

**PROJECT NUMBER:** 30160 07-86256  
**PAGE:** 1 of 12  
**DATE:** June 28, 2007

662 Cromwell Avenue Telephone : (651) 645-3601  
Saint Paul, MN 55114 Toll Free : (888) 645-TEST  
USA Telefax : (651) 659-7348  
Website : www.twincitytesting.com

Investigative Chemistry Geotechnical Construction Materials  
Non Destructive Testing Failure Analysis Product Evaluation  
Metallurgical Analysis Materials Testing Welder Qualification

**TEMPERATURE PERFORMANCE TEST OF  
AKDUKT PLASTIC VS PVC DUCTING**

**Prepared for:**  
**CDC ENTREPRISES, INC.**  
**Attn: Mr. Jon Jungers**  
**13355 George Weber Drive, Suite M**  
**Rogers, MN 55374**

**Client Purchase Order Number: 6-5-07**

**Prepared By:**



Scott W. Britzius  
Project Manager  
Product Evaluation Department  
Phone: (651) 659-7307

**Reviewed By:**



Thad Harnois P.E.  
Project Engineer  
Construction Materials Department

**The test results contained in this report pertain only to the samples submitted for testing and not necessarily to all similar products.**

PROJECT NUMBER: 30160 07-86256

PAGE: 2 of 12

DATE: June 28, 2007

### **INTRODUCTION:**

This report presents the results of a controlled temperature performance comparison test conducted on two types of underground heating/AC duct pipe. The testing was requested by Mr. Jon Jungers of CDC Enterprises / AKDUCT on June 5, 2007.

The scope of work was limited to documenting the test set-up, parameters and results of a controlled temperature performance comparison test to substantiate that the self insulating nature of AKDUCT plastic duct pipe buried directly underground can perform as good as PVC duct pipe insulated as per Minnesota code. The test was conducted at the CDC Enterprises / AKDUCT facility in Riverton, MN on June 13, 2007.

### **SUMMARY OF RESULTS:**

The 10" AKDUCT with its ½" thick walls of low density self insulating nature material under the test conditions outlined in this report maintains temperatures and thermal efficiencies greater than or equivalent to 10" PVC duct insulated per Minnesota code with ASTM C518 R10 or R5 insulation.

The outlet air and exterior duct surface temperatures for the AKDUCT system achieved consistently lower and higher temperatures compared to those of the PVC system during changes from a constant state condition to a lower or higher temperature condition as a result of the thermal losses through the duct wall. Once the envelope of surrounding sand covering the top of the PVC duct increased enough to reduce the thermal loss effects the temperatures remained comparable between the two systems. Evidence to this effect is noted by the sand envelope of the PVC system measuring temperatures of 2-4 degrees above or below that for the sand surrounding the AKDUCT system.

These results appear to indicate that although the code calls for an insulated enclosure around the PVC duct, the duct itself is a poor insulator. The duct would have to be wrapped tight around with insulation sufficient enough to obtain a true R10 resistance. The code enclosure creates a containment area insulated from the surrounding environment to contain the energy readily lost through the PVC duct itself, which is a fairly conductive material. The enclosure insulation contacts the duct only for a small area on the two sides and bottom that sits on the foam leaving a substantial amount of sand on top and air pocket below inside the foam enclosure which acts as a significant heat sink that absorbs energy readily lost through the PVC duct.

See "Test Data" section for actual temperatures obtained for the cooling and heating tests.

PROJECT NUMBER: 30160 07-86256

PAGE: 3 of 12

DATE: June 28, 2007

**SAMPLE IDENTIFICATION / TEST SET-UP & PARAMETERS:**

20 foot length of AKDUCT - 10" Plastic Duct Pipe, 8.5" inside diameter and 1/2" wall thickness. The pipe was buried in common brown sand 3 to 4" deep from the top most of pipe, centered in a nominal 16" deep by 17" wide wood trough with a 4" x 12" sidewall outlet at the end of the run.

