLE 9 - Performance Testing Limits

Specification	AASHTO T 324, Hamburg Wheel Track				ASTM D8225, CT_{Index}	AASHTO PP 78[1, 2], ΔTc
Property	Traffic Level (Millions of ESALs)	Maximum Rut Depth at 20,000 Passes (mm)	SIP (minimum passes)	Minimum Passes at 12.5mm Rut Depth	CT_{Index}[3]	ΔTc
	<3	≤15 ≤20	N/A 14,000	N/A 10,000		
Cracking[3]	<3 3 and <10 ≥10				>70 >80 >90	
High RAP / RAS (≥ 0.35 RBR)[1]	All					>-5.0C

Wearing Courses Only

(1) Only applies to JMFs with an RBR greater than or equal to 0.35
Recycled Binder Ratio (RBR) = $((Pb_{RAP} \times P_{RAP}) + (Pb_{RAS} \times P_{RAS})) / (100 \times Pb_{Total})$
Where:
- Pb_{RAP} = Percent Asphalt in the RAP
- P_{RAP} = Percent of RAP by weight in the JMF
- Pb_{RAS} = Percent asphalt in the RAS
- P_{RAS} = Percent RAS by weight in the JMF
- Pb_{Total} = Total Percent of asphalt in the JMF

(2) Compute ΔTc according to AASHTO PP 78, Section 7.2, using Section 7.6 Procedure for Evaluating Specific Mixtures .

(3) ASTM D8225 CT_{Index} Tests with an average peak load result of less than 75 psi is a failing test.

TABLE 10 – EXCEPTION TO CURRENT MIX DESIGN REQUIREMENTS IF PERFORMANCE LIMITS MET

TABLE 10 - Exceptions for JMFs that Meet All Table 9 Requirements

Property	AASHTO Specification	Existing PA Specification Requirement	Specification Requirement if Table 9 Limits are Met
Percent Air Voids at N_{Design}	R 35 Table 2	4.0	3.0 to 4.1
Moisture Susceptibility	R 35 - Sect. 4.4, M 323 - Sect. 7.3, & T 283	<0.80 AASHTO T 283 TSR, mandatory anti-strip	AASHTO T 283 and mandatory anti-strip waived
Asphalt PG Grade	M 323 Sect. 5, and as specified	As specified	PG grade bumping to meet all performance testing limits allowed

Note: The DME/DMM may allow or disallow any or all of the exceptions in Table 10 for any JMF.

Note: The DME/DMM may allow or disallow any or all of the exceptions in Table 10 for any JMF.

IMPLEMENTATION PHASES

- Less than 0.3 Million ESAL (50 gyration) wearing course JMFs submitted for the 2023 design year. **(Next year)**
  - Will **require** performance testing to be input into eCAMMS for information only.
  - DMEs **may** approve less than 0.3 million ESAL wearing course JMFs without performance testing on a case-by-case basis. (The data still needs to be input.)

