Memorandum

U.S. Department
of Transportation

**Federal Highway
Administration**

6300 Georgetown Pike
McLean, Virginia 22101

Subject: **ACTION**: LTPP Directive M-32 Date: July 24, 2019

From: Jack Springer JACK H SPRINGER Digitally signed by JACK H SPRINGER Date: 2019.07.29 08:07:16 -04'00' Reply to
Long-Term Infrastructure Performance Team Attn of: HRDI-30

To: Dr. Ramon Bonaquist, PM - LTPP SPS-10 Material Testing Contract

Attached is the Long-Term Pavement Performance (LTPP) Program Directive M-32. This directive updates the Fenix Fracture Energy Test that is part of the SPS-10 material testing contract.

Please ensure that all personnel involved with conducting testing on SPS-10 materials are aware of this new directive. Should you have any questions or would like to discuss this directive, please do not hesitate to contact Larry Wiser via email at larry.wiser@dot.gov (202) 493-3079.

Attachments (2)

FHWA:HRDI-30 L. Wiser:jeh:202-493-3079:07/24/19
File: M:\LTPP Directives\MATERIALS\M-32
cc:
Jonathan Groeger
Larry Wiser
Gabe Cimini
Directive Binder
LTPP Team
Official file

LONG TERM PAVEMENT PERFORMANCE PROGRAM DIRECTIVE

For the Technical Direction of the LTPP Program

Program Area:	Materials	Directive Number:	M-32
Date:	July 24, 2019	Supersedes:	N/A
Subject:	Material Test Protocol P-79 (AC10) Fenix Fracture Energy Test		

The following material test protocol is an update to the Fenix Fracture Energy Test. This test method is to be used on designated material samples obtained from LTPP SPS-10 project sites.

Prepared by: TSSC

Approved by:

JEAN NEHME Digitally signed by JEAN NEHME
Date: 2019.07.29 18:46:25 -04'00'

Jean A. Nehme, Ph.D., P.E.
Long-Term Infrastructure Performance Team Leader (HRDI30)

PROTOCOL P79 TEST METHOD FOR DETERMINING FRACTURE ENERGY OF ASPHALT MATERIALS AT LOW AND INTERMEDIATE TEMPERATURES (FENIX FRACTURE ENERGY) (AC10)

SCOPE

This LTPP protocol describes procedures for the determination of the fracture energy of asphalt materials at temperatures of -10˚C, -5˚C, and 20˚ C. This protocol is applicable to 152- mm diameter cores that are at least 38 mm in height. The core is sawn in half along the diametral axis. The specimen is then notched, and steel loading plates are glued to the sawn face of the specimen. The specimen is loaded in tension, through the steel plates, at a constant rate of displacement of 1 mm/minute. The loading is continued past the peak load until a residual load value of 1 N is reached.

Data collected during this testing are used to determine Fracture Energy, maximum load and corresponding displacement, displacement at 50% of the peak load, and displacement at the residual load value.

APPARATUS

Loading Device and Transducers

The testing machine shall be capable of applying a load of at least 10 kN with a constant rate of ram displacement of 1 mm ± 0.1 mm per minute. It shall have a transducer such as an LVDT capable of measuring ram displacement with a range of at least 10 mm and an accuracy of at least 0.01 mm. It shall have a transducer such as a load cell capable of measuring applied load with a maximum load of at least 10 kN and an accuracy of at least 1 N.

Data Acquisition System

The data acquisition system shall be capable of electronically recording simultaneous measurements from the load and displacement transducers at a rate of at least 500 samples per second.

Loading Plates

Two loading plates are required. Drawings are shown in Appendix A.

Alignment Plates

One alignment plate is required. Drawings are shown in Appendix A

Clevis Pins

Two clevis pins are required. Drawings are shown in Appendix A

Environmental Chamber

The environmental chamber temperature control system shall be capable of maintaining temperature control within ± 0.2˚ C at settings ranging from -10 to 20 ˚ C.

TEST SPECIMEN

Specimen Requirements

For all LTPP testing, the specimen shall be a 152-mm diameter core. Cores shall have smooth and uniform vertical (curved) surfaces. Cores that are obviously deformed or have any visible cracks must be rejected. Irregular top and bottom surfaces shall be trued up as necessary. The surface of the core shall be marked in the field with the direction of traffic.

