

Solar Technology
Message Sign and Arrow Panel Sight Test

Report No. DES-060304

Date of Report: June 22, 2004

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Signed: _____

	<u>Table of Contents</u>	<u>Page #</u>
1.0	Introduction	3
2.0	Test Procedure	4
3.0	Test Results	8
4.0	Summary, Conclusions & Recommendations	9
5.0	References	9
	Appendix A – Test Data Sheets	
	Addendum – Operational Performance Test Data Sheets	

1.0 Introduction

Gary Delserro, P.E. from Delserro Engineering Solutions (DES) performed a sight test on illuminated transportation Message Signs and Arrow Panels. The test was performed for Steve Bailey from Operations Resources (OR) and the sign manufacturer Solar Technologies (ST). Two arrow panels were tested: the **Silent Sentinel 25 lamp** and the **Silent Sentinel 15 lamp**. Three portable changeable message signs were tested: the **Silent Messenger MB**, the **Silent Messenger II MB2**, and the **Silent Messenger III MB3**. This report summarizes the procedure and results of that test.

2.0 Test Procedure

The test was performed on Thursday, 6/3/2004. The test was conducted using the Sight Test Section 2 of the NTPEP Project Work Plans for Flashing Arrow Panels and for Portable Changeable Message Signs as guidelines [1,2].

The following measurements were taken using the NTPEP work plans [1,2] as a guideline. All measurements were taken 25 ft from the center of signs.

- **Visibility** – Starting from a point “f” which is 4,980 feet from the front of the sign and 25 feet from the center, move towards the sign and record the distance “d” where the message or arrow mode was visible but not legible (Figure 1).
- **Legibility** - Starting from a point “f” which is 4,980 feet from the front of the sign and 25 feet from the center, move towards the sign and record the distance “d” where the message or arrow mode was legible (Figure 1).
- **Angularity** - Starting from a point “e” which is 2,640 feet from the front of the sign and 25 feet from the center, move towards the sign and record the distance “d” where the message or arrow mode was illegible (Figure 2). Calculate the angle shown in Figure 2.

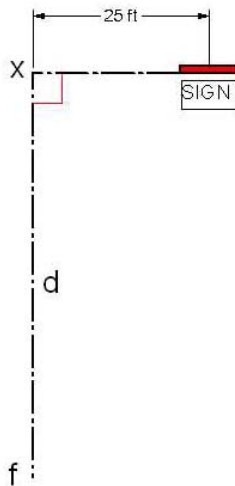


Figure 1.

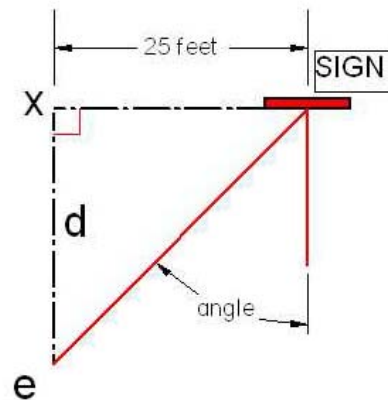


Figure 2.

In addition, the legibility angle, similar to Figure 2, was calculated using the legibility distance.

Mill Road in Allentown PA was used for the course, Figures 3A – 3C. A course of 4,950 feet was set up on Mill Road by S. Bailey (OR) and C. Owens (ST) using a transit and a measuring wheel, Figure 3C. The course was reviewed by G. Delserro, PE (DES).

