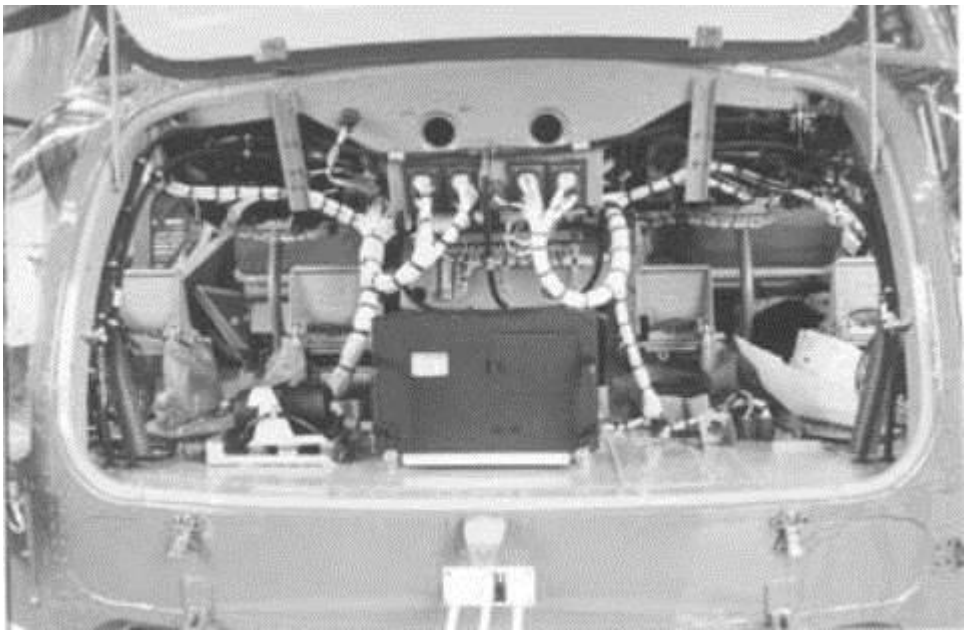
Erickson Aircrane

Providing services out of the ordinary

Wiring harnesses are put to use in hundreds of unusual ways. One of the most unique applications is in 19 helicopters produced and owned by Erickson Air-Crane (EAC), an international company based in southwestern Oregon.

Even the services provided by EAC helicopters are out of the ordinary. For example, they are used to fight forest fires, haul logs out of forests, construct ski lifts and tramways, install towers for power transmission lines and move petroleum drilling rigs and platforms.



Inside the upper nose compartment contains all Navigation, GPS, Communications and Gauges.

(Photo courtesy of EAC)

Other Erickson helicopter services include installing heating, ventilating and air-conditioning (HVAC) units on buildings; placing steel beams and sections in place during high-rise building construction; positioning artworks, statues and ornamental steel pieces; dropping plant seeds on steep terrain; and transporting heavy mining construction equipment.

EAC helicopters are based on Sikorsky Skycranes that were built in the 1950s and '60s by Sikorsky Aircraft Corp. in Stratford, Conn. The copters were constructed in commercial models for use by companies as well as military models for use by U.S. forces, primarily in Vietnam.

In 1971 Jack Erickson, a second-generation logger who owned Erickson Lumber Co. in Marysville, Calif., leased a Skycrane from Sikorsky for aerial timber harvesting. After successfully adapting the helicopter to hauling logs out of inaccessible places, he bought four Skycranes the following year, and the company name was changed to Erickson Air-Crane.

In addition to logging, for the next 20 years the helicopters mainly were used for erecting power transmission line towers in the West and putting HVAC units on buildings along the East Coast. In 1992 the Erickson company acquired the manufacturing rights to the Sikorsky helicopter, meaning any Sikorsky helicopter remanufactured by EAC could bear its name and not Sikorsky's.

An Erickson is identified easily by its appearance. With no compartment for carrying passengers, the belly of the aircraft is open. Thus, the machine resembles a grasshopper.

A remanufactured S-64 Aircrane Helitanker awaits final flight testing before being released to the Korean Forest Service.
(Photo courtesy of EAC)

While lifting is the primary function of the Erickson fleet, each versatile helicopter can be converted in 3-4 hours into a Helitanker for firefighting. Attached at eight points on the fuselage, the 2,650-gallon tank can be filled with water, retardant or foam mix. The tank replaces the hoist, winch and stiff pendant (with a six-foot cargo hook) used for lifting.

Liquid can be sprayed on a fire up to 30,000 gallons per hour. That is possible because the tank can be filled by a snorkel system in 45 seconds from a water source whose depth has to be a minimum of only 18 inches.

