

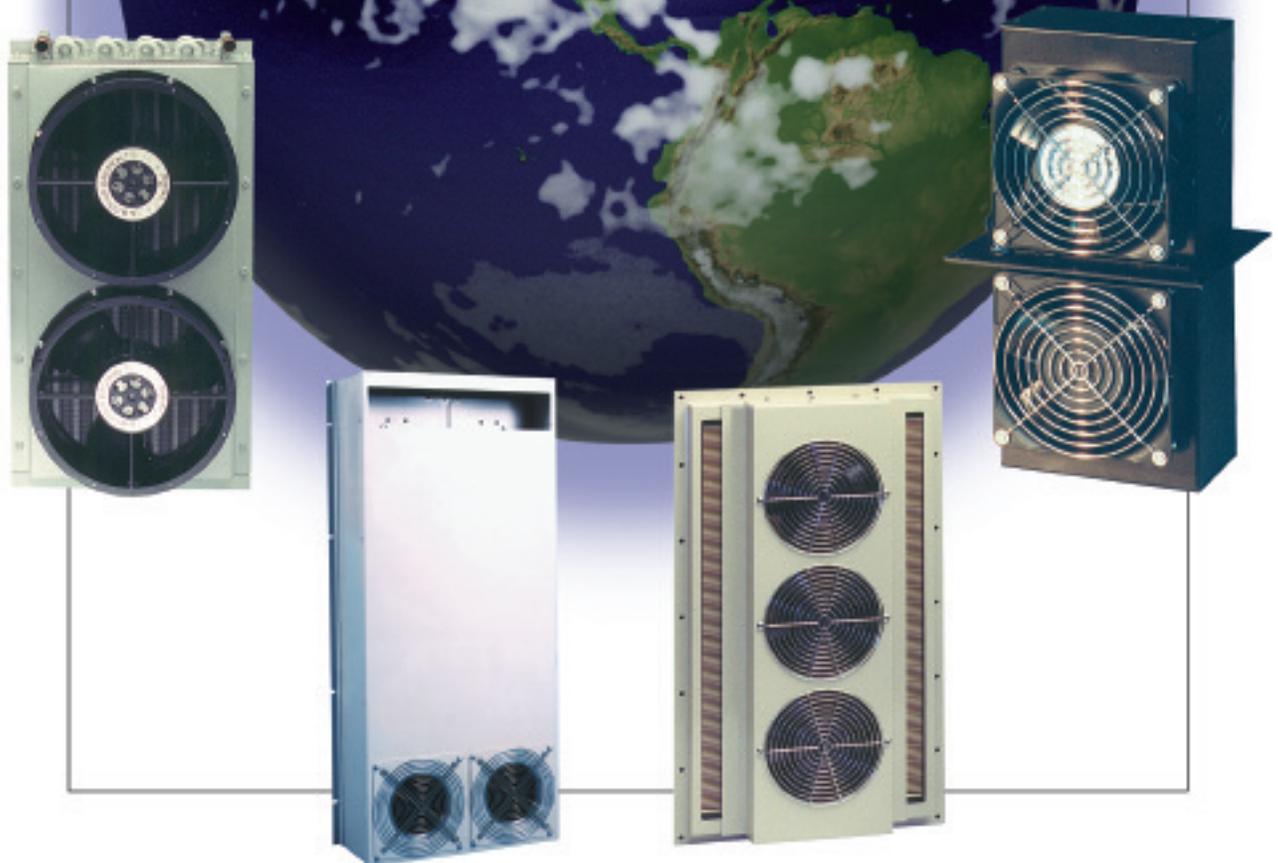


THERMACORE

Thermal Management Solutions

Heat Exchangers and System Level Cooling Products

GLOBAL SUPPLIERS OF THERMAL MANAGEMENT SOLUTIONS



www.thermacore.com



HEAT EXCHANGERS FOR COOLING ELECTRONIC ENCLOSURES

The trend toward greater miniaturization and compactness of electronic components and assemblies has increased the capability to get more electronics into enclosed cabinets. The resulting increased heat loads have placed greater demands on cabinet cooling to ensure that electronics are protected while performing as intended.

Thermacore offers a family of compact, high-efficiency cabinet-cooling heat exchangers that are capable of meeting the increasing thermal requirements as well as NEMA enclosure standards. These rugged units also meet

operational requirements under various weather conditions as frequently encountered in the communications industry.

Reliability, thermal performance, cost and size are four governing factors in choosing heat exchangers for cooling electronic enclosures. Combined with lower maintenance cost and greater reliability, Thermacore heat exchangers are the ideal solution for many cabinet-cooling applications.

Thermacore manufactures heat exchangers that are categorized according to packaging applications.



HX™ Series

HX™ Series air-to-air heat exchangers utilize two-phase heat pipe technology, providing performance, reliability and cost effectiveness for many applications. HX™ style heat exchangers are an efficient heat transfer mechanism that enables multiple packing options.



HXi™ Series

Thermacore's HXi™ Series air-to-air heat exchangers are designed primarily for cooling indoor and outdoor electronic enclosures. The HXi™ uses a double-sided impingement technology to achieve significantly improved heat transfer performance while reducing heat exchanger size. Comparative tests verified that a HXi™ heat exchanger is capable of dissipating twice the heat load of many other types of heat exchangers at a comparable size. Thermacore's patent-pending design makes the HXi™ Series heat exchanger a lower-cost and higher-performance alternative to conventional heat exchanger technologies.



5300 Series

The 5300 Series high-pressure heat exchanger is a high performance liquid-to-air heat exchanger. It is designed to provide effective cooling in a closed-loop cooling system where heat dissipation is too great for natural or forced air convection systems, or where heat must be dispersed at a distance from the components being cooled. Typical applications include cabinets, MRI and process.



HXc™ Series

HXc™ Series air-to-air heat exchangers utilize high efficiency cross-flow plate cores to dispel multiple kilowatts of heat. Thermacore's cross-flow core elements make the HXc™ unit highly effective, space efficient and easily customized for OEM applications.