Specimen Preparation

Each specimen shall represent a single layer, as defined by LTPP. If the field core includes two or more different AC layers, the layers shall be separated at the layer interface by sawing. After sawing, truing or trimming the core sample shall have a minimum height of 38 mm and a maximum height of 63.5 mm. If the core must be further trimmed to meet the maximum height requirement, an equal thickness shall be trimmed from the top and bottom of the core. Care shall be taken to maintain the direction of traffic reference through any sawing or trimming activities. The trimmed core shall be cut along the diametral axis parallel to the direction of traffic as shown in Figure 1. The maximum kerf width shall be 6.3 mm . The kerf shall be evenly divided across the center of the core, yielding two symmetrical specimens.

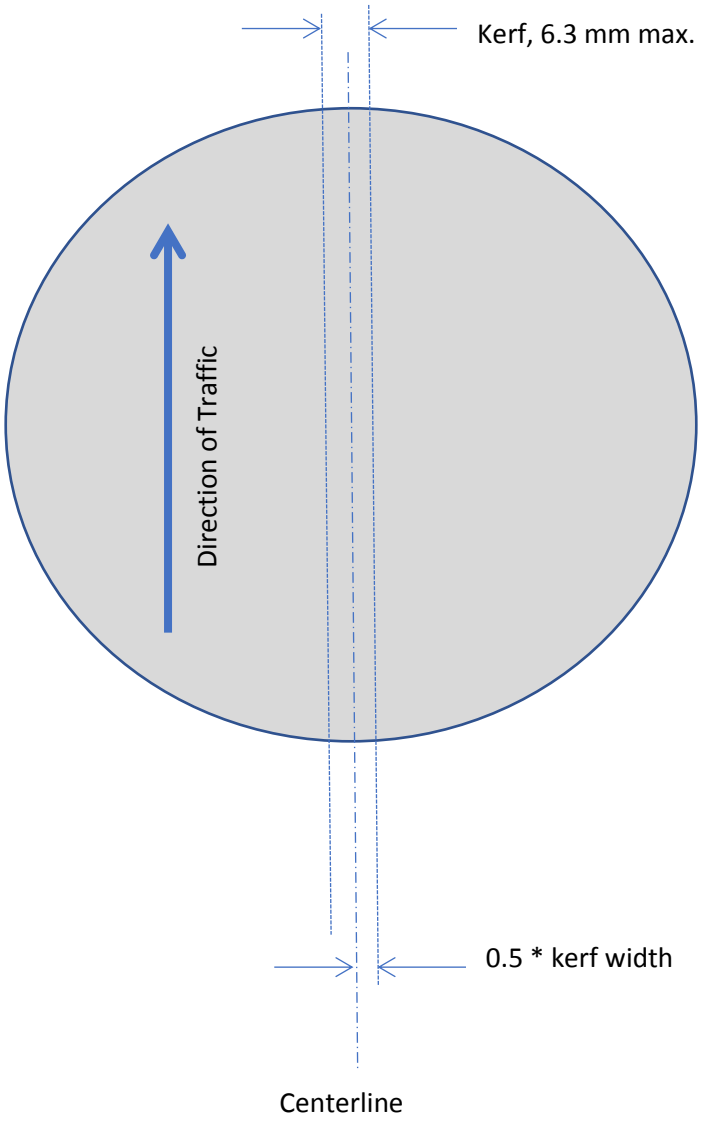


Figure 1. Diagram. Specimen Sawing.

The cut specimen shall then be notched across the full height of the vertical axis, as shown in Figure 2. The notch shall be 6.3 mm deep by 6.3 mm wide.