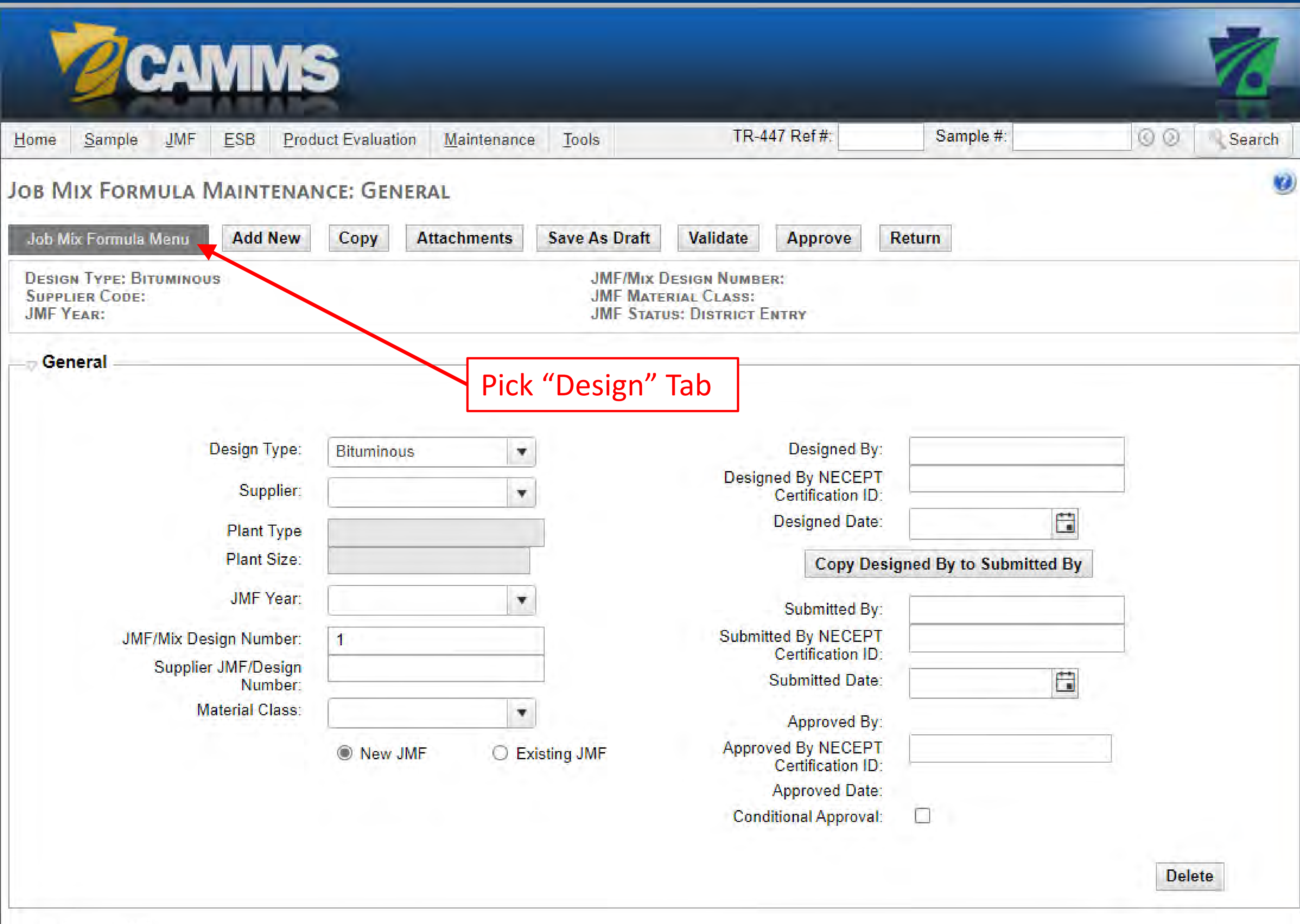
- All wearing course JMFs submitted for the 2024 JMF design year.

  (2 Years)

