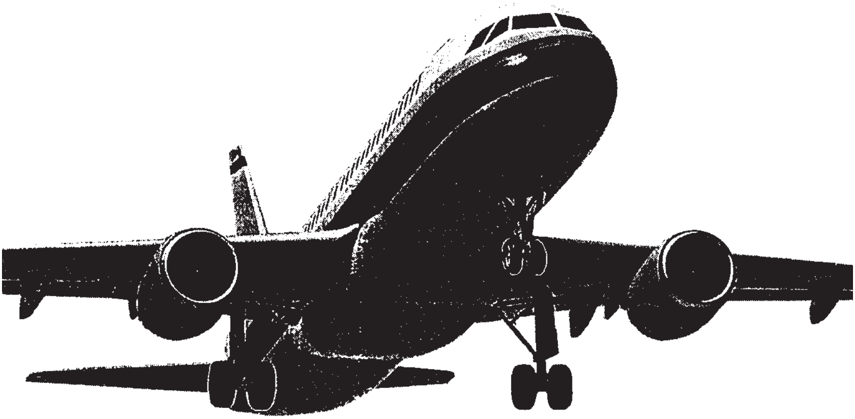

How to Practice Good Tire Sense

Catastrophic tire failures can be minimized by proper attention to storage, maintenance and operational practices.

by
Hennie Venter
Supervisor for Mechanical Systems
South African Airways (SAA)

The last component to leave the runway on takeoff and the first component to touch the runway on landing is a round, black, nitrogen-filled rubber component called a tire. The tires on an aircraft are not required during flight, however a landing without them would be dangerous.

To best explain how tire failures can be prevented and how safe the tires are on aircraft, it is necessary to get some background on them.

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Tread separation can result from overloading or from flex heating due to underinflation. Shown is an area of separation between tire components in the tread area that occurred when excessive heat caused loss of adhesion.

Aircraft Tire Construction Is Important

The important items to consider in tire construction are the wire bead around the edge of the tire, and the apex strips and body cords. The latter two form the carcass and fold around the bead wires. The bead is the heaviest and least flexible part of the tire construction.

The bead also forms the seal between the hub and the tubeless tire. All current tires used by South African Airways (SAA) are of cross-ply construction.

Development of radial-ply tires has only reached the stage where they are fitted to the latest aircraft such as the Airbus A320 and the Boeing 747-400.

The next item to consider is the tread area directly in contact with the runway. This is where all the wear takes place. Under the tread are the tread reinforcing plies (normally two) which provide rigidity to the tread and protect the tire's fabric carcass against foreign object damage (FOD). The reinforcing plies run only from shoulder to shoulder.

Another important item is the rubber section between the body plies (carcass) and reinforcing plies. It is referred to as the buff-line. When a tire is retreaded, the tread and reinforcing plies are buffed off at the buff-line. New reinforcing plies and tread are then placed back on the buffed carcass. It is important that a tire is not worn down into the buff-line because it could mean that a carcass cannot be retreaded and must be scrapped. The cost of a retread is approximately a third of the cost of a new tire.

Last, but not least, is the sidewall, which consists of a rubber layer that protects the body plies. In this area you'll find the brand name, size, speed rating, ply rating, skid depth, specification markings, date of manufacture, retread status (R), date of retread and part number.

An aircraft tire is designed to take high loads; e.g., 54,700 pounds per tire on a Boeing 747-300, and high speed — 235 mph on the Boeing 747 fleet. Tires are *not* designed to take high side loads and cannot run continuously in a straight line. The tire is subject to failure from excessive heat buildup if it is run constantly for approximately six miles. The danger areas on an aircraft tire, where most heat is accumulated due to flexing, are the beads and shoulders. It is for this reason that an aircraft manufacturer plots minimum and maximum pressures within which a tire may be operated. This pressure is called the operating pressure and will be found in the manuals. These limits can then be used by the operator to get the best wear pattern for his operation.