The tank contains eight doors. Controlled by microprocessors, the doors can be opened for eight coverage levels and adjusted for copter airspeed. Liquid also can be shot at a fire with a cannon delivering a horizontal stream up to **160 feet** at **300 gallons per minute**.

Controlling the water cannon, tank doors and all other components and systems on each Erickson helicopter is done by an elaborate series of wiring harnesses that are completely new when the aircraft is built. EAC buys old Sikorsky helicopters that are stripped bare and rebuilt as if new. Each machine requires approximately three months to build. When finished, it costs $**15 million** to purchase.

"We have 19 helicopters in the Erickson fleet that are used all over the world," said Gari Wolff, supervisor of the EAC Electrical and Avionics Department. "Therefore, we're busy with them all the time. We also have 8-10 old Sikorsky military airframe hulks in stock to rebuild." The firm also maintains three UH-1 "Huey" helicopters (also from the Vietnam era) and two corporate airplanes.

Technicians completing final avionics adjustment on the Aircrane before test flight.

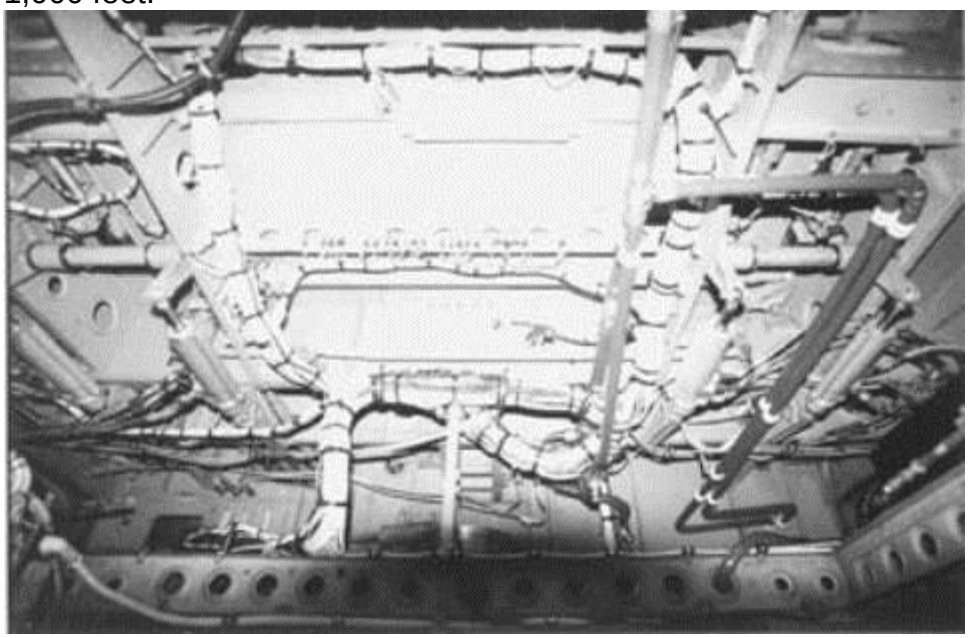
According to Wolff, each helicopter requires approximately six miles of wire. Most of the wire is made of tin-coated copper, and some is produced with tin-coated silver. All of the wire has a high-tech polyurethane coating. It is nontoxic, should the wiring catch on fire. The wire insulation is made of fluoropolymer, cross-linked Teflon.

"Our wire meets military specifications," Wolff said. "That is our requirement. The Federal Aviation Administration does not require military specs, but it does accept them."

Wire in 18, 20 and 22 gauges is used. The larger gauge is for power supply, while the smaller gauge meets control requirements. For instance, the 20-gauge wire can handle up to 7.5 amps, and the 18-gauge wire is rated at a maximum of 15 amps.

"The wire is rated for a certain job by our engineers," Wolff said. "They specify the gauge wire to use, but it is flight and shop tested before it is used on the aircraft."

Specifications for the wire are built around several factors. Among them are the cross diameter of the wire, temperature rating and maximum resistance per 1,000 feet.



Inside of lower nose compartment of S-64 Aircrane helicopter.

Wire, connectors and terminals are obtained from various suppliers, Wolff said. His department enters its needs into a computer, and EAC's purchasing department acquires all materials. Many of them are stockpiled in an EAC warehouse to meet production needs.

"We have a good chain of people to get us what we need," Wolff said. "Our vendors are good at giving us leads if they don't have the materials we need."

Each harness is made in-house wire by wire as a system is installed on the helicopter. Only the engine harness is constructed on a bench, consisting of large plywood sheets.

