RAW DATA. REFINED RESULTS.

TECHNICAL NOTES

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AST350 & VAST350 – ASPHALT STRAIN TRANSDUCERS INSTALLATION

Document Revision History

Rev	Date	Changes
A	11/23/2022	Initial release document

CONTENTS

1. INTRODUCTION

1.1 ABOUT THE AST350/VAST30 STRAIN TRANSDUCERS

Asphalt Strain Transducers (AST350/VAST350) measure axial strain in flexible pavement under high-frequency (dynamic) conditions. These low-modulus, ruggedized sensors are built to withstand the high temperature and vibratory rolled compaction required for asphalt placement.

Utilizing four active elements of a Wheatstone Bridge circuit, this gage is easily adaptable to most data acquisition systems. These transducers are made with a high-temperature resistant lead wire attached. Each sensor is individually calibrated and provided with Quality Control documentation and calibration plots.

1.2 ABOUT THIS GUIDE

This quick guide document explains the installation of the AST350 & VAST350 strain transducers. The following highlighted message blocks will appear throughout the manual and contain important information that the user should be aware of.

STOP: This symbol and corresponding message represents information regarding the device that if not followed could lead to damaging the device! Pay close attention to this message.

WARNING: This symbol and corresponding message represents vital information and is critical for the device operation and/or the operational settings/configuration.

INFORMATION: This symbol and corresponding message represents general information and/or tips on successfully operating/configuring the device.

2. AST350 & VAST350 OVERVIEW

2.1 TECHNICAL SPECIFICATIONS

Table 1: AST350 & VAST350 Specifications

MODEL	AST350-8	AST350-6	VAST350
GAGE LENGTH (HORIZONTAL)	8 in (203 mm)	6 in (152 mm)	N/A
PLATE SEPARATION (VERTICAL)	N/A	N/A	1.375-3 in (35-76 mm)
CIRCUIT	Full Wheatstone bridge with 4 active 350Ω strain gages		
EXCITATION VOLTAGE	+1.0 to +5.0 Vdc		
OUTPUT	mV level, ratiometric to Excitation Voltage		
SENSITIVITY @1,000 με	~1.3 mVout/Vexc		
POWER RATING			
MAX	300 mW		
TYPICAL	72 mW @ +5.0 Vdc		
INTELLIDUCER[1]	13 mW @ +5.0 Vdc		
STRAIN RANGE	5,000 με		
CABLE	Custom lead cable length made to order: IC-02T-125 (24 AWG, 2 pair, drain wire, Teflon insulation, and Jacket)		
TEMPERATURE RATING[2]	-50° to +300 °F (-45° to 150 °C)		

[1] Intelliducer connector required with STS Intelliducer data acquisition nodes.

[2] Temperature limit based on instrumentation cable operating temperatures, call BDI for wide temperature range cable options.

Figure 1: The AST350 Asphalt Strain Transducer

Figure 2: The VAST350 Vertical Asphalt Transducer

3. Asphalt Strain Transducer (AST350) Installation Procedure

3.1 Before the Asphalt Paving Operation

1. Determine the location(s) for the asphalt sensors installation. Record the AST350 serial numbers and the location information of each sensor. BDI's Quality Control (QC) sheet is available to manually record the location information in the field.

INFORMATION: Be sure to record the serial number and location of each AST350 strain gage. Use BDI's Quality Control Sheet to manually record the location information in the field.

2. For the sensor at the bottom of the asphalt layer, place the gage horizontally on the ground. Trench out wire paths, if needed. Lead wires will be routed from each sensor in a 2-in deep slit trench leading to the shoulder edge.

Figure 3: AST350-6, 6-inch Asphalt Strain Transducer laid out on top of the base course. Sensors are arranged in perpendicular orientation as shown. Be sure to record the serial number and location of each AST350 strain gage.

3. Prepare mastic mix, or primer, consisting of type CSS1 bitumen, or equivalent, and sand. The resulting mixture should be a thick pourable paste, like pancake batter.
4. Pour mastic into a small puddle the size of the gage area. Place the gage into the mastic mix by gently pressing the gage. Anchor the strain gage in full contact with the mix. The gages should be placed so they are flat and do not 'rock' once in position. The sensors are to be placed with the leads pointing in the direction of the first roller pass.

Figure 4: Sensors are covered with a thin layer of asphalt primer to the leveled base or subgrade surface at each location. The primer should completely cover an area 6 in x 10 in sq.

