Memorandum

U.S. Department
of Transportation

Federal Highway
Administration

6300 Georgetown Pike
McLean, Virginia 22101-2296

Subject: ACTION:LTPP Directive FWD-17
FWD Temperature Sensor Checks

Date: April 27, 1998

From: Antonio Nieves Torres
Pavement Performance Division

Reply to
Attn. of: HNR-30

To: Mr. Bill Phang, LTPP Regional PI (NA)
Mr. Brent Rauhut, LTPP Regional PI (S)
Mr. Mike Darter, LTPP Regional PI (NC)
Mr. Dennis Morian, LTPP Regional PI (W)

Attached is the Long-Term Pavement Performance (LTPP) Program Directive FWD-17 that addresses the "FWD Temperature Sensor Checks". Please make sure that all office personnel involved in the use of the FWD are aware of this new directive.

If you have any questions concerning this transmittal, please do not hesitate to call me at 703-285-2526.

Antonio Nieves Torres

FHWA:HNR-30:anieves:ant:285-2526:April 27, 1998
File: h:\data\anieves\wp\directv\covdir20.doc
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LONG TERM PAVEMENT PERFORMANCE PROGRAM DIRECTIVE

For The Technical Direction Of The LTPP Program

Program Area: Monitoring **Directive Number:** FWD-17

Date: April 27, 1998 **Supersedes:** n/a

Subject: FWD Temperature Sensor Checks

This directive details the procedure to be followed by the RCOCs to periodically (at least monthly) check the accuracy of the FWD air temperature and infra-red (IR) sensors as well as the equipment and materials required to perform these checks. The procedure is portable to allow for temperature checks at the office as well as in the field. ***These checks should not be construed as a calibration of the referenced sensors. RCOCs shall not calibrate temperature sensors. If a sensor fails one or more temperature checks, it shall be sent back to manufacturer for repair or calibration, or it shall be replaced with a new sensor.***

Equipment and Materials Required

Materials needed to perform the FWD temperature sensor checks described in this directive include:

NIST Traceable Mercury Thermometer
3.8 Liter (1 Gallon) Bucket
- Hot Plate
- Large Wooden Spoon or Paint Stirrer
- Medium Size Cooking Pot (Approx. 125 mm diameter)
- Leather Heat Resistant Gloves

Cooking Oil
Ice
Copy of LTPP Temperature Sensor Check (TSC) form

Procedure

Procedures to check accuracy of air temperature sensor and of IR sensor vary slightly. Temperature checks for IR sensor shall be performed at three different temperatures - one near

0 degrees (cold temperature test), one near ambient air temperature, and one near 60 degrees Celsius (hot temperature test). Air temperature sensor checks shall only be performed at the first two temperatures - near 0 degrees Celsius and near ambient air temperature. Detailed steps for checking both of these sensors are provided as follows.

Step 1: Park FWD van and trailer on a smooth surface, in area with good ventilation and not exposed to direct sunlight.

Step 2: Start Edition 20 FWD Software and proceed to Measurements Screen. Record air and surface temperatures displayed on measurement screen on LTPP Temperature Sensor Check (TSC) form.

Step 3: Unclip air temperature sensor so that it may hang freely

Step 4: Conduct cold temperature sensor checks.

A Prepare ice water bath for cold temperature check. Place ice and water in 3.8 liter bucket and begin stirring with wooden spoon. By agitating water, ice water temperature should fall to 0 to 1 degrees Celsius. Place ice water directly under IR sensor. When IR temperature reading stabilizes, record temperature of ice water with mercury thermometer and IR sensor simultaneously. Record readings on TSC form. Continue agitating ice water for one (1) minute and record temperatures again.

Next, calculate temperature difference between IR sensor and mercury thermometer for each set of readings. If difference is less than or equal to 2 degrees Celsius for both sets, IR sensor shall be considered to be working properly at cold temperatures. If difference for both sets is greater than 2 degrees, IR sensor shall be considered unacceptable. If difference is greater than 2 degrees for one of two sets, obtain a third set of IR sensor and mercury thermometer readings and if difference between those readings is within 2 degrees, consider IR sensor acceptable. Otherwise, consider IR sensor unacceptable (see Unacceptable Check).

B. After completing IR sensor check, place air temperature sensor in ice water bath beside mercury thermometer. Once air temperature sensor reading stabilizes, record temperature of ice water with mercury thermometer and air temperature sensor simultaneously. Record readings on TSC form. Continue agitating ice water for one (1) minute and record temperatures again.

Next, calculate temperature difference between air temperature sensor and mercury thermometer for each set of readings. If the difference is less than or equal to 2 degrees Celsius for both sets, air temperature sensor shall be considered to be working properly at cold temperatures. If difference for both sets is greater than 2 degrees, air temperature sensors shall be considered unacceptable. If difference is greater than 2 degrees for one of two sets, obtain a third set of air temperature and mercury thermometer readings and if difference between those readings is within 2 degrees, consider air temperature sensor acceptable. Otherwise, consider air temperature sensor unacceptable (see Unacceptable Check).

Step 5: Conducting ambient air temperature sensor checks.

A Even if IR sensor and/or air temperature sensor fails cold temperature check, proceed with ambient air temperature check. Replace ice water in bucket with luke warm tap water and allow water to sit under IR sensor for 10 minutes. Agitate water to allow excess heat to dissipate. After 10 minutes, record temperature of water with mercury thermometer and IR sensor simultaneously. Record readings on TSC form. Wait one (1) minute and record temperatures again.