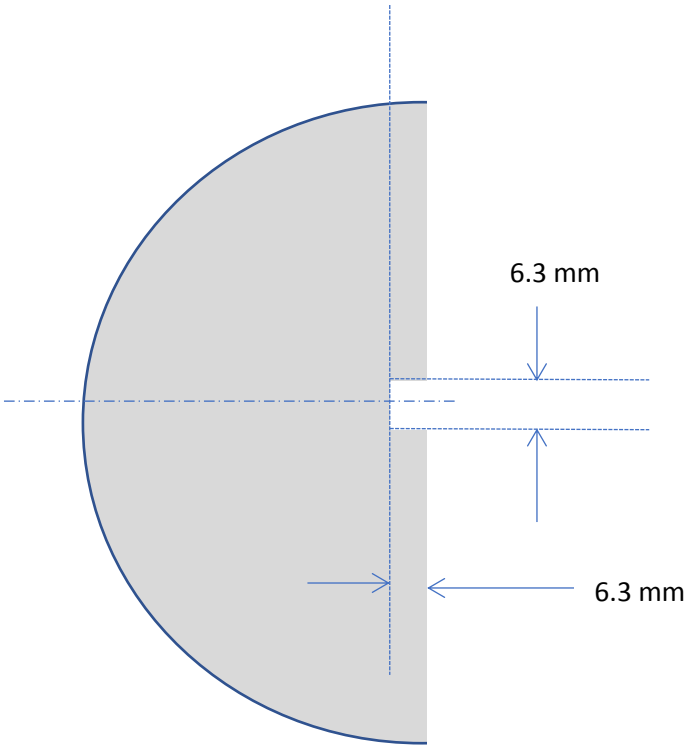


Figure 2. Diagram. Specimen Notching

Loading Plate Mounting

The loading plates shall be glued to the specimen using thixotropic adhesive mortar containing epoxy resins as shown in Figure 3, using the alignment plate to ensure that the loading plates are in alignment. If the loading plates are wider than the specimen, the specimen shall be centered in the load plates.

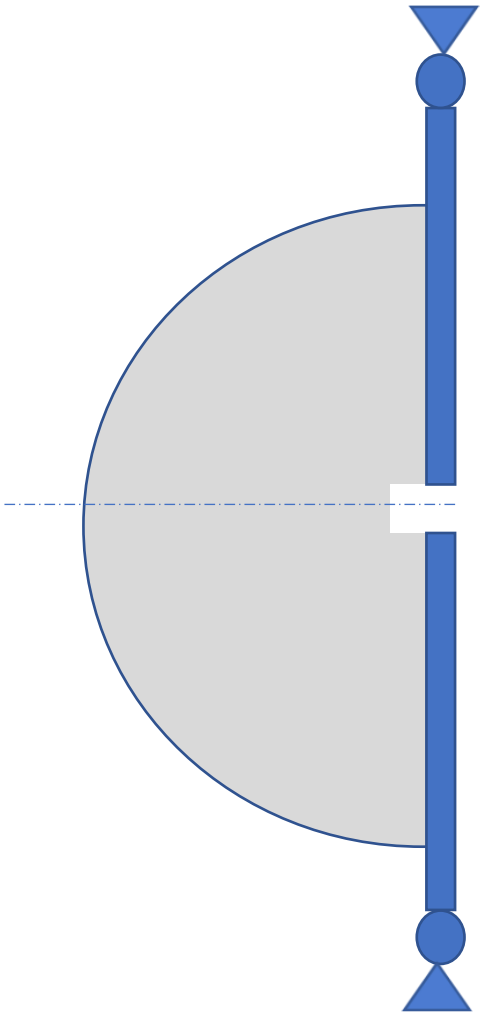


Figure 3. Diagram. Specimen with attached load plates

PROCEDURE

Test temperatures are -10° C, 5° C and 20° C. Two specimens shall be tested at each temperature.

Pre-Test Measurements

Prior to testing, the following dimensions of the specimen shall be measured and recorded: Initial Ligament Length, ℓ (shown in figure 4). Measure at each edge of the core and in the center of the core, to the nearest 0.1 mm. Record the average of the three measurements.

Specimen thickness, h. Measure at the three locations along the initial ligament indicated on Figure 4, to the nearest 0.1 mm. Record the average of the three measurements.

