



Protection is a concrete idea.



# REPORT

## A THERMAL AND STRUCTURAL COMPARISON BETWEEN THE HI-R<sup>®</sup> MASONRY WALL SYSTEM ( HI-R ) AND THE NRG INSULATED BLOCK SYSTEM ( NRG )

ADDENDUM ADDED: 1 FEBRUARY 2014

COMMONWEALTH OF MASSACHUSETTS  
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 10 November 2010

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Member of NCMA and EPSMA



## **ADDENDUM**

### **ADDENDUM TO DOCUMENT: HI-R VS. NRG**

WE HAVE BEEN ADVISED BY NRG THAT FLEXURAL TESTING WAS DONE

AND IS AVAILABLE ON THEIR WEBSITE

[www.energyefficientblock.com](http://www.energyefficientblock.com)

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### **APPENDIX**

- Exhibit “A” Description of the Hi-R System**
- Exhibit “B” Description of the NRG System**
- Exhibit “C” National Concrete Masonry Association Letter Covering the NRG System**
- Exhibit “D” Holometrix Lab Report Covering the NRG System**

## **INTRODUCTION**

The Hi-R Masonry Wall System was developed and introduced to the market in 1978.

The NRG System was introduced in the late 1980's.

Both Systems are promoted to the industry as products improving the thermal integrity of masonry with no impact on the structural capabilities of the masonry.

This report covers published data for both Systems, with a "Discussion of Results" Section as well as a "Conclusion" Section, covering the findings of this report.

## **THERMAL COMPARISON**

The Hi-R Masonry Wall System has published data regarding thermal efficiency listed on Page 4 of this report. Further substantiation is published in the Technical Library Section of the Concrete Block Insulating Systems, Inc. Company website, [www.cbisinc.com](http://www.cbisinc.com), pdf File No. 316 entitled, "Development of Hi-R Block Thermal Values".

The NRG System has published data on thermal efficiency listed on Pages 5 and 6 of this report. The writer was unable to find additional thermal substantiation published by NRG.

## Thermal Properties:<sup>A</sup>

Preinsulated Hi-R Masonry Units. U-values are based on conventional 3/8" Mortar Joint Construction, U-value units are Btu/hr/sqft/degF

8 Inch wide Hi-R Wall System						
DENSITY OF BLOCK—LBS/FT <sup>3</sup>	Wall Type 1* R <sub>t</sub> U		Wall Type 2** R <sub>t</sub> U		Wall Type 3*** R <sub>t</sub> U	
80	12.21	0.082	13.61	0.074	15.04	0.067
100	10.27	0.097	11.67	0.086	13.10	0.076
120	8.50	0.118	9.90	0.101	11.33	0.088

10 Inch wide Hi-R Wall System						
DENSITY OF BLOCK—LBS/FT <sup>3</sup>	Wall Type 1* R <sub>t</sub> U		Wall Type 2** R <sub>t</sub> U		Wall Type 3*** R <sub>t</sub> U	
80	13.92	0.072	15.32	0.065	16.75	0.060
100	11.87	0.084	13.27	0.075	14.70	0.068
120	9.95	0.100	11.35	0.088	12.78	0.078

12 Inch wide Hi-R Wall System						
DENSITY OF BLOCK—LBS/FT <sup>3</sup>	Wall Type 1* R <sub>t</sub> U		Wall Type 2** R <sub>t</sub> U		Wall Type 3*** R <sub>t</sub> U	
80	14.56	0.069	15.96	0.063	17.39	0.058
100	12.48	0.080	13.88	0.072	15.31	0.065
120	10.50	0.095	11.90	0.084	13.33	0.075

12 inch Cavity Wall, 4 inch Dense Outer Wythe, 3/4 inch Air Space, 8 inch wide Hi-R Unit						
DENSITY OF BLOCK—LBS/FT <sup>3</sup>	Wall Type 1* R <sub>t</sub> U		Wall Type 2** R <sub>t</sub> U		Wall Type 3*** R <sub>t</sub> U	
80	13.62	0.073	15.02	0.067	16.45	0.061
100	11.68	0.086	13.08	0.077	14.51	0.069
120	9.91	0.101	11.31	0.088	12.74	0.079

\* Hi-R Wall System only.