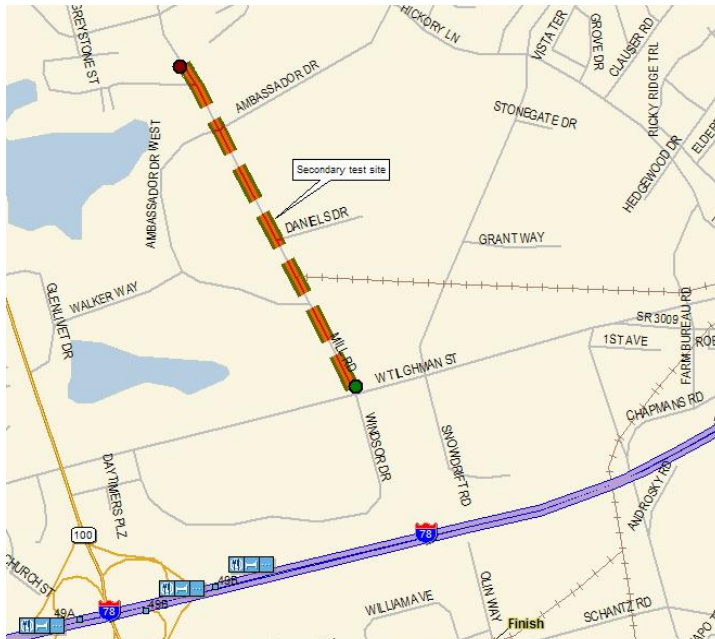


Figure 3A. Course Location

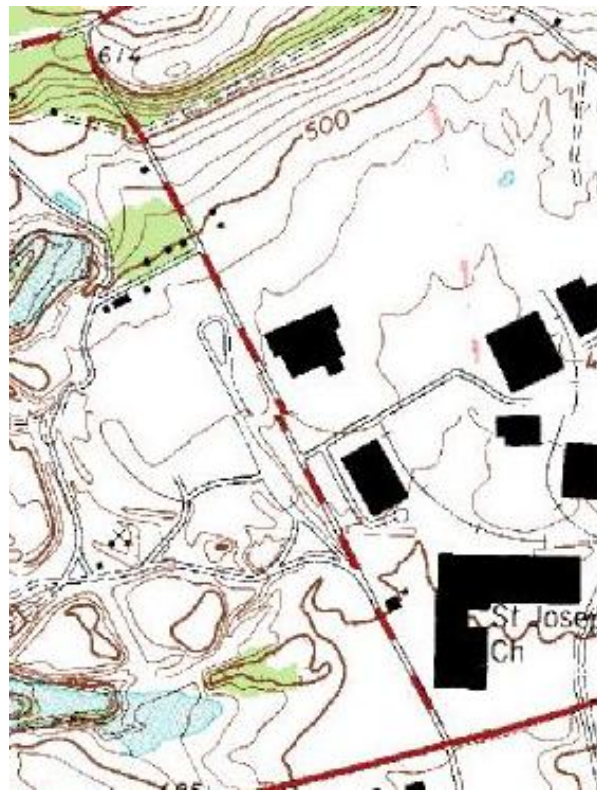


Figure 3B. Course Topology

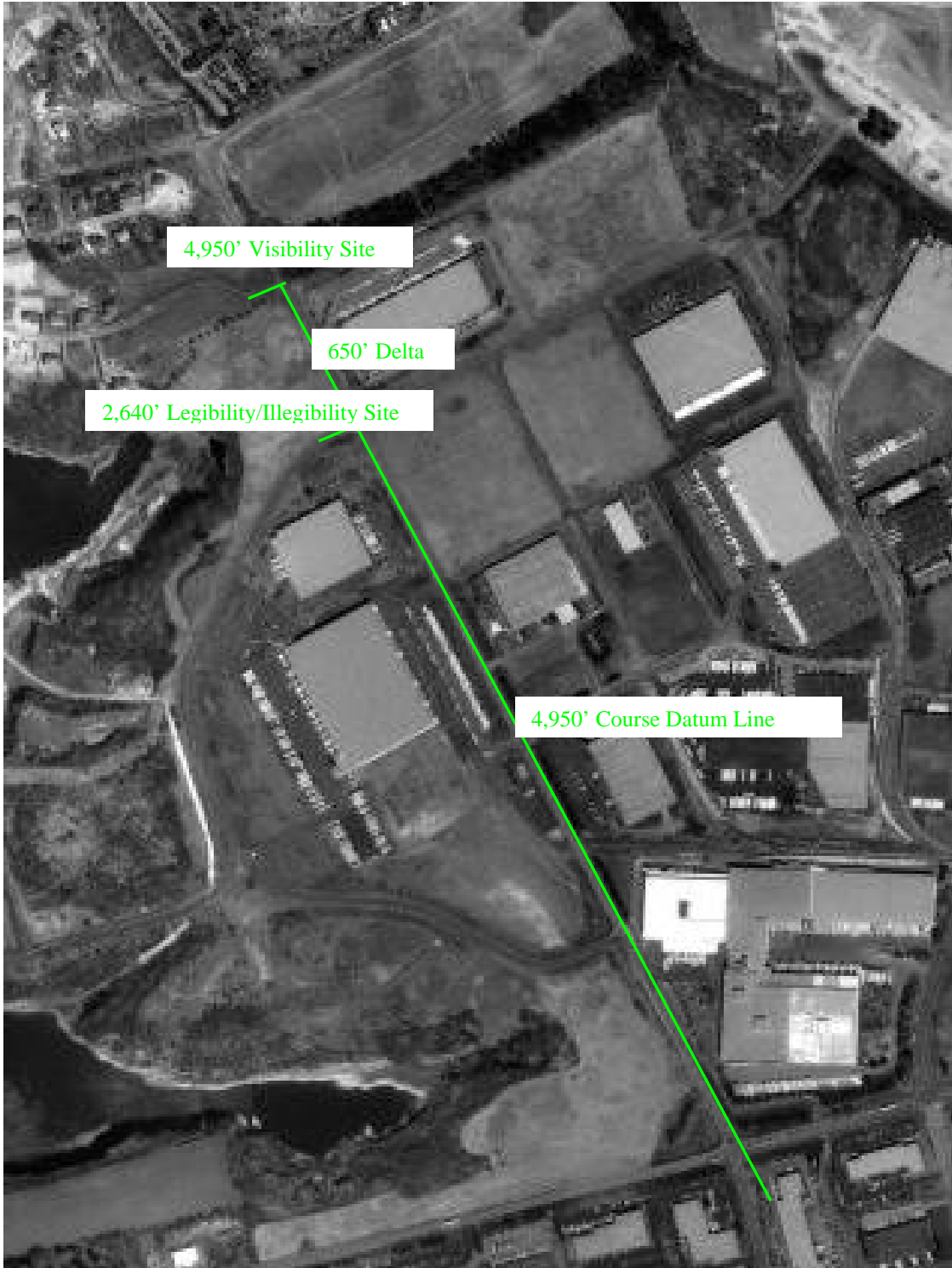


Figure 3C. Course Layout (Aerial View)

For the longer distance sight tests, a straight line of 4,950 feet was measured and surveyed from the intersection of Mill Road & Lochaven Street to the parking lot of 7150 Windsor Drive, Figures 3C and 4. The signs were positioned at the intersection of Mill Road and Lochaven Street facing south and were positioned 25 feet from the center of the road in the west direction. The sight tests were conducted while standing in the parking lot of 7150 Windsor Drive as trees blocked visibility from the sedan. The signs were aimed at the 4,950 ft mark.



Figure 4. View From Mill Road & Lochaven Street Looking South

For the shorter distance sight tests, the signs were positioned at the intersection of Mill Road & Ambassador Drive facing south and were positioned 25 feet from the center of the road in the west direction, Figure 3C. The sight tests were conducted while driving slowly in a Pontiac Grand AM Sedan. The Arrow Panels were aimed at a mark 200 feet in front of the sign along the center of the road. The Message Signs were aimed at a mark 650 feet in front of the sign along the center of the road.

The sight tests were performed by G. Delserro, PE and C. Owens (ST). The sign setup was performed by Marty Gorr (ST) and Eric Zerphy (ST).

3.0 Test Results

The sight test results are summarized in Tables 1A and 1B. Detailed test data sheets are contained in Appendix A.