Tire pressure is a vitally important aspect in the safe operation of a tire. The inflation pressure should be correct at all times for maximum safety. For fire safety all SAA tires are filled with nitrogen gas only.

Aircraft Tires Require Specifications and Qualifications

Prior to any new design or size of tire being fitted to an SAA aircraft, it must first be qualified by the manufacturer per a specification, which is U.S. Federal Aviation Administration (FAA) approved. The specification calls for dynamometer tests (which simulates taxi, takeoff, landing and taxi in), adhesion tests (which are done at specified levels throughout the carcass and tread) and a burst test. Limits are laid down in the specification, which the tire must meet to be qualified. A further specification, AC145-4, also FAA approved, is used as the minimum requirement for the retreading of SAA aircraft tires.

Maintenance Is the Key to Safety

The best suited tire pressure will be specified in the relevant manu-

Photograph not available.

Tire beads can be easily affected by excessive heat from heavy brake use. Damage sustained by this tire included rubber blistering, melted and solidified nylon fabric and very hard, brittle, surface rubber. It had to be scrapped.

als. It is also stenciled on the landing gear or landing gear doors. The maintenance staff will check the tire pressures on every preflight. Under-inflation creates an excessive deflection in the tire called a traction wave. This is a very high flex point that causes heat buildup, especially in the shoulder and bead areas (Figure 1). It can result in tread separation or a complete breakup of the carcass.

The best time to check the tire pressure is when the tires are cold; the pressures should be checked at least two hours after landing to allow sufficient cooling time. If a tire pressure is suspect, the best procedure is to compare it to the other tires on that bogie. If required, inflate it to the average of the other tires. Never deflate a hot tire if the pressure is too high.

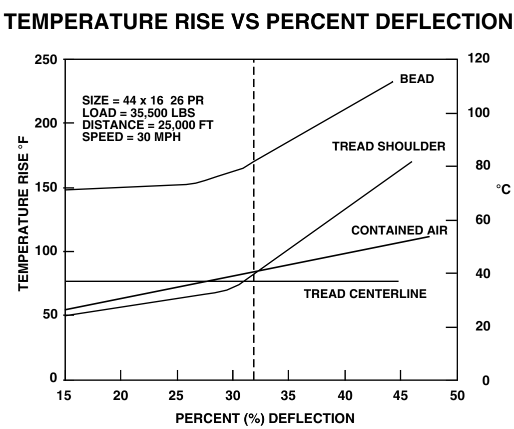

Figure 1

All the wear, cuts and other damage limits are clearly defined in the manuals. Tires that are being evaluated for a high retread (R) status will be identified with a white "E" on the sidewall. Only one "E" tire is allowed per bogie. Tires that have reached their maximum R status will be marked with a yellow triangle. There is no restriction on their location.

Taxi Speeds and Taxi Distances Affect Tire Longevity

We already recognized that aircraft tires cannot handle high side loads because of their design. However, aircraft must be maneuvered on the ground which does result in side loads. It is for this reason that the speed at which these maneuvers are done should never exceed the limits specified. Taxi speed should never exceed 15 knots through a 45-degree turn and 10 knots through a 90-degree turn. Figure 2 clearly displays the heat build up as the speed increases.

After six miles of taxiing, the temperature almost doubles on a tire that has eight percent more deflection than specified. This excessive heat buildup can be the cause of separation in the shoulder or in the bead. If not discovered in time, it may end in a failure. Very close inspection will be required to see a bubble that might form in the area of separation. If a tire becomes a "leaker" in service — that is a tire that has a pressure drop of 10 percent or greater over a 24-hour period — it may also suffer a separation. The manual's procedure for such a leaker is that it must be removed and returned to the shop for inspection.

