

# **Roof Integrated Solar Absorbers: The Measured Performance of “Invisible” Solar Collectors**

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U.S. Department of Energy  
Building Technologies Program

## *Innovative, Low-Cost Solar Water Heaters*

### **Goal:**

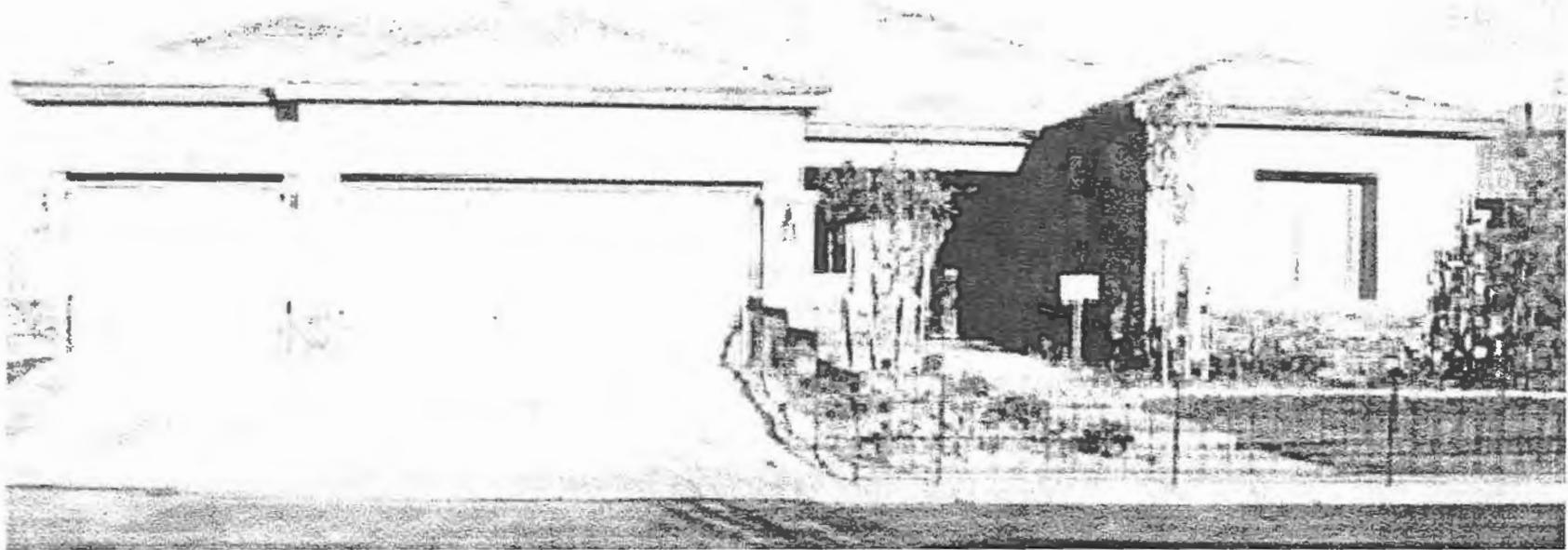
Cut the delivered, life-cycle energy cost of solar water heating systems in half by the year 2005.

### **Timeline:**

- **1998** - *“New Concepts for Solar Systems”* RFP
- **1999** - *“Low-Cost Solar Systems”* RFP to industry; Phase 2 of *“New Concepts for Solar Systems”* RFP
- **2000** - Select “best” concepts and focus R&D