20 foot length of PVC - 10" Duct Pipe, 9.8" inside diameter and 0.2" wall thickness with a 2-1/2" x 12" sidewall outlet at the end of the run. The duct was installed in a nominal 16" deep by 17" wide wood trough, insulated with 2 inch ASTM C518 R10 extruded foam insulation, as per Minnesota code of a three sided enclosure configuration of R5 insulation on the bottom and two sides with 3" to 4" of sand/dirt covering the top to facilitate over pouring of a concrete floor (see photographs on pages 9 - 12).

The air flow to the inlets to the duct systems was supplied through 12" duct work from a furnace and the outlet air flows for the AKDUCT and PVC systems were 340 to 345 cfm and 225 to 230 cfm respectively at a static pressure of 0.13 inches of water. Air stream temperatures were measured in the center of the ducts at the beginning of the 20 foot section and at the sidewall outlets. The duct outside surface temperatures were measured 12" back from the outlets on the top centerline. The sand temperatures were measured 2 inches deep in the sand at locations of 1inch (7-1/2" from centerline) for the cold test & 3 inches (4" from centerline) from the wood trough wall for the heating test on the AKDUCT and 1 inch from the foam insulation (3 inches from the wood trough wall and 4" from centerline) on the PVC duct.

The performance testing was divided into two scenarios; one during a cool-down mode to simulate an air-conditioning (A/C) environment, and a second for a heating environment simulation.

**TEST VERIFICATION EQUIPMENT:**

Alnor Digital Micromanometer, Stork-TCT# MM140-037, calibrated traceable to the NIST on 10-25-06, due 10-25-07.

Extech CFM Thermo-Anemometer, Model 407113, S/N Q266780, Stork-TCT# MM162-006 calibrated traceable to the NIST on 2-12-07, due 2-12-08.

Fluke Digital Thermometer, Model 52II, S/N 85980117, calibrated traceable to the NIST on 8-22-06, due 8-22-07.