Custom Solutions Available Through Thermacore

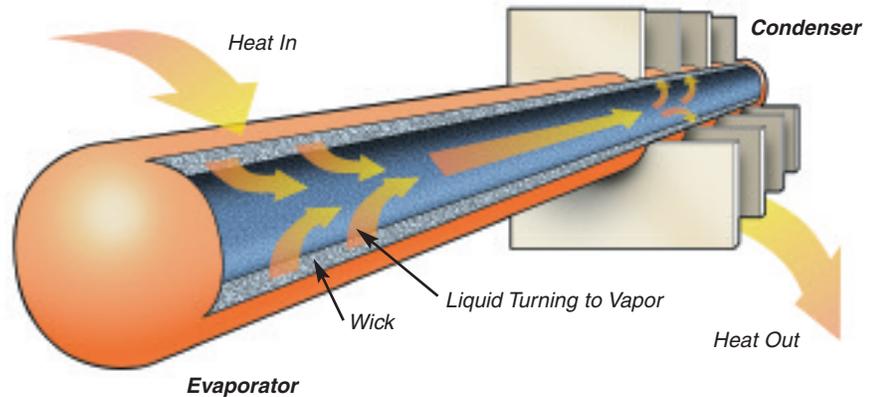
As a Heat Transfer Specialist, Thermacore will design a custom heat exchanger system to meet special requirements. Telephone Thermacore at **(717) 569-6551** for complete information.



HX™ Series - Heat Pipe Cooling

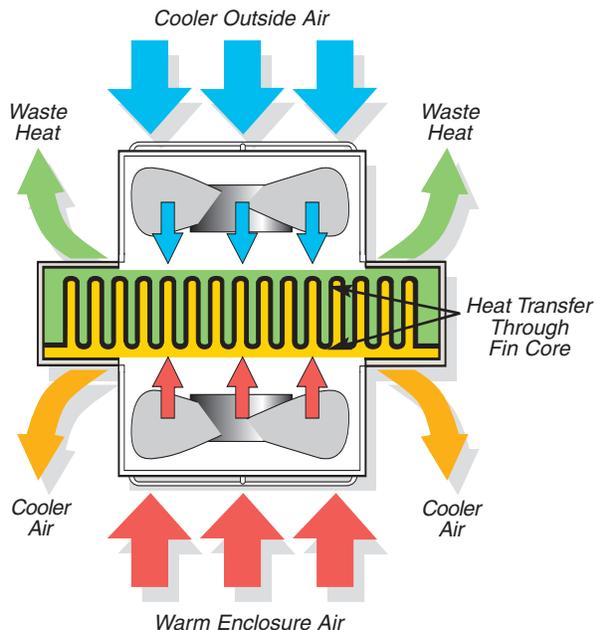
A heat pipe is a two-phase heat transfer device with an extremely high effective thermal conductivity. It can be cylindrical or planar, and the inner surface is lined with a capillary wicking material. The heat pipe is evacuated and back-filled with a small quantity of a working fluid such as water, acetone or methanol. Heat is absorbed in the evaporator region by vaporizing the working fluid. The vapor transports heat to the condenser region where the vapor condenses, releasing heat to the cooling media, such as air. The condensed working fluid is pumped back to the evaporator by gravity or by capillary action if working against gravity.

Heat pipes have a lower total thermal resistance than solid conductors, enabling them to transfer heat more efficiently and evenly. They are totally passive heat transfer systems, having no moving parts to wear out and requiring no energy to operate. Heat pipes offer the design engineer low-cost packaging flexibility because they can be manufactured in a variety of shapes and sizes. Their light weight and compact size also make them the ideal choice for space-constrained applications. Heat pipes can be manufactured to survive freeze-thaw conditions.



HXi™ Series - Impingement Cooling

Thermacore's HXi™ Series heat exchanger utilizes double-sided impingement cooling technology for exceptional heat removal efficiency. The double-sided impingement system utilizes a folded fin core that separates the enclosure inside and outside. A set of inside fans draws in the hotter, inside air and blows it toward the fin core. This inside impingement efficiently transfers the heat to the fin core. Similarly, a set of outside fans draws in the cooler, ambient air and blows it toward the outer side of the fin core removing the waste heat. The fin core is made of thin aluminum so that the thermal resistance due to heat conduction is negligible.



Fin core is rotated for illustrative purposes.



Fin Core

The HXi™ heat exchanger's higher heat transfer performance increases the convective heat transfer coefficient by a factor of two, compared to conventional counter-flow heat convection parallel to the fins. The superior design and greater efficiency result in a 50% size reduction, along with smaller fans, compared to counter-flow and/or heat pipe heat exchangers with similar heat transfer performance. This smaller size provides more packaging flexibility for enclosure manufacturers.

The HXi™ Series includes the use of multiple, low power fans on both sides of the unit for increased reliability in the event of a single fan failure. The airflow also travels short distances from inlet to exit which corresponds to low pressure drops, low fan power consumption and reduced noise levels.



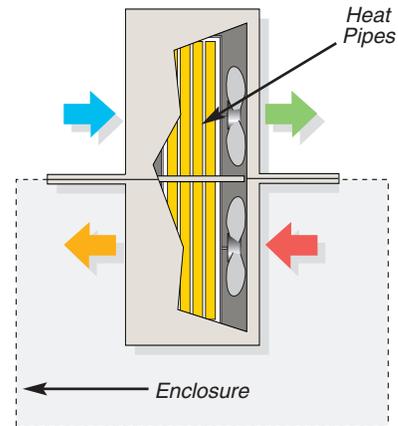
HX™ SERIES AIR-TO-AIR COOLING: HEAT PIPE HEAT EXCHANGER



HX™ Series Compact Heat Exchangers

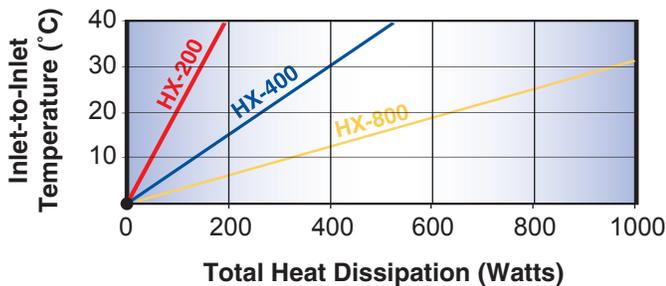
Description

Thermacore HX™ Series Heat Exchangers are designed to provide economical cooling to enclosed electronic equipment with high heat loads. The HX™ Series utilizes passive heat pipe technology with energy-efficient cooling



fans for economical operation. The HX™ maintains the integrity of NEMA 4 and NEMA 12 (IP 55 and IP 66) enclosures by utilizing a flange and closed-cell neoprene gasket between the unit's interior and exterior heat exchanger. This arrangement prevents the introduction of contaminated exterior air into the sealed NEMA enclosure.