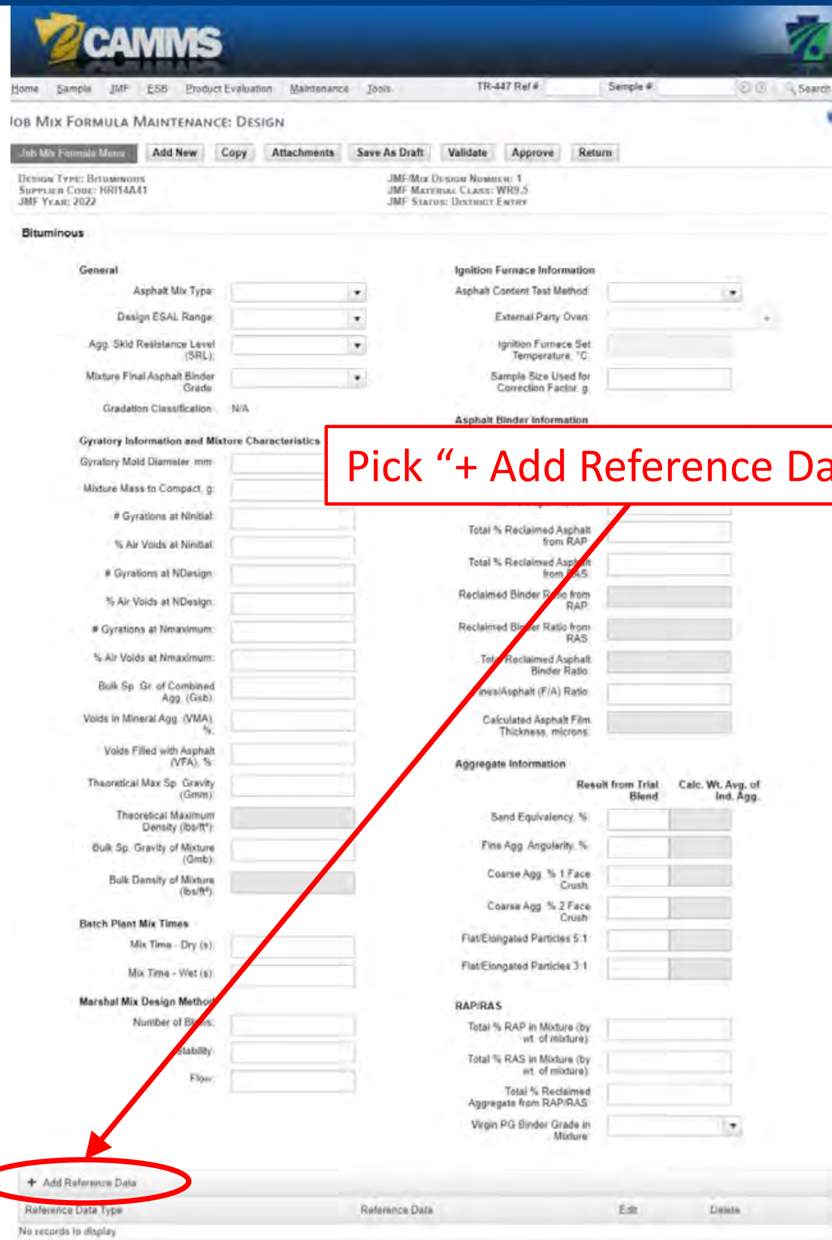
  - Performance testing entry into eCAMMS is **required before JMF approval is given**.

- **Only effects wearing course mixtures.**

- After the 2024 construction season either limits will be set or the data acquisition process will be adjusted and continued so that **meaningful and achievable limits** can be established.