**PROJECT NUMBER:** 30160 07-86256

**PAGE:** 4 of 12

**DATE:** June 28, 2007

**TEST DATA**

**COOLING TEST**

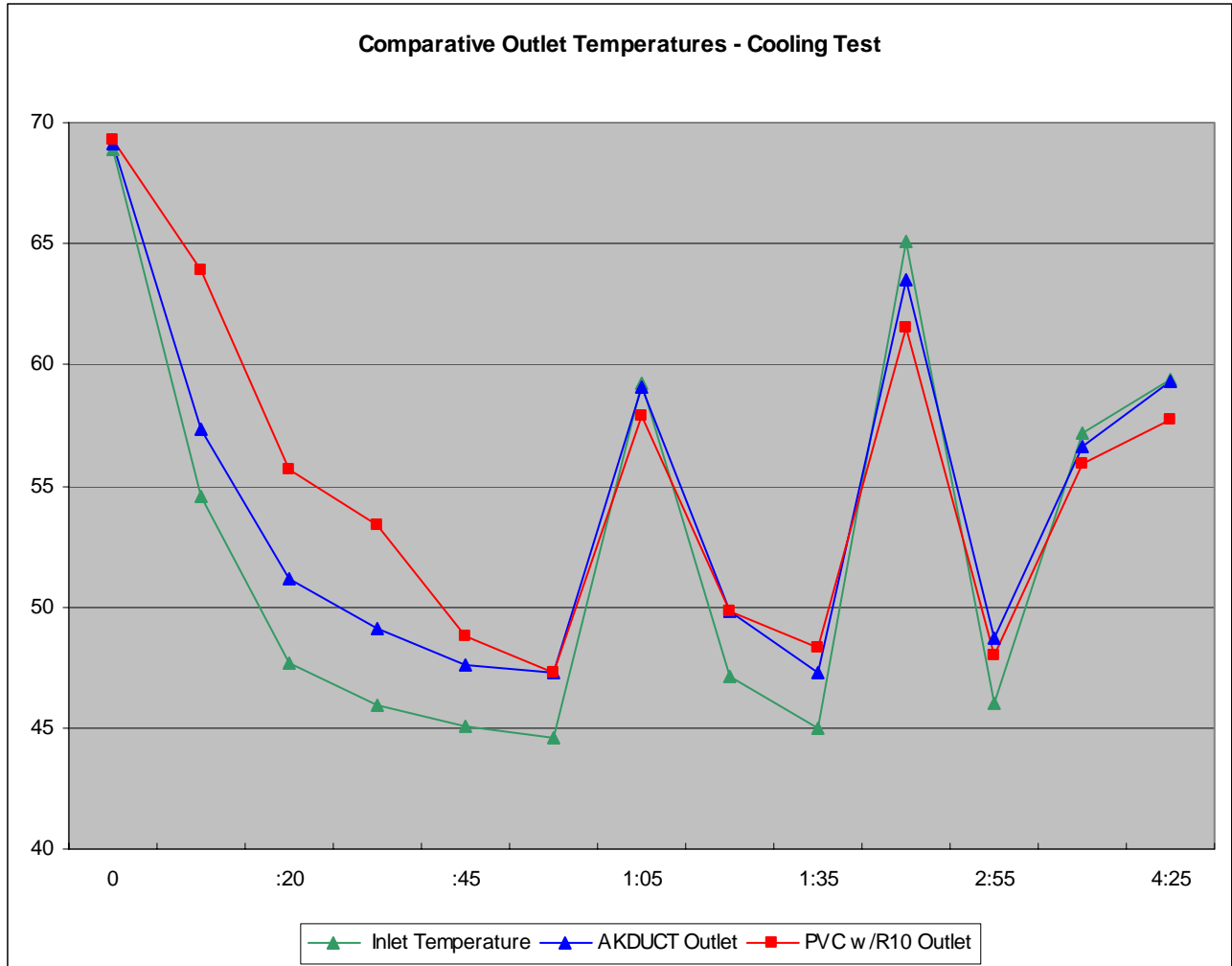
<u>Elapse Time, min.</u>	<b>AKDUCT</b>		<b>PVC/R10</b>		
	<u>Inlet air temp, °F</u>	<u>Outlet air temp, °F</u>	<u>Inlet air temp, °F</u>	<u>Outlet air temp, °F</u>	
0	68.9	69.1	68.9	69.3	
:5	54.6	57.3	55.9	63.9	
:20	47.7	51.2	55.5	55.7	
:35	45.9	49.1	46.2	53.4	
:45	45.1	47.6	45.5	48.8	
:55	44.6	47.3	45.0	47.3	A/C Off @ 0:56
1:05	59.2	59.1	59.2	57.9	A/C On @ 1:10
1:15	47.1	49.8	47.5	49.8	
1:35	45.0	47.3	45.1	48.3	A/C Off @ 1:45
1:55	65.1	63.5	65.1	61.5	
2:55	46.0	48.7	46.6	48.0	
3:05	57.2	56.6	57.4	55.9	
4:25	59.4	59.3	59.5	57.7	

<u>Elapse Time, min.</u>	<b>AKDUCT</b>		<b>PVC/R10</b>		
	<u>Duct surface temp, °F</u>	<u>Sand @ 7-1/2" temp, °F</u>	<u>Duct surface temp, °F</u>	<u>Sand @ 4" temp, °F</u>	
0	69.1	69.3	69.3	69.1	
:5	69.2	69.0	69.1	69.0	
:20	68.4	68.9	66.4	68.5	
:35	67.3	68.7	64.6	67.6	
:45	66.4	68.7	63.3	67.2	
:55	65.8	68.5	62.4	66.2	A/C Off @ 0:56
1:05	65.3	68.4	62.8	66.0	A/C On @ 1:10
1:15	65.5	68.2	62.8	65.4	
1:35	64.8	67.8	61.3	64.9	A/C Off @ 1:45
1:55	64.2	67.5	62.2	64.5	
2:55	66.9	68.9	63.3	63.1	
3:05	64.8	68.5 (65.2)	62.2	62.7	(TC added @ 4")
4:25	62.2	67.6 (64.5)	61.3	61.7	

Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

**TEST DATA** (cont')

**COOLING TEST**



Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

PROJECT NUMBER: 30160 07-86256

PAGE: 6 of 12

DATE: June 28, 2007

**TEST DATA** (cont')**HEATING TEST**

Elapse Time, min.	AKDUCT		PVC/R10		
	Inlet air temp, °F	Outlet air temp, °F	Inlet air temp, °F	Outlet air temp, °F	
0	59.4	59.3	59.5	57.7	room stat set 75°F
:10	97.9	93.0	97.0	84.9	
:20	107.6	102.0	107.2	94.8	
:25	110.1	102.7	109.9	98.4	
:30	111.0	105.6	110.8	100.2	
:35	111.7	105.8	111.6	102.0	
:45	112.5	106.3	112.3	102.2	
:50	112.8	107.0	112.8	102.0	
:55	113.4	108.1	113.2	102.5	
1:00	114.4	108.6	114.3	103.1	
1:05	107.6	103.8	107.1	100.2	Fan Off 1:06
1:10	91.4	81.1	86.5	77.3	
1:15	104.2	96.6	102.9	94.8	Fan On 1:13
1:17	111.2	102.9	110.8	102.0	
1:20	113.4	106.5	113.2	102.9	
1:25	113.5	107.6	113.5	105.6	
1:30	114.1	108.3	114.1	105.6	
1:32	99.5	98.4	100.4	91.5	Fan Off 1:31
1:35	94.3	84.0	91.0	84.0	
1:43	109.4	102.2	109.2	100.2	Fan On 1:40
1:47	112.1	105.6	112.1	102.3	
1:50	103.4	107.4	113.4	102.9	
1:54	99.3	98.4	100.6	91.9	Fan Off 1:53
2:00	90.1	79.5	89.1	79.5	