Next, calculate temperature difference between IR sensor and mercury thermometer for each set of readings. If difference is less than or equal to 2 degrees Celsius for both sets, IR sensor shall be considered to be working properly at ambient air temperature. If difference for both sets is greater than 2 degrees, IR sensor shall be considered unacceptable. If difference is greater than 2 degrees for one of two sets, obtain a third set of IR sensor and mercury thermometer readings and if difference between those readings is within 2 degrees, consider IR sensor acceptable. Otherwise, consider IR sensor unacceptable (see Unacceptable Check).

B. After completing IR sensor check, place air temperature sensor in water bath beside mercury thermometer. Once air temperature sensor stabilizes, record temperature of water with mercury thermometer and air temperature sensor simultaneously. Record readings on TSC form. Wait one (1) minute and record temperatures again.

Next, calculate temperature difference between air temperature sensor and mercury thermometer for each set of readings. If difference is less than or equal to 2 degrees Celsius for both sets, air temperature sensor shall be considered to

be working properly at ambient air temperature. If difference for both sets is greater than 2 degrees, air temperature sensors shall be considered unacceptable. If difference is greater than 2 degrees for one of two sets, obtain a third set of air temperature and mercury thermometer readings and if difference between those readings is within 2 degrees, consider air temperature sensor acceptable. Otherwise, consider air temperature sensor unacceptable (see Unacceptable Check).

Step 6: Conducting hot temperature sensor checks.

If IR sensor has failed either cold temperature and/or ambient temperature check(s), do not perform hot temperature test. Also, do not perform hot temperature check on air temperature sensor.

The hot temperature sensor checks are optional if checks are being performed in the field. To perform hot temperature test, cooking oil must be heated. Pour cooking oil to a depth of approximately 50 mm in cooking pot and begin to warm on hot plate. Once cooking oil temperature has reached 60 degrees Celsius, stabilize oil temperature to 60 degrees +/- 5 degrees. Carefully stir oil to ensure consistent temperature throughout. Individual stirring oil **must** be wearing gloves. Use IR sensor to determine initial oil temperature.

Once oil temperature stabilizes, record temperature simultaneously with IR sensor and mercury thermometer. Record the readings on TSC form. Wait five (5) minutes and repeat this step.

Next, calculate temperature difference between IR sensor and mercury thermometer for each set of readings. If difference is less than or equal to 2 degrees Celsius for both sets, IR sensor shall be considered to be working properly at ambient air temperature. If difference for both sets is greater than 2 degrees, IR sensor shall be considered unacceptable. If difference is greater than 2 degrees for one of two sets, obtain a third set of IR sensor and mercury thermometer readings and if difference between those readings is within 2 degrees, consider IR sensor acceptable. Otherwise, consider IR sensor unacceptable (see Unacceptable Check).

Frequency of Checks and Reporting Requirements

Temperature sensor calibration checks shall be performed monthly to ensure accurate temperature data are being collected during FWD operations. In addition, these check shall be performed when FWD operator observes "suspicious" temperature readings.

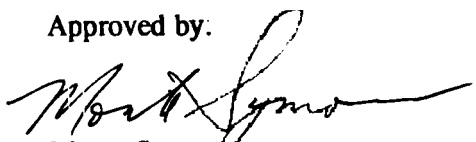
Completed Temperature Sensor Check (TSC) forms shall be kept at the RCOC offices with copies in the FWD for reference; they shall not be submitted to the FHWA LTPP Division unless a sensor is rated as "unacceptable" after completion of sensor checks. To be considered "acceptable," a sensor must pass **all** required check. A sensor is considered "unacceptable" if it fails **one or more** temperature sensor checks -- cold temperature, ambient air temperature or hot temperature.

Unacceptable Check

If a sensor is rated as "unacceptable," RCOC shall submit a FWD problem report (FWDPR) with appropriate TSC form attached. In addition, no further testing shall be conducted with the faulty sensor until it is fixed or replaced by a working sensor that passes all temperature checks. Please also refer to LTPP Directive FWD-15: Notification of Defective Sensors for FWD Testing for further reporting.

Prepared for: Antonio Nieves

Approved by:



Monte Symons
Team Leader, LTPP Operations

TSC#

LTPP TEMPERATURE SENSOR CHECK (TSC) FORM

RCO:

Date:

FWD Operator Name:

FWD SN:

Assistant's Names:

Air Temperature SN:

IR SN:

Thermometer SN:

Check Location: Office / Field

If Field, Where?

Initial Air Temp. (C)

Initial IR Temperature (C)

COLD TEMPERATURE TEST					
Step No. 4 - A	IR Sensor (C)	Mercury Therm. (C)	Diff.	P or F	Acceptable?
Reading 1					Yes
Reading 2					No
Reading 3 (if Necessary)					
Step No. 4 - B	Air Temp Sensor (C)	Mercury Therm. (C)	Diff.	P or F	Acceptable?
Reading 1					Yes
Reading 2					No
Reading 3 (if Necessary)					

AMBIENT TEMPERATURE CHECK					
Step No. 5 - A	IR Sensor (C)	Mercury Therm. (C)	Diff.	P or F	Acceptable?
Reading 1					Yes
Reading 2					No
Reading 3 (if Necessary)					
Step No. 5 - B	Air Temp Sensor (C)	Mercury Therm. (C)	Diff.	P or F	Acceptable?
Reading 1					Yes
Reading 2					No
Reading 3 (if Necessary)					

HOT TEMPERATURE CHECK - IR SENSOR ONLY					
Step No. 6	IR Sensor (C)	Mercury Therm. (C)	Diff.	P or F	Acceptable?
Reading 1					Yes
Reading 2					No
Reading 3 (if Necessary)					

Was IR sensor acceptable for all three checks? YES or NO

Was air temperature sensor acceptable for checks 1 and 2? YES or NO