ACT

ADVANCED COOLING TECHNOLOGIES





DESIGN | ANALYSIS | MANUFACTURING | TESTING

THE THERMAL MANAGEMENT EXPERTS I WWW.1-ACT.COM

THERMAL MANAGEMENT EXPERTS

ADVANCED COOLING TECHNOLOGIES, INC. IS A PREMIER THERMAL MANAGEMENT SOLUTIONS COMPANY

We serve our customers' thermal management and energy recovery needs in diverse markets including Defense, Aerospace, HVAC, Medical, Enclosure Cooling, and Calibration Equipment. Our extensive product portfolio allows us the ability to meet our customers' performance, cost and reliability requirements.

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200+ EMPLOYEES

150K SQUARE FOOTAGE

2 FACILITIES IN CENTRAL PA

CORE VALUES

- INNOVATION
- TEAMWORK
- CUSTOMER CARE

QUALITY
& CONTINUOUS IMPROVEMENT

The overarching goal for ACT is to provide a superior standard of service to our customers through responsiveness, competitive pricing and most importantly, the quality of our products and services.

ACT continues to improve our quality assurance capabilities through new techniques and technology. It is ACT's commitment to achieve the highest quality standard in the industry, providing our customers with exceptional products and solutions.

PARTNERING WITH YOU AT ANY POINT IN YOUR PROJECT

- ASSESS REQUIREMENT
- DETERMINE FEASIBILITY
- BRAINSTORM CONCEPTS
- CONCURRENT ENGINEERING
- DETAILED THERMAL/ MECHANICAL DESIGN
- DRAWING/MODELING DEVELOPMENT
- PROTOTYPES
- TESTING
- LOWRATE PRODUCTION
- PRODUCTION

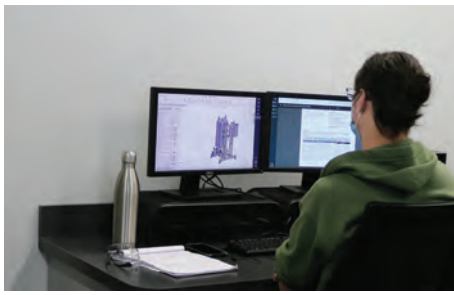
DESIGN AND ANALYSIS

ACT's engineering staff has a wealth of knowledge in CFD and heat transfer analysis. We use commercial software to create or modify computational codes as required.

THERMAL MANAGEMENT CONSULTING

- Feasibility studies
- Trade studies

Save time and avoid costly delays by identifying the correct thermal solution before prototyping



PROTOTYPING & LOW VOLUME PRODUCTION

HIGH VOLUME MANUFACTURING

ISO9001 AND AS:9100D Quality Standards

PRODUCT TESTING

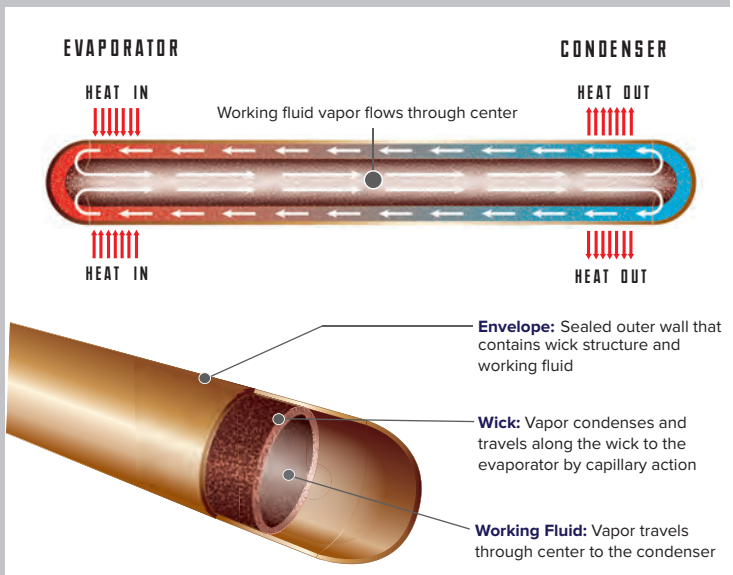
PRODUCTS

FOR ANY TEMPERATURE, ANY POWER

HEAT PIPES are one of the most efficient ways to move heat from one point to another. First developed by Los Alamos National Laboratory for high temperature energy conversion systems in the 1960s, heat pipes are used today in a variety of applications from satellite thermal control to microprocessor-cooling to industrial waste heat recovery. Copper water heat pipes are the most common variant and typically operate in the range of 20-150°C.

WHEN ARE HEAT PIPES USED?

They are used for cooling discrete components by moving heat from the heat generating source to a remote heat sink. The primary use of spot-cooling heat pipes is to decrease component temperature to increase maximum power output.