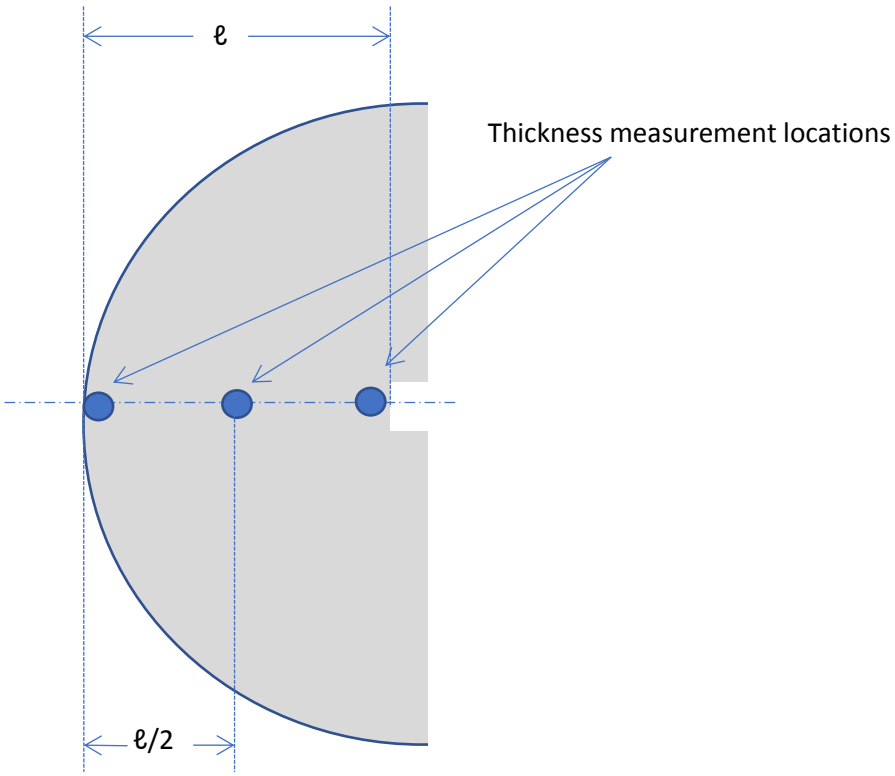


Figure 4. Diagram. Specimen Dimension Measurements

Specimen Conditioning

The specimens shall be placed in a temperature-controlled chamber and brought to the specified test temperature. Unless the specimen temperature is monitored in some manner or can be reasonably inferred from a dummy specimen placed in the chamber at the same time, the specimen shall remain in the cabinet for a minimum of 24 hours prior to testing.

Testing

Affix the specimen to the loading apparatus, using the load plates. Start the data acquisition system, and apply load, using a constant rate of ram displacement of 1 mm ± 0.1 mm per minute. Testing is complete when the post-peak load diminishes to 100 N.

CALCULATIONS

Dissipated Work, W_D (J)

Dissipated work is the area under the force versus displacement curve from the start of the test until the residual load value of 100 N is reached. Compute dissipated work using the trapezoidal rule as follows.

$$W_D = \sum_{i=1}^{n-1} (d_{i+1} - d_i) \frac{F_i + F_{i+1}}{2}$$

Where:

d_i = ram displacement at i-th data point, m

F_i = force at i-th data point, N

5.2 Fracture Energy, G_D (J/m^2)

$$G_D = \frac{W_D}{h \cdot l}$$

Where:

h = specimen thickness, m

l = initial ligament length, m

REPORT

Specimen Identification

Test Temperature, ˚C

Specimen Dimensions – h (mm), ℓ(mm)

Fracture Energy, G_D (J/m^2)

Peak Load -Fmax (N)

Displacement at one-half pre-peak load – Δm (mm)

Displacement at one-half post-peak load - Δmdp (mm)

Displacement at residual load - ΔR (mm)

Load (N) versus displacement (mm) values recorded during the test

LTPP-SPS LABORATORY MATERIAL HANDLING AND TESTING FOR EXPERIMENT SPS-10
LABORATORY MATERIAL TEST DATA
FENIX FRACTURE ENERGY
LAB DATA SHEET T79

ASPHALT CONCRETE LAYER (ASPHALT CONCRETE PROPERTIES)
LTPP TEST DESIGNATION AC10 / LTPP PROTOCOL P79

SHEET NO. _____ OF _____
STATE _____
STATE CODE [ ][ ]
SHRP ID. [ ][ ][ ][ ]
FIELD SET NO. [ ][ ]

LABORATORY PERFORMING TEST: _____ **LAB CODE**.....[ ][ ][ ][ ]

SAMPLED BY: _____ DATE SAMPLED: ____-____-____

LAYER NUMBER.....[ ][ ]