\*\* Hi-R Wall System, 1/2 inch gypsum board on furring strips.

\*\*\* Hi-R Wall System, 1/2 inch foil-backed gypsum board on furring strips.

<sup>A</sup> A third party thermal analysis was completed making use of the Hot Box Test Data from three accredited laboratory services. A complete Engineering Report dated November 20, 1996, including Addendum Added Nov. 1, 2002, is available upon request. It covers the thermal values of the Hi-R Masonry Wall Systems.

### Availability and Cost

**Availability:** The **Hi-R Masonry Wall System** is manufactured under protection of a United States Patent. It is sold only to concrete block manufacturers. Contact a CBIS/KORFIL representative for order and delivery information. The **Hi-R Masonry Wall System** is nonproprietary.

**Cost:** Specific price information is available only through local block manufacturers.

**Warranty:** **Hi-R Inserts** are warranted to meet published specifications at the time of delivery. For further information, contact a CBIS/KORFIL representative.

**Maintenance:** No maintenance is necessary.

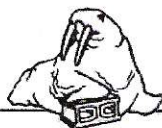
**Technical Services:** Support is provided by full-time, technically-trained CBIS/KORFIL sales representatives and technical service personnel, backed by a central research and development department and technical service staff.

For further information, contact CBIS/KORFIL, Inc.

**Hi-R** is a registered trademark of CONCRETE BLOCK INSULATING SYSTEMS, INC.

We hope the information given here will be helpful. It is based on data and knowledge considered to be true and accurate and is offered for the user's consideration, investigation and verification. Nothing contained herein constitutes a representation but we do not warrant the results to be obtained. Please read all statements, recommendations or suggestions in conjunction with our Conditions of Sale which apply to all goods supplied by us. No statement, recommendation or suggestion is intended for any use which would infringe any patent or copyright.

**CBIS**  
**Korfil**



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Member of NCMA, SPI and EPSMA

Block Size	Density (pcf)			
	95	105	115	125
8"	14.9	14.6	14.5	14.3
10"	18.7	18.4	18.2	17.9
12"	24.2	23.8	23.5	23.3

The calculation method used to arrive at the table values was the Series-Parallel Method (i.e. Isothermal Planes Method), as recommended by the National Concrete Masonry Association (NCMA) and mandated by the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 90.1-1989 and the United States Department of Energy.

## R-Value Comparisons for Filled Blocks

8" Inch (100 pcf)	No Insulation	Vermiculite Fill	EPS Fill	In-Core Inserts	Foam-In Place	NRG BLOCK
Outside Surface Film (15mph Wind)	0.17	0.17	0.17	0.17	0.17	0.17
Block	1.75	1.75	1.75	1.75	1.75	1.80
Insulation	0.00	3.10	4.00	3.76	6.00	12.95
Inside Surface Film (Still Air)	0.68	0.68	0.68	0.68	0.68	0.68
<b>Total Resistance (R)</b>	<b>2.60</b>	<b>5.70</b>	<b>6.60</b>	<b>6.36</b>	<b>8.60</b>	<b>15.60</b>