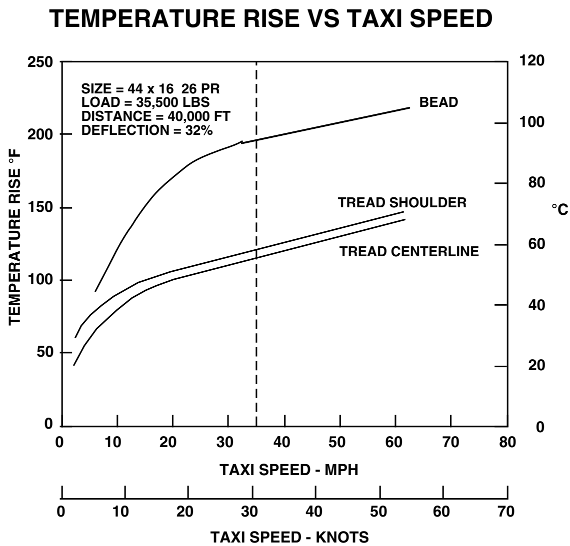

Figure 2

No one can tell if the limits are exceeded except, perhaps, for the excessive wear on the tread. Nevertheless, a condition could be created that could lead to a catastrophic tire failure.

Excessive Brake Temperatures Can Lead to Tire Damage

Brake over-temperatures can severely damage tires. During taxiing, brake temperatures can increase unnecessarily if the brakes are continuously applied to keep the aircraft from exceeding its proper taxi speed. It is better to apply a firm brake application to bring the speed down below the taxi speed and then let it run up again. From a tire and brake standpoint, use the next turn off after landing rather than turn at too high a speed. Also avoid using brakes at too high a speed. Severe braking could also have a negative affect on tire safety.

Foreign Object Damage (FOD) Is the Main Culprit

Approximately 60 percent of all tires scrapped at retread plants are scrapped because of FOD.

To improve this situation would require a dedicated effort from every employee involved in and around aircraft. Taxiways, runways and technical areas should be cleaned regularly. The apron and freight areas are difficult to keep clean because of the variety and intensity of activity in those areas.

Safe tire operation requires attention, and the following provide some guidelines:

- *Manufacturer/Retreader*. Work must be done according to specifications and with great care and responsibility.

- *Storage.* Aircraft tires should be stored in an ozone-free area under a constant temperature, correctly racked. They should never come in contact with any toxic fluids, gases, etc.

- *Overhaul.* Tires must be fitted correctly and it must be ensured that the tire fitted has been qualified. The tire/wheel assembly must pass its leak check before being released for service.

- *Engineering.* Prior to any tire being released for installation on an aircraft it must be qualified. Any new retread status must also be qualified prior to release for use. Maintenance personnel must thoroughly investigate all failures and take positive steps to prevent further similar failures. They also must keep close contact with tire manufacturers and retreaders.

- *Maintenance.* The tire pressure must be kept at the operating levels specified in the manuals. Thorough inspections are required by technicians for signs of cuts, cracks, bulges, FOD contamination, signs of brake overtemps and leakers, etc.

- *Operation.* Proper operation of the aircraft is required at all times:

  <u>Braking</u>
  Avoid high-speed braking. Use thrust reversers.
  Use low speed braking.
  Avoid riding the brakes.

  <u>Turning</u>
  Avoid sharp turns.
  Avoid fast turns.
  Avoid pivoting.

  <u>Taxiing</u>
  Taxi within speed limits at all times.
  Avoid long taxi runs.

- *Foreign Object Damage.* F.O.D. is a problem that everybody must combat by either removing foreign objects or by reporting them with a request that the area be cleaned.