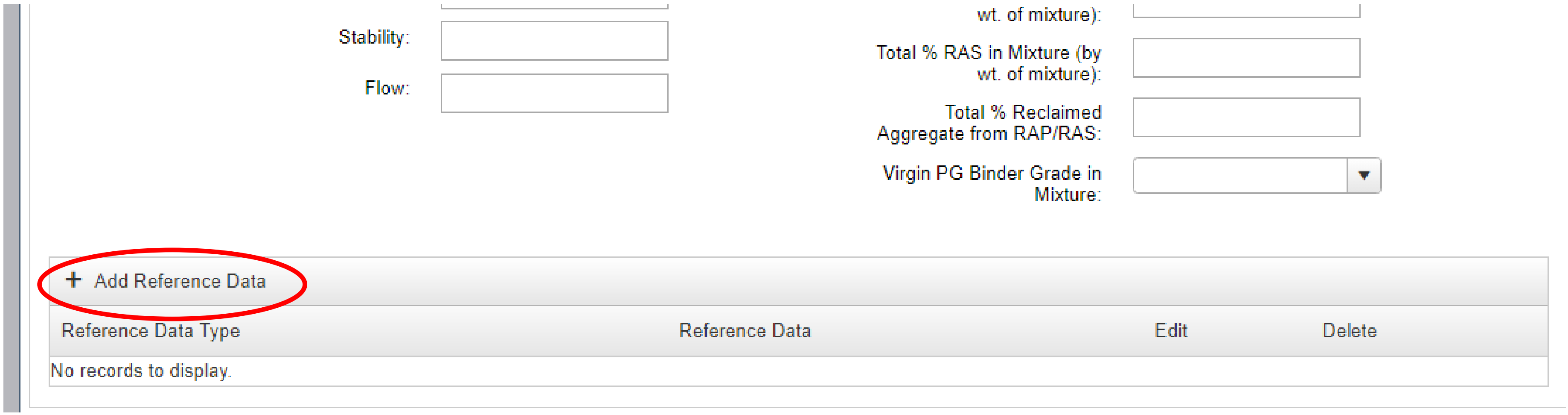

eCAMMS
Home
Sample
JMF
ESB
Product Evaluation
Maintenance
Tools
TR-447 Ref #:
Sample #:
Search
JOB MIX FORMULA MAINTENANCE: GENERAL
Job Mix Formula Menu
Add New
Copy
Attachments
Save As Draft
Validate
Approve
Return
DESIGN TYPE: BITUMINOUS
SUPPLIER CODE:
JMF YEAR:
JMF/MIX DESIGN NUMBER:
JMF MATERIAL CLASS:
JMF STATUS: DISTRICT ENTRY
General
Pick “Design” Tab
Design Type:
Bituminous
Supplier:
Plant Type
Plant Size:
JMF Year:
JMF/Mix Design Number:
1
Supplier JMF/Design Number:
Material Class:
New JMF
Existing JMF
Designed By:
Designed By NECEPT Certification ID:
Designed Date:
Copy Designed By to Submitted By
Submitted By:
Submitted By NECEPT Certification ID:
Submitted Date:
Approved By:
Approved By NECEPT Certification ID:
Approved Date:
Conditional Approval:
Delete