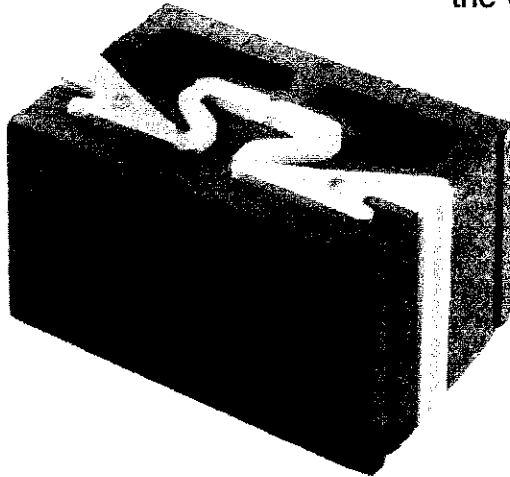
10" Inch (100 pcf)	No Insulation	Vermiculite Fill	EPS Fill	In-Core Inserts	Foam-In Place	NRG BLOCK
Outside Surface Film (15mph Wind)	0.17	0.17	0.17	0.17	0.17	0.17
Block	1.97	1.97	1.97	1.97	1.97	2.03
Insulation	0.00	3.10	4.00	3.76	6.00	16.52
Inside Surface Film (Still Air)	0.68	0.68	0.68	0.68	0.68	0.68
<b>Total Resistance (R)</b>	<b>2.82</b>	<b>5.92</b>	<b>6.82</b>	<b>6.58</b>	<b>8.82</b>	<b>19.40</b>

12" Inch (100 pcf)	No Insulation	Vermiculite Fill	EPS Fill	In-Core Inserts	Foam-In Place	NRG BLOCK
Outside Surface Film (15mph Wind)	0.17	0.17	0.17	0.17	0.17	0.17
Block	2.14	2.14	2.14	2.14	2.14	2.20
Insulation	0.00	3.10	4.00	3.76	6.00	21.80
Inside Surface Film (Still Air)	0.68	0.68	0.68	0.68	0.68	0.68
<b>Total Resistance (R)</b>	<b>2.99</b>	<b>6.09</b>	<b>6.99</b>	<b>6.75</b>	<b>8.99</b>	<b>24.85</b>



**PRODUCT DESCRIPTION:**

All other insulated building blocks simply have insulation added to their standard shape. Only the NRG™ ICMU has been *specifically designed to insulate* while retaining as much strength as a common block. Its unique construction allows it to take advantage of insulated thermal mass, which modulates all temperature fluctuations within the building. The expanded polystyrene insulation extends slightly above and to the sides of the block so when the wall is layed up the insulation forms a continuous barrier between the inside and the outside of the wall. There are **NO** webs to conduct heat, cold, noise or moisture from one side of the wall to the other.



TEST RESULTS	
<b>10" CMU ASTM C 90-85</b>	
Compression strength:	
Light wt (CMU 40 lbs) psi average (28 days) .....	2530
Net area sq in average .....	82.33
Total load average .....	208,800
Absorbion lbs/cu. ft .....	11.9
Equivalent thickness .....	5.2
Fire rating .....	4 hours
<b>8" Wall System ASTM (conducted on normal weigh CMU)</b>	
Fire hose stream (non-load bearing) .....	2.04 hrs
Wall flexure (3x avg.) .....	43.3 psf
Flexural (3 walls avg. load) .....	125 mph
Wall compression (3x 1/6 avg.) .....	460 psi
447 Prism compression (9 pr avg.) .....	930 psi
519-81 Diagonal tension (shear) .....	48.0 kips

**COST COMPARISONS:**

When you factor in the cost per square foot per R value and the labor, material and construction savings gained by eliminating scaffolding, interior walls, secondary insulation, exterior facades and painting, it's clear that the NRG™ ICMU offers solid savings every time!

PRE-INSULATED		
	NRG™ ICMU	Common Block
Description:	12"	12"
Insulation:	Pre-ins EPS	ICON
R value	24.00	6.62
Cost/sq. ft.	\$6.25	\$5.91
Cost/sq. ft./R	\$0.26	\$0.89
<i>NRG™ ICMU offers 3.63 times more R value at 29% of the price.</i>		

POUR-IN INSULATION		
	NRG™ ICMU	Common Block
Description:	12"	12"
Insulation:	Pre-ins EPS	Pour-in
R value	24.00	7.86
Cost/sq. ft.	\$6.25	\$7.86
Cost/sq. ft./R	\$0.26	\$1.00
<i>NRG™ ICMU offers 3.0 times more R value at 26% of the price.</i>		