**PROJECT NUMBER:** 30160 07-86256

**PAGE:** 7 of 12

**DATE:** June 28, 2007

**TEST DATA** (cont')

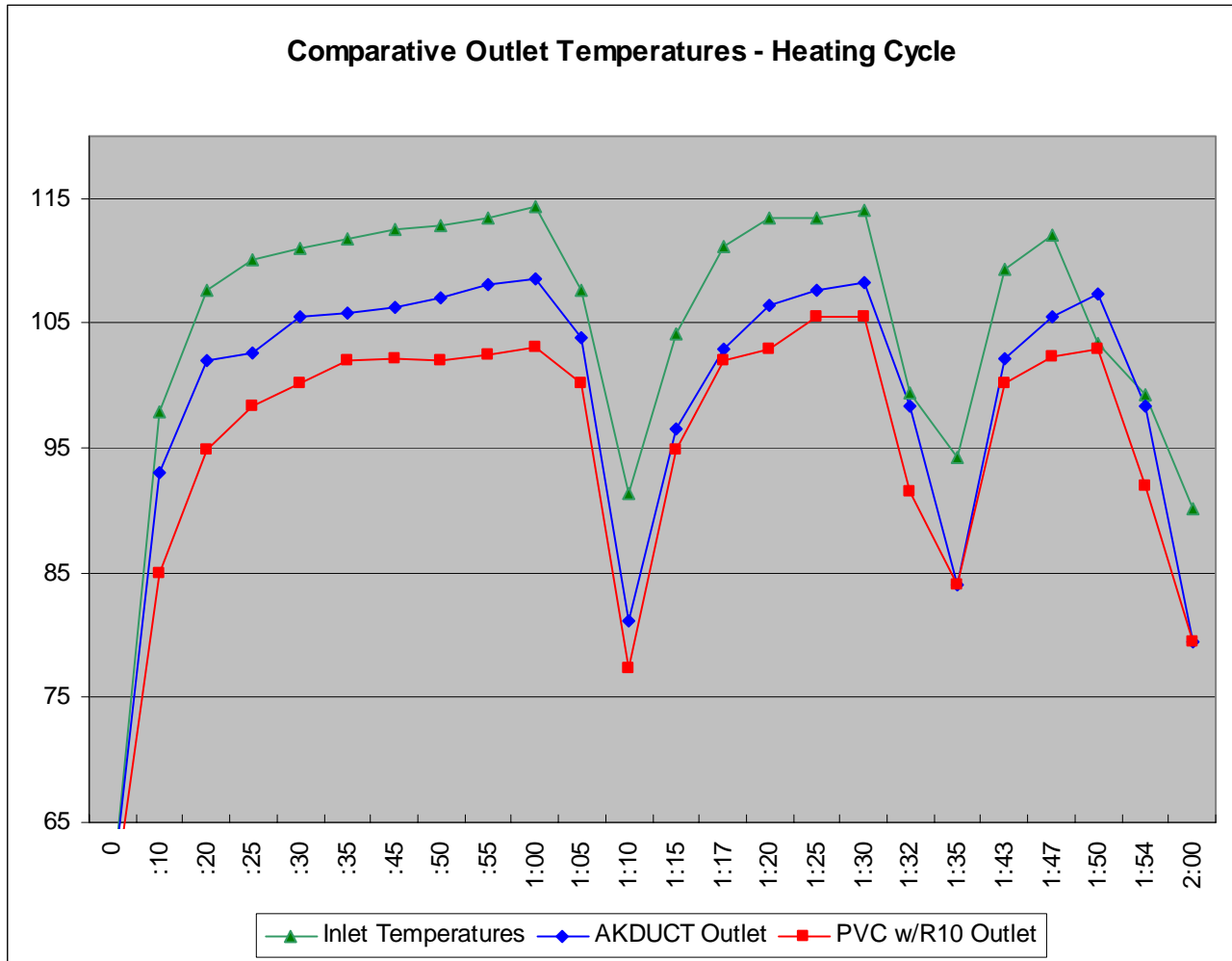
**HEATING TEST**

Elapse Time, min.	AKDUCT		PVC/R10			
	Duct surface temp, °F	Sand, temp, °F @ 7-1/2"	Sand, temp, °F @ 4'	Duct surface temp, °F		Sand temp, °F @ 4"
0	62.2	67.6	64.6	61.3	61.7	
:10	63.1	67.5	64.4	64.0	69.0	
:20	65.8	67.5	64.4	68.2	68.5	
:25	68.2	67.5	64.5	71.1	67.6	
:30	69.4	67.6	64.7	72.7	67.2	
:35	71.1	67.6	65.1	75.0	66.2	
:45	73.0	67.8	65.7	77.5	66.0	
:50	74.1	68.0	66.1	78.8	65.4	
:55	75.2	68.2	66.5	80.1	64.9	
1:00	76.1	68.4	67.0	81.7	64.5	
1:05	77.0	68.5	67.4	83.2	63.1	Fan Off 1:06
1:10	77.5	68.7	67.9	81.5	92.7	
1:15	77.4	68.9	68.3	81.1	61.7	Fan On 1:13
1:17	77.4	68.9	68.5	81.5	71.7	
1:20	77.5	69.3	68.7	82.2	72.1	
1:25	78.4	69.4	69.1	83.1	72.8	
1:30	79.2	69.6	69.5	83.0	73.4	
1:32	79.5	69.6	69.7	84.0	73.7	Fan Off 1:31
1:35	79.7	69.8	69.9	38.7	74.1	
1:43	79.5	70.2	70.5	82.9	75.3	Fan On 1:40
1:47	79.5	70.3	70.7	83.7	75.7	
1:50	80.1	70.5	71.0	84.4	76.1	
1:54	80.6	70.7	71.2	84.6	76.2	Fan Off 1:53
2:00	80.8	70.9	71.6	83.8	77.1	

Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

**TEST DATA** (cont')

**HEATING TEST**



Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

**PROJECT NUMBER:** 30160 07-86256**PAGE:** 9 of 12**DATE:** June 28, 2007Photographs of Test Set-up

AKDUCT System

PVC / R10 System



Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

Stork Twin City Testing is an operating unit of Stork Materials Technology B.V., Amsterdam, The Netherlands, which is a member of the Stork group

