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Aviation Safety

Maintainer

Learn from the mistakes of others and avoid making them yourself . . . **Issue 1/2001**

Backwards Trim Hookup

Ed.: Original article, "Trim Reversal Mindset," published in Maintainer 4/98 contained preliminary information. The article below expands upon human factors issues based on TSB Final Report A97O0077.

The pilots of the Convair 580 cargo flight were confronted with a severe nose-up pitch tendency immediately after takeoff. The aircraft had been loaded, and documentation, including the weight and balance sheet, maintenance records, and flight plan, was checked by the flight crew prior to boarding the aircraft. It was noted by the flight crew that considerable maintenance work had been done to the aircraft and that some of the work had involved the elevator and elevator trim. Despite this information and the fact that the aircraft was nearing an uncontrolled condition, the flight crew diagnosed the problem as a weight shift. The pressure of hands and feet on the control column by both pilots was barely enough to get the nose down for a safe landing—an extremely hazardous situation.

Back on the ground it was determined that the centre of gravity was within limits and not related to the actual problem. It was also discovered that the elevator trim tab was in the full nose-up position and moved in the opposite direction to the trim control wheel and to the trim indicator in the cockpit. A number of years ago, the Canadian Forces had several incidents resulting from inattention and carelessness during maintenance of flight controls on Cosmopolitan aircraft, the military version of the Convair 580.

At this point, a host of human factors come to light that I will list from the report, as follows:

1. The maintenance base was remote from the parent company and had operated for three years, during which time the company experienced rapid expansion and an increased workload without an increase in staff.
2. The expansion required new staff, but the company found that there were few licensed AMEs available, so they hired technicians in training.
3. There are no regulations regarding the ratio of licensed engineers to technicians in a company, so over half of the employees were under supervision.
4. To fulfill the requirement for 24-hr. servicing coverage, the crews worked rotating 10-hr. shifts.
5. The maintenance work involved in this occurrence took place on the second and third nights of a four-night work cycle. The crew had been working the night shift for a period of five weeks. They were on days, off for three days, and then started back on the night shift schedule. This was their last night shift before returning to the day shift cycle.
6. The occurrence aircraft was a Convair 440 that had been converted by a supplemental-type certificate to a Convair 580. This was an older generation aircraft for which the company had not yet developed a complete set of work cards.
7. The aircraft was acquired at the maintenance base five days before the occurrence for the completion of numerous maintenance tasks.
8. As a result of non-destructive testing (NDT), corrosion that required the removal of the elevator and stabilizer was found. These were

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removed as a single unit, which meant that only the elevator connection bolts, the stabilizer connection bolts, and the elevator trim cables needed to be disconnected. The elevator trim cables were not marked when they were disassembled; it is not a procedure specified in the maintenance manual, but is one that is considered good practice in the industry. The horizontal stabilizer and elevator were repaired as necessary and reinstalled.

9. The maintenance crew that removed the stabilizer assembly was not available when it was time to reinstall it, so the job was finished by another crew.
10. There were not enough qualified engineers, so the crew chief showed the technicians how to install the stabilizer and hook up the elevator trim cables.
11. The crew chief selected the cables, and the technicians installed the turnbuckles. The crew chief then provided them with the appropriate information on bolt torque and cable tension and left them to complete the job. It was his view that he was helping them with the routine but important task of installing and inspecting the stabilizer, elevator, and elevator trim systems.
12. The technicians, on the other hand, viewed their task as lending a hand to the crew chief, who was responsible for the work. All of the work related to the reinstallation of the elevator and stabilizer was completed on the night shift.
13. Everything seemed to be progressing OK at this point. The following night, both lead AMEs were available, so the crew was at full staff. On this shift, the crew chief instructed one of the AMEs to complete an "independent inspection" of the work. After inspecting the work, the AME pointed out to the technicians several items that had not been properly completed, including missing cotter pins and locking clips, a nut that was not fully installed on its bolt, and lockwire that was not of adequate thickness. They then redid their work and presented it for reinspection.
14. Because of concurrent tasks, the AME did not reinspect the work until the end of the shift, and he did not have any assistance while accomplishing the inspection. Since the details had been completed satisfactorily, he checked the trim for freedom of movement but failed to have someone outside the aircraft to observe what was happening on the tailplane. As a result, he missed the most important failure in the process: the fact that the trim was operating in a reverse direction.
15. At the end of the shift, the lead engineer assisted the crew chief in filling out the aircraft logbook, indicating that the horizontal stabilizer and elevator were reinstalled and the rigging was checked as per the maintenance manual, although no one actually completed a rigging check because the crew chief had asked a technician to follow the rigging procedure as detailed in the maintenance manual, and he had highlighted two of the important tasks: special attention to the cable tension and dimensional check. The technician understood the instruction as a request to check the cable tension and dimension, which he did; however, the rigging was not performed properly.