Performance Data

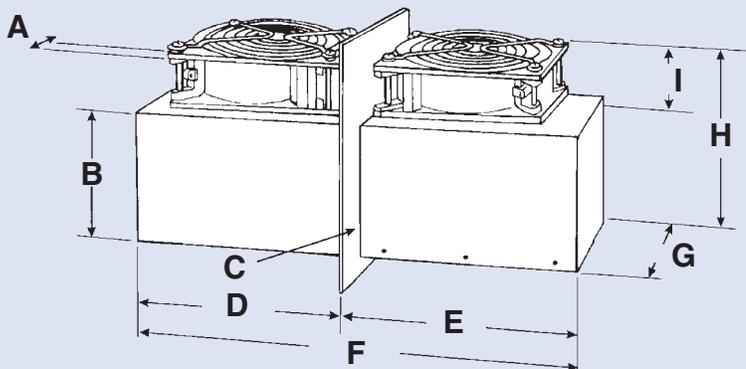


Installation

The HX™ Series can be used with both new or existing enclosures. The versatile mounting design allows for placement on doors, side, top or back of the enclosure. Neoprene gasket, instructions and a template showing the exact position of the cutout and screw placement are included. HX™ Series heat pipe heat exchangers have a long, maintenance-free life.

	HX-200	HX-400	HX-800
A	.25" (6)	.25" (6)	.25" (6)
B	2.125" (54)	3.75" (95)	5.875" (149)
C	4.5sq" (114)	6.75sq" (171)	10.00sq" (254)
D	4.075" (104)	6.10" (155)	7.40" (188)
E	4.075" (104)	6.10" (155)	7.40" (188)
F	8.25" (210)	12.30" (312)	14.90" (378)
G	3.25" (83)	5.25" (133)	6.50" (165)
H	3.85" (98)	5.25" (133)	8.125" (206)
I	1.50" (38)	1.25" (32)	2.00" (51)

() = millimeters



Performance Data:

Model	Performance	Weight
HX-200	4.8 W/°C	2.7 lbs.
HX-400	13.2 W/°C	6.8 lbs.
HX-800	32.0 W/°C	15.1 lbs.

HX™ SERIES CUSTOM DESIGNS



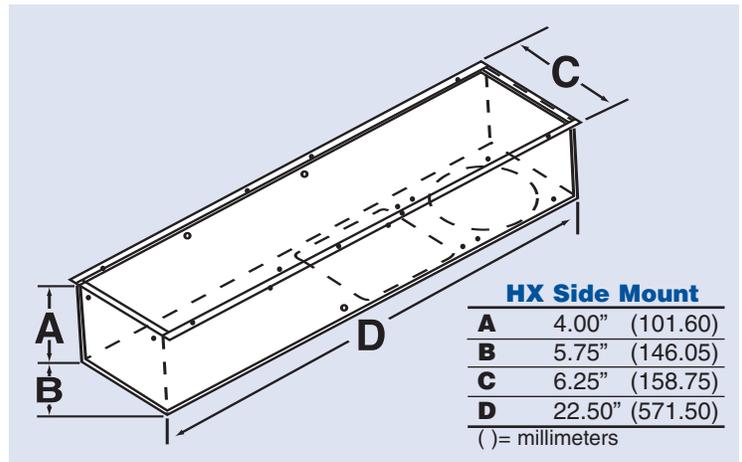
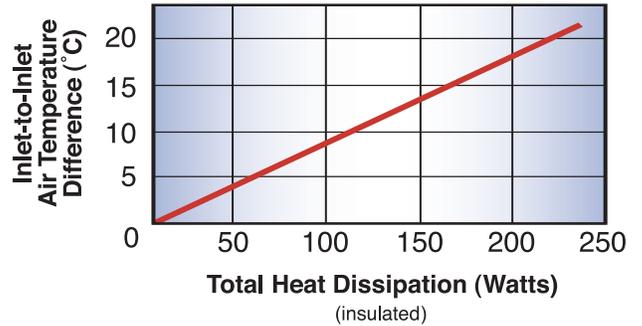
HX™ Side Mount

Heat pipe heat exchangers are an easily adaptable technology for custom applications. Whether mounted externally, partially recessed or captured within ductwork, the heat pipe heat exchanger is a reliable and highly efficient heat transfer mechanism that can maintain NEMA 4 and NEMA 12 enclosure integrity.

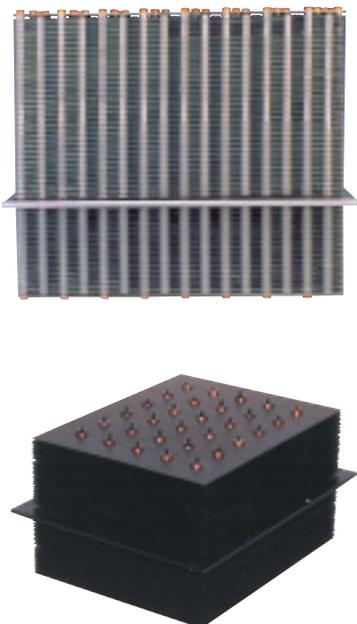
Designed to provide a thermal performance of 12W/°C, this unit uses the flexibility of heat pipe heat exchanger technology to accommodate different mounting configurations.

The product design can easily be scaled to larger or smaller capacity configurations and can be equipped with either AC or DC fans.

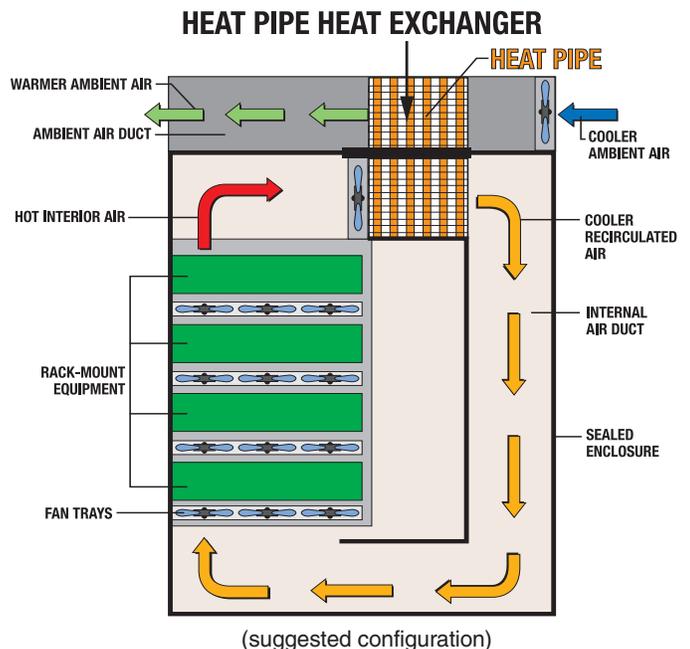
HX Side-Mount Air-to-Air Heat Exchanger Performance Data