Harness testing is done after installation when systems and components are put into operation. "A wiring harness is not tested per se," Wolff said. "However, every wire runs through everybody's hands."

A major harness can span the length of the helicopter. Such a harness, which can be three inches in diameter, has up to 200 wires. Smaller system harnesses branch off from a main harness, and each of the smaller clusters contains up to 30 wires. A smaller harness can be up to a half-inch thick.

The harnesses on every Erickson copter are divided into main disconnects. Each disconnect has six 55-pin cannon plugs that use military threaded and snap connectors. "In theory, the main disconnects enable us to change the rear or the cockpit harnesses, but in actuality we've never had to do that," said Wolff, who has worked seven years at EAC as a hands-on lead supervisor.

Servicing the instrument panel are four major disconnects. Each has 75-pin square plugs with 18-gauge wire.

Another large junction point is for the buss for the radio and audio. They provide communication through the pilots' headsets, push-to-talk mechanisms and audio microphones. Since the devices operate on low current, 22-gauge wire suffices. However, much of it is shielded with tin and copper braiding.

Each wire is labeled every six inches by hand using a pedal-operated Kingsley heat transfer machine. For easy reference, the wire numbers correspond to those on wiring schematics.

None of the harnesses is wrapped. Some portions of harnesses are strung through conduit in open areas of a helicopter. However, the harnesses are tied every 4-5 inches and strapped down tightly to avoid damage due to vibration.

Vibration also contributes to chafing where the harnesses cross one another or encounter bends in the helicopter. To further protect the harnesses, they are wrapped at those points with rubber up to an eighth-inch thick. The wiring serves two systems. One is 115 volts AC, and the other is 28 volts DC, which is enabled by two 200-amp transformer rectifiers.

Serving as the primary power source is the AC system, which includes two 3-phase generators. Each is driven off one of two turbine engines on the helicopter. "One generator can run the aircraft, but both are run through interlocking relays," Wolff said. "It is a redundant system, so if one power source is lost, the other is available."

Emergency AC power is provided by a battery and an inverter. The battery is a 28-volt unit, standard for a heavy-duty aircraft such as the Erickson helicopter. The voltage is twice as much as that used in a general aviation aircraft. The amp loads are highest for the generators. Protection is provided by a cross-feed current limiter

that is maximized at 60 amps on the DC system. However, the system usually only sees 40 amps.

Wolff also pointed out the power system has current limiters that resemble large fuses to protect against cross-feeding. Feeder fault systems detect irregularities in voltage, such as it being over or under and in or out of phase. An auxiliary powerplant is used. It is a small turbine engine that operates the accessory drive on the transmission. The drive keeps the generators operating on the ground without the transmission turning or the engines running.

Workers in the EAC Electrical and Avionics Department are involved in maintaining the company's fleet, which is stationed all over the world. They travel frequently to remote locations to fix the copters with electrical problems. Although the firm is based in Central Point, Ore., subsidiaries are located in British Columbia, Canada; Lima, Peru; and Sibu, Malaysia. Erickson helicopters also have done logging, firefighting and lifting work in Korea, Australia, Borneo (island country southwest of the Philippines), Turkey, Greece, Ecuador, Mexico and all across the United States, Canada and Europe.

"It happens quite a bit that our people have to do work in the field," Wolff said. "Regular crews maintain the aircraft out there, but sometimes they'll get into some headaches that will be over their heads. We must be able to travel anywhere in the world on a moment's notice.

"When we go, we often have to work all night because they don't want to down the aircraft during the day when it could be working," he said. "We might have to install systems and do upgrades in the field. That involves getting into the belly or the attic of the helicopter to break open and then retie wiring harnesses."

Dirt, grease and grime contribute to wire breakdown, but none more than chafing from vibration. It is worst when a helicopter does logging, for which half of the EAC copters are used. They spend eight or more hours a day lifting huge logs and slinging them out of the forest to a distribution point.

"All the work is done as fast as possible for the maximum number of turns per day," Wolff said. "The helicopters are worked pretty hard, and the loads and stress on them are tremendous. It is a continuous job maintaining those aircraft. They may not have had problems for 30 years before coming to us, but things can go bad in five or six years under these conditions."

When field repairs may be too extensive, a helicopter can be returned to an EAC subsidiary location or the Oregon headquarters for work. "You can repair as you go only so much," he said. "Sometimes you have to start fresh because of the amount of time and money for repairs is too much."

Whether electrical components and systems need to be modified or produced new as part of another project on a helicopter, research and development can last between two months and a year. Production of wiring harnesses have to be coordinated with other departments, and all operations have to receive approval by the Federal Aviation Administration to make sure every helicopter

is flight-worthy.