ECAMMS

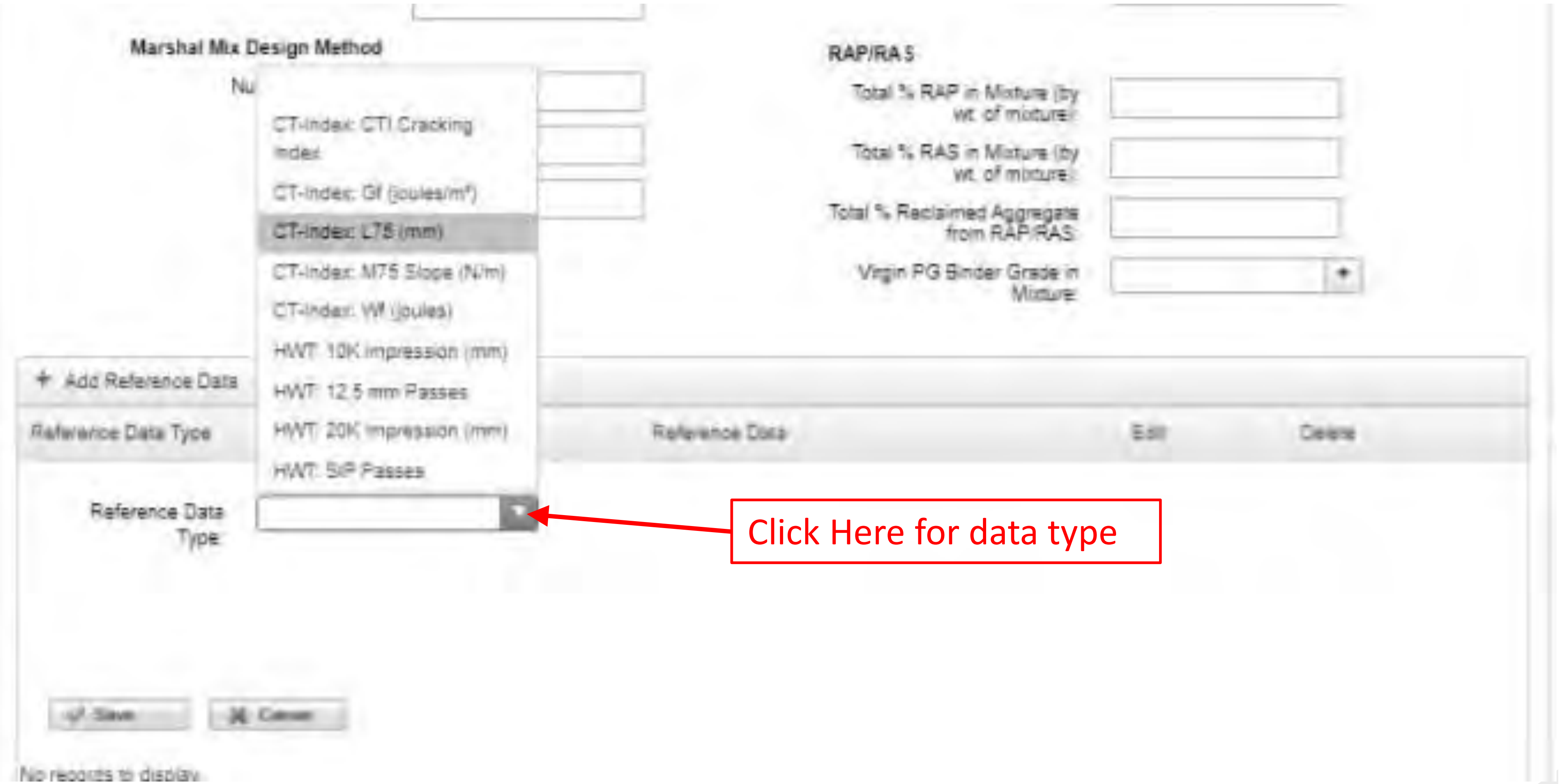


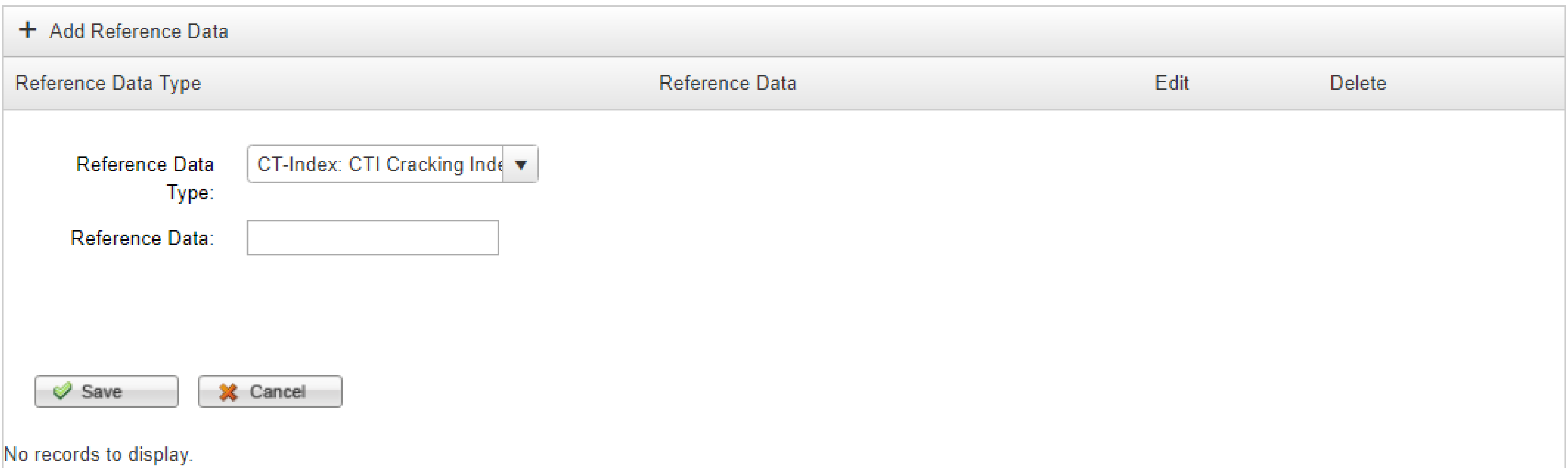
Pick "+ Add Reference Data"