HEAT PIPE CORE ONLY DESIGNS

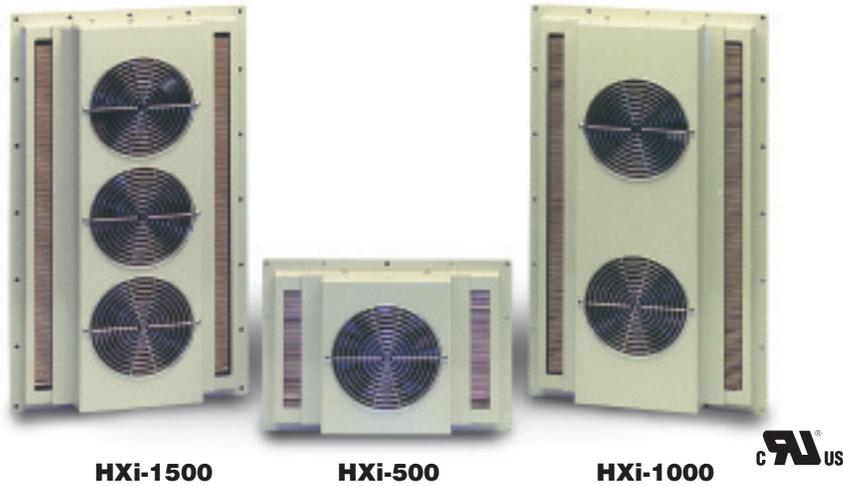


Heat pipe core units can be a flexible thermal management system used to interface with duct work and other customized heat exchanger applications. Fin stacks can be tailored to accommodate different air velocities in the ambient and internal loops. All heat pipe core units provide a NEMA 4 & 12 compliant seal to separate the two air streams. Thermacore engineering can design the appropriate heat pipe core for each customer's application.





HXi™ SERIES AIR-TO-AIR COOLING: IMPINGEMENT HEAT EXCHANGER



HXi-1500

HXi-500

HXi-1000



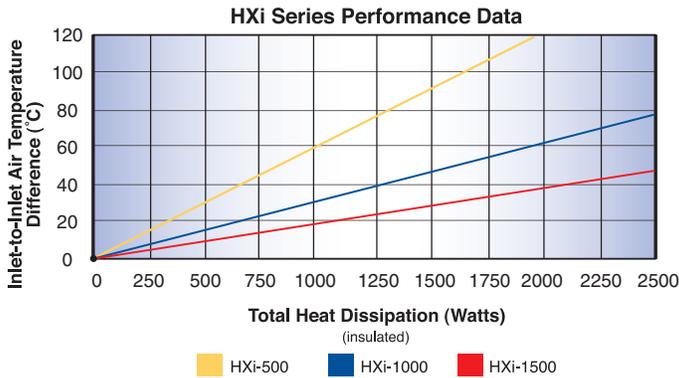
HXi™ Series Low Profile Heat Exchangers

Description

Thermacore achieves high heat transfer performance and compactness with its efficient impingement cooling and superb packaging. This closed-loop system is UL recognized and meets Bellcore GR-487-CORE while also maintaining NEMA 4 and NEMA 12 (IP 55 and IP 66) cabinet integrity. There are fewer moving parts for less chance of mechanical problems. Stock units are available as 2, 4, 6, or 8 fans with noise level 69 dB for 6 fans. Custom designs are available to handle high wattage heat dissipation requirements.

Installation

The HXi™ series' low-profile design and modular dual-fan configuration can be used singly or in combination to provide installation flexibility in any orientation. Custom features such as alarms and temperature controls are available as an optional package. Minimum orders may apply.

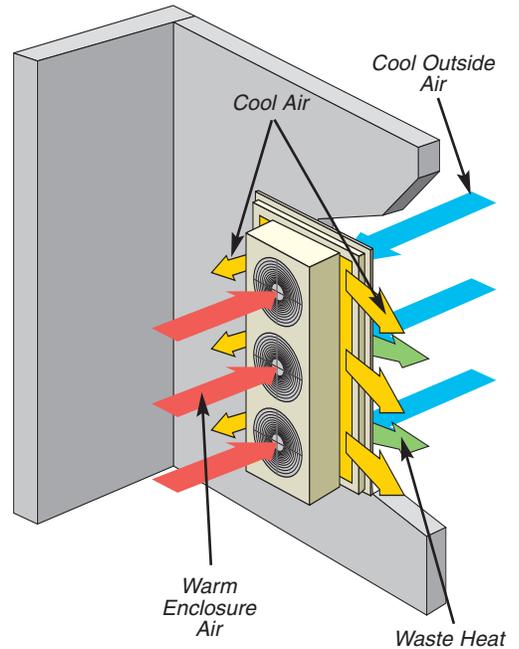
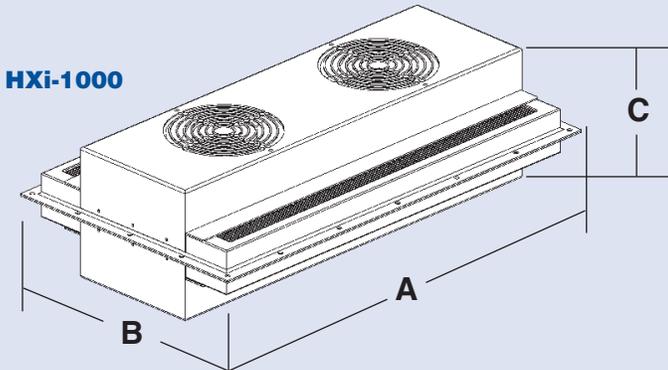


Enclosure Rating Descriptions

NEMA, UL, CSA Type	Appropriate IEC/IP Class.	Abbreviated Protection Description
3R	IP32	Outdoor with some protection from rain, sleet and ice damage
4	IP66	Indoor/Outdoor with some protection from windblown dust, rain, splashing water, hose-directed water and ice damage
4x	IP66	Indoor/Outdoor with some protection from windblown dust, rain, splashing water, hose-directed water and ice damage
12	IP55	Indoor with protection from dust, falling dirt and dripping non-corrosive liquids
13	IP65	Indoor with protection against dust, spraying water, oil and non-corrosive liquids