BATT INSULATION		
	NRG™ ICMU	Struct steel 6" steel studs
Description:	12"	Brick
		\$275/m
Insulation:	Pre-ins.	3.5" Batt
R value	24	12.90
Cost/sq. ft.	\$16.00	\$17.05
Cost/sq. ft./R	\$0.67	\$1.32
<i>NRG™ ICMU offers 1.9 times more R value at 51% of the price, eliminates storage and additional handling. Downgrade interior paint for even greater savings.</i>		

RIGID INSULATION (Ext. Polystyrene)		
	NRG™ ICMU	Common Block
Description:	10" Split face	10" Split face
Insulation:	Pre-ins.	2" Ext. Poly
R value	24.40	13.80
Cost/sq. ft.	\$9.74	\$9.85
Cost/sq. ft./R	\$0.40	\$0.71
<i>NRG™ ICMU offers 1.8 times more R value at 56% of the price. Downgrading interior finish to paint only reduces cost/sq. ft./R to \$0.34</i>		

RIGID INSULATION (Ext. Polystyrene)		
	NRG™ ICMU	Struct steel 6" steel studs
Description:	12"	5/8" drywall
	split face	& stucco
Insulation:	Pre-ins.	2" Ext. Poly
R value	24.00	11.70
Cost/sq. ft.	\$8.37	\$13.56
Cost/sq. ft./R	\$0.35	\$1.16
<i>NRG™ ICMU offers 2.1 times more R value at 30% of the price, eliminates storage and additional handling. Downgrade interior paint for even greater savings.</i>		



Exclusive Marketers of the NRG™ ICMU throughout New England

24 Honek Street, Milford, CT 06460  
 Toll Free: 800-308-4297  
 Phone: 203-878-3564  
 Fax: 203-876-8038



## STRUCTURAL

The Hi-R Masonry Wall System has been tested in detail by the National Concrete Masonry Association (NCMA) Laboratories in Herndon, Virginia. This test information is listed in the Technical Library Section of our website, [www.cbisinc.com](http://www.cbisinc.com) pdf File No. 310 (71 pages), entitled "Research Investigation of the Structural Properties of Korfil Hi-R Concrete Masonry". A copy of Page 63 of this report covering design recommendations is included as Page 8 in this report.

The writer has been unable to find any information relative to the structural testing of the NRG System.

## 5.6 Design Recommendations

Korfil Hi-R Masonry is recommended to be designed in accordance with conventional masonry design provisions except as modified by this section. For those jurisdictions governed by the Uniform Building Code, pre-insulated Korfil Hi-R masonry should be designed in accordance with UBC Chapter 24 except:

- (1) The allowable shear stresses permitted by UBC Section 2406(c)6.A. and Section 2406(c)6.B. shall be reduced by 10% for fully grouted walls.
- (2) The allowable shear stresses permitted by UBC Section 2406(c)6.A. and Section 2406(c)6.B. shall be reduced by 20% for nongrouted or partially grouted walls.

## DISCUSSION OF RESULTS – STRUCTURAL

One of the most significant structural tests performed on masonry units with internal insulation inserts is the ASTM E-72 Flexural Test in Vertical Span. This test primarily confirms the bond between the masonry unit and the mortar itself.

During the design phase of the Hi-R System, it was found the height of the insert, [which originally measured a full eight (8) inches], caused the insert to hold up the block directly above it when walls were constructed. As the walls were mortared, the inserts prevented the mortar from curing under compression.

It was found during ASTM E-72 Testing, the bond between mortar and blocks did not take place, causing wall failure. The conclusion reached was – unless compression takes place between the block and mortar, the mortar may shrink away from the block during curing.

A re-design of the face of the block and a reduction in the height of the Hi-R insert eliminated the failures.

The design of any insulation product extending above the block by as much as 3/8 inch could, in fact, cause walls to fail in flexure.