In conclusion, the maintenance entry was signed as having been completed by the AME who had actually completed the "independent inspection," while the "independent inspection" was signed off by the crew chief who supervised the task. This occurred at the end of the shift when logbooks from several aircraft were being completed and signed by the two AMEs.

Both AMEs felt confident in the other's work, and they simply signed off the work completed by the crew, regardless of their personal involvement.

There were five people who had a hand in the installation/ rigging/ inspection of the elevator trim tab control system of this aircraft, and it was still released with the elevator trim control operating in reverse.

The task of hooking up the control cables is, in itself, very basic. There are only two cables, and it does not require training to expert levels to understand the system and to recognize that the consequences of hooking the cables up backwards can be disastrous. This story could fill another page or two, but I think you have got the main safety message related to managerial changes, shift changes, minimally trained technicians, inadequate supervision, poorly communicated instructions and log entries. This all added up to a simple but near- fatal mistake, and the whole mess could easily be avoided if manufacturers paid more attention to designing control hookups with different cable ends that could not be applied in reverse, if AMEs paid more attention to clearly tagging cable ends and connection points at the time of removal, and, finally, if those responsible applied some knowledge of aerodynamics with a physical check of the operation of flight controls before releasing the aircraft for flight.

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Sécurité aérienne — Mainteneur est la version française de cette publication.

Mechanical Happenings

The following aircraft incidents reported to TC from Sept. 1, 2000, to Nov. 30, 2000, are a heads-up for AMEs; they mainly focus on the maintenance outcome of the incident and do not include all the circumstances of each flight. In most cases of component failures it can be assumed that an SDR was submitted.

Most maintenance problems associated with undercarriage and flaps affect all types of aircraft similarly; for this reason I have included these systems under separate headings, as follows: **Flap systems**—The following list of problem component areas applies to all types of aircraft because of their harsh operating environment and high system usage: flap position indicators; slat, flap and spoiler actuators; flap jack screws; wire connections; indicator circuits/bulbs; hydraulic line leaks; and system out-of-phase or reset requirements. **Undercarriage**—This list is similar to that for flaps with respect to indicators and electrical components, such as corroded and broken wire, loose cannon plugs and system rigging. This list suggests that these circuits and riggings should be inspected in their entirety to allow early replacement of apparent failing parts. Words found within many undercarriage failure reports include defective or poorly installed O-rings, fittings, seals, chaffing of lines, dirt, moisture, deteriorated wires, burned-out indicator bulbs, squat switches and sticking uplocks resulting from improper lubrication of associated component parts.

Preventative maintenance on these systems could save operators a lot of time and money. Repetitive items illustrate weaknesses in the overall system. Look at these areas in your own operation and aircraft type(s) with a view to improving ongoing maintenance.

Airbus A320—The flight crew reported an engine flameout then landed safely. Maintenance found that the engine had a gearbox failure. The chip detectors and oil filters were full of metal.

Beech 99—Shortly after takeoff, the crew observed flames inside the No. 2 engine cowling and shut it down. Maintenance found that the engine autofeathered because of an internal engine failure. Initial indications suggest the failure may have been in the nose case because bearing parts were on the magnet chip detector. The main oil filter also contained metal particles.

Beech B95—The pilot advised he had shut down one engine because of a propeller problem. Maintenance found that the left propeller unfeathering valve failed and replaced it.

Beech King Air 100—The crew advised tower that the gear would not retract normally. After the landing that followed, the left main gear collapsed. The cause of the gear problem is unknown at time of writing but, as a result, an AME, suffered serious injuries when the aircraft further collapsed on him as he was working to recover it from the runway. Also, a large fuel spill occurred, and the aircraft was further damaged when hoisted back up onto its gear.