	HXi-500	HXi-1000,1500	Custom
A	10" (254)	24" (610)	Custom
B	14" (355)	14" (355)	Sizes
C	6.87" (174)	6.87" (174)	Available

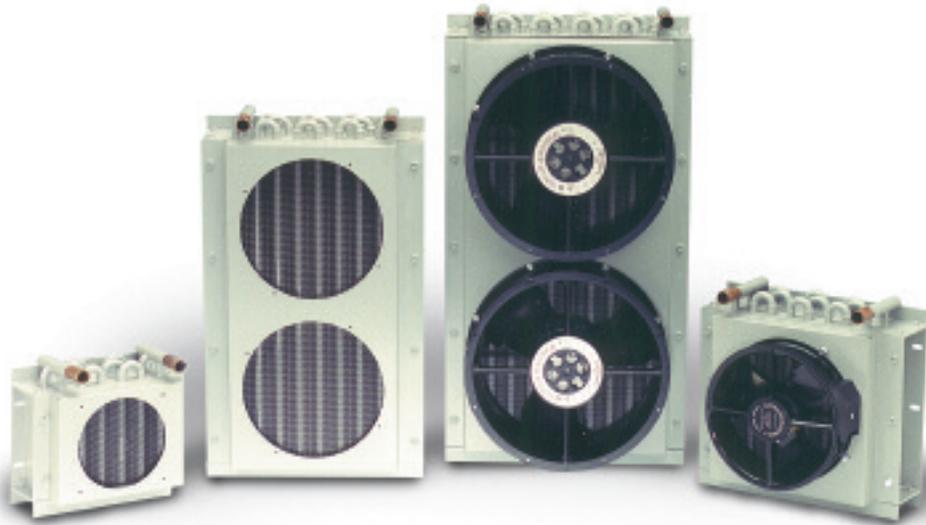
() = millimeters



Performance Data:

Model	Performance	Weight
HXi-500	16W/°C	15 lbs.
HXi-1000	33W/°C	20 lbs.
HXi-1500	52W/°C	25 lbs.
HXi-1500+	Per Customer Requirement	

5300 SERIES LIQUID-TO-AIR HEAT EXCHANGERS



5310

5340

5360

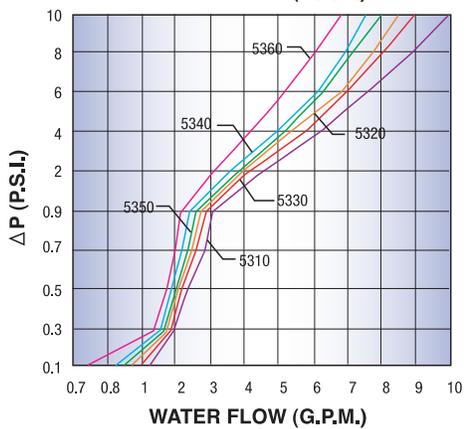
5330

High Pressure Heat Exchangers

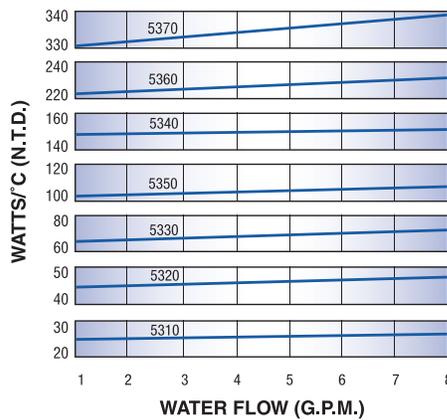
Description

The Series 5300 Liquid-To-Air Heat Exchangers are available in six different sizes (3 with double fans), with heat rejection capabilities from 1.5 kilowatts to 15 kilowatts. These compact high-pressure units have rippled pattern aluminum fins for air-side passages. The liquid-side passages are copper tubing with a maximum operating pressure of 200 psi. The inlet/outlet tubes are arranged perpendicular to the exchanger. The standard finish is galvanized steel for the housing with painted inlet/outlet tubes and tube bends. Standard fans are rated 110-115 volts AC, single phase and 60 cycle.

WATER PRESSURE DROP (P.S.I.) VS. WATER FLOW (G.P.M.)



CAPACITY - WATTS/°C (N.T.D.) VS. FLOW - G.P.M. OF WATER



Installation

Unless otherwise specified, all models have inlet/outlet tube ends suitable for attachment of flexible tubing with hose clamps. The steel housing's slotted flanges provide easy installation of the unit.

Thermal performance is expressed in terms of capacity as in the following relation:

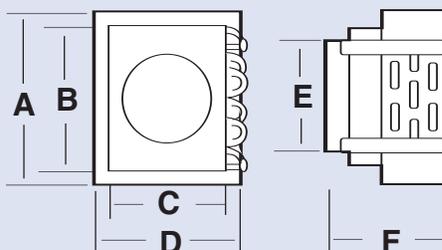
$$C = \frac{Q}{(T_{h20_{av}} - T_{air_{in}})^*}$$

*= NTD (nominal temperature difference)

Single Units

	5310	5330	5350
A	7.63" (193)	10.75" (273)	12.13" (349)
B	6" (153)	9" (228)	10" (254)
C	5" (127)	8.13" (207)	10.13" (259)
D	6.62" (168)	9.75" (247)	11.75" (298)
E	5" (127)	7" (178)	9" (228)
F	5.37" (137)	6.13" (156)	7.5" (190)

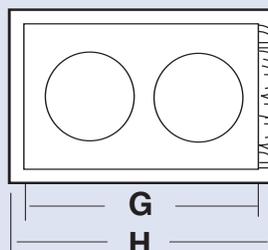
() = millimeters



Double Units

	5320	5340	5360
A	7.63" (193)	10.75" (273)	12.13" (349)
B	6" (153)	9" (228)	10" (254)
E	5" (127)	7" (178)	10" (254)
F	5.37" (137)	6.13" (156)	7.5" (190)
G	10" (254)	16.13" (410)	20.88" (531)
H	11.62" (295)	17.75" (451)	22.50" (571)

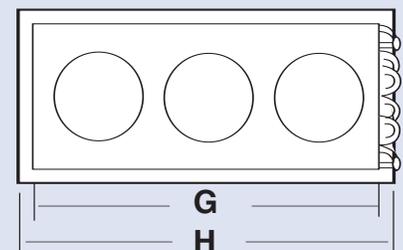
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Triple Units