ACT is the only U.S. manufacturer that routinely ships heat pipe products for terrestrial, spacecraft and high temperature applications.

HEAT PIPE FAQ

BENEFITS

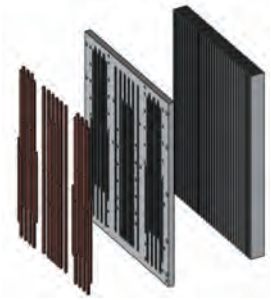
- **High Effective Thermal Conductivity:** Transfer heat over long distances, with minimal temperature drop (i.e. near isothermal operation)
- **Passive Operation:** No moving parts or mechanical or electrical energy input for operation, resulting in long term reliability
- **Lower Costs:** Cost of ownership is inherently low because of the high reliability and system simplicity

HEAT PIPE INTEGRATIONS

HEAT PIPE ASSEMBLIES

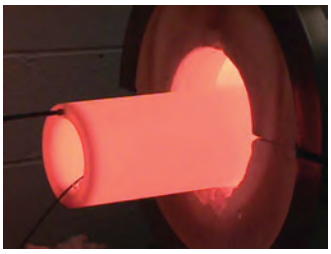
Heat pipes are typically integrated into assemblies in order to fully dissipate critical components' waste heat. Whether the ultimate heat sink is air or liquid cooled, heat pipes can efficiently transport heat and improve overall heat sink efficiency.

HiK™ PLATES (HIGH CONDUCTIVITY PLATES) are heat spreaders with embedded heat pipes. They are particularly useful for cooling multiple high power components. They collect and move heat from discrete heat sources to a liquid-cooled edge or an air-cooled heat sink with minimal temperature gradients.



VAPOR CHAMBERS are planar heat pipes used for cooling extremely high heat flux electronics. A vapor chamber can accept heat from one or more sources and transfer the heat to an integated air-cooled heat sink or liquid-cooled edge rails.

HEAT PIPE VARIANTS



HIGH TEMPERATURE HEAT PIPES (also known as alkali metal heat pipes) are typically defined as heat pipes that operate between 400 and 1100°C. They are often used to provide precise temperature uniformity or provide high-temperature heat transfer.

ISOTHERMAL FURNACE LINERS (IFLS) & HEAT PIPE BLACKBODY CAVITIES are annular heat pipe-based products that provide a highly stable and uniform temperature work zone. IFLs enable this work zone when inserted into a tubular furnace; and Blackbodies use a hemispherical end cap to form an isothermal blackbody cavity.

PRESSURE CONTROLLED HEAT PIPE FURNACES (PCHP) provide significantly improved temperature stability and temperature control.

THERMAL STORAGE

PHASE CHANGE MATERIAL (PCM) HEAT SINKS are used for for military, aerospace and industrial thermal management applications. PCM Heat Sinks can absorb thermal energy (heat) with minimal temperature rise during the solid to liquid phase transition. During this phase transition, the latent heat (J/kg) is at least one (1) to two (2) orders of magnitude higher than the sensible energy that can be stored by the specific heat of a material in its solid or liquid phase. Figure 1 illustrates this phenomena by plotting the temperature rise of a PCM over time with a steady state energy input.

BENEFITS

- Absorbs heat with minimal temperature rise during the PCM's solid to liquid phase transition.
- The latent heat of the phase change is at least an order of magnitude higher than the sensible heat that can be stored.
- Particularly useful for pulsed power applications; rapid on/off cyclying benefits from thermal storage technology.
- Prevents overheating by providing temporary heat storage during the transient peaks of heat generation.
- Reduces thermal mass, volume and consumption without the need to oversize the compressor, you can size for peak load rather than average.

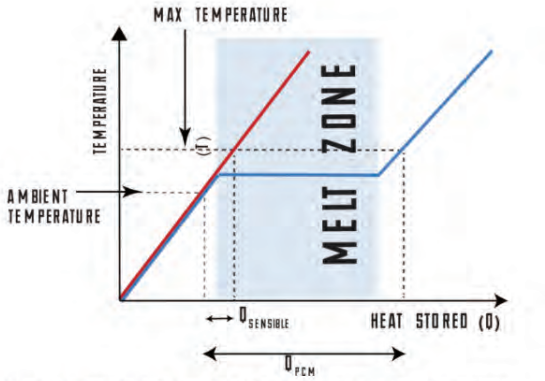
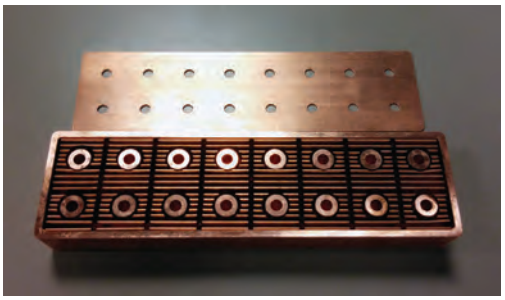


Figure 1. Temperature Rise vs Time. Temperature is maintained during phase transition.