Bell 206—The pilot of a Bell 206 made a forced landing because of an engine failure. Maintenance reported that the engine (an Allison 250-C20R) appeared to have turbine rub in both the hot section and the gas generator section. The engine was removed for overhaul inspection.

Bell 206B—Following installation of the Allison 250-C20B engine, a pressure check of the P3 air system was not performed, as required by the engine maintenance manual. Consequently, a loose B nut at the fuel control was not detected, the engine decelerated to idle, and the aircraft landed hard.

The operator has responded by adding a pressure check of the P3 air system to a company "Checks After Maintenance" form.

Bell 206B—The pilot felt the controls becoming very stiff and suspected hydraulic failure. He followed checklist procedures, but the controls remained stiff. Company maintenance found metal particle contamination in the hydraulic system from the bushings on the hydraulic pump. The pump was replaced, and the aircraft was returned to service.

Boeing B767-333—The aircraft diverted because of a smoke smell in the cockpit. Maintenance found that the standby inverter had failed. There has been no history of this type of failure in the B767 fleet.

Boeing 767—The pilot aborted the takeoff after hearing a loud bang that appeared to originate in the left main landing gear area. Maintenance found a cracked EPR line as well as minor damage to the fourth, fifth and eighth stage compressor blades of the No. 1 engine (Pratt & Whitney (P&W) JT9D-7R4). The damaged components were replaced, ground runs completed satisfactorily, and the aircraft was returned to service.

Boeing 737—The pilot declared an emergency because of a suspected fuel leak. Maintenance found an unserviceable fuel gauge and returned the aircraft to service in accordance with the minimum equipment list (MEL).

Boeing 737—The aircraft was on final approach when the crew reported a system hydraulic failure. Maintenance determined that a service port (check valve) in the system "A" reservoir was leaking. The check valve was replaced. All hydraulic systems were rechecked, and the aircraft was returned to service.

Boeing 737-300—The aircraft was on approach when the forward cargo compartment fire warning light illuminated. Maintenance determined that it was a false warning caused by a warning switch cannon plug that was not fully seated. It was secured, and the system checked normal.

Boeing 767—The aircraft was parked when, during a walk-around inspection, maintenance found a right aft wheel-well bulkhead spherical bearing access panel (195CR) missing and an adjacent panel (196DR) damaged. The aircraft skin under panel 196DR was scratched. Panel fasteners were found to have failed.

Boeing 737—The crew had just started the take-off roll when they noticed that the No. 2 engine (P&W JT8D) was not producing adequate thrust and rejected the takeoff. Maintenance found that the fuel control unit (FCU) had failed. They replaced the FCU and the No. 2 fuel pump.

Boeing 727—The takeoff was rejected at low speed, and the aircraft returned to the ramp without further incident. Maintenance found the No. 2 engine-driven fuel pump unserviceable and replaced it.

Boeing 767—The aircraft was en route when the crew noticed a right engine overheat indication and shut down the engine. Maintenance determined an Automatic Fire Overheat Logic Test System (AFOLTS) circuit board had failed. The circuit board was changed, and the aircraft was returned to service.

Boeing 727-200—After the aircraft departed, the hydraulic system lost pressure. The crew returned to the airport. Maintenance located and replaced an inoperative hydraulic flap motor.

Boeing 737—The aircraft was on the take-off roll when the No. 1 engine spooled down (P&W JT8D-9A). The main fuel pump's (P/N 743602-5, S/N 89711) time since overhaul (TSO) was 11,551.7 hr. P&W issued an alert service bulletin (PW ASB A6381), dated March 15, 2000. The FAA has issued a notice of proposed rule-making (NPRM) in the form of an airworthiness directive based on P&W Docket No. 99-NE-29-AD. This information is being issued to prevent a loss of engine throttle control, which could result in reduced airplane control during a critical phase of flight. However, this AD had not been issued at the time of writing. Routine C-checks do not cover the workscope involved in the overhaul of an engine or its components. *Compliance with alert service bulletins is not mandatory. This is important safety information for those working on this aircraft type. —Ed.*

Canadair CL 600—The crew reported an overheat condition, which maintenance later diagnosed as a faulty overheat control unit. There was no fire in the wheel well. The faulty unit was replaced.