## *Available Roof Surface*

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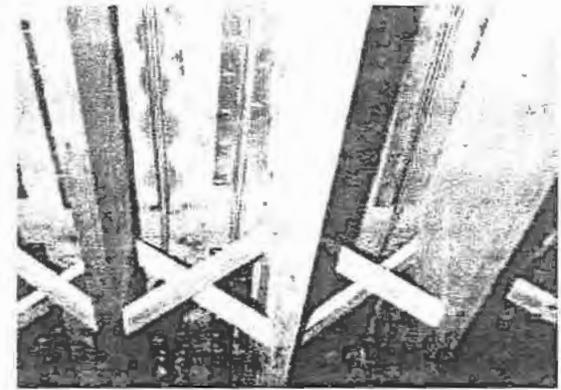
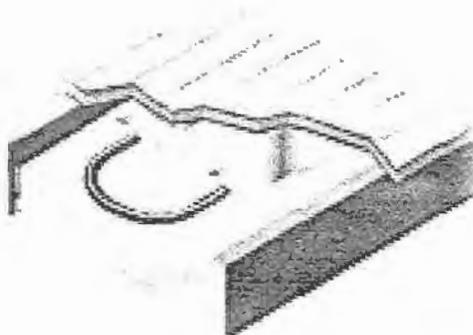
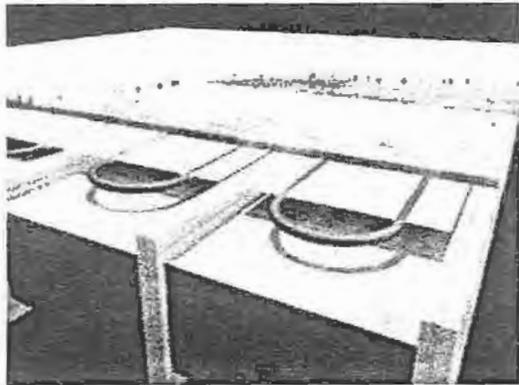
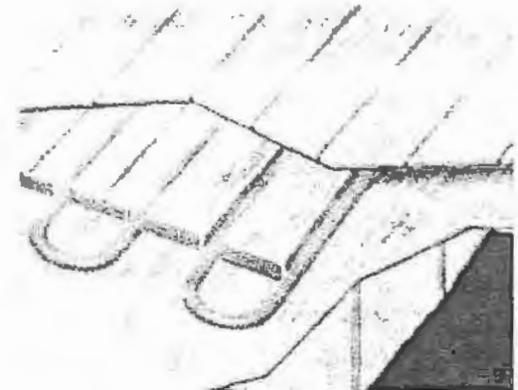
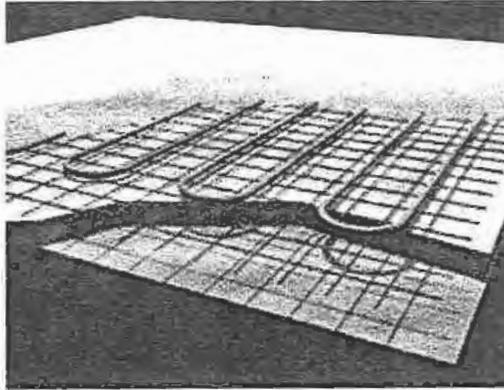
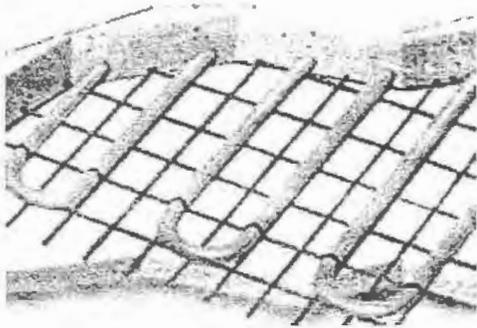
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## **Roof Integrated Solar Absorber (RISA)**

- A thermal absorber installed in contact with the roof sheathing, yet underneath the weatherable roof surface and not exposed directly to solar radiation.

# *Radiant Floor Heating*

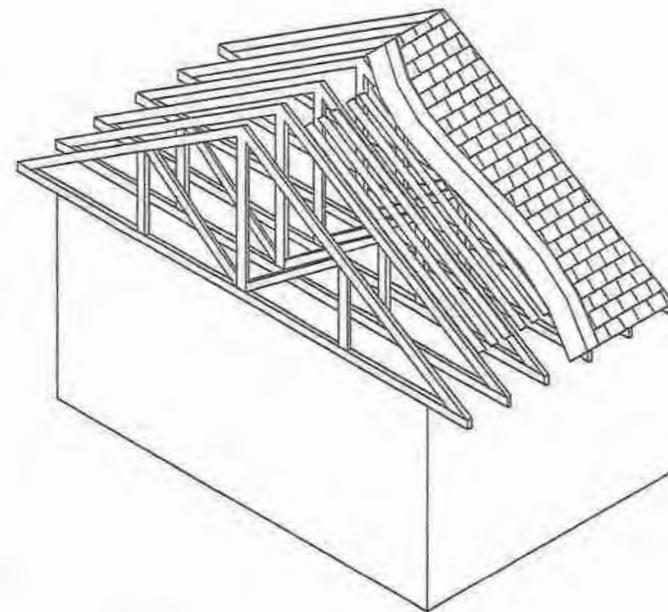
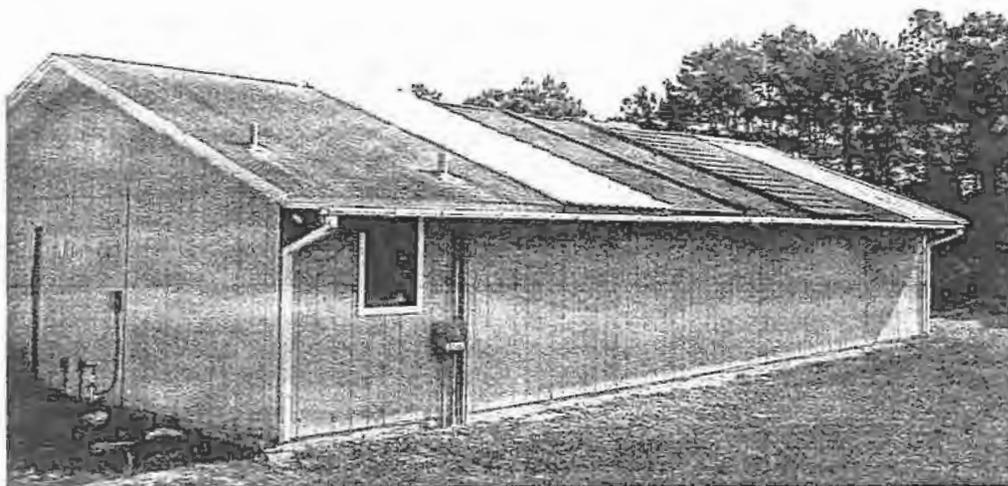
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## *“Proof-of-Concept” System*