5. Read and record the output of each gage using a strain indicator readout unit. BDI's QC sheet can be used to manually record the gage readings in the field.

INFORMATION: Read and record the output of each gage using a strain indicator readout unit. Use BDI's Quality Control Sheet to manually record the gage readings in the field.

6. Fill wire trenches and near gages with sand for protection. Attempt to keep the sand off the mastic as much as possible.

Figure 5: Lead wires will be routed from each sensor in a 2-in deep slit trench leading to the shoulder edge.

7. Add a protective layer of mastic over the asphalt strain transducers. Cover the instrumentation cable with sand avoiding the mastic around the gage as much as possible.

3.2 During the Asphalt Paving Operation

1. Immediately prior to the paving train passing over the gage, obtain hot mix from the paver. Remove large aggregate particles by hand, then place approximately 2 in of the mix over and around each gage. Compact this protection layer using a hand tamper.

Figure 6: Using a hand tamper, compact or tamp the asphalt and aggregate just enough to tighten up around gage. Caution: Do not tamp too hard.

CAUTION: Do not tamp too hard. Too much force or vibration may cause damage to the AST350 transducer.

2. Pour the asphalt per usual paving operation. If not using a paving train, use a gas push tamper on the first few layers to ensure a good amount of asphalt cover. Carry out compaction of the first lift of asphalt concrete in the direction of the lead wires extending from the gage. Subsequently, any sensor movement during the first rolling pass results in compression rather than tension in the lead wire. Finish off with a drivable tamper or rolling compactor.

Figure 7: Cover with asphalt as in normal paving operation. Then compact to the desired compaction for the paving operation.

4. Vertical Asphalt Strain Transducer (VAST350) Installation Procedure

1. Determine the location(s) for VAST sensor installation. Record the output of each gage using a strain indicator readout unit. BDI's QC Sheet can be used to manually record the location information in the field.

> **INFORMATION:** Be sure to record the serial number and location of each VAST350 strain gage. Use BDI's Quality Control Sheet to manually record the location information in the field.

2. Place the gage vertically with the extended spike end installed into the base layer. Trench out wire paths, if needed. Lead wires will be routed from each sensor in a 2-inch deep slit trench leading to the shoulder edge.
3. Start to fill wire trenches with sand for protection. Attempt to the sand keep off asphalt mastic as much as possible.

Figure 8: Be sure the gage has flat ground to stand on with the spike end embedded in the base course. Fill in around the base of the gage with mastic to hold the sensor in the vertical position. Fill wire trenches with sand for protection.

4. Fill in around the base of the gage with mastic paste to hold the position.

Figure 9: Use mastic to hold gage in a vertical position.

5. Finish filling sand to protect the sensor cable and near gages. Attempt to keep sand off the mastic and gage as much as possible.

Figure 10: Finish filling sand to protect the sensor cable and near gages.

6. Remove the top disk from threads and layer asphalt around the gage leaving the top threads exposed. Tamp asphalt with a hand tamper. Caution: Do not compact too hard but just enough to tighten up around the gage.

CAUTION: Do not compact too hard but just enough to tighten up around the gage. Too much force or vibration may cause damage to the VAST350 transducer.