PCM HEAT SINK CALCULATOR

PCM HEAT SINKS CAN ALSO INCORPORATE HEAT PIPES TO ADD A HIGH K_{EFF} ELEMENT TO THE PCM

"It was a real pleasure to work with ACT due to their technical capability, product performance, and professionalism."

- LEADING AEROSPACE COMPANY

EMBEDDED COMPUTING SOLUTIONS

SYSTEM AND SUB-SYSTEM LEVEL COOLING

Embedded Computing is an important aspect of defense electronics systems, routinely fielded in aerospace, ground and naval applications. Many critical functions such as data processing, Electronic Warfare (EW), imaging and communications are made possible by specially designed embedded computing systems.

Defense systems require significant computing functionality and speed, leading to high levels of waste heat, which must be managed without affecting the systems' durability or form factor. Complicating the thermal design, embedded computing systems are trending harshly towards higher power and smaller footprint electronics. ACT's team of engineers are well versed on the system and component level challenges and provide a variety of solutions for these types of systems.

ONLINE ORDERING

ICE-LOK™ WEDGELOCK is a thermally enhanced wedgelock for conduction cooled embedded computing systems. Compared to a conventional wedgelock, an ACT ICE-Lok™ provides additional heat transfer paths between the card and the chassis, allowing heat to avoid traveling through numerous high resistance metal-to-metal interfaces. This allows for longer life and higher reliability for critical components, without costly board or chassis redesigns.

2021 Military & Aerospace Electronics Innovators Awards PLATINUM HONOREE

The form factors are compatible with standard VITA systems.

>30% LOWER THERMAL RESISTANCE

HIK™ CARD FRAMES increase thermal conductivity. In conduction systems it's paramount to get heat efficiently to the edge, and spread heat along the edge to lower heat flux into the chassis. Heat pipes can be strategically placed to accomplish both goals simultaneously. On air cooled boards, the increased thermal conductivity will isothermalize the fin stack base and reduce hot spots, optimizing fin efficiency.

HIK™ CHASSIS OR CARD GUIDES include heat pipes implemented into the sidewalls to enhance thermal conductivity and reduce conduction gradients. These are particularly effective when the ultimate heat sink is a located at the base of the chassis.

CUSTOM LIQUID COLD PLATES drive performance when implemented at the board, chassis sidewalls, or chassis base level. For a system level design, there are often significant manufacturing and packaging considerations to work through in parallel.

SPACECRAFT THERMAL CONTROL

INDUSTRY LEADING INNOVATION

With trusted expertise in engineering and manufacturing aerospace thermal control systems, ACT consistently delivers innovative solutions to meet the most demanding performance requirements.

BOARD AND CHIP LEVEL SOLUTIONS

- SATELLITES
- ROVER & EXPLORATORY MISSIONS
- LANDERS & PAYLOADS
- GROUND STATION COOLING

CONSTANT CONDUCTANCE HEAT PIPES (CCHP) use miniature grooves as the wick structure and ammonia or other low freezing temperature fluids as the working fluid to efficiently transfer heat in microgravity. ACT has in house qualified aerospace welding and x-ray capabilities to help you meet your tight launch schedule.

SPACE COPPER-WATER HEAT PIPES (SCWHP) AND HiK™ PLATES FOR SPACE are uniquely manufactured to survive the severities of spaceflight operation. ACT has developed precision processing and sealing techniques in order to pass numerous space qualification programs.

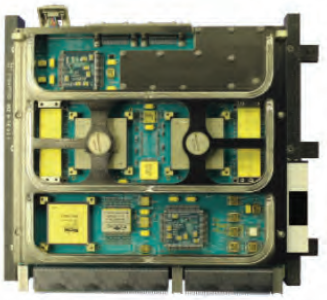


Photo courtesy of BAE systems, showing ACT SCWHP embedded in a SpaceVPX Reconfigurable Computing Module (RCM)

SPACEVPX solutions from ACT solve the thermal challenges at the chip level. Utilizing ICE-Lok™ and Space Copper-Water Heat Pipes (SCWHPs) for in space flight applications, allows customers to manage high heat flux of the electronics.

PHASE CHANGE MATERIAL HEAT SINKS are a valuable technology for spacecraft thermal control. They provide thermal storage for smoothing temperature swings during cyclic operation allowing thermal solutions to be designed for the average heat load rather than the peak load.

VARIABLE CONDUCTANCE HEAT PIPES (VCHP) provide passive control, ensuring consistent payload temperature.