Five Golden Rules For Good Tire Care

- Never deflate a hot tire.
- Ensure that tire pressures are correct.
- Never operate the aircraft outside the limits.
- You may be the cause of an impending failure but somebody else may experience it.
- If in doubt, remove the tire from the aircraft.♦

[This article is adapted from SAA's Springbok Safety News *in the interest of sharing safety information with the worldwide aviation community.* — Ed.*]*

NEWS & TIPS

Joe Chase Award Goes to Krumal

Emil John Krumal, maintenance supervisor for Philip Morris Management Corp., was presented with the 1990 Joe Chase Award during ceremonies at the Flight Safety Foundation's 35th Corporate Aviation Safety Seminar (CASS) in Montreal, Canada April 18-20. The award, administered by the Flight Safety Foundation, is sponsored by the Professional Aviation Maintenance Association (PAMA). It recognizes the accomplishments of an aviation technician for outstanding contributions to the aviation mechanic profession and their importance to aviation safety and reliability.

Photograph not available.

Krumal, who received a framed certificate from the Foundation, a plaque from PAMA and an honorarium, was cited for "his outstanding dedication and contributions to the furtherance of safety through aviation maintenance." It was further noted that "he has consistently shared his expertise with — and encouraged professionalism among — fellow technicians as well as the crews who fly the aircraft they maintain, and has achieved renown through his extensive efforts to promote career opportunities in the field of aviation maintenance among youth."

Airworthiness Directives Aimed at Aging Aircraft

Three FAA airworthiness Directives, (ADs) proposed last May, were adopted by the U.S. Federal Aviation Administration (FAA), requiring extensive structural modifications to older Boeing 727s, 737s, and 747s. This action was to ensure the continued safety of these aircraft.

These directives are the first in a planned series of far-reaching directives concerning the safety of older aircraft. Although these three directives cover certain Boeing-manufactured aircraft, similar directives covering aircraft from other manufacturers will follow. Other proposals would require the implementation of aircraft corrosion control programs for the above-mentioned aircraft plus the Boeing 707.

The FAA actions reveal a basic change, adopted by the agency in 1988, in the agency's philosophy for maintaining the airworthiness of older aircraft. Traditionally, the FAA has recommended repetitive structural inspections to identify needed repairs due to corrosion and cracking. These inspections increase in frequency as aircraft age and approach their manufacturer's "economic design goal," the point at which the cost of maintenance is expected to significantly increase. With the new philosophy, the FAA is requiring the airlines to make strengthening modifications to the basic critical structures in order to prevent fatigue problems at the aircraft reach their economic design goal. Further, specific parts, such as the landing gear, must be replaced after a specified number of flight hours or cycles.

The impact of the adoption of these ADs will immediately affect 115 U.S.-registered Boeing aircraft — 67 Boeing 727s, 28 737s, and 20 747s. It is estimated that the cost will be $142 million over a four-year period. Additional aircraft will be covered as they reach the age threshold for the modifications. Specifically, these are aircraft that have completed 20 years or 60,000 flights for the Boeing 727, 20 years or 75,000 flights for the 737, and 20 years or 20,000 flights for the 747.

The AD action is attributed to the accident in April 1988 when an Aloha Airlines Boeing 737 that had logged 90,000 flights lost 18 feet off the top of its fuselage but managed a safe landing. Metal fatigue was the cause of the accident, but corrosion was found in a subsequent inspection of the aircraft.

The modification program will be staggered over a period of time and scheduled as a coordinated action along with regularly scheduled maintenance of these aircraft. Safety will provided during this period by the individual operator's structural inspection program, regular maintenance, inspections and modifications required by previous ADs, increased FAA surveillance and the special Supplemental Structural Inspection Program adopted for older aircraft.

First Aviation Mechanic Recognized Posthumously

The Professional Aviation Maintenance Association (PAMA) presented, posthumously, its highest award, the Award of excellence, to Charles E. Taylor (1868-1956) and recognized him as the first aviation mechanic. The award was announced during PAMA's Annual Symposium and Trade show in Houston, Texas, in February. At the award ceremony, U.S. Federal Aviation Administration (FAA) Administrator James Busey stated that, "without Charles Taylor, the Wright Brothers might have a different place in the history books today."