SAMPLE LOCATION DESIGNATION.....[ ][ ][ ][ ][ ][ ]

SAMPLE NUMBER.....[ ][ ][ ][ ][ ][ ][ ]

SPECIMEN HEIGHT, h (mm).....[ ][ ].[ ]

INITIAL LIGAMENT LENGTH, ℓ (mm).....[ ][ ].[ ]

TEST TEMPERATURE (°C).....[ ][ ].[ ]

FRACTURE ENERGY, G_0 (J/mm^2).....[ ][ ][ ][ ][ ]

PEAK LOAD, F_{max} (N).....[ ][ ][ ][ ]

DISPLACEMENT AT 0.5 PRE-PEAK LOAD, **Δm** (mm).....[ ][ ].[ ]

DISPLACEMENT AT 0.5 POST-PEAK LOAD, **Δmdp** (mm).....[ ][ ].[ ]

DISPLACEMENT AT RESIDUAL LOAD, **ΔR** (mm).....[ ][ ].[ ]

COMMENT CODES.....[ ][ ], [ ][ ], [ ][ ], [ ][ ]

COMMENT OTHER: _____

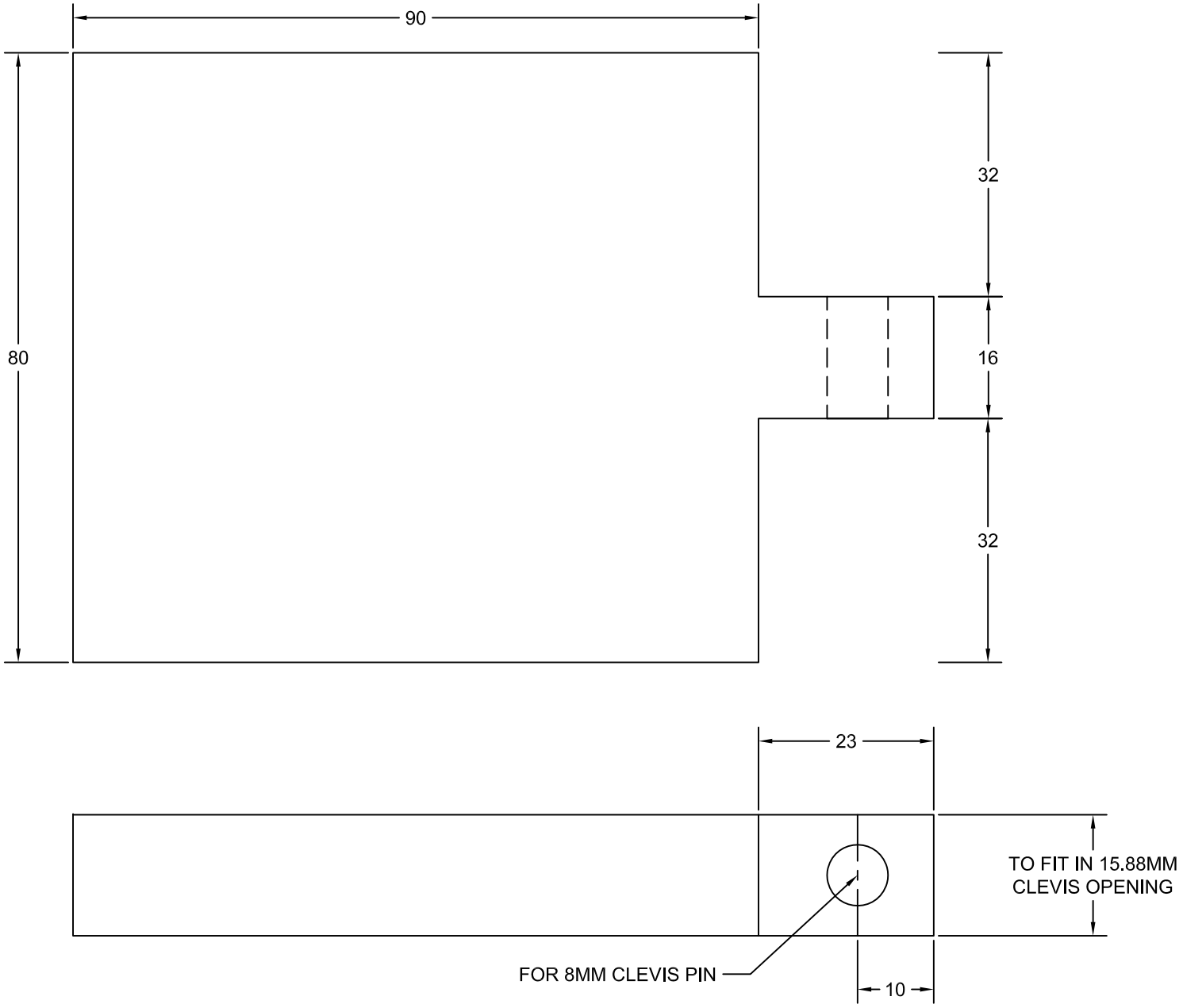
TEST DATE (month-day-year).....[ ][ ]/[ ][ ]/[ ][ ]