Based on the analysis of the NRG Block, it appears their insulation insert does extend significantly above the top face of the block which could in fact cause the same failure situation the Hi-R System detected in its design phase. Another key factor that can cause added failure in the flexural mode is when wall reinforcing such as Dura-Wall is placed on top of the insert, which in effect could add an additional approximate 1/8 inch height to the combination height of the insert and wall reinforcing.

I have seen no test data by NRG to verify structural integrity with their system.

## **DISCUSSION OF RESULTS – THERMAL**

The published values for the thermal efficiency of the Hi-R fall in a range of  $R_T = 8.50$  to 13.62, depending on block width and density.

Published data for the NRG System ranges from  $R_T = 14.3$  to 23.3, again depending on block width and density. Additional research found documents with other results from NCMA and Holometrix Products Test Labs, showing lower  $R_T$  value numbers. Both of these reports are included in the Appendix of this report. They reference the product, Thermo Block and ThermaLock, the original names of the NRG block.

## CONCLUSION

The sole purpose of this report was to draw a comparison between the Hi-R System and the NRG System.

Based on the published data by each company, along with other information researched, it is the writer's conclusion the Hi-R System has sufficient data to justify their Thermal Values, while the published Thermal Values of NRG could not be verified. Challenges to the NRG values are listed in the Appendix of this report and are the basis of the writer's conclusion.

Regarding the structural comparison, the Hi-R System has verifiable test data from NCMA to show the Structural Values of Hi-R are equivalent to standard masonry. There is no available data to reach this same conclusion for NRG.

It is the writer's conclusion the eight (8) inch height of the NRG insert, along with conventional wall wire reinforcing could, in fact, cause the wall to fail in the Flexure Mode (ASTM E-72). This conclusion is based on the results obtained with the Hi-R System when the "A" insert measured eight (8) inches and caused the system to fail in the Flexure Mode, resulting in a re-design of the Hi-R insert.