Sign Model	Daytime Distance (ft) & Degrees				
	Measured Visibility Distance (ft)	Measured Legibility Distance (ft)	COMPUTED Legibility Angle (degrees)	Measured Distance to Illegibility (ft)	COMPUTED Illegibility Angle (Angularity) (degrees)
Solar Powered Portable Changeable Message Signs					
Silent Messenger MB	4,950	1,140	1.3	40.0	32.0
Silent Messenger II MB2	4,950	763	1.9	15.5	58.2
Silent Messenger III MB3	4,950	589	2.4	28.0	41.8
Solar Powered Arrow Panels					
Silent Sentinel 15 Lamp	4,950	4,950	0.3	29.2	40.6
Silent Sentinel 25 Lamp	4,950	4,950	0.3	29.8	40.0

Table 1A. Solar Tech NTPEP **Daytime** Sight Test Results Summary

Sign Model	Nighttime Distance (ft) & Degrees				
	Measured Visibility Distance (ft)	Measured Legibility Distance (ft)	COMPUTED Legibility Angle (degrees)	Measured Distance to Illegibility (ft)	COMPUTED Illegibility Angle (Angularity) (degrees)
Solar Powered Portable Changeable Message Signs					
Silent Messenger MB	4,950	1,004	1.4	6.7	75.0
Silent Messenger II MB2	4,950	690	2.1	5.3	78.0
Silent Messenger III MB3	4,950	491	2.9	8.0	72.3
Solar Powered Arrow Panels					
Silent Sentinel 15 Lamp	4,950	4,950	0.3	15.2	58.7
Silent Sentinel 25 Lamp	4,950	4,950	0.3	20.1	51.2

Table 1B. Solar Tech NTPEP **Nighttime** Sight Test Results Summary

4.0 Summary, Conclusions & Recommendations:

- The distance to Illegibility or Angularity was the most subjective of all measurements. The arrow panel displays were still legible even when only the light reflections in the shrouds were visible.
- Legibility was worst at night because of the glare from the LED intensity for all of the portable changeable message signs.

