Testing of TMP-13 thermocouples at the Bridgeton Landfill, LLC

TMP-13 has shown moderate to significant temperature increases at several depth intervals. The resistance check of the thermocouple wire at these intervals returned anomalously low resistance values indicating that the wires are compromised. To further substantiate the conclusion that the thermocouple wires are compromised, a forensic evaluation of these intervals was performed August 19, 2013.

The study was performed by first removing the thermocouple leads from the position switch so that each lead could be read individually without the possibility of stray voltages through the switch. A 6.6 Volt battery was used to apply a voltage across the leads of the suspect thermocouples. A Fluke 175 True RMS multimeter was used to determine if a voltage was present.

The system was tested using 3 different formats. For test series 1 the leads of the other thermocouples in the well by placing the positive lead of the voltmeter on each thermocouple wire while the negative lead of the voltmeter was attached to a grounding rod. In test #2 we connected the positive lead of the battery to both prongs of one end terminal (e.g. thermocouple line #1) and connected the negative lead of the battery to each prong of the next end terminal. Test #3 was set up very similar, except we tested each end terminal's positive and negative prong while connected to the negative lead of the battery. Results were generated for TMP-13, 7R, and 9 for tests 2 and 3 to compare a good well (7R) with two wells that were generating questionable temperature data. The results are listed in Tables 1-3.

The results from these test series indicated that there is a distinctive difference in how the “good’ well’s thermocouples (TMP-7R) responded in the voltage tests verses the two “suspect” wells (TMP-9, and -13). Based on these results it is reasonable to conclude that the thermocouples in TMP-9 and -13 are compromised and are not providing correct temperature readings.

Table 1 Test Series 1

TMP ID (and dial position)	Depth (bgs)	Typical OHM Readings	TMP-13 (7) Voltage (+)	TMP-13 (7) Voltage (-)	TMP-13 (8) Voltage (+)	TMP-13 (8) Voltage (-)
TMP-13 (1)	9	10.6	0.000	0.000	0.000	0.000
TMP-13 (2)	29	15.5	0.315	0.311	0.473	0.496
TMP-13 (3)	49	21.5	0.960	0.950	0.297	0.310
TMP-13 (4)	69	27.3	0.000	0.000	0.000	0.000
TMP-13 (5)	89	33.1	0.000	0.000	0.000	0.000
TMP-13 (6)	109	38.9	0.000	0.000	0.000	0.000
TMP-13 (7)	129	12.3	**6.650**	**6.650**	0.000	0.000
TMP-13 (8)	149	13.5	0.139	0.138	**6.630**	**6.630**
TMP-13 (9)	169	55.2	0.000	0.000	0.000	0.000
TMP-13 (10)	189	58.5	0.000	0.000	0.000	0.000

TABLE 2 Test Series 2

TMP-13 (and unit position)	Depth (bgs)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)
TMP-13 (1)	9	6.2		0		0		0		0		0		0		0		0		0	
TMP-13 (2)	29	0		6.2		5.5		0		2.3		5.9		0		6		0		6.2	
TMP-13 (3)	49	0		5.3		6.2		0		2.4		5.6		0.02		5.7		0		5.1	
TMP-13 (4)	69	0		0		0		6.2		0		0		0		0		0		0	
TMP-13 (5)	89	0		1.5		1.5		0		6.2		2.2		0		2.2		0		2.2	
TMP-13 (6)	109	0		5.8		5.4		0		2.5		6.2		0		6.2		0		5.6	
TMP-13 (7)	129	0		0		0		0		0		0		6.2		0.01		0		0	
TMP-13 (8)	149	0		5.8		5.4		0		2.3		6.1		0		6.2		0		5.6	
TMP-13 (9)	169	0		0		0		0		0		0		0		0		6.2		0.006	
TMP-13 (10)	189	0		6.2		5.3		0		2.1		6		0		6		0		6.2	

TMP-7R (and unit position)	Depth (bgs)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)
TMP-7R (1)	20	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	
TMP-7R (2)	40	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	
TMP-7R (3)	60	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	
TMP-7R (4)	80	6.2		6.2		6.2		6.1		6.2		6.3		6.3		6.3		6.3		6.3		6.3		6.3	
TMP-7R (5)	100	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	
TMP-7R (6)	120	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	
TMP-7R (7)	140	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	
TMP-7R (8)	160	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	
TMP-7R (9)	180	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	
TMP-7R (10)	200	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	
TMP-7R (11)	220	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	
TMP-7R (12)	240	6.2		6.2		6.2		6.1		6.1		6.2		6.2		6.2		6.2		6.2		6.2		6.2	