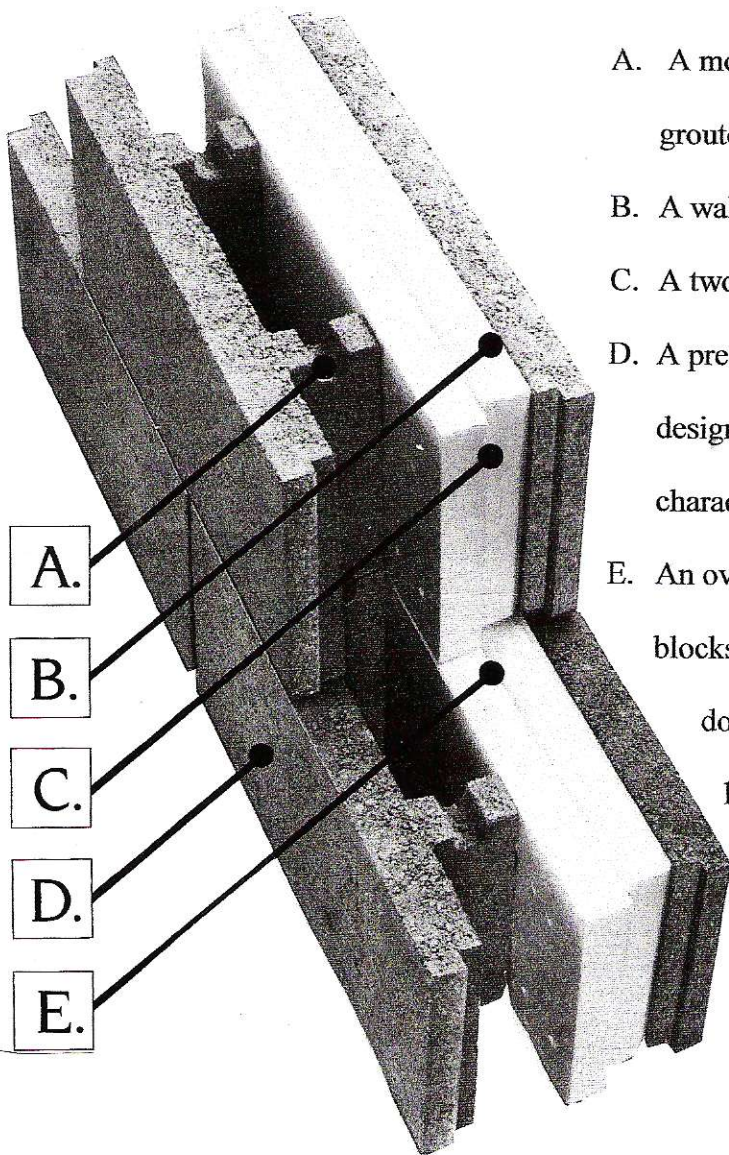
**APPENDIX**

## HI-R<sup>®</sup> MASONRY WALL SYSTEM

The Hi-R<sup>®</sup> Masonry Wall System was developed in 1978 and has been used extensively throughout the country since that time.

Here are three (3) half-size 8 x 8 x 16 inch Hi-R<sup>®</sup> Masonry Units molded, with mortar joints, from Expandable Polystyrene.

The purpose of these samples is to physically show how the Hi-R<sup>®</sup> Masonry Wall System provides the following advantages:



- A. A mortared wall system that can be reinforced and grouted.
- B. A wall system that greatly reduces moisture penetration
- C. A two (2) piece Block Plant-installed Thermal Insert.
- D. A pre-insulated concrete masonry unit that has been designed and tested to provide structural and thermal characteristics superior to conventional masonry units.
- E. An overlapping of thermal inserts between adjacent blocks, both vertically and horizontally, never before done with pre-insulated masonry units. The horizontal overlap occurs when the mason presses down on the inner-most insert during construction of the wall.

For more information contact Concrete Block Insulating Systems, Inc. at (800) 628-8476 or (508) 867-4241 or e-mail us at [korfil@cbisinc.com](mailto:korfil@cbisinc.com)

Now... after 15 years of research and development, A.C.T. announces the  
**MOST IMPORTANT ADVANCE  
 EVER IN INSULATED  
 MASONRY WALLS!**



**SPECIFICALLY DESIGNED  
 AND CONSTRUCTED  
 for  
 SUPERIOR INSULATION  
 against  
 HEAT, COLD, NOISE  
 and MOISTURE**

*The NRG™ ICMU is not just another building block with insulation. It was designed to be and is manufactured as a fully insulated concrete masonry unit.*

Specifiers and contractors welcome the NRG™ ICMU because it:

- Lowers construction costs by eliminating secondary steps such as installing insulation and exterior/interior facades.
- Offers big time savings by speeding up construction schedules.

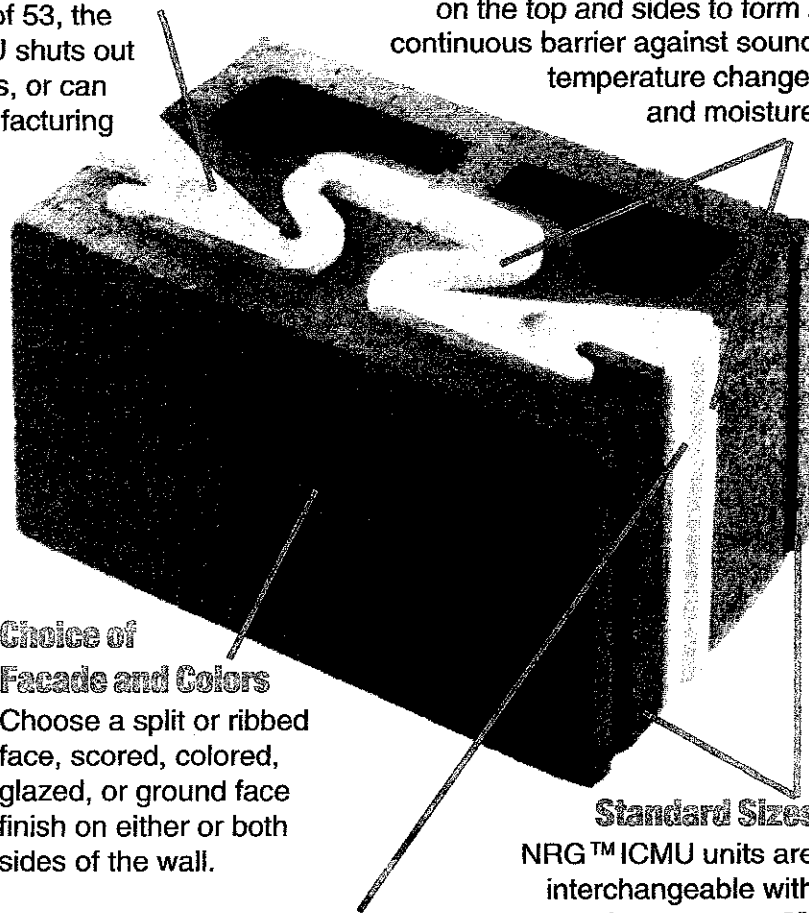
Building owners and tenants welcome the NRG™ ICMU because it:

- Lowers purchase and maintenance costs of heating and cooling equipment.
- Reduces energy bills for greater monthly utility savings.

As with all masonry construction, the NRG™ ICMU provides lower maintenance costs, longer building life, and is fire resistant, reducing insurance costs. And since there are no CFCs or HCFCs used in its construction, an NRG™ ICMU wall system is environmentally friendly to any surroundings.

**Built-in Acoustic Insulation**

With a sound transmission class rating of 53, the NRG™ ICMU shuts out street sounds, or can shut in manufacturing noise.



**Choice of Facade and Colors**

Choose a split or ribbed face, scored, colored, glazed, or ground face finish on either or both sides of the wall.

**Built-in Thermal Insulation**

The NRG™ ICMU provides the most effective insulated wall on the market today, with four times the insulative value of common block walls.

**Standard Sizes**

NRG™ ICMU units are interchangeable with any other common 8", 10" or 12" block with no loss of wall strength or integrity.

**Modified Dovetail Interlocking Design**

The NRG™ ICMU's insulation forms a complete interlocking barrier, with no webs to conduct heat from one side of the wall to the other. This insulation extends on the top and sides to form a continuous barrier against sound, temperature changes and moisture.

**A.C.T.  
 MARKETING, LTD.**

Exclusive Marketers of  
 the NRG™ ICMU  
 throughout New England

24 Honek Street,  
 Milford, CT 06460  
 Toll Free: 800-308-4297  
 Phone: 203-878-3564  
 Fax: 203-876-8038



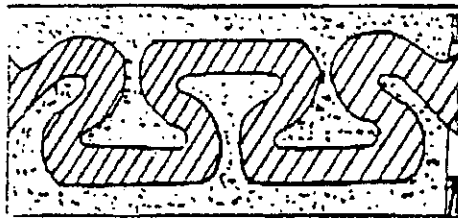


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To whom it may concern:

This letter contains an explanation of calculated R-values for the concrete masonry unit illustrated below.



Because of the unique design, this unit was modeled two different ways, for calculation purposes. If the unit were modeled based strictly on the unit geometry, as conventional masonry units are, there would be a series of lateral thermal "layers". The boundaries of these layers would occur at changes in geometry or materials within the unit. Due to the shape of the insulation layer, each of these thermal layers would contain some concrete. The calculation method cannot account for the fact that the concrete in these layers is not necessarily physically connected. Hence, the conventional model would assume the concrete is continuous through the block, creating thermal bridges through the insulation. Since this is not the case, this calculation would result in unrealistically low R-values.

For this reason, the unit was modeled with one continuous (rectangular) insulation layer, surrounded by two solid layers of concrete. The first model used the actual thickness of the insert as the thickness of the insulation layer, and represents the minimum amount of insulation between the two concrete halves. Because there is actually more insulation than this in the unit, the true R-value of this unit could be higher than the R-value calculated using this model.