	5370
A	12.13" (349)
B	10" (254)
E	10" (254)
F	8.25" (210)
G	31.31" (795)
H	33.4" (848)

() = millimeters



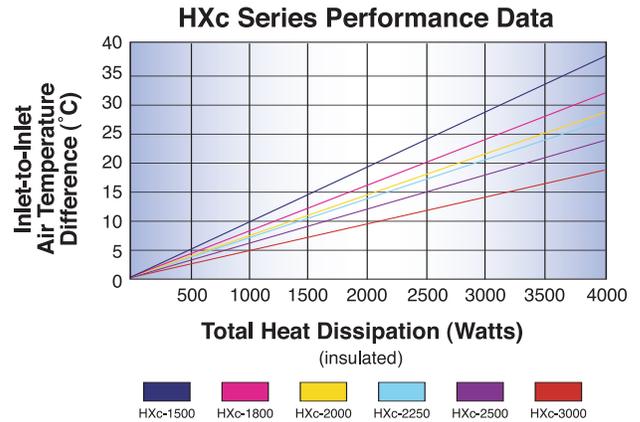
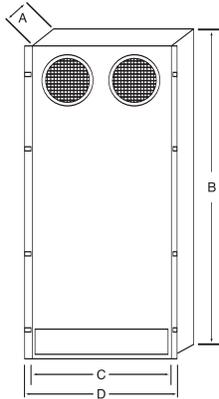
HXc™ SERIES AIR-TO-AIR COOLING: CROSS-FLOW HEAT EXCHANGER

HXc™ - High Capacity Heat Exchangers

For applications exceeding 2000W, Thermacore recommends its high-capacity cross-flow heat exchanger called HXc™. Based on the use of highly effective, cross-flow plate heat cores, the HXc™ units are space efficient and can be easily customized for today's OEM applications. These units can be equipped with such features as Alarms, Heaters and Temperature Controls. HXc™ units can be manufactured to meet Bellcore GR-487-CORE and NEMA 4 (IP 55 and IP 66) requirements.

Constructed from aluminum with optional aluminum epoxy coated plates, the Thermacore cross-flow system is designed for high efficiency while occupying minimum space. The plates are smooth, allowing dirt to pass through the channels without clogging and fowling the exchanger.

The HXc™ series is the efficient and cost-effective answer to large-scale/high-power enclosure cooling for communications and industrial applications.

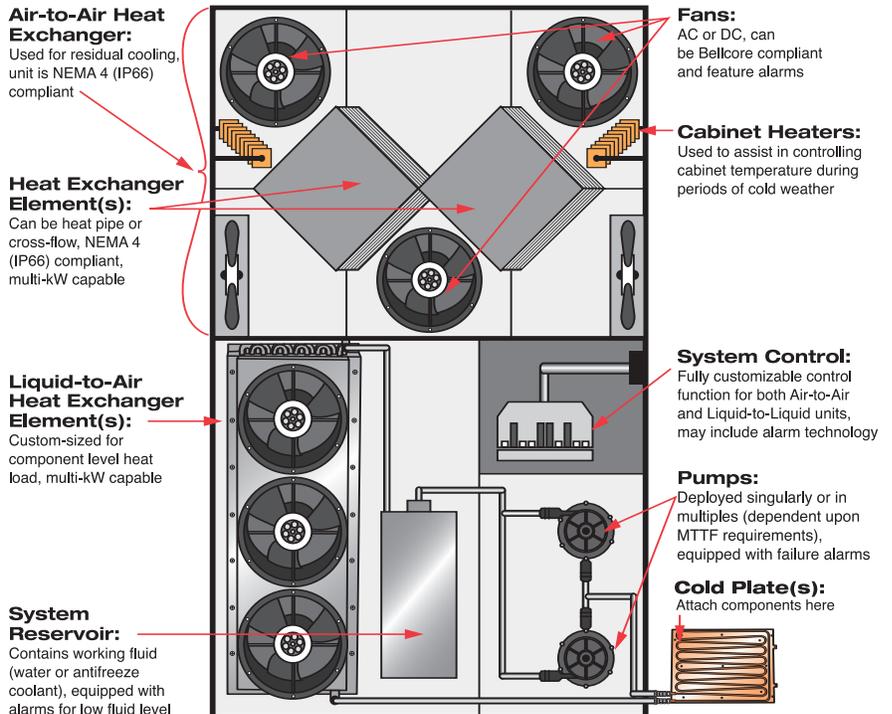


Model	Perf. W/C	# Fans & Diameter	Depth A (mm)	Height B (mm)	Width C (mm)	Flange Width D (mm)	Est. Weight (kg)
HXc-1500	107	2@225mm	160	1050	460	500	22
HXc-1800	120	2@225mm	210	1050	460	500	24
HXc-2000	140	2@225mm	260	1050	460	500	26
HXc-2250	146	4@190mm	260	1050	460	500	29
HXc-2500	167	2@280mm	260	1200	460	500	33
HXc-3000	213	4@225mm	310	1200	460	500	28

Provides Cooling to the Enclosure and High-Heat Dissipating Components in a Unified Package

Thermacore's patented Hybrid Heat Exchanger design utilizes two separate cooling loops: one for cooling components directly and one for cooling the remaining residual heat load in the cabinet. The pumped liquid system is coupled to the heat generating components via a liquid-cooled plate to which the components are attached. The coolant is recirculated in the system and heat is rejected by the liquid-to-air heat exchanger.

- Highly efficient cooling for high heat flux components.
- Liquid-to-Air system capable of multi-kilowatt heat loads.
- Full electronic control of heat transfer functions.
- Can be designed to meet Bellcore, UL and NEBs.



HEAT EXCHANGERS: FREQUENTLY ASKED QUESTIONS



What alarm features can you provide? How?

Temperature control, speed control and fan-failure alarms can be integrated into each heat exchanger. These features can be provided by installing a solid-state control board and/or integrating the feature into the fan itself.

How do you seal the core element in the HXi™ series?

Thermacore uses an RTV sealant to provide a cohesive gasket around both the inner core cassette and the core flange assembly. Each inner core cassette and core flange assembly is subjected to a vacuum test design to simulate NEMA 4 conditions.

Can the fins in an HX™ be coated for environmental protection?

Yes, the typical coating is either a hexavalent chromate or a RoHS compliant clear chromate. Coatings such as Herresite or E-Coat can be added to heat exchangers to provide environmental protection to the unit (minimum volumes apply).