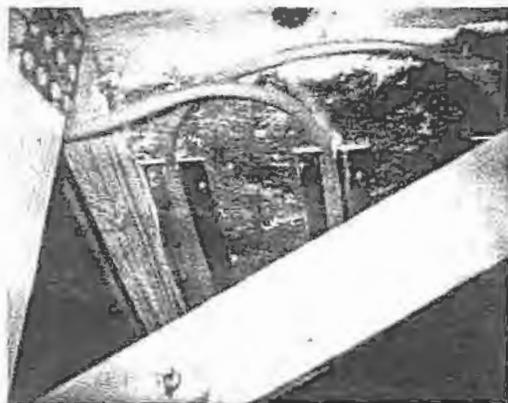
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Flexible Roof Facility (FRF)  
Florida Solar Energy Center

## *Roof Integrated Solar Absorber*

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1/2" PEX-AL-PEX  
Al heat transfer plates  
3/4" rigid insulation

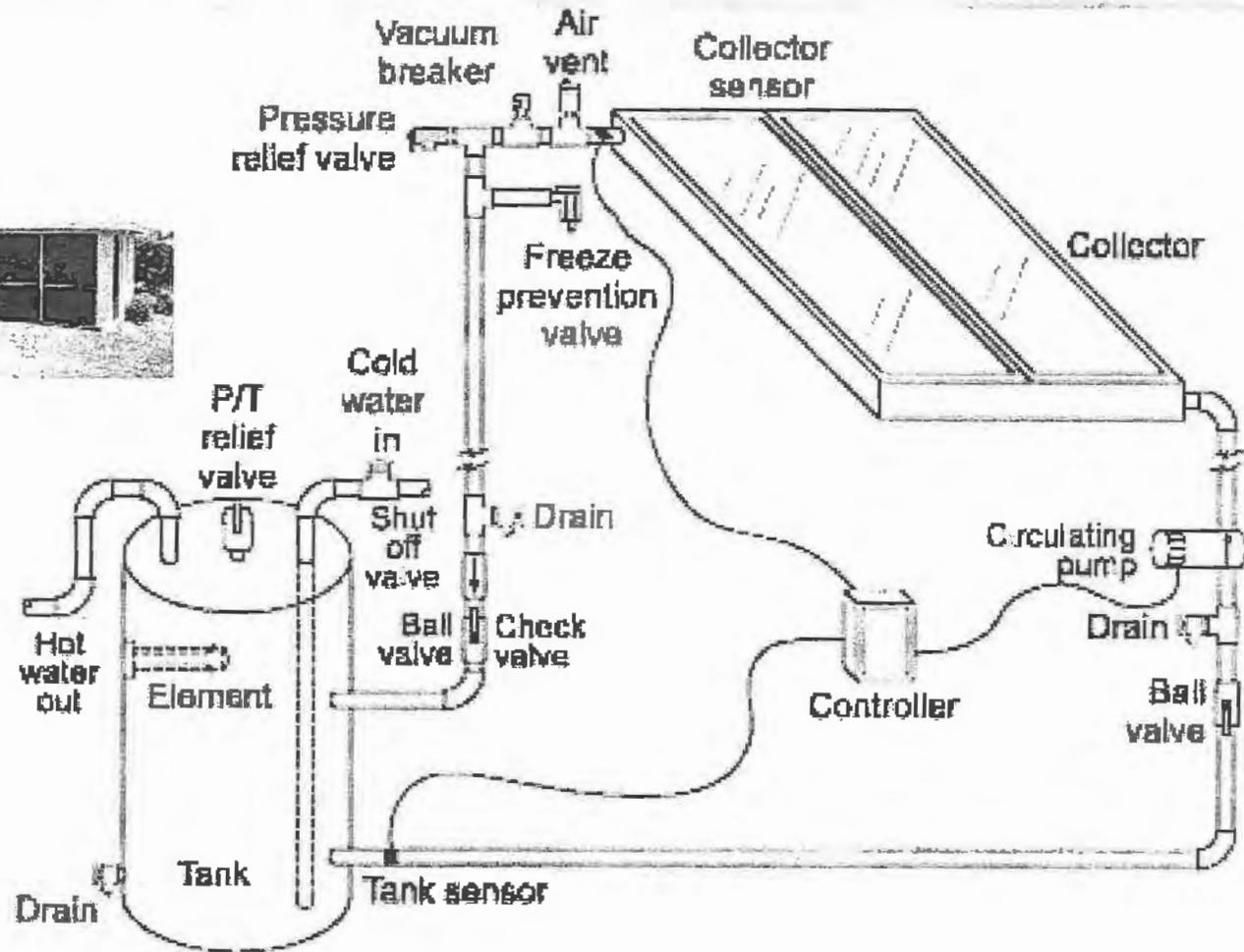


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# Solar Water Heating



## Direct Circulation System

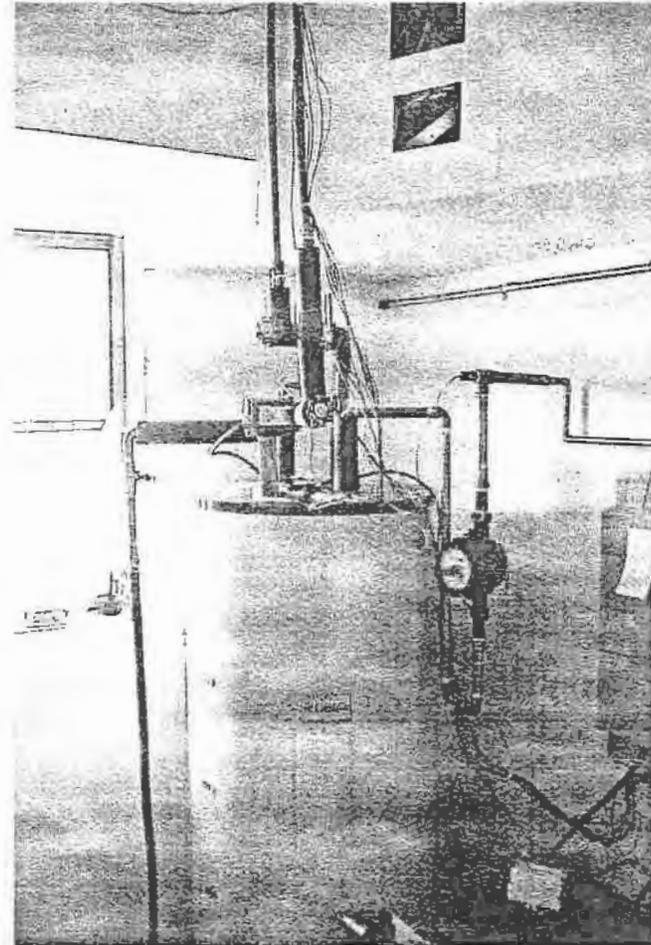


## *Roof Integrated Solar Absorber*

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80 gallon storage tank  
1.2 gpm circulating pump  
Differential controller