The second model used an equivalent thickness for the insulation layer. This thickness was determined from the actual volume of insulation in the unit, divided by the unit length times height, resulting in an equivalent thickness of the insulation. Because the insulation is actually as thin as 1.25" at most points in the unit, the true R-value is likely to be closer to the R-value calculated using Model 1 than that calculated using Model 2.

The R-value calculations are summarized below for a range of concrete densities, using Models 1 and 2 as described above and illustrated below.

Calculated R-Values (hr·sqft.<sup>o</sup>F/Btu)


Concrete Density (pcf)	Foamed-in-Place		Insert (doesn't cover bed joint)		Insert (covers bed joint)	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
80	9.2	17.5	5.7	8.7	8.6	15.3
95	8.6	17.0	5.1	8.3	8.0	14.9
105	8.2	16.8	4.8	8.1	7.7	14.6
115	7.9	16.6	4.6	7.9	7.4	14.5
125	7.7	16.4	4.3	7.8	7.2	14.3
135	7.5	16.3	4.2	7.7	7.0	14.2

As I stated earlier, the actual R-value of a Thermo Block unit probably lies somewhere between the values calculated for Models 1 and 2 above. For this unit, because it is so thermally complex, hot box testing will probably give a better estimate of the R-value than most calculation procedures.

I know of three laboratories that perform hot box testing. They are: Holometrix, Inc. in Cambridge, Mass. (contact Ron Tye at 617-868-8050), Construction Technologies Lab in Skokie, Illinois (contact Martha Van Geem at 708-965-7500), and Jim Walter Research Corp. (contact Gary Miller at 813-576-4171). This is by no means a complete list, it merely represents the labs I happen to be familiar with.

I hope this information is helpful to you. If you have any questions, please feel free to give me a call.

Sincerely,

  
 Maribeth S. Bradfield  
 Energy Engineer

# HOLOMETRIX, INC.

Report on  
THE THERMAL PERFORMANCE OF A MASONRY WALL SYSTEM  
IDENTIFIED AS THE THERMALOCK WALL

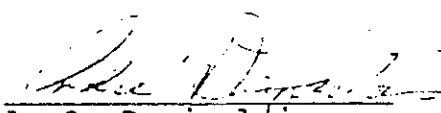
Prepared for:

ThermaLock Products, Inc.  
162 Sweeney Street  
North Tonawanda, NY 14120

Holometrix Report Number TLP-1

Work Performed Under Purchase Order No. 912202

Submitted by:

  
A. O. Desjarlais  
Manager  
Thermal Insulation Evaluation  
Thermophysics Laboratory

March 1991

# HOLOMETRIX, INC.

TABLE 1

THE THERMAL CONDUCTANCE AND THERMAL RESISTANCE OF A MASONRY SYSTEM IDENTIFIED AS THE THERMALOCK WALL SYSTEM

Specimen	Surface Temperature, C		Surface Temperature, F		Thermal Conductance		Thermal Resistance			
	HS	CS	MEAN	CS	W/m <sup>2</sup> K	Btu/hr ft <sup>2</sup> F	m <sup>2</sup> K/W	hr ft <sup>2</sup> F/Btu		
8-inch Block	36.3	10.4	23.4	97.4	50.8	74.1	0.940	0.166	1.06	6.04

*Density 108 / lb-cu ft  
15 Jan 92*

TABLE 2

THE THERMAL TRANSMITTANCE AND OVERALL THERMAL RESISTANCE OF A MASONRY SYSTEM IDENTIFIED AS THE THERMALOCK WALL SYSTEM

Specimen	Air Temperature, C		Air Temperature, F		Thermal Transmittance		Overall Thermal Resistance			
	HS	CS	MEAN	CS	W/m <sup>2</sup> K	Btu/hr ft <sup>2</sup> F	m <sup>2</sup> K/W	hr ft <sup>2</sup> F/Btu		
8-inch Block	38.3	9.7	24.0	101.0	49.4	75.2	0.850	0.150	1.18	6.68