5.0 References

1. National Transportation Product Evaluation Program (NTPEP) Project Work Plan For Flashing Arrow Panels, Rev 1-9-04.
2. National Transportation Product Evaluation Program (NTPEP) Project Work Plan For Portable Changeable Message Signs, Rev 1-9-04.

APPENDIX A

Test Data Sheets

SOLAR TECH NTPEP SIGHT TEST DATA SHEET FOR SOLAR POWERED ARROW PANELS

Test Location: Mill Road - Off Route 100N & I-78 Allentown PA

Test Date: 6/3/2004

Day/Night: Day

Weather Condition: Partly Sunny, Clear

Sign Front

Facing: South

Outside Air Temp (F): 84

Sight Test Conducted By: Gary Delserro, PE / Chad Owens (SolarTech)

Course Layout By: Steve Bailey (OP Resources)

Sign Setup By: Marty Gorr & Eric Zerphy (SolarTech)

Test Equipment Description:

Pontiac Grand AM Sedan 2001 used for sight test

MeasureMark Measure Wheel used for distance measurements

Sign Information

Model: Silent Sentinel 15 Lamp

Description: Solar Powered Arrow Panel

Panel Size: 96 in. wide x 48 in. high

Height above Road Surface (ft): 7 feet

Time of Sight Test	Mode Display	Measured Visibility Distance [2] (ft)	Measured Legibility Distance [2] (ft)	COMPUTED Legibility Angle (degrees)	Measured Angularity Distance to Illegibility [3] (ft)	COMPUTED Angularity Angle (degrees)
15:35	Right Arrow	4,950	4,950	0.3	-----	-----
15:35	Left Arrow	4,950	4,950	0.3	-----	-----
15:35	2 Way Arrow	4,950	4,950	0.3	-----	-----
17:14	Right Arrow	-----	-----	-----	29.2	40.6

Comments:

- All measurements were taken 25 ft from center of sign.
- Sight tests conducted while standing in parking lot of 7150 Windsor Drive. Trees blocked visibility from sedan. Sign at intersection of Mill Road & Lochaven Street on west side. Sign was aimed at 4,950 ft mark.
- Sight tests conducted while sitting in sedan. Sign at intersection of Mill Road & Ambassador Drive on West Side. Sign was aimed at 200 ft mark.

SOLAR TECH NTPEP SIGHT TEST DATA SHEET FOR SOLAR POWERED ARROW PANELS

Test Location: Mill Road - Off Route 100N & I-78 Allentown PA

Test Date: 6/3/2004

Day/Night: **Day**

Weather Condition: Partly Sunny, Clear

Sign Front

Facing: South

Outside Air Temp (F): 84

Sight Test Conducted By: Gary Delserro, PE / Chad Owens (SolarTech)

Course Layout By: Steve Bailey (OP Resources)

Sign Setup By: Marty Gorr & Eric Zerphy (SolarTech)

Test Equipment Description:

Pontiac Grand AM Sedan 2001 used for sight test

MeasureMark Measure Wheel used for distance measurements

Sign Information

Model: **Silent Sentinel 25 Lamp**

Description: Solar Powered Arrow Panel

Panel Size: 96 in. wide x 48 in. high

Height above Road Surface (ft): 7 feet

Time of Sight Test	Mode Display	Measured Visibility Distance [2] (ft)	Measured Legibility Distance [2] (ft)	COMPUTED Legibility Angle (degrees)	Measured Angularity Distance to Illegibility [3] (ft)	COMPUTED Angularity Angle (degrees)
15:20	Right Arrow	4,950	4,950	0.3	-----	-----
15:20	Left Arrow	4,950	4,950	0.3	-----	-----
15:20	2 Way Arrow	4,950	4,950	0.3	-----	-----
17:22	Right Arrow	-----	-----	-----	29.8	40.0

Comments:

- All measurements were taken 25 ft from center of sign.
- Sight tests conducted while standing in parking lot of 7150 Windsor Drive. Trees blocked visibility from sedan. Sign at intersection of Mill Road & Lochaven Street on west side. Sign was aimed at 4,950 ft mark.
- Sight tests conducted while sitting in sedan. Sign at intersection of Mill Road & Ambassador Drive on West Side. Sign was aimed at 200 ft mark.