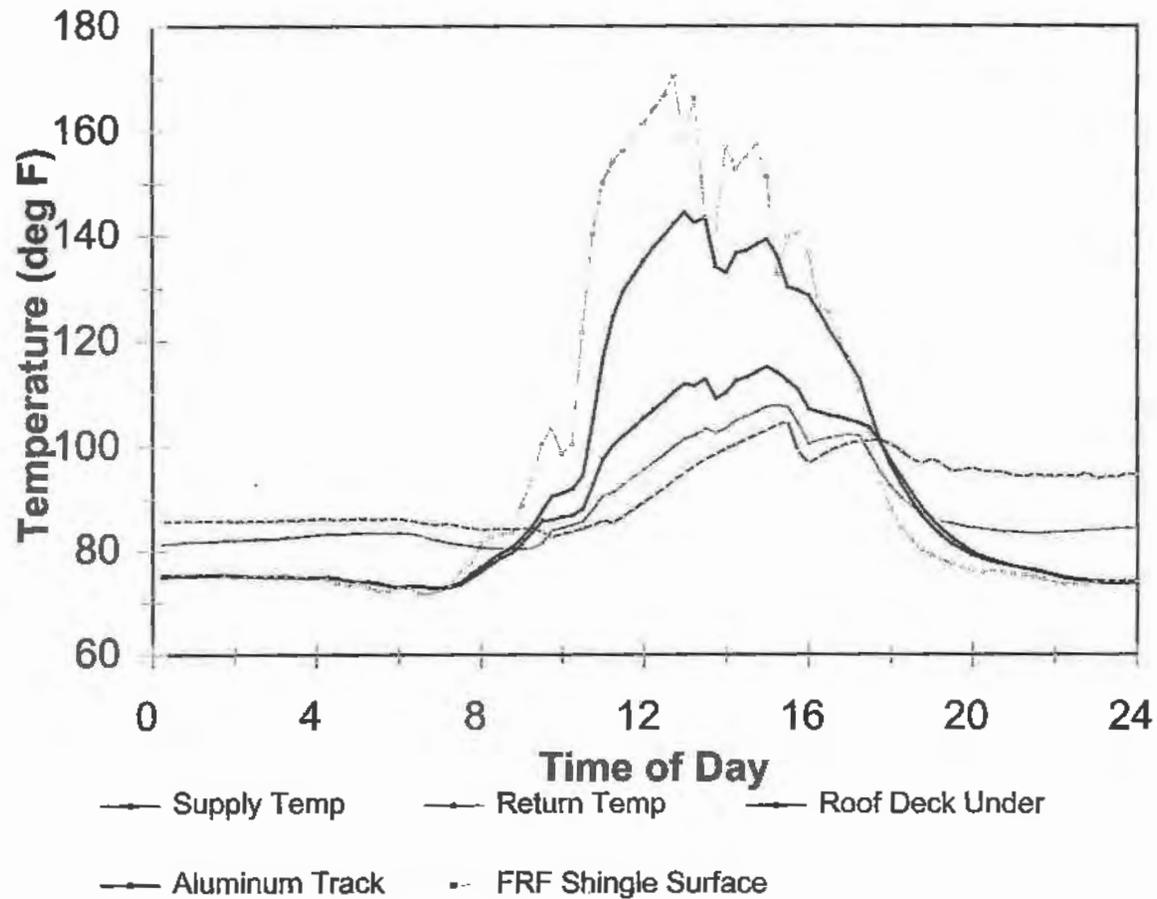


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# Roof Integrated Solar Absorber

## Roof Deck Temperatures and RISA

September 28, 1999



# *Roof Integrated Solar Absorber*

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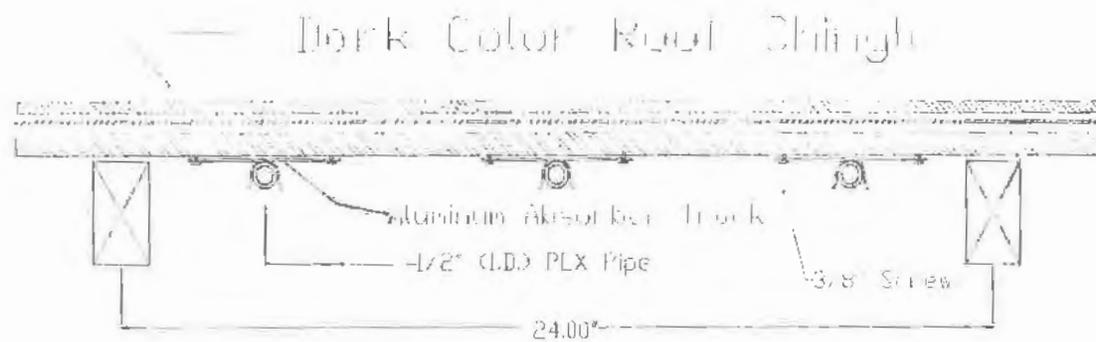
## **RISA Phase 2**

Thermal Performance Testing of 2 Prototypes:

- Asphalt shingle roof
- Metal roof

# Roof Integrated Solar Absorber

## Original RISA Configuration

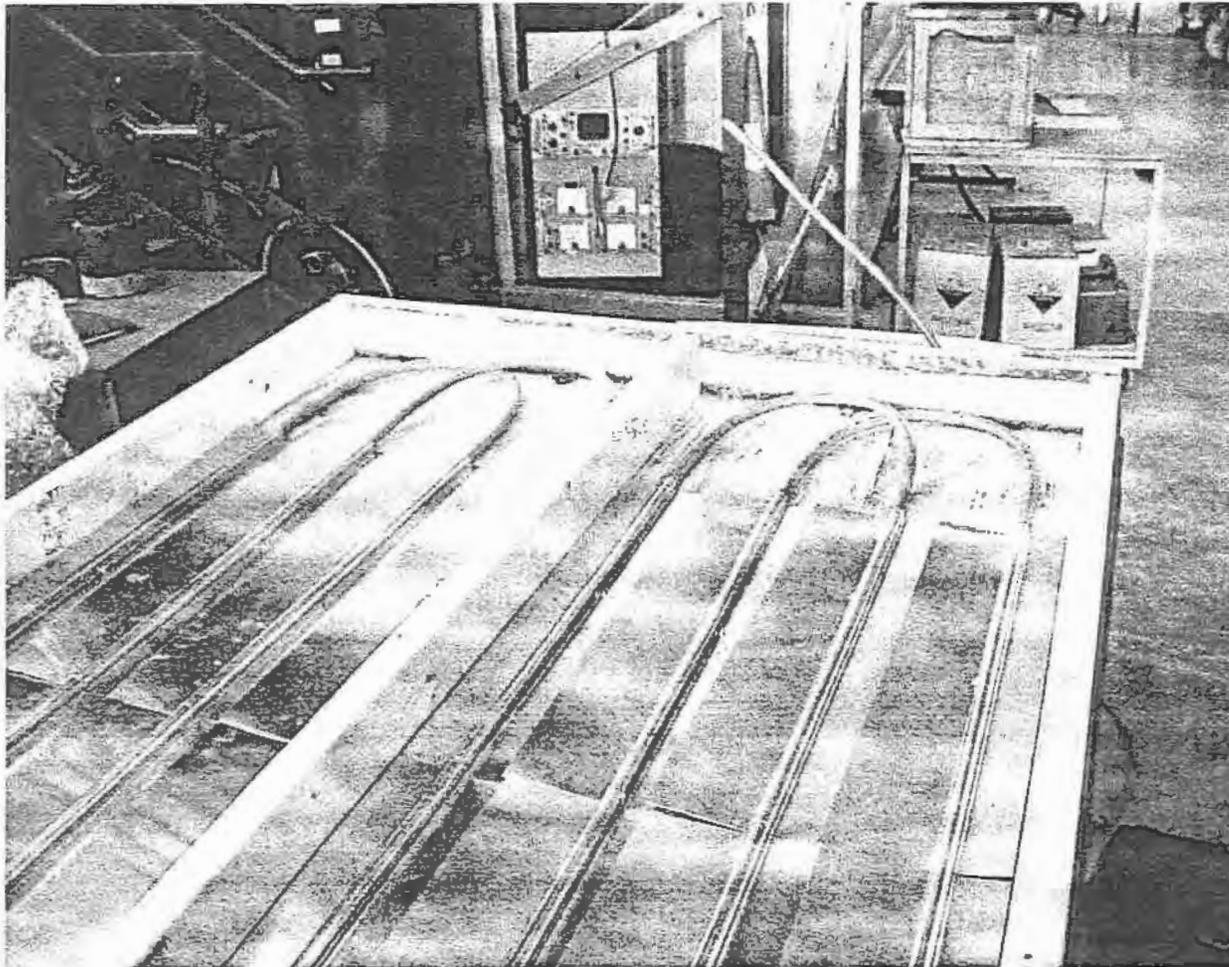


## New RISA Prototype Configuration

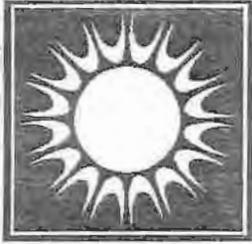