Historically, Taylor was the mechanic working for the Wright Brothers at Kitty Hawk, North Carolina, U.S., and he built the first aircraft engine for the initial flight by the Wrights in 1903. After that flight, he continued to maintain aircraft for the Wrights for many years. In 1911, he was the mechanic for the aircraft "Vin Fiz" that made the first transcontinental flight in history.

Welding Training 'On the Tube'

Aviation technician students at the College of Aeronautics (COA), Flushing, New York are learning how to weld on a unique training aid. The school has been granted a patent titled "An Audiovisual Instructional System," for an interactive instructional system that teaches the complex manipulative skills of oxyacetylene welding by guiding the student through the procedures in a simulated environment. The simulator was developed as a safe, cost-effective means of complying with requirements of the U.S. Federal Aviation Administration (FAA) for aviation technician schools to teach welding training as part of the curriculum.

The system incorporates a computer-

Photograph not available.

controlled horizontally mounted TV screen that simulates the work area for a flat-plate weld project. The student uses a welding rod and a simulated torch. The video screen displays the flame that results from the mix of oxygen and acetylene in the “torch” and shows what the results the student’s welding techniques produce, such as adjusting the “torch” gas pressure incorrectly or lingering too long at one place in the weld.

The system allows the student to learn and practice the basics of gas management and proper use of the torch and welding materials, a learning segment that has an inherent element of danger and normally requires direct supervision by a qualified instructor. The simulation provides a safe environment for individuals to work on their own, and involves step-by-step procedures that lead the student from initial safety procedures to the completion of a flat plate weld. Following the simulated training, transition to actual welding with a real oxyacetylene torch requires only minutes, according to COA instructors.♦

MAINTENANCE ALERTS

This information on accidents and incidents is intended to provide an awareness of problem areas through which such occurences may be prevented in the future. Maintenance alerts are based upon preliminary information from government agencies, aviation organizations, press information and other sources. The information may not be accurate.

Wheel Declares Independence

The Boeing 737 had arrived at Nuremberg, Federal Republic of Germany, after a flight from Las Palmas, Canary Islands. There were a crew of eight and 134 passengers aboard. The approach and touchdown were uneventful; however, shortly before the aircraft was to leave the runway, the number four main wheel separated from its axle.

Investigation revealed that the axle from the inner cylinder of the right shock strut was broken. There were two fractures; one was found behind the brake attachment ring and another in front of it.

Lube Block Breaks Engine

The Piper Cheyenne was departing an Australian airfield after engine maintenance. The noontime flight, with one pilot and one passenger on board, was seen trailing black smoke from the left engine as it climbed to 1,500 feet. It turned towards the airport and rapidly lost height. The twin landed in a pasture and touched down heavily, tail first, after which it bounced and skidded sideways before coming to a stop. The aircraft was substantially damaged and both occupants were seriously injured.

Investigation revealed a drive shaft failure in the left engine. Both right and left camshaft upper bevelshaft gears had overheated because of inadequate lubrication. The engine is equipped with an external oil priming system to lubricate the camshaft drives during engine starting. However, the “T” fittings in the system for the failed engine were omitted and the fittings in the front case oilways were plugged off, blocking off the oil supply to the camshaft drives.

Blocked Line Stops Fuel

The Aerosport Woody Pusher was engaged in aerial application near El Rahad, Sudan, Africa. At the end of an application run, the pilot pulled the airplane into a climbing right bank and the engine failed. The pilot made a forced landing in a nearby field. The aircraft struck an irrigation canal and the main gear and the engine were torn off. The reason for the engine stoppage was traced to fuel starvation. The left tank was not feeding because of a blockage in a vent line. There were 40 minutes of fuel in the right tank, but when the pilot pulled the aircraft up into the right bank, the fuel in that tank collected in the outboard section of the tank, away from the outlet to the engine. Because the left tank could not feed the engine, it stopped.