Canadair CL 600—During cruise, the flight crew noted a fuel imbalance and took the necessary measures to correct the problem. The flight crew further reported that the left wing felt heavy on landing but did not indicate any further control problems. Maintenance found that the electrical connector allowing the right crossflow valve to open for fuel transfer was damaged.

Canadair CL 600-2B19—Following takeoff, the flight crew of the regional jet received a stabilizer trim caution. Maintenance found both stabilizer trim channels to be inoperative. It was determined that the horizontal stabilizer trim control unit (HSTCU) was the cause of the problem and required replacement.

Canadair CL-600—A passenger door warning was received by the flight crew, resulting in an emergency return to the airport. Maintenance found the door was properly closed; however, faults were found with proximity switches S26 and S27. There was too much grease in the mechanisms, and the gap on S27 was out of tolerance. The sensors were cleaned and S27 was re-gapped. The aircraft was tested and returned to service.

Cessna T210—The pilot reported a failed propeller governor and returned to the airport. Maintenance confirmed a failed propeller governor and replaced it.

Cessna 172N—The aircraft experienced an engine failure and subsequently made a forced landing in an open field. No injuries occurred. Maintenance found the aircraft was equipped with a Bendix dual magneto; its approximate TSO is 190 hr. The in-flight engine shutdown was due to a loss of breaker point gap because the cam followers were excessively worn down to the felt pad. Also, there is a possibility that a poor engine ground caused the premature wear.

de Havilland DHC 7—The flight crew experienced an autofeather condition during takeoff. Maintenance could not reproduce the problem on the ground but elected to replace the FCU and fuel pump before returning the aircraft to service.

Douglas DC-9—The pilot reported that the left engine failed as a result of low oil pressure. Maintenance personnel revealed that there was no oil in the engine and that the starter pad carbon seal had failed, allowing the oil to escape.

Douglas DC-9—The crew noticed two fluctuations in the cabin pressure, saw the pressure differential was decreasing, and carried out the checklist procedures. Both air-conditioning packs had shut down, and the crew was unable to bring them back into service. Maintenance found the right air-conditioning pack autopressurization switch had failed and replaced it.

Fairchild SA 22—The aircraft was on the take-off roll when the crew noticed the right engine (ASE TPE331) chip light illuminate. Maintenance suspected the cause to be metal found on the chip detector that may have been the result of new bull gears meshing with existing gears in the reduction gearbox. The bull gears were replaced approximately a week previous during an engine overhaul.

Fokker MK 28—The aircraft had just departed when a flight attendant noticed smoke in the passenger cabin and a lavatory smoke alarm went off. Company maintenance located the problem, replaced the air-conditioning pack, and returned the aircraft to service.

Hawker Siddeley HS 748—During a test flight after maintenance, smoke was observed in the cockpit. The smoke dissipated when the engine power was reduced and the spill valves were opened. Maintenance found the left supercharger contaminated and cleaned it to correct the problem.

Hawker Siddeley HS 748—The pilots reported smoke that was isolated to the weather radar in the cockpit. Maintenance found a faulty unit (Bendix Ind. P/N 400-1373-2201), which was removed, and the transceiver and antenna were removed as a precaution. Associated wiring had no indication of shorting.

Piper PA-31—The pilot landed after advising the tower of an electrical failure. Maintenance discovered one alternator had kicked off-line. The alternator was reset, and the aircraft was ground run serviceable. The alternator contacts were cleaned as a precaution.

Piper PA-31—The pilot reported a hydraulic failure affecting the landing gear. Maintenance found the main hydraulic filter housing to be cracked, requiring replacement.

Piper Navajo—The aircraft was inbound to the airport when the pilot reported that he was unable to throttle the engine back. Maintenance found that the left-hand throttle cable failed internally where it ran under the cockpit floor and would not be readily visible during inspection.

Piper PA-31 Navajo—Cruising at 9000 ft, the pilot noticed oil on the right cockpit floor, and the oil pressure gauge for the No. 2 (right) engine indicated that the oil pressure was low and slowly dropping. Maintenance found that the flexible hose assembly (P/N 23745-14) to the No. 2 engine oil pressure gauge had chafed through in an area behind the instrument panel where it was bundled. Maintenance is replacing the hose and supporting the new hose outside of the bundle where it is less likely to chafe and can be more easily inspected.

