



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 19, 1990

In reply refer to: A-90-147 through -150

Honorable Donald B. Rice
Secretary of the Air Force
Department of the Air Force
The Pentagon
Washington, D.C. 20301-1000

On July 19, 1989, a McDonnell Douglas DC-10-10, operated by United Airlines as flight 232, en route from Denver, Colorado, to Chicago, Illinois, with 296 persons on board, experienced an in-flight emergency following the fragmentation and separation of the No. 2 engine fan disk. The airplane crashed during an attempted emergency landing to runway 4/22 at Sioux Gateway Airport (SUX), Sioux City, Iowa.

During the accident, the airplane separated into four sections and portions burned. The center section of the airplane, which contained most of the passengers, came to rest inverted in a cornfield adjacent to runway 17/35, an active runway. The resting place was about 3,700 feet from the initial impact on runway 4/22. Of the 296 persons on board, 110 passengers and 1 flight attendant were fatally injured: 35 of these persons, some having traumatic blunt force injuries, died of asphyxia secondary to smoke inhalation, and 76 died of blunt force trauma. Of the remaining 185 persons, 47 sustained serious injuries, 125 sustained minor injuries, and 13 were not injured.

Sioux Gateway is a joint-use airport accommodating civilian and Iowa Air National Guard aircraft. The Iowa Air National Guard provides aircraft rescue and fire fighting (ARFF) services for the facility, which is certificated under Federal Aviation Administration (FAA) regulations 14 CFR 139 as an Index B airport. The index is based on the largest airplane with an average of five or more scheduled daily departures; the regulations stipulate the minimum level of fire fighting equipment and agents for each index. For SUX, Index B was based on an airplane equivalent to the Boeing 737-200 series and requires a minimum 1,500 gallons of water for foam production. An airport serving McDonnell Douglas DC-10 series airplanes, for example, would be classified as an Index D-level airport for ARFF services and would require more than double the quantity of fire extinguishing agents required for an Index B airport.

The Safety Board's investigation of this accident has disclosed several problems associated with the ARFF's ability to control continuously the postcrash fire at the accident airplane's right wing root. The investigation also identified deficiencies in the design and operation of the Kovatch A/S32P-18 (P-18) water supply vehicle, the absence of FAA requirements to regularly test fire service vehicles at their maximum discharge capacity, as well as delays in correcting reported deficiencies in Kovatch P-18 fire service vehicles.

The first two ARFF vehicles to arrive at the scene of the accident began a mass application of extinguishing foam immediately. The bottom of the inverted fuselage section of the airplane was blanketed with foam, and the foam blanket temporarily suppressed the fire during the evacuation of passengers and crew. About 9 minutes after the landing and after the depletion of water aboard the two ARFF vehicles, a P-18 water supply vehicle was positioned adjacent to the two ARFF vehicles, and a 2 1/2-inch hose was connected between the P-18 and each vehicle. When the P-18 water pump was charged to its maximum capacity of 500 gallons per minute, a restriction developed in the vehicle's tank-to-pump hose that stopped all water flow to the two ARFF vehicles. Thus, the airport's primary attack vehicles could not be replenished with water to continue attacking the fire.

Two Sioux City Fire Department pumper trucks subsequently resupplied the airport's ARFF vehicles. However, during this delay of about 8 minutes, no extinguishing agent was applied to the fuselage, and the fire at the airplane's right wing root intensified. Soon thereafter, fire penetrated the cabin, resulting in deep-seated fires that could not be attacked by exterior fire fighting tactics. Despite attempts to advance hand lines to the interior of the airplane, the fire intensified inside the cabin and burned out of control for about 2 1/2 hours.

The Kovatch P-18 water supply vehicle has no foam-producing capability and is designed primarily to supply water to the primary ARFF vehicles. As certified by the manufacturer, this vehicle has a water capacity of 2,000 gallons and a maximum water pump discharge rate of 500 gallons per minute (gpm).

In September 1988, the Iowa Air National Guard purchased the P-18 through the Air Force and placed it in service at SUX. The Safety Board has learned that during the 2 years preceding this accident, the Air Force purchased 210 Kovatch P-18 water supply vehicles. The Safety Board has also learned that some P-18's are based at joint-use airports that are certified by the FAA as having ARFF capabilities in compliance with 14 CFR 139.

Although the Kovatch P-18 water supply vehicle was listed in the SUX airport certification manual, the airport fire chief testified at the Safety Board's public hearing that the vehicle had never been tested to its maximum discharge capacity of 500 gpm. In the absence of Air Force/FAA requirements to perform maximum capacity discharge tests, the fire chief relied on the manufacturer's pre-delivery factory tests of the pump's ability to discharge 500 gpm with two 2 1/2-inch lines attached. Additionally, the fire chief

stated that SUX tested the P-18 weekly at nominal pressure and discharge capacity at less than 500 gpm.

During the Safety Board's investigation, the P-18's tank-to-pump suction hose assembly, a soft, 11-inch by 4 1/2-inch inside diameter Gates rubber hose, P/N NR75W, was removed from the vehicle and examined at the SUX facilities. The examination disclosed that the 2-inch internal polyvinyl chloride (PVC) stiffener installed in the hose had rotated laterally 90°. Kovatch stated that the internal stiffener in the soft hose assembly is required to prevent the hose from collapsing. Kovatch also stated that the stiffener was installed by a press fit in the center of the hose.