TMP-9 (and unit position)	Depth (bgs)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)
TMP-9 (1)	20	6.2		0		0		0		0	
TMP-9 (2)	40	0		6.2		0		0		0.06	
TMP-9 (3)	60	0		0		6.2		6.3		6.3	
TMP-9 (4)	80	0.04		0		6.1		6.2		6.2	
TMP-9 (5)	100	0		0		6.1		6.2		6.2	

9/17/13: Test #2 (6 volt battery connected from + to +/- end terminal (A), multimeter connected from - to +/-

Notes: TMP-13 unit position #5/#9 connection noisy (0 - 0.06).
TMP-7R and TMP-9 observed moisture and liquid inside control box. Dried end terminals before conductiong tests.

TABLE 3 Test Series 3

TMP-13 (and unit position)	Depth (bgs)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)
TMP-13 (1)	9	6.2		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TMP-13 (2)	29	0	0	6.2		5.5	5.5	0	0	2.3	2.3	5.9	5.9	0	0	6	6	0	0	6.2	6.2
TMP-13 (3)	49	0	0	5.3	5.3	6.2		0	0	2.4	2.4	5.6	5.6	0.02	0.02	5.7	5.7	0	0	5.1	5.1
TMP-13 (4)	69	0	0	0	0	0	0	6.2		0	0	0	0	0	0	0	0	0	0	0	0
TMP-13 (5)	89	0	0	1.4	1.4	1.3	1.4	0	0	6.2		2.1	2.2	0	0	2.2	2.2	0	0	2.2	2.2
TMP-13 (6)	109	0	0	5.8	5.8	5.4	5.4	0	0	2.3	2.4	6.2		0	0	6.2	6.2	0	0	5.6	5.6
TMP-13 (7)	129	0	0	0	0	0	0	0	0	0	0	0	0	6.2		0.01	0.01	0	0	0	0
TMP-13 (8)	149	0	0	5.8	5.8	5.4	5.4	0	0	2.2	2.2	6.1	6.1	0	0	6.2		0	0	5.6	5.6
TMP-13 (9)	169	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.2		0.005	0.005
TMP-13 (10)	189	0	0	6.2	6.2	5.3	5.3	0	0	2.1	2.1	6	6	0	0	6	6	0	0	6.2	

TMP-7R (and unit position)	Depth (bgs)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)
TMP-7R (1)	20	6.2		6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
TMP-7R (2)	40	6.2	6.2	6.2		6.2	6.2	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
TMP-7R (3)	60	6.2	6.2	6.2	6.2	6.2		6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
TMP-7R (4)	80	6.2	6.2	6.2	6.2	6.2	6.2	6.1		6.2	6.2	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3	6.3
TMP-7R (5)	100	6.2	6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1		6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
TMP-7R (6)	120	6.2	6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.2		6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
TMP-7R (7)	140	6.2	6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.2	6.2	6.2		6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
TMP-7R (8)	160	6.2	6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2		6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2
TMP-7R (9)	180	6.2	6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2		6.2	6.2	6.2	6.2	6.2	6.2
TMP-7R (10)	200	6.2	6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2		6.2	6.2	6.2	6.2
TMP-7R (11)	220	6.2	6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2		6.2	6.2
TMP-7R (12)	240	6.2	6.2	6.2	6.2	6.2	6.2	6.1	6.1	6.1	6.1	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	

TMP-9 (and unit position)	Depth (bgs)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)	Voltage (+)	Voltage (-)
TMP-9 (1)	20	6.2		0	0	0	0	0	0	0	0
TMP-9 (2)	40	0	0	6.2		0	0	0	0	0.08	0.04
TMP-9 (3)	60	0	0	0	0	6.2		6.3	6.3	6.3	6.3
TMP-9 (4)	80	0.03	0.02	0	0	6.1	6.1	6.2		6.2	6.2
TMP-9 (5)	100	0	0	0	0	6.1	6.1	6.2	6.2	6.2	

9/17/13: Test #3 (6 volt battery connected from + to +/- end terminal (A), multimeter connected from - to + then -