Messershmidt MBB BK 117—The pilot observed a No. 1 engine chip light illuminate while in flight. Maintenance found some fuzz on the chip light sensor.

Mooney 20—Maintenance found that the avionics master relay failed, resulting in the loss of all communication and navigation equipment. The switch was replaced.

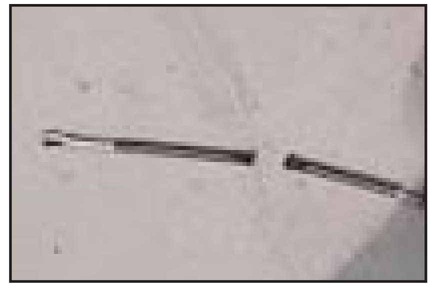
Rockwell 60A—The pilot of a U.S.-registered 60A returned because of propeller vibration. Maintenance found interference between the engine power lever and the speed lever. One lever has a curvature, and this required adjusting by loosening the jam nuts on the rod ends and rotating the rod to fix the problem.

Sikorsky S-76—The pilot declared an emergency because a low-level fuel pressure reading. After a previous similar occasion, an AME discovered that the fuel line connecting to the fuel pump was not sufficiently tight and that the fuel pump sucked in air and flamed out the engine. The problem appeared again during flight a day or so later when the engine decelerated to minimum power, followed by complete failure a few minutes later. Maintenance personnel later inspected and changed the fuel line associated with the No. 2 engine-driven fuel pump.

Cessna 310 Gear Retraction Tubes

The following information is derived from a follow-up inspection of the failed nose gear on a Cessna 310L, serial number 310L-0004, and describes only data relevant to the nose gear. The Cessna 310L uses a mechanical retraction system that consists primarily of an electric motor, a gearbox/transmission assembly and various mechanical linkages, such as push-pull tubes, bell cranks, torque tube and links to retract and extend the nose gear. This system basically converts rotary motion of the electric motor into linear motion. The gearbox assembly is near the main spar of the aircraft, and this linkage covers a distance of about six to eight feet. In other words, the system is quite complex with many moving parts and many opportunities for problems to occur.

What failed: In this case, the failure of the system to extend the nose gear was caused by physical failure (bend) of part number 0842120-1 (tube assembly). This is a push-pull tube and is part of the mechanical linkage. It is the first tube in the series and is connected directly to the gearbox/transmission assembly mentioned above. The next push-pull tube forward in the system was also found to have a slight bend in it. There was no visible damage to either rod end. The tube had bent approximately 30° before breaking into two pieces approximately 13.5 in. from the aft end. The break appeared to be fresh with no visual sign of any previous cracking or breaking. The failed part, and the other tube that was found bent, is very difficult to inspect while still installed in the aircraft. The Continuing Airworthiness Program (CAP) for Cessna 300 series aircraft was reviewed, and there is a section that recommends removal of all the linkage components for inspection. However, it should be noted that the subject CAP item did not apply to this aircraft because of its serial number. There is a small access hole in the floorboards that allows inspection of the forward end of the push-pull tube where it attaches to the idler bell crank, and there is another small access hole in the aircraft's belly. However, neither of these would allow an inspector to fully inspect the tube to determine if there were any bends in it. It is possible that this tube may have had a small bend that was continuously developing to the point of failure.



Torque tube as removed from the Cessna 310 nose gear.

From a safety point of view, it is felt that the tubes in question are impossible to inspect fully during routine inspections under the present circumstances, and the Cessna Maintenance Manual *does not require their removal as part of the inspection process. Also, some serial numbers appear to be outside the CAP program requirement. This is safety advisory information for those maintaining such aircraft until such time as major changes, if warranted, are made to the inspection cycle and procedures. —Ed.*

To the Editor

I would like to make a comment on the Maintainer 4/2000 story on page 3 concerning the turnbuckle lockwiring. As a matter of interest, I am also a TC safety inspector and have run into the issue of turnbuckle lockwiring from time to time during my 17 years with the Department.

Essentially the situation is that we, in Canada, have historically accepted, in addition to AC 43-13, the alternative standard practices provided in the British civil aviation authority's (CAA) *Manual of Civil Aircraft Inspection*. This source used to be referred to specifically in the old E and I Manual [Engineering and Inspection Manual].