ECAMMS

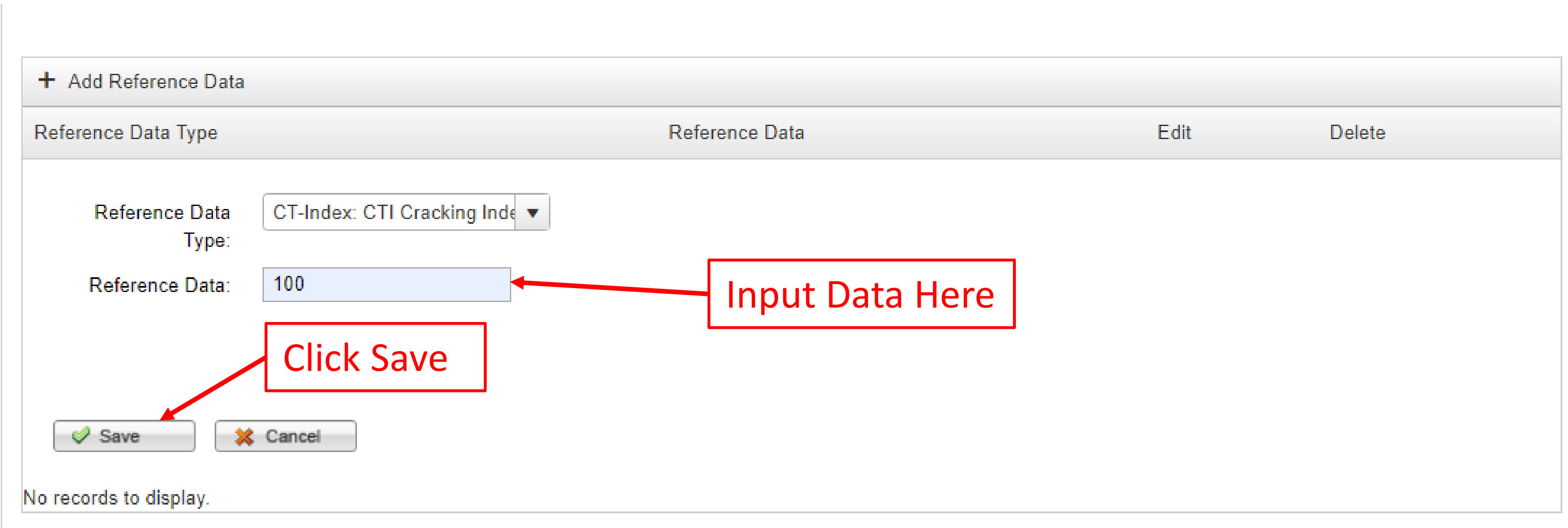


wt. of mixture):
Stability:
Flow:
Total % RAS in Mixture (by wt. of mixture):
Total % Reclaimed Aggregate from RAP/RAS:
Virgin PG Binder Grade in Mixture:
+ Add Reference Data
Reference Data Type
Reference Data
Edit
Delete
No records to display.


Marshal Mix Design Method
CT-Index: CTI Cracking Index
CT-Index: Gf (Joules/m²)
CT-Index: L75 (mm)
CT-Index: M75 Slope (N/m)
CT-Index: Wf (Joules)
HWT: 10K Impression (mm)
HWT: 12.5 mm Passes
HWT: 20K Impression (mm)
HWT: SIP Passes
RAP/RAS
Total % RAP in Mixture (by wt. of mixture):
Total % RAS in Mixture (by wt. of mixture):
Total % Reclaimed Aggregate from RAP/RAS:
Virgin PG Binder Grade in Mixture:
Add Reference Data
Reference Data Type
Reference Data
Edit
Delete
Reference Data Type:
Save
Cancel
No records to display.
Click Here for data type


+ Add Reference Data
Reference Data Type
Reference Data
Edit
Delete
Reference Data Type:
CT-Index: CTI Cracking Inde
Reference Data:
Save
Cancel
No records to display.

ECAMMS


+ Add Reference Data
Reference Data Type
Reference Data
Edit
Delete
Reference Data Type:
CT-Index: CTI Cracking Inde
Reference Data:
100
Input Data Here
Click Save
Save
Cancel
No records to display.