LOOP HEAT PIPES (LHP) can passively transport a large amount of heat (several kW) many meters in micro gravity. Some advanced LHPs have sophisticated control features to enhance thermal control. 3D printing has enabled application of LHPs at a fraction of the cost of traditional LHPs.

"ACT worked closely with the ITT team to successfully manufacture and deliver complex heat pipes for integration at ITT. At the end of the program, ACT received an outstanding supplier award from ITT (Harris)."

-CASE STUDY

POWER ELECTRONICS COOLING

NEXT GENERATION COOLING TECHNOLOGY

At ACT, we do much more than provide components for power electronics cooling. Our team can design, qualify and manufacture a complete system sized and developed for your unique needs. With in-house code coupled with commercial FEA and CFD packages, ACT can support quick designs and validation to give you confidence in a given solution. No matter if the thermal solution is air, liquid or two-phase, ACT has engineering expertise to support your program.

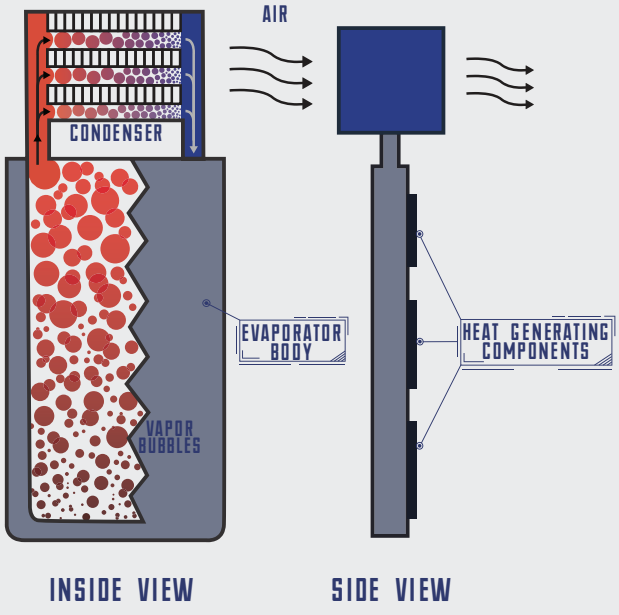
POWER ELECTRONICS COOLING STRATEGIES			
HEAT PIPE ASSEMBLY	LOOP THERMOSYPHON	PUMPED TWO-PHASE	ENCLOSURE COOLER
DEVICE LEVEL COOLING			Cabinet Cooling
Low Power Up to 2kW	Medium Power Up to 75kW	High Power Up to 500kW	Up to 5kW

LOOP THERMOSYPHONS use passive heat transfer technology to move large amounts of waste heat; this scalable technology has been demonstrated from less than 1kW to up to 100kW.

Heat generated by power electronics causes liquid within the loop thermosyphon evaporator to evaporate. The resulting vapor travels in the vapor line to the condenser, which is cooled by airflow. The condensed liquid then returns to the evaporator through a separate liquid line, completing the two-phase loop. This results in an extremely high performance cooler that requires no moving parts or external power for its operation.

BENEFITS

- Passive Operation
- Di-Electric Fluid Options
- High-Performance
- Geometric Design Flexibility
- Ability to Move Heat Very Large Distances



PUMPED TWO-PHASE (P2P) COOLING SYSTEMS transfer heat by the evaporation and condensation of a portion (or all) of the working fluid.