SOLAR TECH NTPEP SIGHT TEST DATA SHEET FOR PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)

Test Location: Mill Road - Off Route 100N & I-78 Allentown PA

Test Date: 6/3/2004

Day/Night: **Day**
Sign Front Facing: South

Weather Condition: Partly Sunny, Clear

Outside Air Temp (F): 84

Sight Test Conducted By: Gary Delserro, PE / Chad Owens (SolarTech)

Course Layout By: Steve Bailey (OP Resources)

Sign Setup By: Marty Gorr & Eric Zerphy (SolarTech)

Test Equipment Description:

Pontiac Grand AM Sedan 2001 used for sight test

MeasureMark Measure Wheel used for distance measurements

Sign Information

Model: **Silent Messenger MB**

Description: Solar Powered Portable Changeable Message Sign

Panel Size: 126 in. wide x 76 in. high

Character Height Used for Test: 18 in.

Height above Road Surface: 7 feet

Time of Sight Test	Message Content	Measured Visibility Distance [2] (ft)	Measured Legibility Distance [3] (ft)	COMPUTED Legibility Angle (degrees)	Measured Angularity Distance to Illegibility [3] (ft)	COMPUTED Angularity Angle (degrees)
15:58	Not Recorded	4,950	----	----	----	----
16:39	A S D F CAUTION VELOCITY	----	1,140	1.3	40.0	32.0

Comments:

- All measurements were taken 25 ft from center of sign.
- Sight tests conducted while standing in parking lot of 7150 Windsor Drive. Trees blocked visibility from sedan. Sign at intersection of Mill Road & Lochaven Street on west side. Sign was aimed at 4,950 ft mark.
- Sight tests conducted while sitting in sedan. Sign at intersection of Mill Road & Ambassador Drive on West Side. Sign was aimed at 650 ft mark.

SOLAR TECH NTPEP SIGHT TEST DATA SHEET FOR PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)

Test Location: Mill Road - Off Route 100N & I-78 Allentown PA

Test Date: 6/3/2004

Day/Night: Day

Weather Condition: Partly Sunny, Clear

Sign Front

Facing: South

Outside Air Temp (F): 84

Sight Test Conducted By: Gary Delserro, PE / Chad Owens (SolarTech)

Course Layout By: Steve Bailey (OP Resources)

Sign Setup By: Marty Gorr & Eric Zerphy (SolarTech)

Test Equipment Description:

Pontiac Grand AM Sedan 2001 used for sight test

MeasureMark Measure Wheel used for distance measurements

Sign Information

Model: Silent Messenger II MB2

Description: Solar Powered Portable Changeable Message Sign

Panel Size: 92 in. wide x 54 in. high

Character Height Used for Test: 12 in.

Height above Road Surface: 7 feet

Time of Sight Test	Message Content	Measured Visibility Distance [2] (ft)	Measured Legibility Distance [3] (ft)	COMPUTED Legibility Angle (degrees)	Measured Angularity Distance to Illegibility [3] (ft)	COMPUTED Angularity Angle (degrees)
15:51	Not Recorded	4,950	-----	-----	-----	-----
16:56	J K V B REGULAR PADLOCKS	----	763	1.9	15.5	58.2

Comments:

- All measurements were taken 25 ft from center of sign.
- Sight tests conducted while standing in parking lot of 7150 Windsor Drive. Trees blocked visibility from sedan. Sign at intersection of Mill Road & Lochaven Street on west side. Sign was aimed at 4,950 ft mark.
- Sight tests conducted while sitting in sedan. Sign at intersection of Mill Road & Ambassador Drive on West Side. Sign was aimed at 650 ft mark.

SOLAR TECH NTPEP SIGHT TEST DATA SHEET FOR PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)

Test Location: Mill Road - Off Route 100N & I-78 Allentown PA

Test Date: 6/3/2004

Day/Night: **Day**

Weather Condition: Partly Sunny, Clear

Sign Front

Facing: South

Outside Air Temp (F): 84

Sight Test Conducted By: Gary Delserro, PE / Chad Owens (SolarTech)

Course Layout By: Steve Bailey (OP Resources)

Sign Setup By: Marty Gorr & Eric Zerphy (SolarTech)

Test Equipment Description:

Pontiac Grand AM Sedan 2001 used for sight test

MeasureMark Measure Wheel used for distance measurements

Sign Information

Model:

Silent Messenger III MB3

Description:

Solar Powered Portable Changeable Message Sign

Panel Size:

70 in. wide x 42 in. high

Character Height Used for Test:

9 in.