Work in Wolff's department is done by between six and 15 employees. The number varies according to how many are in the field, which in turn depends on the number of helicopters in use, primarily for logging.

For example, some of the department workers were included in a company lay-off of 40 employees in December because of lower flight-hour projections for 2002. They resulted from a 19-percent tax imposed by the U.S. Government on Canadian timber after American lumber companies complained of Canadian timber companies dumping lumber in the United States. That drastically affected the logging business in British Columbia, where Erickson had most of its logging helicopters.

Employees in the department have experience in electricity or electronics. They were trained in the military or at technical colleges offering airframe and powerplant programs. Most of the training at EAC is on the job. Wolff said a good supply of employees always is available.

Despite the lay-off, morale at the company is good, according to Wolff. His view was backed by Dennis Hubbard, the firm's media manager. "I would say the culture here is like that of a family," Hubbard said. "It's due to the spur-of-the-moment calls to go out into the field and the other unique challenges.

"We have to get personal with people under those conditions, so there is a higher level of communication than in a normal corporate structure," he said. "Plus, employees have an immense amount of pride in the product. We're the only company in the world manufacturing these helicopters, so our people have a lot of pride in ownership of what they do."

EAC has 450 employees worldwide, including the 250 in Central Point, Ore. Many of them were there when the first Erickson-made S-64 helicopter rolled out of the factory in January 1993. That machine and others that have followed it are produced in two configurations – S-64E and S-64F. They include more than 300 modifications to the original Sikorsky helicopter design engineered at EAC.

The major difference between the two models is their lifting capacities. The S-64E can lift up to 20,000 pounds, while the S-64F can move up to 25,000 pounds. Each rating is at sea level.

The different capacities are due to the horsepower of the two Pratt & Whitney turbine engines on each helicopter. Each engine on the **S-64E** is rated at 4,500 h.p. for a total of 9,000. Each powerplant on the **S-64F** produces 4,800 h.p., making a total of 9,600.

Each helicopter is **89 feet** long and **25 feet** high. The diameter of the main rotor, which contains **six blades**, is **72 feet**. The four blades on the tail rotor span **16 feet**.

When empty, the S-64E weighs 19,500 pounds, while the S-64F weighs 25,000 pounds. Maximum cruising speed of the E model is 115 knots, and F model's is

104 knots.

Fuel capacity on each machine is 1,300 gallons, including two main tanks and an auxiliary tank. The E burns 500 gallons of fuel per hour, and the fuel consumption of the more powerful F is 550 g.p.h.

In addition to the cockpit at the front of the helicopter, a pilot station with a full set of flight controls is in the rear, covered by a Plexiglass shield. The arrangement allows a pilot to have a clear view of a load and to make precise movements when removing or setting down an object or piece of machinery. Interestingly, an Erickson copter was used in 1993 in the removal and replacement of the Statue of Freedom atop the U.S. Capitol in Washington, D.C., to accommodate renovation of the famous statue.

Such notoriety for the company was unusual until founder Jack Erickson sold it in 1997 to a group of investors from New York. They wanted to increase the firm's profile – and volume of business. Hubbard was hired to market the company after working on numerous radio, TV and documentary film projects for Southern Oregon University.

"Since 1997 we have told the world we exist, and the demand has been overwhelming, especially for the firefighting unit," Hubbard said. EAC has contracted with departments of forestry in California, Oregon and Minnesota; U.S. Bureau of Land Management; National Park Service; Bureau of Indian Affairs; and the Federal Emergency Management Authority.

Fires also have been fought by Erickson aircraft in Australia, Greece, Canada, Borneo and Mexico. The Korean Forest Service is buying a new S-64, and the Italian government has expressed interest in buying five helicopters.

In the helicopter's newest use developed this year, each machine can be converted into an emergency response vehicle (ERV). A large wire basket extending from a long wire can evacuate up to 75 people at one time from a burning skyscraper, a shipwreck or any other life-threatening situation. A patent in pending on the basket device.

"The ERV is going to revolutionize aerial rescue," Hubbard said. "Usually helicopter rescues have meant taking one, two or three people at a time, but we'll be able to pick up in one trip what would have required many trips in the past."

A government or civil protection agency could buy one helicopter and use it for fighting fires and doing rescues. "It could be a comprehensive disaster relief package at a station year 'round," Hubbard said. "Everyone at Erickson is very enthusiastic about the possibilities and opportunities the new multi-mission capabilities will open up. The innovations that make us an industry leader never seem to end."