## *Roof Integrated Solar Absorber*

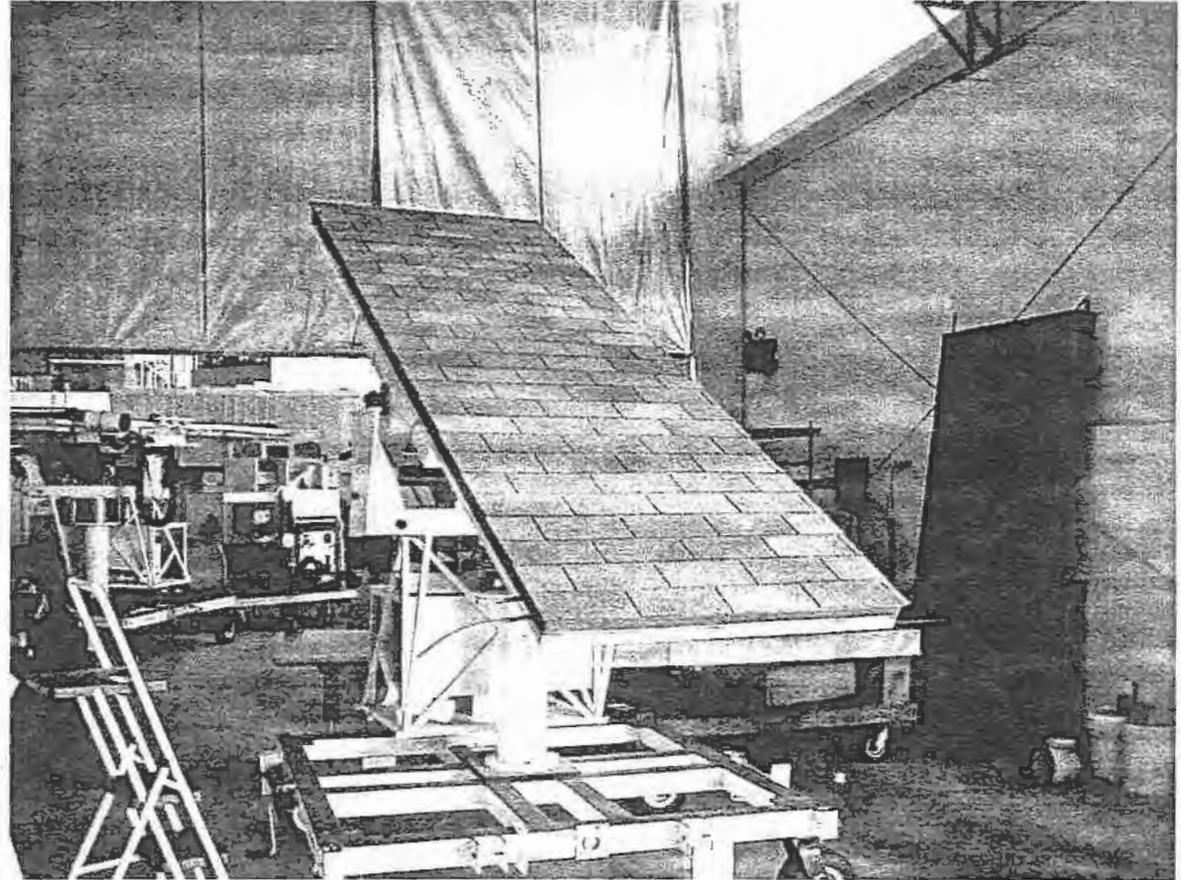
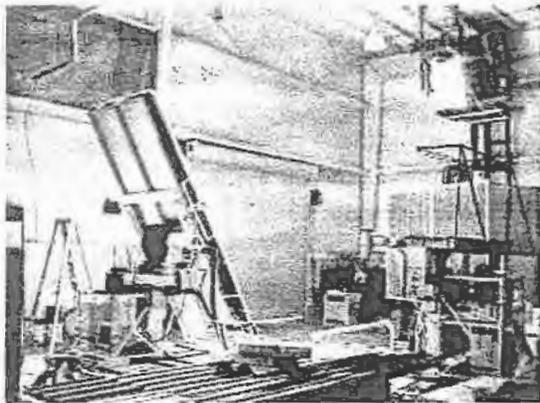
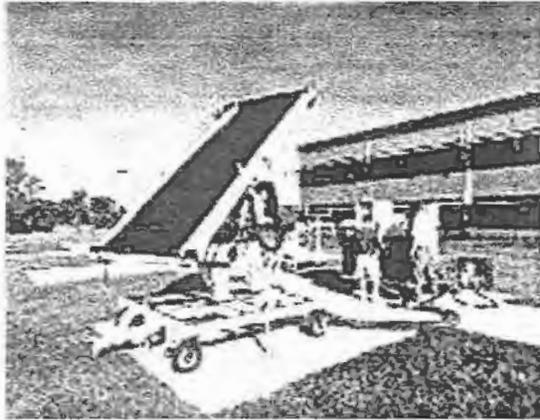
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## *FSEC Thermal Performance Testing*