Height above Road Surface:

7 feet

Time of Sight Test	Message Content	Measured Visibility Distance [2] (ft)	Measured Legibility Distance [3] (ft)	COMPUTED Legibility Angle (degrees)	Measured Angularity Distance to Illegibility [3] (ft)	COMPUTED Angularity Angle (degrees)
15:45	Not Recorded	4,950	-----	-----	-----	-----
17:07	C K H A STEPHEN SOLARTEC	----	589	2.4	28.0	41.8

Comments:

- All measurements were taken 25 ft from center of sign.
- Sight tests conducted while standing in parking lot of 7150 Windsor Drive. Trees blocked visibility from sedan. Sign at intersection of Mill Road & Lochaven Street on west side. Sign was aimed at 4,950 ft mark.
- Sight tests conducted while sitting in sedan. Sign at intersection of Mill Road & Ambassador Drive on West Side. Sign was aimed at 650 ft mark.

SOLAR TECH NTPEP SIGHT TEST DATA SHEET FOR SOLAR POWERED ARROW PANELS

Test Location: Mill Road - Off Route 100N & I-78 Allentown PA

Test Date: 6/3/2004

Day/Night: **Night**

Weather Condition: Clear

Sign Front Facing: South

Outside Air Temp (F): 74

Sight Test Conducted By: Gary Delserro, PE / Chad Owens (SolarTech)

Course Layout By: Steve Bailey (OP Resources)

Sign Setup By: Marty Gorr & Eric Zerphy (SolarTech)

Test Equipment Description:

Pontiac Grand AM Sedan 2001 used for sight test

MeasureMark Measure Wheel used for distance measurements

Sign Information

Model: **Silent Sentinel 15 Lamp**

Description: Solar Powered Arrow Panel

Panel Size: 96 in. wide x 48 in. high

Height above Road Surface (ft): 7 feet

Time of Sight Test	Mode Display	Measured Visibility Distance [2] (ft)	Measured Legibility Distance [2] (ft)	COMPUTED Legibility Angle (degrees)	Measured Angularity Distance to Illegibility [3] (ft)	COMPUTED Angularity Angle (degrees)
22:45	Right Arrow	4,950	4,950	0.3	-----	-----
22:45	Left Arrow	4,950	4,950	0.3	-----	-----
22:45	2 Way Arrow	4,950	4,950	0.3	-----	-----
21:31	Right Arrow	-----	-----	-----	15.2	58.7

Comments:

- All measurements were taken 25 ft from center of sign.
- Sight tests conducted while standing in parking lot of 7150 Windsor Drive. Trees blocked visibility from sedan. Also, power line wires interfered with sight (at night only) which made legibility more difficult than day. Sign at intersection of Mill Road & Lochaven Street on west side. Sign was aimed at 4,950 ft mark.
- Sight tests conducted while sitting in sedan. Sign at intersection of Mill Road & Ambassador Drive on West Side. Sign was aimed at 200 ft mark.

SOLAR TECH NTPEP SIGHT TEST DATA SHEET FOR SOLAR POWERED ARROW PANELS

Test Location: Mill Road - Off Route 100N & I-78 Allentown PA

Test Date: 6/3/2004

Day/Night: **Night**

Weather Condition: Clear

Sign Front Facing: South

Outside Air Temp (F): 74

Sight Test Conducted By: Gary Delserro, PE / Chad Owens (SolarTech)

Course Layout By: Steve Bailey (OP Resources)

Sign Setup By: Marty Gorr & Eric Zerphy (SolarTech)

Test Equipment Description:

Pontiac Grand AM Sedan 2001 used for sight test

MeasureMark Measure Wheel used for distance measurements

Sign Information

Model: **Silent Sentinel 25 Lamp**

Description: Solar Powered Arrow Panel

Panel Size: 96 in. wide x 48 in. high

Height above Road Surface (ft): 7 feet

Time of Sight Test	Mode Display	Measured Visibility Distance [2] (ft)	Measured Legibility Distance [2] (ft)	COMPUTED Legibility Angle (degrees)	Measured Angularity Distance to Illegibility [3] (ft)	COMPUTED Angularity Angle (degrees)
22:30	Right Arrow	4,950	4,950	0.3	-----	-----
22:30	Left Arrow	4,950	4,950	0.3	-----	-----
22:30	2 Way Arrow	4,950	4,950	0.3	-----	-----
21:30	Right Arrow	-----	-----	-----	20.1	51.2

Comments:

- All measurements were taken 25 ft from center of sign.
- Sight tests conducted while standing in parking lot of 7150 Windsor Drive. Trees blocked visibility from sedan. Also, power line wires interfered with sight (at night only) which made legibility more difficult than day. Sign at intersection of Mill Road & Lochaven Street on west side. Sign was aimed at 4,950 ft mark.
- Sight tests conducted while sitting in sedan. Sign at intersection of Mill Road & Ambassador Drive on West Side. Sign was aimed at 200 ft mark.