Mixture.

+ Add Reference Data

Reference Data Type	Reference Data	Edit	Delete
CT-Index: CTI Cracking Index	100		

ECAMMS

Mixture:

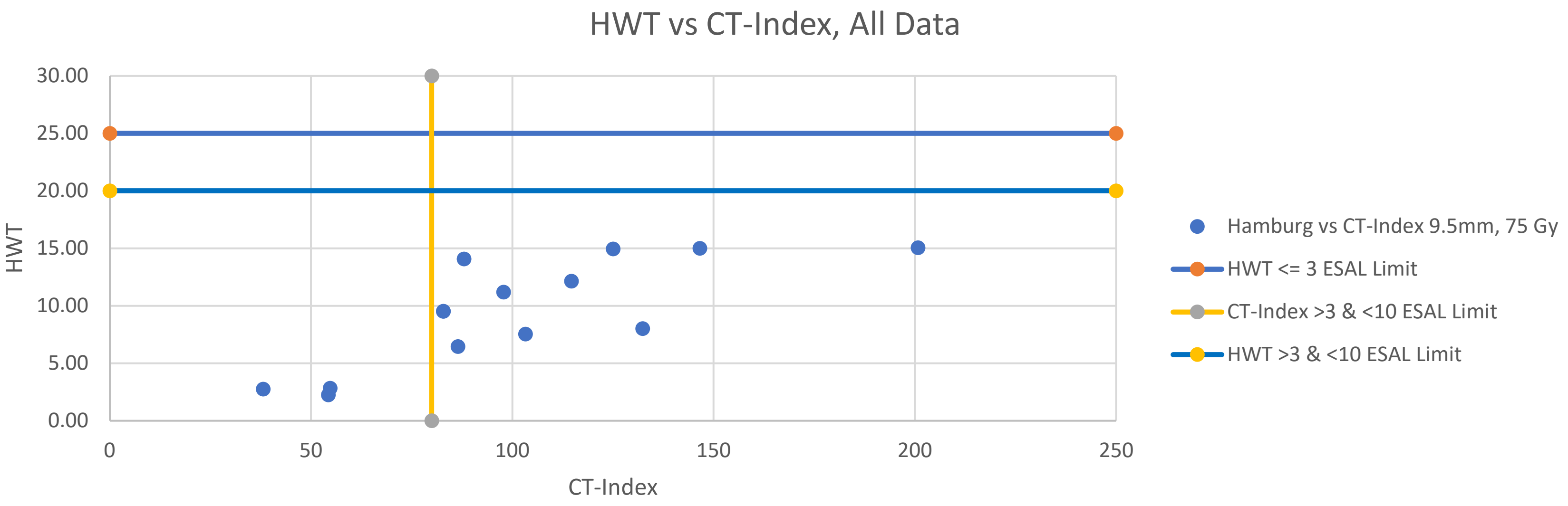
+ Add Reference Data

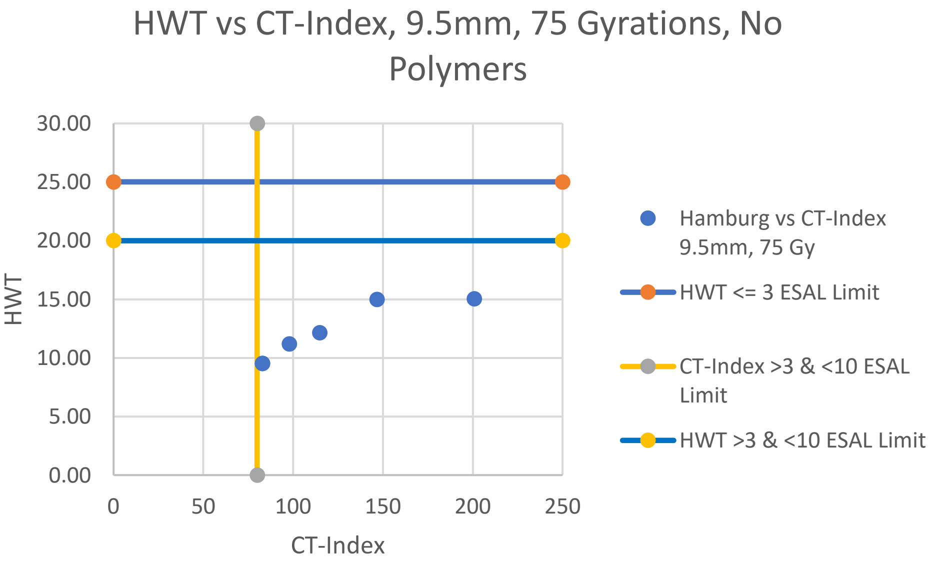
Reference Data Type	Reference Data	Edit	Delete
CT-Index: CTI Cracking Index	100		
CT-Index: Gf (joules/m²)	1000		
CT-Index: L75 (mm)	4		
CT-Index: M75 Slope (N/m)	0.0012		
CT-Index: Wf (joules)	2300		
HWT: 10K Impression (mm)	3.5		
HWT: 12.5 mm Passes	18000		
HWT: 20K Impression (mm)	13		
HWT: SIP Passes	10000		