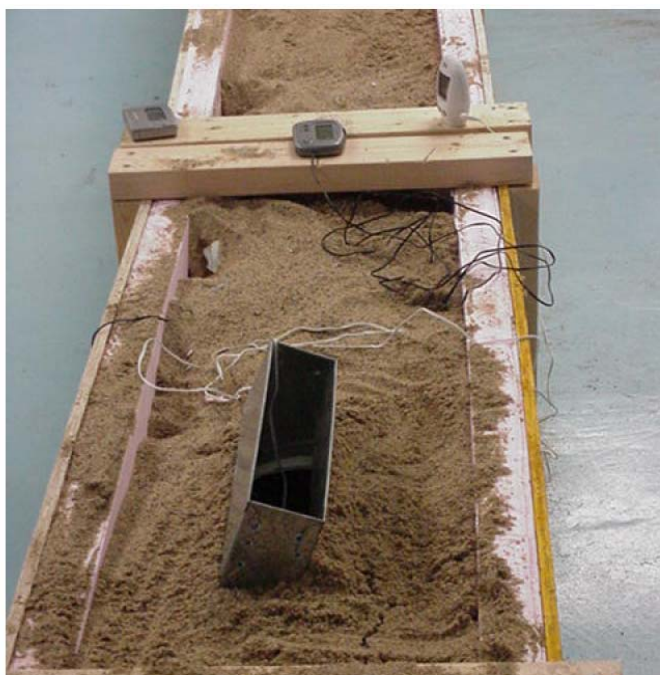
**Furnace Supply to Test Systems**

Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

AKDUCT outlet area

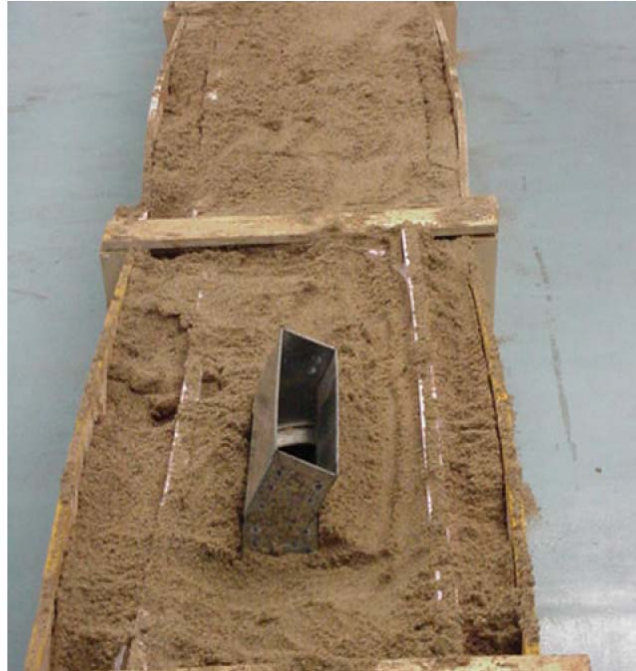


PVC / R10 outlet area



**PROJECT NUMBER:** 30160 07-86256**PAGE:** 12 of 12**DATE:** June 28, 2007

## Typical Minnesota Code R5 installation



G:\MM\MMFILES\SWB\07FILES\REPORTS\ AK DuctCDC-86256

Information and statements in this report are derived from material, information and/or specifications furnished by the client and exclude any expressed or implied warranties as to the fitness of the material tested or analyzed for any particular purpose or use. This report is the confidential property of our client and may not be used for advertising purposes. This report shall not be reproduced except in full, without written approval of this laboratory. The recording of false, fictitious or fraudulent statements or entries on this document may be punished as a felony under Federal Statutes including Federal Law Title 18, Chapter 47

Stork Twin City Testing is an operating unit of Stork Materials Technology B.V., Amsterdam, The Netherlands, which is a member of the Stork group