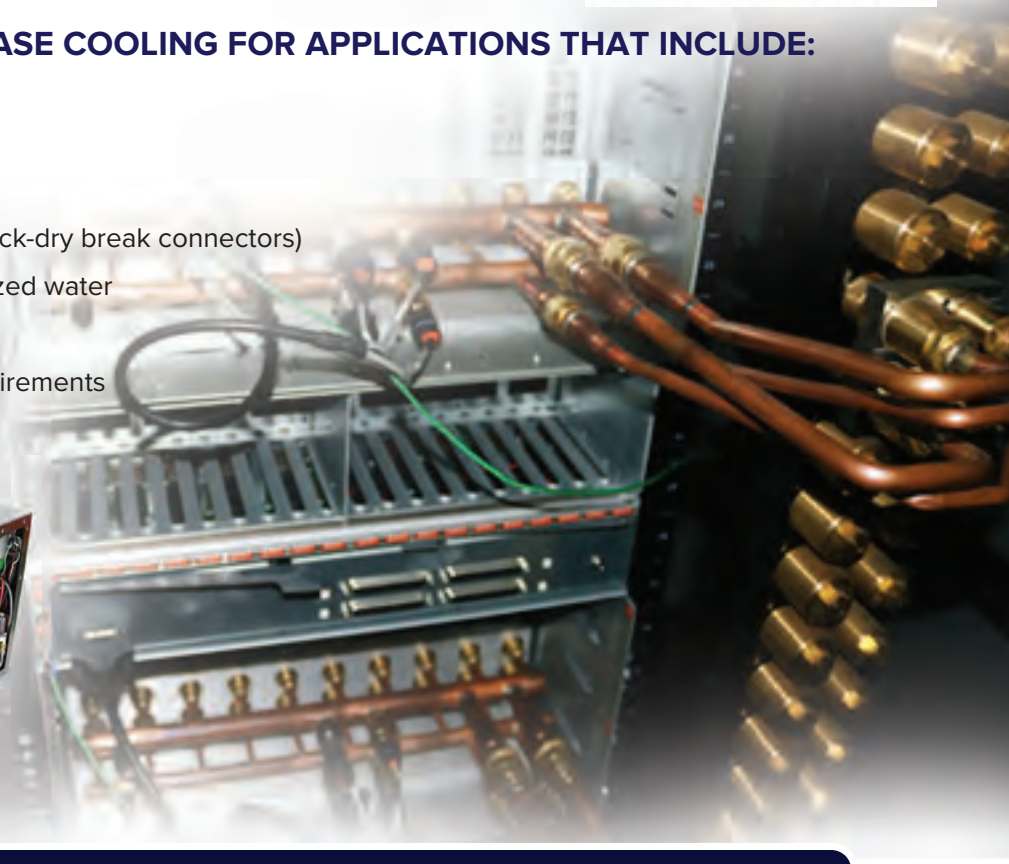
Typically, a liquid (generally a di-electric fluid) near saturation is pumped into the cold plate (evaporator), where it starts to boil, cooling the electronics. The two phase (liquid and vapor) fluid then flows to the condenser, where the heat is dissipated using a heat exchanger, causing the vapor to condense. The system pressure forces the single phase (liquid) to exit the condenser and the cycle repeats.

ACT WINS

2020 Military & Aerospace Electronics INNOVATORS AWARDS GOLD HONOREE

CONSIDER PUMPED TWO-PHASE COOLING FOR APPLICATIONS THAT INCLUDE:

- Critical packaging constraints
- A propensity for high cyclical loads
- Variable heat loads
- A modular and easy field service (quick-dry break connectors)
- Involve high-voltage and use de-ionized water
- Elimination of the chiller
- Extreme temperature uniformity requirements



PUMPED TWO PHASE SYSTEM ADVANTAGES

- Increased power density
- Reduced weight
- Smaller enclosures
- 2 to 4 times better heat transfer
- Lower flow rates - 85% less than that of EG water systems
- Increased system reliability and MTBF
- Safer - no risk of electrical shorting

- Modular; scalable; hot swappable
- No altitude or hot climate de-rating
- Isothermal, increasing silicon life and simplifying plumbing
- Smaller pumps with 50,000 L10 life
- Opportunity for reduced wiring, switchgear, magnetics

- Ability to free cool - reduced HVAC system heat load
- 85% reduced energy consumption
- Shorter commissioning time
- Maintenance-free; no set-up, biocides, filters, tear downs
- Less thermal cycling for increased electronics life

SEALED ENCLOSURE COOLING

KEEPING YOUR POWER ELECTRONICS CLEAN, COOL AND OPERATIONAL

We understand your need for quick and cost-effective solutions available with easy online ordering. For help selecting the right enclosure cooler for your cabinet, our design selection tool leverages background engineering logic for the perfect fit.

HSC SERIES

HEAT SINK COOLER
HEAT EXCHANGER

ECONOMIC

Part Number	Thermal Capacity W @ 20°C ΔT
ACT-HSC-22:	440
ACT-HSC-45:	900
ACT-HSC-68:	1,360

HPC SERIES

HEAT PIPE COOLER
HEAT EXCHANGER

COMPACT

Part Number	Thermal Capacity W @ 20°C ΔT
ACT-HPC-15:	300
ACT-HPC-40:	800
ACT-HPC-50:	1,000
ACT-HPC-80:	1,600

TEC SERIES

THERMOELECTRIC COOLER
AIR CONDITIONER

ENVIRONMENTALLY FRIENDLY

Part Number	Cooling Capacity (Watts) at 0° C ΔT
ACT-TEC-90:	90
ACT-TEC-300:	300

VCC SERIES

VAPOR COMPRESSION
COOLER
AIR CONDITIONER

HIGH POWER

Part Number	Cooling Capacity (Watts) at 0° C ΔT
ACT-VCC-1000-DC:	1000
ACT-VCC-2000-AC:	2,000
ACT-VCC-3000-DC:	3,000
ACT-VCC-5000-AC:	5,000

ONLINE SELECTION TOOL

This tool was designed by our engineering team to help you quickly and easily select the appropriate cooler for your application.

ONLINE ORDERING

Get your units fast with our convenient and easy to use online ordering platform.

SPECS & DATA SHEETS

Download everything you need to know about ACT's sealed enclosure cooling product lines.