"Airing" the Brakes Is Not a Good Practice

The Canadian Beechcraft Model 45 had just received maintenance servicing. After a midday flight, the twin-engine aircraft landed at its destination airport. All went well until the rollout. When the pilot applied brakes, he lost directional control because the left-hand brake failed to operate properly. The aircraft veered off the runway and was substantially damaged. There were no injuries to the crew of two and the three passengers. Investigation revealed that the left brake failed because there was air in the lines, the cause of which was traced to inadequate maintenance and quality control.

Loss of Stability Bends Helicopter

The Bell 47 was approaching to land, with the student pilot being the only person aboard. While on the downwind leg, the helicopter began to vibrate, and the nose lifted up. The pilot immediately entered autorotation. The rotorcraft touched down in a cow pasture in a nose-up attitude and with a slight forward speed. It hit a rise and rolled an its side. The aircraft was substantially damaged but the pilot was able to evacuate without injury. Investigation revealed that the helicopter's stabilizer bar had failed in flight; the failed part could not be located.

A Little Dab Will Do Ya

The Bellanca Citabria was departing the U.K. airfield for the 15th glider tug of the day. As the aircraft lifted off, a grating noise was heard coming from the right main gear area of the tailwheel aircraft. Visual inspection revealed that the wheel fairing of the gear was vibrating abnormally.

The pilot returned to the airport and landed. The grating sound was again heard and loss of braking was experienced when the aircraft was almost at a stop. It was then noticed that the right main wheel was cocked at an abnormal angle. The aircraft had sustained damage to the right gear but the pilot, the only occupant, departed with no trouble or injury. The single main wheel on this lightplane is mounted on a stub axle with a pair of tapered roller bearings that should be lubricated every 100 flying hours, according to the manufacturer's service manual. Investigation revealed that the outer of the two bearings for the right main wheel had suffered extensive breakup. This allowed the wheel to move outward and contact the retaining nut, causing the cotter pin to shear which allowed the nut to unscrew and the wheel to move to the end of the axle.

Clutch Slips, Helicopter Falls

The Hughes 369 was being used to transport small trees from a cutting field to a transport truck. When the pilot began to lift one load in the external long line, he heard a loud bang and the helicopter began to lose main rotor rpm. The pilot began an autorotation from the hover. The aircraft landed hard and rolled over. There was no fire but the rotorcraft was destroyed. The pilot escaped without injury.

Investigation revealed that the Sprague clutch, which transmits power to the main rotor but allows autorotation in case of power failure, had failed. The result was an interruption in the transmission of power to the rotor during a critical phase of flight.

Muscles No Match For Volts

The U.K. pilot of the Beechcraft F33A had just taken off for what was intended as a pleasure flight. Shortly after departure, the aircraft's avionics equipment failed. The pilot found that the alternator had failed and, further, that the battery was dead. He could not re-energize the alternator.

Remaining clear of controlled airspace because he had lost communications capability, the pilot returned to his departure airport. He lowered the landing gear by the emergency system; he cranked a small handle located on the floor behind the pilot at least 50 revolutions. He cranked the handle until he encountered positive resistance and interpreted this as an indication that the gear was down and locked, since without electric power the down-and-locked indicator lights were inoperative.

The approach and landing were without incident, but during rollout the nose gear collapsed. The aircraft slid to a stop 150 feet later. There was no fire and no injury to the pilot, who evacuated without trouble. Investigation revealed no defects with the emergency gear-lowering system.

Can of Worms

The pilot of the twin-engine Beechcraft Model 95 found nothing amiss during preflight or pretakeoff checks, and he and two other passengers departed the U.K. airport. However, when he retracted the landing gear, the pilot lost radio communication with the control tower. He checked the avionics master switch and the circuit breakers and, despite selecting the emergency electrical supply, was not able to regain electrical power in the avionics system. However, he heard an occasional crackling sound on the intercom. He decided to return and land at the airport from which he had departed.