RAW DATA FILENAME.....

Appendix A

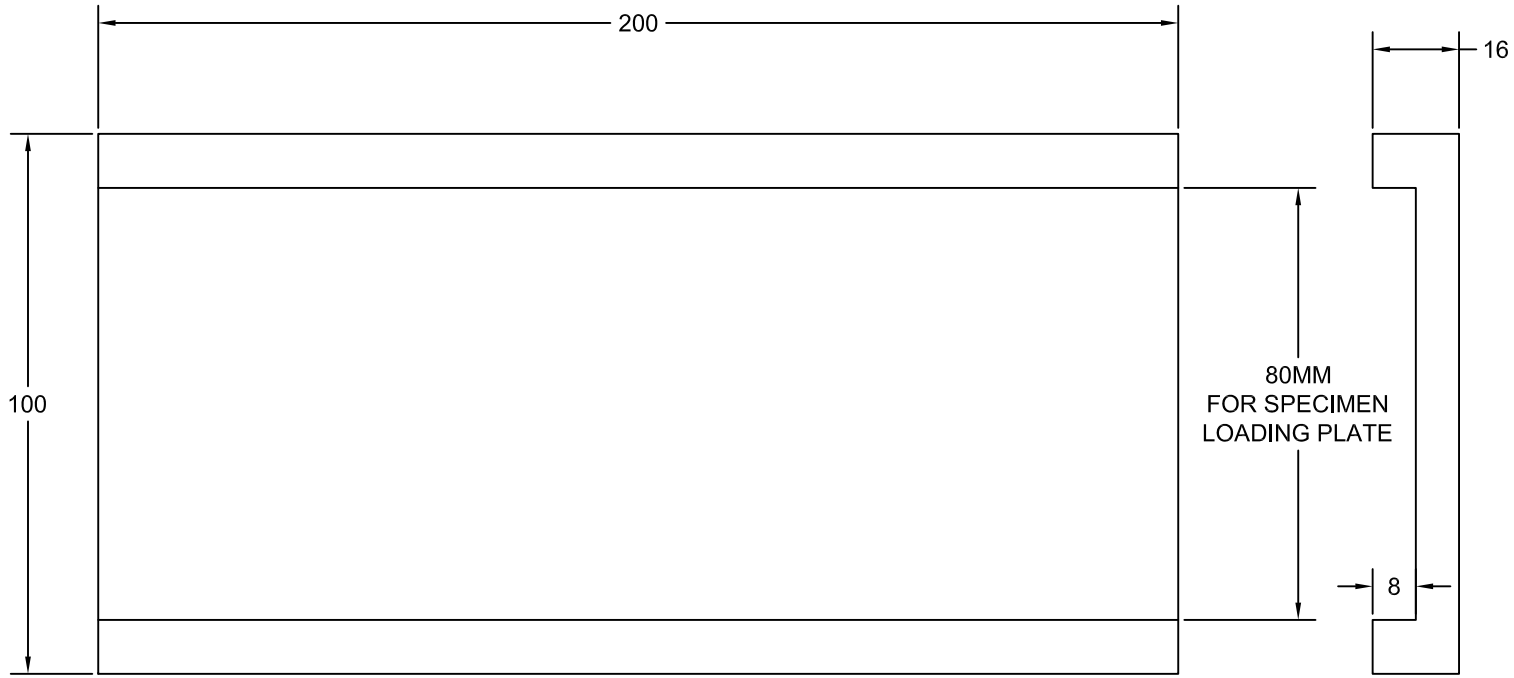
Loading Plate, Alignment Plate, and Clevis Pin Details