ENERGY RECOVERY SOLUTIONS

HVAC HEAT PIPE HEAT EXCHANGERS

HVAC HOME PAGE

ACT's HVAC solutions provide effective and affordable energy recovery during the hot summer and cold winter months as well as throughout the year. Compared to traditional energy wheel technology, heat pipe heat exchangers require less maintenance as they have no moving parts, and the passive systems require no external energy for their operation.

WRAP-AROUND SYSTEMS
(Enhanced Dehumidification)

- Energy Savings
- Passive System
- Enhanced Dehumidification
- Pipe to pipe WAHX
- Split Loop & Pump Assisted Split Loop WAHX

AIR-TO-AIR ENERGY RECOVERY SYSTEMS

- Maintains zero cross contamination between air streams
- Energy Savings
- Passive System

CUSTOMIZATION OPTIONS FOR CONTROL

- Capacity Control
- Frost Control
- Reheat Control

ENERGY RECOVERY

NO CROSS-AIR CONTAMINATION

ENERGY COST SAVINGS

PUMP ASSISTED SPLIP LOOP THERMOSYPHON HVAC HEAT EXCHANGER

BENEFITS

- Compatible with large systems or long distance
- Energy efficient
- Optional temperature control (without the need for bypass dampers)
- Compact packaging
- Design flexibility
- High reliability, low maintenance needs

AHR EXPO INNOVATION AWARDS 2021 WINNER

INNOVATIVE SOLUTIONS FOR EXTREME ENVIRONMENTS

ENVIRONMENTAL CONTROL UNITS (ECUS) are machines that are responsible for taking in the ambient air, cooling (or heating) it, and returning the conditioned air to the controlled space, which may include shelters, base camp facilities, or command centers. This keeps the equipment at optimum temperature and humidity, as well as keeping personnel safe and comfortable during deployment.

Unlike commercial air conditioners, Tekgard ECUs are designed to be rugged. They must survive the rough terrain that the military encounters daily and they need to remain in operation at the extreme temperatures and conditions to which they will be exposed. Tekgard ECUs are mobile, capable, durable, and proven solutions for environmental control needs.

ECU CONFIGURATIONS

HORIZONTAL

UNITARY

VERTICAL

LIQUID COOLERS AND CHILLERS keep mission-critical equipment at optimum operating temperatures, Tekgard liquid chillers and heat exchangers are proven, with fielded heritage in dozens of deployed operations. These units deliver superior results for high-intensity workloads. Radar and missile defense programs rely on our chillers to keep their systems cool and their personnel safe. Thanks to their rugged design and build quality, Tekgard chillers can support operations anywhere in the world.

LIQUID-TO-AIR SYSTEMS rejects heat to the ambient air and provides cooling fluid at a maximum specified increase over the ambient temperature.

CHILLER SYSTEMS are utilized where cooling fluid below ambient temperature is needed. These include a vapor-compression cycle to provide cold coolant even when ambient temperatures reach 60°C +(140°F).

VIEW TEKGARD PRODUCTS ONLINE

CUSTOM UNITS DESIGNED TO YOUR SPECS

- Rugged, user-friendly ECUs
- Multiple size packages and control strategies
- Mil-Std-810 and Mil-Std-461 tested
- Max/Rating Temperatures up to 140°F (60°C)
- 120 / 208 / 230 / 270 / 380 / 460 Volts
- Single and 3 Phase, 50 / 60 / 400 Hz Power
- MIL-STD-810G qualification testing
- Quiet fan technology <70dbs
- Active Dehumidification
- EMI compatibility
- Soft Start & Load Shedding capability
- Remote Control options
- Customizable ducts (diameter, length, and color)
- Variable Speed Fans available for many sizes

BOTH RUGGED AND INDUSTRIAL APPLICATIONS

SYSTEM INTERFACE

INPUT POWER: 120-480 Voltages, single or 3 phase, 50 HZ, 60 HZ, 400 HZ or DC power options

POWER AND CONTROL CONNECTIONS: Hard-wired or with your preferred MIL-STD connector

FIELDED EXAMPLES

HOWLER COUNTER-DRONE SYSTEM

This program combines the Coyote Block 2 Unmanned Aerial System (UAS) with the Ku-band Radio Frequency System (KuRFS). The KuRFS radar system tracks incoming enemy drones and other aerial threats, simultaneously guiding the Coyote UAS to safely destroy these dangerous targets. The Tekgard chiller functions as a key part of the system, ensuring the equipment remains at the optimum temperature for reliable operation.

PATRIOT AIR AND MISSILE DEFENSE SYSTEM FMS CASES

As a subcontractor to Tyonek: Tekgard developed custom ECU systems for the shelters of the Patriot Missile Defense system. This MIL-STD-qualified equipment proved to be reliable in some of the harshest weather conditions on the planet.