The MCACI is a very comprehensive set of books, although it is not easy to find. It contains a number of alternative ways of lockwiring turnbuckles, one of which is pigtailing. Since it is a quicker and easier process than the single or double wrap method given in AC 43-13, it has been used by a great many AMEs in Canada for a very long time, and to my knowledge it has not caused any problems.

From the sound of the incident described in the Maintainer, the source of the problem was not the lockwiring method per se, but rather that an excessively long and incorrectly stowed tail end was left on the lockwire.

I hope that this story doesn't leave the impression that we in Canada will only accept AC 43-13, and I urge you to have a look at the MCACI yourself. The engineers in the Aircraft Certification Branch will likely have a copy since that was where I originally researched this issue myself back in 1985. At that time, I was working in the then Western Region and found the set of books in the former Aeronautical Engineering Branch at regional headquarters in Edmonton.

Regards,
D.G. Hilchie,
Vancouver, B.C.

Transport Canada's Aviation Safety Seminar, CASS 2001, May 14-16, Westin Ottawa hotel
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info/registration: http://www.tc.gc.ca/aviation/cass2001/

Lack of Oil Causes Tail Rotor Gearbox to Fail

The Bell 47 helicopter, piloted by a student pilot and his flight instructor, took off from Abbotsford Airport in visual meteorological conditions. As the helicopter climbed through about 700 ft over the airport, it lost tail rotor thrust and began to spin to the right. As it descended further in a spiral, the helicopter appeared to be totally out of control and struck the ground in a steep nose-down attitude with fatal injuries to the occupants.

Inspection of the wreckage at the accident site revealed damage to the tail rotor consistent with that demonstrated by a tail rotor not turning on impact. Also, gears in the tail rotor gearbox had uncoupled and suffered heat distortion. Further inspection at the TSB regional wreckage examination facility and an independent engineering facility confirmed that the gears in the tail rotor gearbox had overheated, smeared, and disengaged. No remnant of oil or burnt oil was in the tail rotor gearbox. Inspection of the controls, including the forward cables for the horizontal stabilizer, revealed no anomalies.

The day before the flight, maintenance personnel conducted a 100-hr. inspection on the helicopter. Among other details, this inspection required that the tail rotor gearbox oil be changed. While the AME conducted other portions of the inspection, he assigned a technician the job of changing the oil. The technician drained the tail rotor gearbox oil, inspected it for metal particles, and installed and lockwired the drain plug. The AME signed the aircraft journey logbook to indicate that the 100-hr. inspection was completed. The 100-hr. inspection checklist item that called for draining and refilling of the tail rotor gearbox was initialled by the technician.

On the morning of May 10, 2000, the student pilot conducted a pre-flight inspection on the helicopter in the hangar. An item on the inspection was to visually check, through a small sight gauge (window), the oil level in the tail rotor gearbox. It is sometimes difficult to tell whether there is oil behind the window. The instructor was not involved in the pre-flight inspection but was aware that a 100-hr. inspection had been completed and a control cable had been changed. The helicopter had been operating for about 15 min on the ground and about 2 min in the air before the loss of yaw control, as previously described.

Two common techniques are taught to pilots to stop a helicopter from rotating as a result of a loss of tail rotor thrust. One is to maintain enough airspeed or flow to allow the helicopter's vertical stabilizer to be aerodynamically effective enough to oppose the torque generated by the engine and main rotor. The other is to remove the engine torque by lowering the collective and, if required, shutting off the engine (enter autorotation). If yaw control is not re-established, it is easy for a pilot to become disoriented and not be able to coordinate control inputs to maintain other control parameters. For tail rotor failures, the Bell 47 flight manual stipulates to "immediately execute an autorotative descent . . . ."

Since there was heat distortion of the gears and no remnant of oil in the tail rotor gearbox, it was concluded that no oil was in the gearbox when the helicopter started operating on the morning of the accident. It was also concluded that, since the lack of oil was not detected prior to flight, the technician, the AME, the student, and the instructor did not check the oil level or erred in reading the sight gauge.

Findings as to the cause of the accident listed the fact that the oil had been drained from the gearbox and, for undetermined reasons, was not replaced, leaving the gearbox to fail, most probably because of a lack of lubrication.