Examination of the rotated stiffener strongly suggests that when the P-18 operator attempted to resupply the two ARFF vehicles with water via the two 2 1/2-inch hoses, with the pump set to its maximum rated capacity of 500 gpm, a momentary high-pressure surge occurred within the tank-to-pump piping system that caused the stiffener to move and rotate to a position that blocked the flow of water to the pump.

In examining the susceptibility of the internal stiffener to displace and rotate, the Safety Board found that the stiffener's length was about half the internal diameter of the soft suction hose. Because of the short length of the stiffener and because it was not clamped, it was free to rotate and block the flow of water or even to slide toward the pump intake, making the soft suction hose susceptible to collapse.

The Safety Board is concerned that the design of the P-18, which uses a soft suction hose at a critical location upstream of the vehicle's pump and depends on the stiffeners, is susceptible to blockage. This concept is used not only in the P-18 but in other pumpers manufactured by Kovatch. A hose made of more rigid material, which would have obviated the need for an internal stiffener or an improved stiffener design, is necessary to reduce the likelihood of hose blockage regardless of operating conditions.

On February 15, 1989, a P-18 operated by the Air Force at Tyndall Air Force Base, Florida, was unable to supply water to an ARFF vehicle during a pumping operation. The Air Force determined that the "A/S32P-18 tank suction line was restricted by a PVC [stiffener] inside [the] rubber suction line...and [they] installed [a] clamp around [the] hose and PVC to hold it in place." On August 16, 1989, a similar P-18 deficiency was found at Malstrom Air Force Base, Montana.

Following discussions with the Air Force, Kovatch issued Technical Service Bulletin 86-KFT5-P-18-5, dated August 21, 1989, which called for the removal of the tank-to-pump hose assembly installed on all 210 A/S32P-18 vehicles and the replacement of the hose assembly with a new tank-to-pump hose assembly that has a 4-inch PVC internal stiffener. Kovatch agreed to supply modification kits directly to air bases whose addresses were provided by Warner Robins Air Logistics Center.

On August 22, 1989, the Air Force issued a Materials Deficiency Report that directed a one-time test of all Kovatch P-18 vehicles at the maximum

pump discharge rate of 500 gpm and the replacement of the 2-inch stiffener with the 4-inch stiffener. Within 30 days, eight Air Force bases responded that tests found deficiencies similar to those described in this letter. The bases then replaced the 2-inch stiffeners with 4-inch stiffeners.

The Air Force has advised the Safety Board that it anticipates completing the modification of all 210 Kovatch vehicles during 1990. The Safety Board is concerned, however, that during the interim unmodified Kovatch P-18 vehicles may still be in service. Because of the demonstrated deficiency of the Kovatch P-18 vehicle, the Safety Board believes that the Air Force should expedite the completion of the hose modification on the remaining Kovatch vehicles.

The Safety Board also believes that alternative water resupply resources should be arranged by users of unmodified Kovatch P-18s, until the modifications are completed, to prevent any possibility of failure during critical emergency conditions.

The Safety Board is also concerned that 14 CFR 139 certificate holders are not required to test on a regular schedule all fire service equipment at the maximum rated discharge capacity. In the absence of scheduled maximum capacity testing, deficiencies in the operation of key fire service equipment may remain undetected. The Safety Board believes that all fire service equipment should be tested at full rated capacity prior to being accepted for ARFF service and tested on a regularly scheduled basis thereafter.

Therefore, the National Transportation Safety Board recommends that the U.S. Department of the Air Force:

Require that Kovatch A/S32P-18 vehicles comply with Kovatch Technical Service Bulletin 86-KFTS-P-18-5 and expedite the distribution of modification kits that will permit compliance with the service bulletin. (Class II, Priority Action) (A-90-147)

Immediately remove from service all Kovatch A/S32P-18 vehicles until they have been so modified. (Class II, Priority Action) (A-90-148)

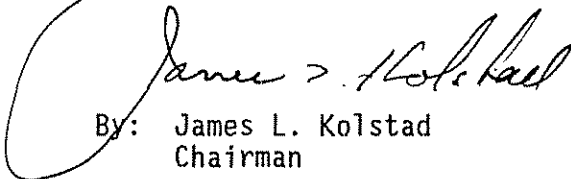
Require maximum capacity discharge tests of all emergency response fire service vehicles before the vehicles are accepted for service and on an established regular schedule thereafter. (Class II, Priority Action) (A-90-149)

Make available to all operators of Department of the Air Force air bases an account of the circumstances of the accident described in Safety Recommendation letter A-90-147 through -150 as they relate to the deficiencies in the Kovatch A/S32P-18 water supply vehicle. (Class II, Priority Action) (A-90-150)

Also, as a result of its investigation, the Safety Board issued safety recommendations A-90-151-155 to the Federal Aviation Administration.

The National Transportation Safety Board is an independent federal agency with the statutory responsibility "...to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendation in this letter. Please refer to Safety Recommendation A-90-147 through -150 in your reply.

KOLSTAD, Chairman, COUGHLIN, Vice Chairman, and LAUBER and HART, Members, concurred in these recommendations. BURNETT, Member, filed the following statement.



By: James L. Kolstad
Chairman

BURNETT, Member, dissenting statement:

We should classify as "Class I, Urgent Action" those safety recommendations which relate specifically to the existing Kovatch A/S32P-18 vehicles, i.e., the first, second and fourth recommendations to the U.S. Department of the Air Force and the first and third recommendations to the Federal Aviation Administration.