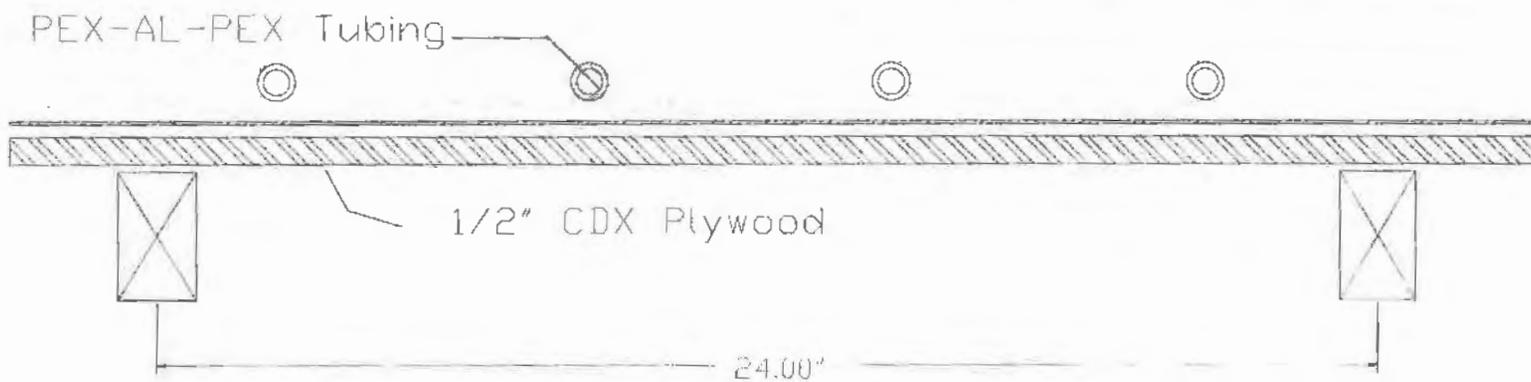


Mobile Tracking Platform -- Florida Solar Energy Center

# *Roof Integrated Solar Absorber*

## Metal RISA Prototype Cross-Section

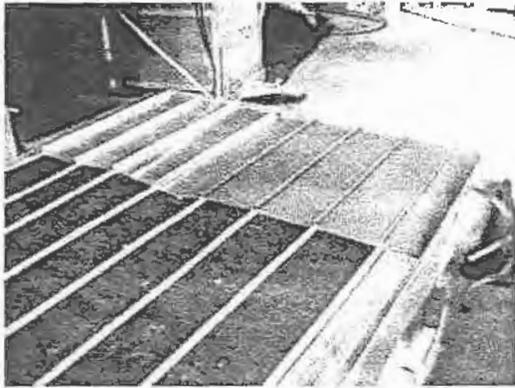
Kynar Coated - Aluminum Plate Absorber



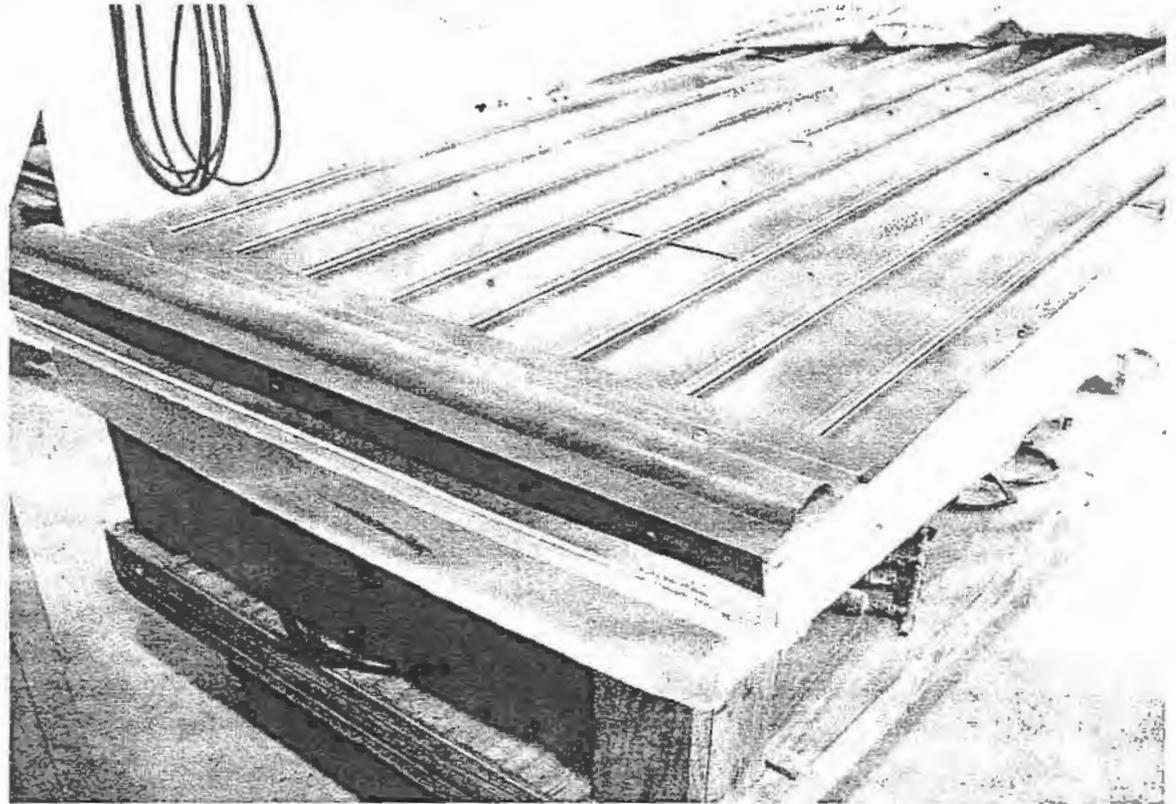
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## *Roof Integrated Solar Absorber*

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1/2" PEX-AL-PEX  
30 gauge Al sheet  
Kynar coating



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# Florida Solar Energy Center

## Sample FSEC Thermal Performance Ratings

Collector		Glazing		Absorber		Gross Area	Thermal Performance: Intermediate Temperature Rating	
Manf.	Model	No.	Type	Material	Coating	Sq. Ft	Btu/Day	Btu/ft <sup>2</sup>
AET	AE-40	1	Glass	Copper tubes and fins	Selective	39.78	31300	786
AET	AE-21E	1	Glass	Copper tubes and fins	Moderately selective	20.73	14300	689
ASN	ASN30A	1	Clear rigid plastic	UV Stabilized EPDM	None	31.17	21100	676
UMA	Solar Max-40	1	FRP	UV stabilized PP	None	39.49	18800	475
Heliocol	Heliocol 40	0	None	UV stabilized PP	None	40.68	11160	274

## *Thermal Performance Ratings*

	<b>Shingle RISA</b>			
Collector Inlet Temperature	Btu/day	Btu/ft <sup>2</sup> /day	kWh/day	kWh/m <sup>2</sup> /day