The pilot selected gear down when established on the downwind leg and, although he and the passengers believed they heard and felt the landing gear lower, none of the gear indication lights illuminated — neither the gear unsafe nor the gear down lights. The aircraft's mechanical gear position indicator, connected to the nose gear only, appeared to indicate that the gear was extended. When the pilot selected 15 degrees of flaps, the electrically actuated system extended only to about five degrees and stopped.

Since he had no radio contact with the control tower, the pilot turned the landing light switches on and off to indicate his emergency situation and continued with the landing. During touchdown, both propellers struck the runway simultaneously. The aircraft slid on its belly for about 450 feet. The occupants departed the aircraft without injury, but the aircraft sustained damage to its propellers, engines, landing gear doors and lower fuselage skin.♦

NEW PRODUCTS

Water Detector For Fuel Checks

A detector pad to help aircraft fuelers identify the presence of water in aircraft fuels is available from United Desiccants-Gates. The Aqua-Tector® pads, when used with ultraviolet (UV) water detection systems, can determine free water content in fuel systems from 0-60 parts per million (ppm). The pads are made of rigid filter paper that has a chemically coated

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surface. The pads become fluorescent in ultraviolet light when water is detected.

The disposable pads meet military specification (Mil-D-81248B) and are individually packaged and sealed in a light-barrier envelope. They may be used for both military and commercial fuels.

For more information on Aqua-Tector Pads, contact United Desiccants-Gates, P.O. Box 32370, Louisville, KY, U.S. 40232. Telephone (502)-634-6801.

Blast Room Claims Safer Paint Stripping

The New Generation Multi-media Blast Room is designed to provide the user with a controlled environment to dry-strip paint from aircraft parts and components without the usual hazards associated with chemical stripping, cleaning, and surface preparation. The design also incorporates lighting and engineering features aimed at optimum work efficiency as well as operator comfort and safety.

The facility was developed to produce rapid media reclaim time, a high stripping speed and a controlled safe environment without liquid chemical hazards. When blasting with plastic media, the room is said to permit the rapid removal of old coatings down to the bare surface by blasting with plastic particles that are harder than the prevailing coating but softer than the substrate. The plastic media or abrasive is reclaimed for reuse.

The blast rooms are supplied in three modules and two standard sizes. Modular construction allows size adjustments and ease of installation, according to the manufacturer.

Further details can be obtained from Pauli & Griffin, 907 Cotting Lane, Vacaville, CA 95688, U.S. Telephone (707) 447-7000. Fax (707) 447-7036.

Wind Shelter Shields Mechanics

Aviation mechanics working on the line in windy weather can now work behind a portable shelter. The Ins-

Photograph not available.

Tent wind-break shelter is designed to protect mechanics from the effects of wind chill and scattered tools, parts and manuals — factors that interfere with safe work practices as well as worker comfort.

Weighing in at 55 pounds, this portable shelter folds to a five-foot-square by four-inch thick package that erects quickly as a break wall measuring five-feet high by 15 feet long. It can be arranged in various configurations to meet differing needs. The unit comes in varied colors, and company logos can be added.

Further details can be obtained from Ins-Tent, 402 Arch Street, Cloquet, MN 55720, U.S. Telephone (218) 879-9712.

Scissor-Lifts Take the Strain

A line of hydraulic scissor-lift tables from Lee Engineering is designed to position work at the proper level to eliminate bending, lifting, reaching and to reduce the risk of back injuries. The Presto XL series incorporates large work platforms with power units controlled by a hand-held control or a foot pedal. They have capacities up to 6,000 pounds, allowing heavy objects to be lifted and worked on at proper heights. The units are built of heavy guage steel with three-quarter-inch plate steel legs, and have lifetime lubricated bearings on all rollers and pivot points.

Contact Lee Engineering Co., Inc., 505 Narragansett park Drive, Pawtucket, RI 02861, U.S. Telephone (800) 343-9322.♦

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