SPECIMEN LOADING PLATE



UNITS = MM

ALIGNMENT PLATE



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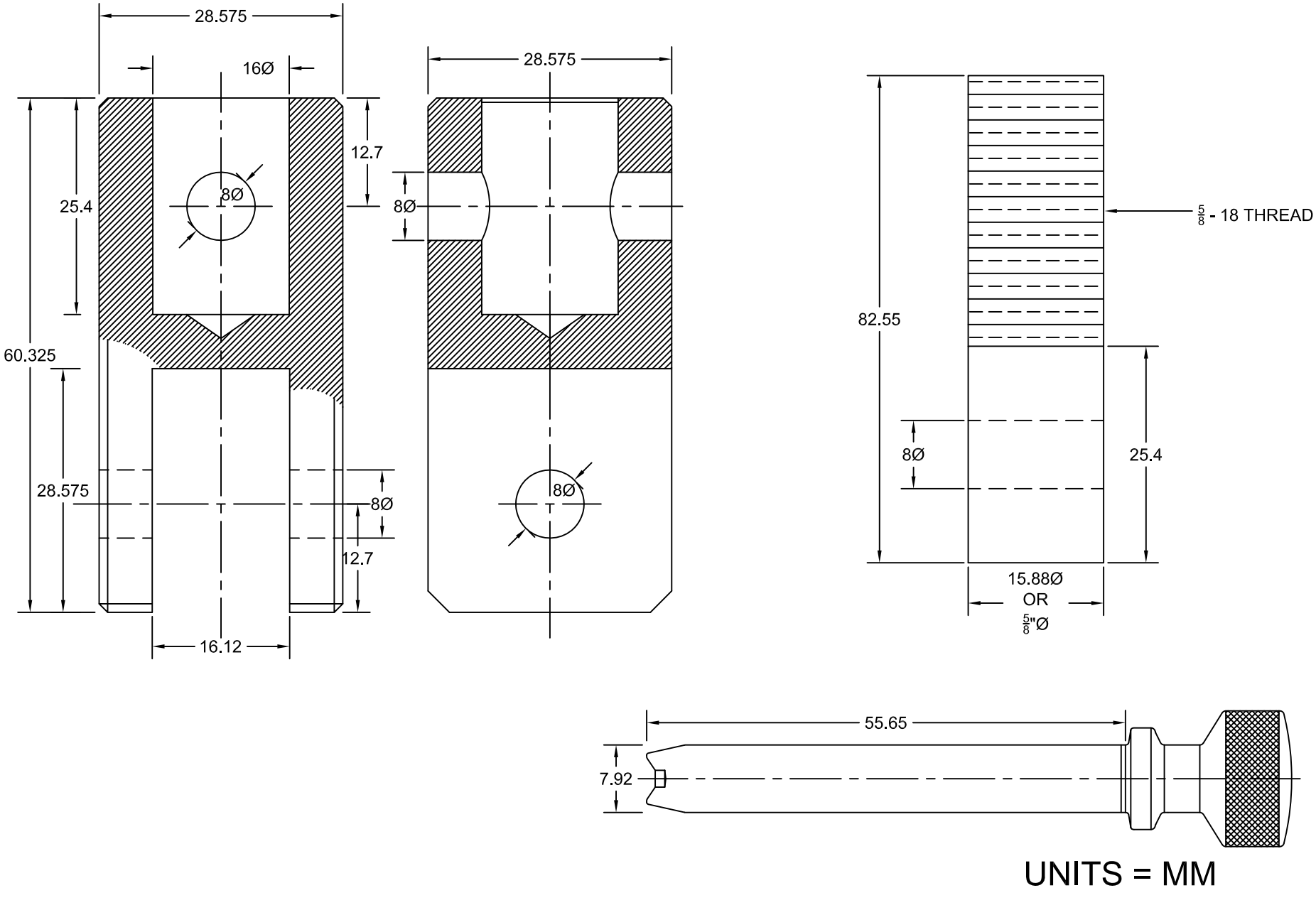
CLEVIS PIN AND PIN DEVICES



UNITS = MM