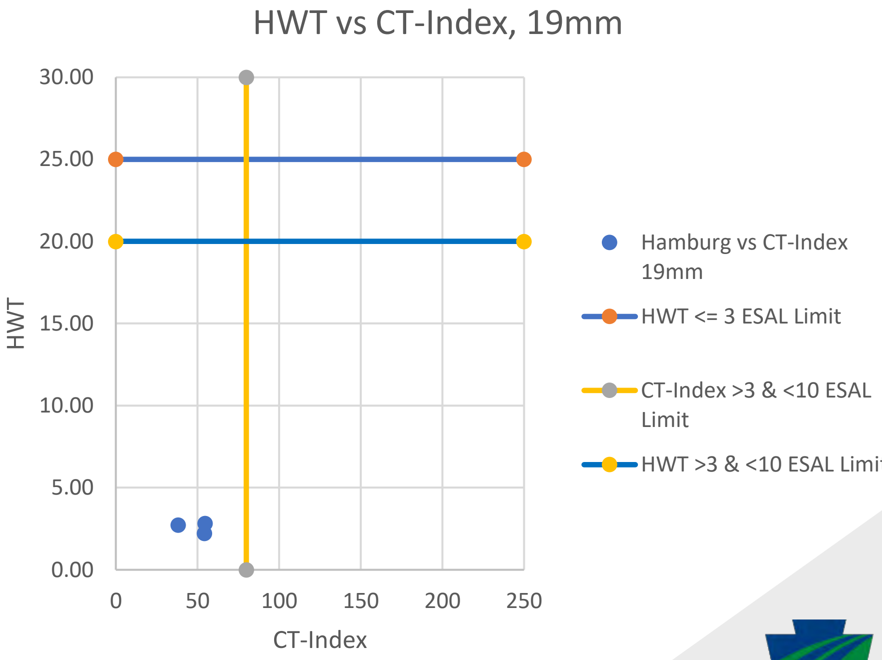
2020 PILOT PROJECT DATA

Number of passes at Max. impression	Max. Impression (Rut depth) (mm)	Number of Passes at 12.5mm Rut Depsth
10550	14.94	9600
18198 / 20000	15 / 6.488	17256 / NA
20000	7.544	N/A
8158 / 10600	15	7372 / 9800
20000	12.146	NA
20000 / 16208	7.391 / 15	NA / 15572
20000	2.228	NA
15.00 / 13.146	13462 /20000	15970
20000	2.8315	NA
20000	9.5195	NA
20000	9.5195	NA
20000	2.731	NA
20000	8.01	NA
17109	15.04	15516

2020 PILOT PROJECT DATA







QUESTIONS???????

PERFECTION IS THE ENEMY OF PROGRESS!

THE MAXIM - NOTHING AVAILS BUT PERFECTION MAY BE SPELT SHORTER: "PARALYSIS"

WINSTON CHURCHHILL

Neal Fannin P.E.
nfannin@pa.gov
(814)496-6144