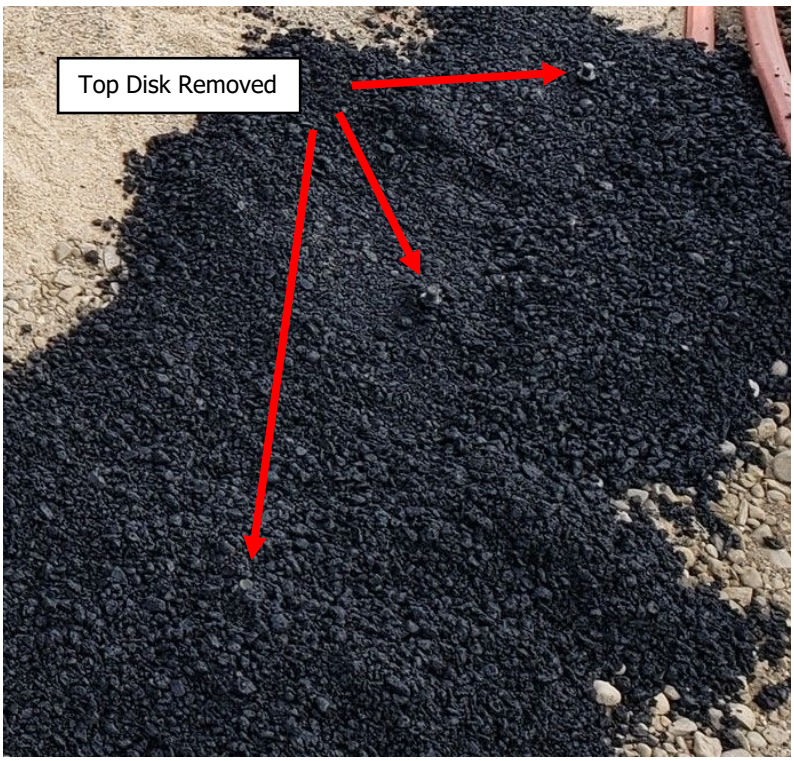


Figure 11: Exposed gage threads sticking above the asphalt.

7. Prepare mastic mix consisting of type CSS1 bitumen (or equivalent) and sand. Mix until a moldable paste consistency. Apply mastic mixture around the exposed thread to fill in under the top disk. Be careful not to get paste on threads. Note: if you have a nut that fits the thread, you can put the nut on threads while you complete these steps. The nuts on the threads will prevent threads from getting compromised with asphalt mastic. This will help clean them off when the nut is removed.
8. Replace the top disk on gage and ensure mastic is filled in well under the disk.

STOP: After replacing the top disk on gage, be sure to ensure mastic is filled in under the disk.

Figure 12: Remove the protective nut if used.
Replace the top disk on the gage.
Be certain to ensure mastic is filled in well under it.

9. Once the disk is back on cover the gage with asphalt and using your hand pat down the asphalt as a tamper.

Figure 13: With the top disk reinstalled cover the gage with asphalt again and using your hand pat down the asphalt (as a tamper).

10. Pour the asphalt per usual or if not using a paving train, then use a gas-powered push tamper on the first few layers. Continue until there is a good amount of cover. Finish off with a rolling compactor.
11. Read and record the output of each gage using a strain indicator readout unit. BDI's Quality Control sheet can be used to manually record the location information in the field.

INFORMATION: Read and record the output of each gage using a strain indicator readout unit. Use BDI's Quality Control Sheet to manually record the gage readings in the field.

Figure 14: Continue the paving operation per usual. Start with the use of a gas-powered push tamper on the first few layers until a good amount of cover. Complete the paving using a conventional rolling compactor.

5. Quality Control Sheet (Example)

BDI's Quality Control Sheet has fields for recording the required information during installation. There is a section to record the sensor location as well as the sensor readings during installation.

QUALITY CONTROL FABRICATION AND HOOK-UP SHEET

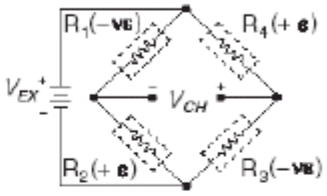
VAST350
VERTICAL ASPHALT STRAIN TRANSDUCER

Gage ID:_____

Lead Length: _____

NOTE: MANUAL READINGS TAKEN USING VISHAY P-3500. GF = 2.00 BALANCE = 500

FABRICATION



GAGE RESISTANCE :_____

INITIAL READING AFTER WIRING GAGE : _____

SHORT TO SHIELD : _____

TENSION = _____ IN READING

READING AFTER J-COAT : _____

READING AFTER ALL PROTECTION : _____
(after butyl rubber and heat shrink)

DATE : _____ WHO : _____

SHORT TO SHIELD : _____

COMMENTS: _____

COLOR	BRIDGE	P-3500
Red	V_{EX}+	P+
Black	V_{EX}-	P-
White	V_{CH}-	S-
Green	V_{CH}+	S+

CALIBRATION

EXCITATION : _____ CAL FACTOR : _____ ue/mV/V OTHER : _____

DATE : _____ WHO : _____

FINAL READING AFTER CALIBRATION AND DIPPING : _____

INSTALLATION

NOTE: MANUAL READINGS TAKEN USING VISHAY P-3500. GF = 2.00 BALANCE = 500

LOCATION : _____ X:_____ Y: _____ Z:_____

DATE : _____ READING : _____ EVENT : _____

DATE : _____ READING : _____ EVENT : _____

HOOKUP TO SYSTEM

SPU : _____ CHANNEL : _____

DATE : _____ READING : _____ EVENT : _____