What is the difference between the HX™, HXi™ and HXc™ technologies?

Each technology offers its own merits in regard to size, efficiency, adaptability for customization and power capability. Allow Thermacore to review the application and recommend the best solution.

Do you build custom designs?

This catalog offers a broad product selection of product that will meet the needs of most users. However, Thermacore is dedicated to designing and delivering the custom thermal solutions that OEM customers need. Custom heat exchangers are an important part of our product mix (production minimums may apply).

Can you provide a computer generated model of how your heat exchanger will operate in my application?

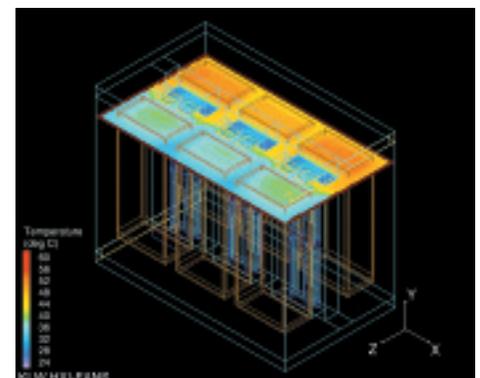
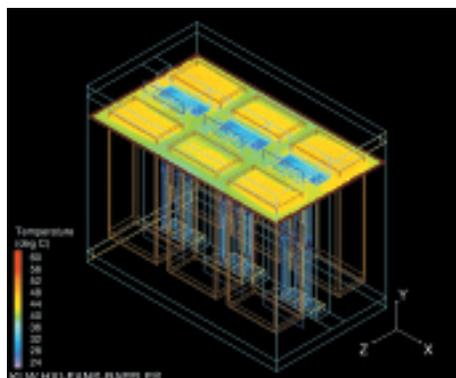
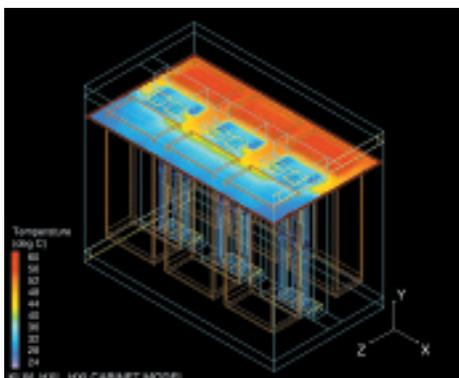
Yes, Thermacore can utilize CFD (computational fluid dynamics) programs such as Flotherm to model the performance of a heat exchanger within the enclosure.

Which of your facilities currently build heat exchangers?

Each of the Thermacore facilities (US and UK) is equipped to build heat exchanger products.

Why should we buy a heat exchanger from Thermacore?

Understanding of the total thermal circuit is crucial to a product's success. Thermacore has the capability to design and manufacture thermal management solutions at the component, board and system levels.





DESIGN GUIDE: HOW TO SPECIFY A HEAT EXCHANGER

Please copy this form, fill it out and fax it to (717)569-8424.

Name		Company	
Address			
City	State	Zip	

Contact
Phone
Fax

E-mail
Estimated 12 Month Demand
Production Required Date

Application Q&A

1. Does the enclosure meet NEMA 4 or 12 (IP55 or IP66) specifications?	Yes	No	
2. Is the heat source non-localized (not component level)?	Yes	No	
3. Is this an indoor or outdoor application?	Indoor	Outdoor	
4. What are dimensions of the cabinet?	(Length)	(Height)	(Depth)
5. What is total power within the cabinet that is to be dissipated by the heat exchanger?	1 Watt = 3.41 Btu		
6. Is the cabinet insulated?	Yes	No	
7. Is there a solar shield on the cabinet?	Yes	No	
8. Is the solar load included within the total power estimate?	Yes	No	
9. What maximum temperature difference is to be maintained between the cabinet and the max. ambient environment? (DT)	$^{\circ}\text{C} = (^{\circ}\text{F}-32)/1.8$		
10. What operating voltage will be required to run the fan system?	(VAC)	(VDC)	(Core Only)
11. Are there any alarms, heaters, or controls required?	Yes	No	

Sketch of Application

<ul style="list-style-type: none"> • Show planned mounting position of heat exchanger. • Identify location of heat generating components. • Indicate planned air flow pattern in the cabinet.
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PHYSICAL DATA



Visit the Heat Exchanger Selector on the **Design Center** at www.thermacore.com to see which heat exchanger best suits your application.

HXi™ SERIES

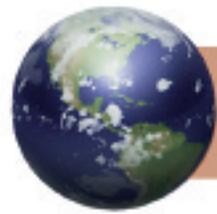
Part No.	Description	Performance	Electrical Requirements	Power Requirements	Material	Mounting Flange	Mounting Position
0002507	HXi-500-12VDC	16W/°C	12 vdc	53 Watts	Aluminum	See pg. 4	Side, Back, Door
0002522	HXi-500-24VDC	16W/°C	24 vdc	41 Watts	Aluminum	See pg. 4	Side, Back, Door
0001423	HXi-500-48VDC	16W/°C	48 vdc	40 Watts	Aluminum	See pg. 4	Side, Back, Door
0001458	HXi-500-115VAC	16W/°C	115 VAC, 50-60Hz	82 Watts	Aluminum	See pg. 4	Side, Back, Door
0002516	HXi-500-230VAC	16W/°C	230 VAC, 50-60Hz	84 Watts	Aluminum	See pg. 4	Side, Back, Door
0002508	HXi-1000-12VDC	33W/°C	12 vdc	106 Watts	Aluminum	See pg. 4	Side, Back, Door
0002523	HXi-1000-24VDC	33W/°C	24 vdc	82 Watts	Aluminum	See pg. 4	Side, Back, Door
0001609	HXi-1000-48VDC	33W/°C	48 vdc	80 Watts	Aluminum	See pg. 4	Side, Back, Door
0001459	HXi-1000-115VAC	33W/°C	115 VAC, 50-60Hz	163 Watts	Aluminum	See pg. 4	Side, Back, Door
0002517	HXi-1000-230VAC	33W/°C	230 VAC, 50-60Hz	168 Watts	Aluminum	See pg. 4	Side, Back, Door
0002509	HXi-1500-12VDC	52W/°C	12 vdc	159 Watts	Aluminum	See pg. 4	Side, Back, Door
0002524	HXi-1500-24VDC	52W/°C	24 vdc	123 Watts	Aluminum	See pg. 4	Side, Back, Door
0001416	HXi-1500-48VDC	52W/°C	48 vdc	120 Watts	Aluminum	See pg. 4	Side, Back, Door
0001460	HXi-1500-115VAC	52W/°C	115 VAC, 50-60Hz	245 Watts	Aluminum	See pg. 4	Side, Back, Door
0002518	HXi-1500-230VAC	52W/°C	230 VAC, 50-60Hz	250 Watts	Aluminum	See pg. 4	Side, Back, Door