PROVIDING RUGGED THERMAL SYSTEM SOLUTIONS

RESEARCH AND DEVELOPMENT HAS BEEN A CORE COMPETENCY OF ACT SINCE ITS INCEPTION and continues to lead our product and market diversification efforts. ACT's research focus areas include a variety of topics.

ADVANCED PUMPED SINGLE & TWO-PHASE COOLING SYSTEMS provide the ability to cool high power and high heat fluxes up to 1200W/cm², while operating in any orientation.

ADVANCED HEAT EXCHANGERS are used for pulsed power systems, passive temperature control of chemical reactant streams, and direct contact heat transfer situations.

ADVANCED THERMAL STORAGE SYSTEMS using tunable phase-change materials and metal hydrides or salt hydrate materials can be a volume saving solution.

PHASE SEPARATION TECHNOLOGY for uses in multiple industries. The patented Momentum-driven Vortex Phase Separator provides gravity-independent separation and inventory management of liquids, gases, and solids.

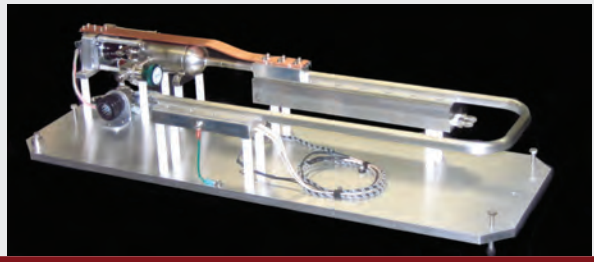
DIRECTED ENERGY WEAPON (DEW) COOLING: research has achieved up to 50% system mass reduction by combining P2P technology with PCM thermal storage. The thermal storage allows the heat to dissapate gradually from an energy pulse.

COMBUSTION AND SYNFUELS research includes fuel reforming for fuel cells or JP8 (Swiss Roll Reformer), nano-catalysts for low temperature methanol combustion, and solar power for synfuels and coal gasification.

ADVANCED COATINGS available for corrosion/erosion resistance, boiling enhancement, wettability control, and Plasma-Enhanced CVD coatings for nanoparticles.

ADVANCED MULTI-SCALE MODELING AND RESEARCH provides the ability to model material behavior in extreme environments. Capabilities include: atomic scale modeling, Boltzmann transport models for semiconductors (gate level), peridynamics-based damage and corrosion fatigue models, and reactive multi-phase flow modeling for gasification and chemical processes.

ADVANCED HEAT PIPES Standard heat pipes act as thermal superconductors, transmitting heat with minimal temperature drop in both directions. By adding small amounts of Non-Condensable Gas (NCG) and modifying the heat pipe design, it is possible to create many heat pipe variations that provide temperature control. Other advanced heat pipes include CTE match high heat flux vapor chambers (>1,000 W/cm^2), as well as heat pipes with new working fluids and envelopes for high temperature and cryogenic applications.



ONLINE TOOLS & RESOURCES

HEAT PIPE CALCULATOR This program will give a performance curve of a copper-water heat pipe with the given input values. This curve is a guide for ACT's standard heat pipes; custom solutions are readily available to meet a large variety of design specific requirements.

THERMAL STORAGE CALCULATOR This program can be used to determine the approximate size and mass of a Phase Change Material (PCM) heat sink required for thermal storage applications.