When yaw control was lost during flight, the pilot had two choices. He apparently made the wrong choice in this instance because the helicopter could not regain directional control through increased speed. The immediate execution of an autorotative descent probably would have been a better choice, but this would have been complicated because the student was flying and there was so little time for the instructor to take over the controls in this low-altitude, low-airspeed situation after takeoff.

As for the question of whether human factors were involved in this accident, the answer is yes. The initiating factor was the lack of a more visible warning to the aircrew, or anyone else about to start the aircraft, that fluids were drained. It is always prudent to hang a sign on the controls or over the instrument panel, warning others that fluids are drained. The sign should remain in place until the fluids, oil in this case, are replaced. This is a simple and effective procedure that I follow myself and was a common maintenance practice in the general aviation industry for many years. If this had been done, the crew would have had a second chance to avoid the accident. Human factors are about people missing the little things, and at least four people missed the first link in this chain of tragic events. —Ed.

Ref: TSB A00P0077

King Air Emergency Extension

Beech King Air 100 similar to the aircraft involved in this accident.

The crew of a Beech King Air 100 was unable to lower the gear properly using either normal or emergency extension procedures and landed with an unsafe indication. Although a fly-by confirmed that the gear appeared OK, it subsequently collapsed on landing with considerable damage to the aircraft.

The landing gear did not extend when selected down because the circuit breaker (CB) for the electric motor that operated the hydraulic pump had tripped. A major contributor to the problem may have been a leaking nitrogen system; this depleted the supply bottle because of a defective hydraulic accumulator that would not maintain the nitrogen charge. This would result in more frequent cycling of the hydraulic pump motor to maintain hydraulic pressure until the repeated recycling caused an overheated circuit, which popped the circuit breaker. The emergency landing gear extension failed to lock the right main gear for undetermined reasons.

As a result of the accident, the operator initiated the following safety actions, which are listed below to assist in obtaining the widest possible circulation of this information to other operators of similarly equipped Beech King Air 100 aircraft.

1. Beech King Air 100 standard operating procedures (SOP) were amended to allow a single, in-flight reset of the electric hydraulic pump motor 60-amp CB.
2. The 60-amp CB in the accident aircraft has been relocated to the cockpit, similar to other King Airs in fleet that have Aviadesign STC hydraulic landing gear installed.
3. A mirror has been installed on the inboard side of the engine cowlings to allow observation of the nose gear from the cockpit for landing.
4. The company flight operations manual was amended to read "where practicable it is recommended that the pilot contact the applicable ASD operations centre, and state the nature of the problem, the assistance required, and the time remaining before a landing is necessary."

The company safety actions could have possible continuing airworthiness operational implications for any fleet of similar aircraft in the service of other operators who may wish to take advantage of this information. Additionally, if pilots or maintenance personnel notice the hydraulic pump light recycling continuously, it suggests leaking pressure, and an immediate attempt should be made to locate and repair the source or cause of the declining pressure. —Ed.

Ref: TSB A98O0184

Water in Fuel Brings Down DHC 2 Beaver

DHC 2 Beaver similar to the accident aircraft.

The aircraft crashed because of an engine failure about 45 min after departure from Mary's Harbour, Newfoundland, seriously injuring the pilot and front-seat occupant. The accident was apparently the result of water contamination in the fuel.

On the morning of the accident, the pilot and a passenger had refuelled the aircraft from a sealed drum that had been delivered to the Mary's Harbour airstrip three weeks before the accident. During the refuelling process, a cloth was used to strain the fuel into the centre and aft tank, which were filled. No fuel was added to the forward tank because it was already full. Moving the fuel selector from the aft tank position to the centre tank position during flight caused the engine to quit without warning. The fuel selector was then moved to the forward tank position and, after some delay, the engine was successfully restarted and ran for approximately 10 to 20 seconds before it quit again and the aircraft hit trees.

During recovery of the fuselage, the salvage team drained the centre tank. Maintenance observed a considerable amount of water present. Further inspection revealed varying quantities of water in other areas of the fuel system, including the carburetor fuel strainer, float bowl, and wobble pump fuel lines. What can be learned from this accident? Since water in fuel is always a hazard, probably the best lesson would be for all operators using remote fuel systems, such as barrels, to include the refuelling procedures and checks in the operations manual. Operators should ensure that crews follow the instructions, particularly checks for water and precautions against static electricity, during every such refuelling operation.