HX™ SERIES

Part No.	Description	Performance	Electrical Requirements	Power Requirements	Material	Mounting Flange	Mounting Position
0000097	HX-200-115VAC	4.8W/°C	115 VAC, 50-60Hz	18 Watts	Aluminum (114x127)	4.5"x 5"	Top, Side Back, Door
0001559	HX-200-24VDC	4.8W/°C	24 vdc	5.3 Watts	Aluminum (114x127)	4.5"x 5"	Top, Side Back, Door
0000103	HX-400-220VAC	13.2W/°C	220 VAC, 50-60Hz	29 Watts	Aluminum (171x171)	6.75"x 6.75"	Top, Side Back, Door
0000102	HX-400-115VAC	13.2W/°C	115 VAC,	29 Watts	Aluminum (171x171)	6.75"x 6.75"	Top, Side Back, Door
0001133	HX-400-24VDC	13.2W/°C	24 vdc	14.4 Watts	Aluminum (171x171)	6.75"x 6.75"	Top, Side Back, Door
0000108	HX-800-230VAC	32.0W/°C	230 VAC, 50-60Hz	41 Watts	Aluminum (254x254)	10"x 10"	Top, Side Back, Door
0000107	HX-800-115VAC	32.0W/°C	115 VAC, 50-60Hz	42 Watts	Aluminum (254x254)	10"x 10"	Top, Side Back, Door

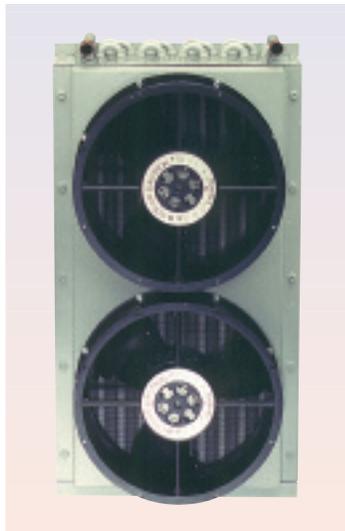
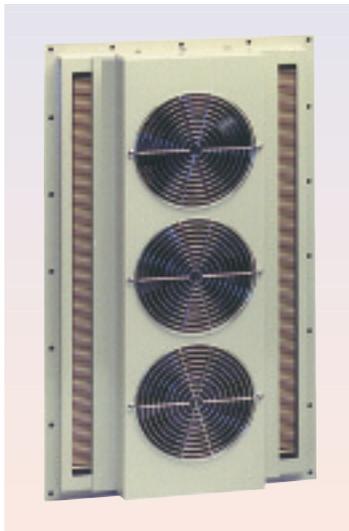
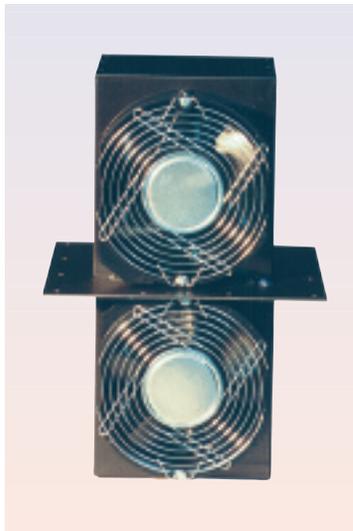
5300 SERIES

Part No.	Description	Color	Fan Yes/No	Voltage	Fitting
0000001	HX5310-ONN	Grey	No	N/A	0.625 O.D. w/0.69 Bead
0000013	HX5320-ONN	Grey	No	N/A	0.625 O.D. w/0.69 Bead
0000025	HX5330-ONN	Grey	No	N/A	0.625 O.D. w/0.69 Bead
0000037	HX5340-ONN	Grey	No	N/A	0.625 O.D. w/0.69 Bead
0000049	HX5350-ONN	Grey	No	N/A	0.625 O.D. w/0.69 Bead
0000061	HX5360-ONN	Grey	No	N/A	0.625 O.D. w/0.69 Bead
0000088	HX5370-ONN	Grey	No	N/A	0.625 O.D. w/0.69 Bead
0000002	HX5310-BNN	Grey	Yes	110 VAC	0.625 O.D. w/0.69 Bead
0000014	HX5320-BNN	Grey	Yes	110 VAC	0.625 O.D. w/0.69 Bead
0000026	HX5330-BNN	Grey	Yes	110 VAC	0.625 O.D. w/0.69 Bead
0000038	HX5340-BNN	Grey	Yes	110 VAC	0.625 O.D. w/0.69 Bead
0000050	HX5350-BNN	Grey	Yes	110 VAC	0.625 O.D. w/0.69 Bead
0000062	HX5360-BNN	Grey	Yes	110 VAC	0.625 O.D. w/0.69 Bead
0000090	HX5370-BNN	Grey	Yes	110VAC	0.625 O.D. w/0.69 Bead



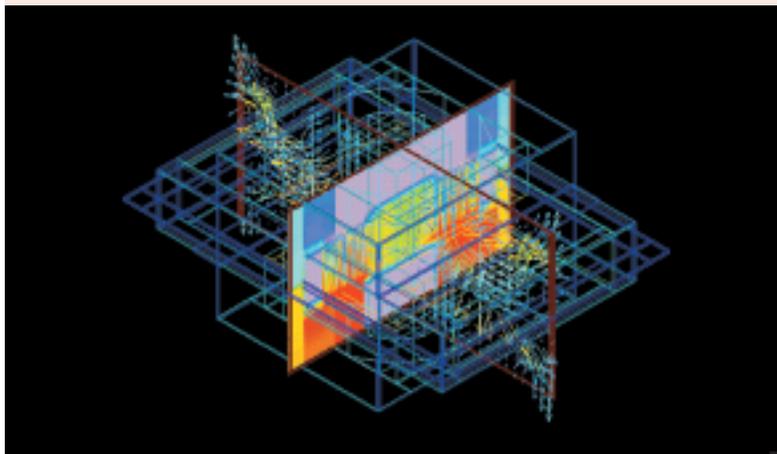
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