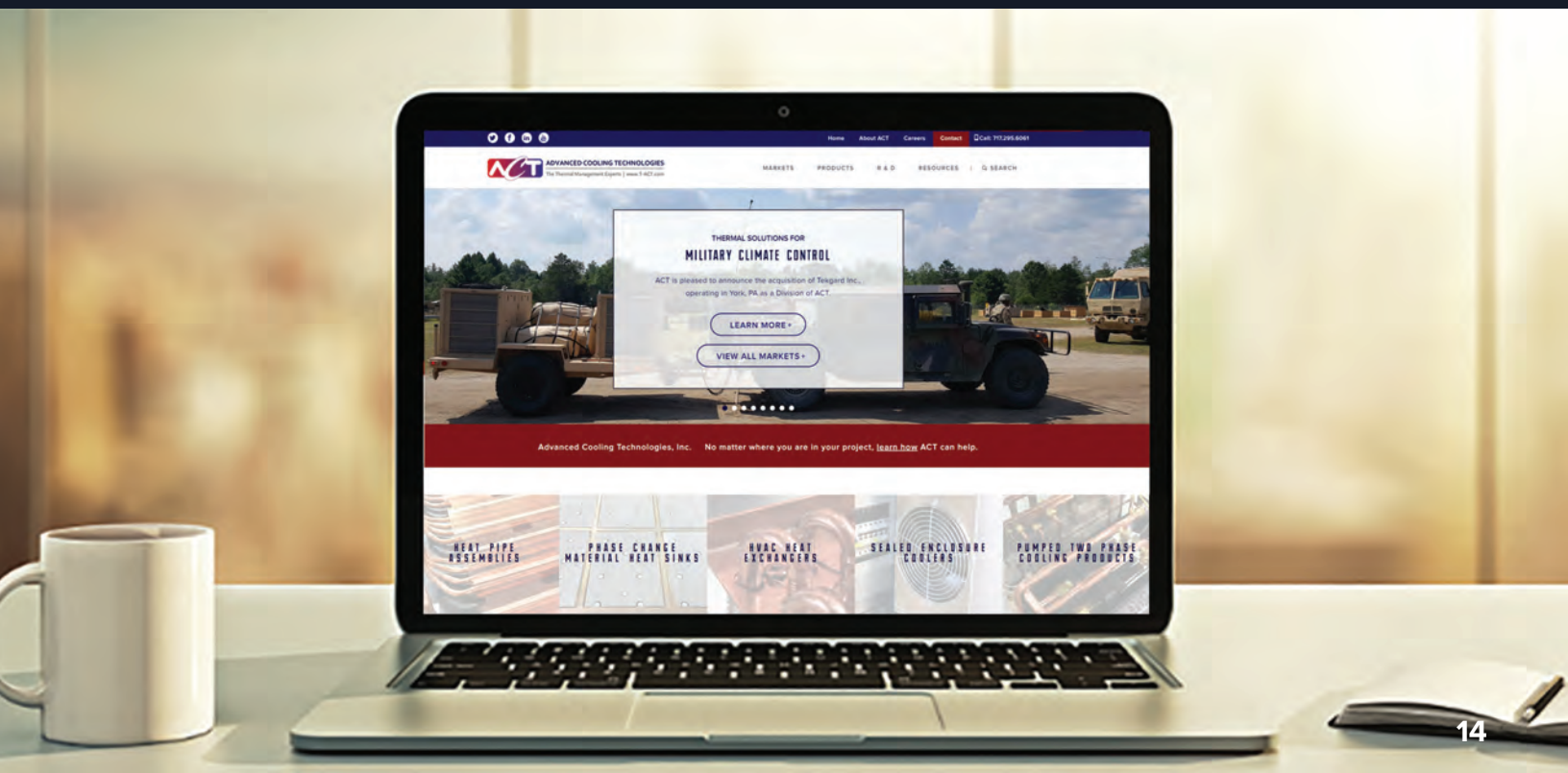
HVAC ONLINE SELECTION TOOLS will assist the HVAC design engineer in the proper selection of an Air-to-Air Heat Pipe Heat Exchanger (AAHX) or a Wrap-Around Heat Pipe Heat Exchanger (WAHX) and provide energy savings estimates. The tool provides the designer with the capability to perform a preliminary design selection and to evaluate and rate the AAHX or WAHX performance at various design conditions. It is also intended as a tool to communicate engineering requirements to ACT for additional evaluation.

ENCLOSURE COOLING ONLINE SELECTION TOOL This program will assist end users in the proper selection of an enclosure cooler. The tool will select the best Enclosure Cooler products based on user inputs, allowing for easy online purchase.

ONLINE ORDERING ACT offers online ordering for it's line of Sealed Enclosure Coolers and ICE-Lok™ products. Choose your product and preferred options and conveniently pay online.

WEBINARS Our library of webinars cover a wide variety of thermal management topics and discuss industry trends, the latest technology, and more.

HEAT PIPE RESOURCES PAGE contains the most extensive information on heat pipes and related technology available anywhere on the web, including Fundamentals, Limits, Wicks, Working Fluids and Envelopes, Different Kinds of Heat Pipes, and Advanced Developments.



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ISO 9001 & AS9100 Certified
ITAR Registered

MARKETS

Avionics/Aircraft
Electronics Cooling
Enclosure Cooling
HVAC Energy Recovery
Materials Processing
Medical
Military
Photonics
Power Electronics
Solar
Spacecraft Thermal Control
Temperature Calibration & Control
Transportation

PRODUCTS

Heat Pipes for Thermal Management
Spacecraft Thermal Control
Embedded Computing Solutions
Pumped Two-Phase Cooling (P2P)
Phase Change Material (PCM) Heat Sinks
Tekgard ECUs & Chillers
Sealed Enclosure Coolers
HVAC Heat Exchangers
Loop Thermosyphon
ICE-Lok™ (Isothermal Card Edge wedgelock)
Liquid Cold Plates - Custom
Furnace Liners (IFLs) and Blackbody Cavities
Custom Thermal and Mechanical Systems

RESEARCH & DEVELOPMENT

THERMAL TECHNICAL SERVICES