Low (35°C)	5788	149	1.7	0.5
Intermediate (50°C)	208	5.4	0.06	0.02

	<b>Metal RISA</b>			
Collector Inlet Temperature	Btu/day	Btu/ft <sup>2</sup> /day	kWh/day	kWh/m <sup>2</sup> /day
Low (35°C)	14,256	368	4.2	1.2
Intermediate (50°C)	2,067	53.4	0.6	0.2

## *RISA Performance Summary*

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### **Water Heating**

- Glazed collectors are ~10-15 times more efficient (per unit area) than metal roof RISAs
- Metal roof RISAs are ~10 times more efficient than asphalt shingle RISAs

### **Pool Heating**

- Unglazed collectors are ~2-3 times more efficient (per unit area) than metal roof RISAs
- Metal roof RISAs are ~2-3 times more efficient than asphalt shingle RISAs

## *Roof Integrated Solar Absorber*

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### **Conclusions:**

- Roof-integrated solar absorbers are able to provide  $\sim 1$  kWh/m<sup>2</sup>/day of hot water energy ( $\sim$  the same solar conversion efficiency as PV systems!)
- For both hot water and pool heating, roof-integrated solar absorbers are an aesthetic alternative to roof-mounted solar collectors.
- Roof-integrated solar absorbers are also able to reduce solar heat gain in cooling load-dominated climates.