SOLAR TECH NTPEP SIGHT TEST DATA SHEET FOR PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)

Test Location: Mill Road - Off Route 100N & I-78 Allentown PA

Test Date: 6/3/2004

Day/Night: Night

Weather Condition: Clear

Sign Front

Facing: South

Outside Air Temp (F): 74

Sight Test Conducted By: Gary Delserro, PE / Chad Owens (SolarTech)

Course Layout By: Steve Bailey (OP Resources)

Sign Setup By: Marty Gorr & Eric Zerphy (SolarTech)

Test Equipment Description:

Pontiac Grand AM Sedan 2001 used for sight test

MeasureMark Measure Wheel used for distance measurements

Sign Information

Model: Silent Messenger MB

Description: Solar Powered Portable Changeable Message Sign

Panel Size: 126 in. wide x 76 in. high

Character Height Used for Test: 18 in.

Height above Road Surface: 7 feet

Time of Sight Test	Message Content	Measured Visibility Distance [2] (ft)	Measured Legibility Distance [3] (ft)	COMPUTED Legibility Angle (degrees)	Measured Angularity Distance to Illegibility [3] (ft)	COMPUTED Angularity Angle (degrees)
22:16	Not Recorded	4,950	----	----	-----	-----
22:05	J C B O PONTIAC FLORIDA	----	1,004	1.4	6.7	75.0

Comments:

- All measurements were taken 25 ft from center of sign.
- Sight tests conducted while standing in parking lot of 7150 Windsor Drive. Trees blocked visibility from sedan. Sign at intersection of Mill Road & Lochaven Street on west side. Sign was aimed at 4,950 ft mark.
- Sight tests conducted while sitting in sedan. Sign at intersection of Mill Road & Ambassador Drive on West Side. Sign was aimed at 650 ft mark.

SOLAR TECH NTPEP SIGHT TEST DATA SHEET FOR PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)

Test Location: Mill Road - Off Route 100N & I-78 Allentown PA

Test Date: 6/3/2004

Day/Night: Night

Weather Condition: Clear

Sign Front

Facing: South

Outside Air Temp (F): 74

Sight Test Conducted By: Gary Delserro, PE / Chad Owens (SolarTech)

Course Layout By: Steve Bailey (OP Resources)

Sign Setup By: Marty Gorr & Eric Zerphy (SolarTech)

Test Equipment Description:

Pontiac Grand AM Sedan 2001 used for sight test

MeasureMark Measure Wheel used for distance measurements

Sign Information

Model: Silent Messenger II MB2

Description: Solar Powered Portable Changeable Message Sign

Panel Size: 92 in. wide x 54 in. high

Character Height Used for Test: 12 in.

Height above Road Surface: 7 feet

Time of Sight Test	Message Content	Measured Visibility Distance [2] (ft)	Measured Legibility Distance [3] (ft)	COMPUTED Legibility Angle (degrees)	Measured Angularity Distance to Illegibility [3] (ft)	COMPUTED Angularity Angle (degrees)
22:22	Not Recorded	4,950	-----	-----	-----	-----
21:57	1 5 # P MACUNGIE LEHIGH U.	----	690	2.1	5.3	78.0

Comments:

- All measurements were taken 25 ft from center of sign.
- Sight tests conducted while standing in parking lot of 7150 Windsor Drive. Trees blocked visibility from sedan. Sign at intersection of Mill Road & Lochaven Street on west side. Sign was aimed at 4,950 ft mark.
- Sight tests conducted while sitting in sedan. Sign at intersection of Mill Road & Ambassador Drive on West Side. Sign was aimed at 650 ft mark.

SOLAR TECH NTPEP SIGHT TEST DATA SHEET FOR PORTABLE CHANGEABLE MESSAGE SIGNS (PCMS)

Test Location: Mill Road - Off Route 100N & I-78 Allentown PA

Test Date: 6/3/2004

Day/Night: Night

Weather Condition: Clear

Sign Front

Facing: South

Outside Air Temp (F): 74

Sight Test Conducted By: Gary Delserro, PE / Chad Owens (SolarTech)

Course Layout By: Steve Bailey (OP Resources)

Sign Setup By: Marty Gorr & Eric Zerphy (SolarTech)

Test Equipment Description:

Pontiac Grand AM Sedan 2001 used for sight test

MeasureMark Measure Wheel used for distance measurements

Sign Information

Model: Silent Messenger III MB3

Description: Solar Powered Portable Changeable Message Sign

Panel Size: 70 in. wide x 42 in. high

Character Height Used for Test: 9 in.

Height above Road Surface: 7 feet

Time of Sight Test	Message Content	Measured Visibility Distance [2] (ft)	Measured Legibility Distance [3] (ft)	COMPUTED Legibility Angle (degrees)	Measured Angularity Distance to Illegibility [3] (ft)	COMPUTED Angularity Angle (degrees)
22:27	Not Recorded	4,950	----	----	----	----
21:45	B K O P CORVETTE JAGUARS	----	491	2.9	8.0	72.3

Comments:

- All measurements were taken 25 ft from center of sign.
- Sight tests conducted while standing in parking lot of 7150 Windsor Drive. Trees blocked visibility from sedan. Sign at intersection of Mill Road & Lochaven Street on west side. Sign was aimed at 4,950 ft mark.
- Sight tests conducted while sitting in sedan. Sign at intersection of Mill Road & Ambassador Drive on West Side. Sign was aimed at 650 ft mark.

Report No. DES-060304 Addendum

**BATTERY ONLY (SOLAR ARRAYS DISCONNECTED)
NTPEP RUNTIME TEST DATA - STI**

Date	MB (Volts)	MB2 (Volts)	MB3 (Volts)	AB-15 (Volts)	AB-25 (Volts)
5/17/2004	12.5	12.5	12.5	12.6	12.6
5/18/2004	12.5	12.5	12.3	12.6	12.6
5/19/2004	12.4	12.5	12.2	12.5	12.5
5/20/2004	12.4	12.4	12.2	12.5	12.5
5/21/2004	12.4	12.4	12.1	12.5	12.5
5/22/2004	12.4	12.3	12.1	12.5	12.5
5/23/2004	12.4	12.3	12.0	12.5	12.5
5/24/2004	12.3	12.3	11.9	12.5	12.5
5/25/2004	12.3	12.2	11.8	12.5	12.5
5/26/2004	12.2	12.2	11.7	12.4	12.4
5/27/2004	12.2	12.1	11.6	12.4	12.4
5/28/2004	12.2	12.0	11.5	12.4	12.4
5/29/2004	12.1	12.0	11.3	12.3	12.3
5/30/2004	12.1	11.9	11.1	12.3	12.3
5/31/2004	12.1	11.9	10.9	12.3	12.3
6/1/2004	12.0	11.8	10.7	12.3	12.3
6/2/2004	11.9	11.8	(S/D)	12.3	12.3
6/3/2004	11.9	11.7		12.3	12.3
6/4/2004	11.9	11.6		12.2	12.2
6/5/2004	11.8	11.6		12.1	12.1
6/6/2004	11.8	11.5		12.1	12.1
6/7/2004	11.7	11.5		12.1	12.1
6/8/2004	11.7	11.4		12.1	12.1
6/9/2004	11.7	11.4		12.1	12.1
6/10/2004	11.6	11.4		12.1	12.1
6/11/2004	11.5	11.3		12.0	12.0
6/12/2004	11.4	11.2		12.0	12.0
6/13/2004	11.3	11.1		12.0	12.0
6/14/2004	11.2	11.0		11.9	11.9
6/15/2004	11.1	10.8		11.9	11.9
6/16/2004	TEST COMPLETE ALL UNITS SECURED				

NOTES:

1. MB displayed 3-line normal font "CAUTION CAUTION CAUTION" 50% duty cycle with 8.58 amps max & 1.6 amps min - operated for 30 days.
2. MB2 displayed 3-line normal font "CAUTION CAUTION CAUTION" 50% duty cycle with 4.85 amps max & 1.4 amps min - operated for 30 days.
3. MB3 displayed 3-line normal font "CAUTION CAUTION CAUTION" 50% duty cycle with 2.80 amps max & 0.9 amps min - operated for 15 days.
4. Both AB displayed single flashing arrow 50% duty cycle with 1.5 amps max & 0.4 amps min - operated for 30 days.
5. All units started with a full battery charge - solar arrays were disconnected - units operated outdoors in normal weather for given time period.