

Heavy Equipment Investigation #2

ENGINEERING REPORT

OCTOBER 2003

PREPARED FOR: INSURANCE COMPANY #1

ATTENTION: MR. MIKE WENDELL

INSURED: FIRE DEPARTMENT #1

DATE OF LOSS: SEPTEMBER 2003

LOSS LOCATION: KENTUCKY

CLAIM NUMBER: <omitted>

IC1 FILE NUMBER: <omitted>

INTRODUCTION

On September 2003, a single vehicle collision involving a Kentucky fire truck occurred while the vehicle was deployed at a fire scene. The subject vehicle was a 2000 Pumper with an Fire Truck Manufacturer #1 pump deck mounted on a Chassis Manufacturer #1 cab and incomplete chassis. The vehicle reportedly suddenly accelerated while hoses were being deployed at the fire scene. The vehicle entered a wooded area and impacted at least one tree, causing substantial damage to the vehicle.

On September 2003, Mr. Richard Guerrero of Subrogation Company #1 of Kentucky, contacted Investigation Company #1 (IC1) and requested IC1's assistance in determining the cause of the sudden vehicle acceleration. Mr. Guerrero was acting on behalf of the insurer, Insurance Company #1.

The author of this report, Scott A. Jones, P.E., Mechanical Engineer of IC1, (812) 944-9988, was assigned to conduct the investigation. The observations and conclusions from the investigation are contained in this report.

BACKGROUND

Interview with Fire Department #1 Fire Chief Todd Stevens

On September 2003, the author interviewed Chief Todd Stevens at the Fire Department #1 to learn his observations of the events preceding the subject collision. Chief Stevens reported that the subject vehicle was purchased new in 2000. The vehicle was equipped with a Chassis Manufacturer #1 custom aluminum cab, a Louracy 315 HP diesel engine, and an Duvalt 4-speed automatic transmission.

Chief Stevens reported that the department firefighters performed minor monthly preventive maintenance on the vehicle, and a local repair shop, Transmission Shop #1, performed all annual preventive maintenance. The Transmission Shop #1 records were not available for the author's review. Chief Stevens knew of no corrective repairs since the vehicle was purchased. The subject pumper was last used prior to the day of the event on August 2003.

Interview with Volunteer Firefighter Victor Matthews

On September 2003, the author interviewed Firefighter Matthews, a 20 year veteran firefighter at the Fire Department #1. Firefighter Matthews was the driver and pump operator on the five-man crew that responded to a fire on the day the event.

Firefighter Matthews reported that he arrived at the scene after an approximate 12 mile transit from the fire department. Upon arriving at the scene, he reported that he placed the transmission in NEUTRAL, set the pneumatic spring brakes, and then selected the pump gear using the dashboard-mounted Dean pump power shift lever.

He reportedly observed the two green lamps illuminate on the Dean pump drive selector, indicating that the Dean transfer gearbox had transferred engine power from the drive wheels to the Dean pump. He then placed the Duvalt transmission in DRIVE to power the Dean pump.

Firefighter Matthews reported that he left the cab, stationed himself on the pump deck immediately aft of the cab, and observed the illumination of the single green pump ready lamp. He reportedly began turning the (pump deck) engine throttle to increase pump speed to deliver the proper water pressure. One firefighting hose was reportedly receiving water while a second hose was being prepared for use.

As engine speed was increasing, the vehicle suddenly accelerated while Firefighter Matthews was standing at the pump deck. The vehicle reportedly traveled approximately 75 feet and struck a large tree, which held the vehicle stationary while the engine was running and the rear (drive) wheels were spinning on loose earth.

OBSERVATIONS

On September 2003, the author traveled to the Fire Department #1 in Kentucky, to inspect the subject fire pumper. The pumper had reportedly been returned to the fire department and stored indoors since the event. Chief Stevens, Firefighter Snape, and Firefighter Matthews accompanied the author during a portion of the inspection.

Fire Truck Manufacturer #1 (FTM1) of Florida, manufactured the subject pumper, VIN <omitted>, in 2000 (*Photograph 1* -manufacturer's door sticker). The Federal Motor Vehicles Safety Standards certification sticker that was supplied by the incomplete chassis and cab manufacturer Chassis Manufacturer #1 is shown in *Photograph 2* along with the cab identity plate (*Photograph 3*).

Photograph 4 shows a front view of the pumper, identified as Unit #24 in the Fire Department #1 inventory system. The driver's side bumper served as the primary impact point (*Photograph 5*). A small impact had occurred on the passenger's side bumper (*Photograph 6*). *Photographs 7, 8, and 9* show passenger's side, rear, and driver's side views of the pumper, respectively.

The FTM1 pump machinery ratings plate is shown in *Photograph 10*, and the driver's side hose connections are shown in *Photograph 11*. The pump deck that was situated immediately behind the cab is shown in *Photograph 12*. Small buckles in the sheet

aluminum cab top were apparent when viewing from the pump deck (*Photograph 13* – passenger’s side and *Photograph 14* – driver’s side). The cab or chassis had been substantially displaced aft on the driver’s side relative to the pump deck as shown in the down-facing view of the gap between the cab and pump deck in *Photograph 15*.

The driver’s instrument panel appeared as shown in *Photograph 16*. The pumper had 500 hours usage (*Photograph 17*) at the time of the inspection. The automatic transmission selector button appeared as shown in *Photograph 18*, and the Dean pump power shift, which controlled operation of the Dean transfer gearbox, appeared as shown in *Photograph 19* in the ROAD position (i.e., transmission supplied power to the rear wheels). The green “PUMP ENGAGED WHEN LIT” and “OK TO PUMP” illumination lamps are also shown in the photograph.

The pneumatic spring brakes were set by the dashboard control switch (*Photograph 20*). The Duvalt 4-speed automatic transmission appeared as shown in the aft-looking-forward view in *Photograph 21*. The Dean transfer gearbox (*Photograph 22*) had the drive shaft from the transmission enter at the front, and the Dean pump was mounted at the top of the gearbox. The drive shaft continued from the rear side of the gearbox to the rear axle that was equipped with combination spring brakes (*Photograph 23*).

Operational Testing

With the assistance of Firefighter Snape and Chief Stevens, the author outlined and then executed two tests to simulate the reported conditions at the time of the collision. The firefighters filled the 1,000 gallon on-board storage tank in preparation for the testing (*Photograph 29*).

Test #1

The diesel engine was started with the spring parking brakes set. Chief Stevens reported pneumatic air pressure at 120 psi. Chief Stevens selected the automatic transmission to DRIVE and slowly depressed the throttle pedal to raise engine speed from 500 rpm (i.e., idle speed). At approximately 1,100 rpm, the fire truck began moving forward. The test was terminated. The transmission was shifted to NEUTRAL.

Test #2A

The diesel engine was started with the spring parking brakes set. Firefighter Snape was positioned at the driver’s station and Chief Stevens was positioned at the pump deck. With the transmission in NEUTRAL, Firefighter Snape positioned the Dean pump power shift to the PUMP position. (*Author’s note: Throttle control was transferred from the driver’s station to the pump deck.*) Firefighter Snape then commanded the transmission to DRIVE.

After the author observed the two pump lamps at the driver's station and a corresponding single green lamp at the pump deck illuminate, Chief Stevens advanced the pump deck engine throttle to achieve approximately 150 psi pump pressure (*Photograph 24*) at 1,400 rpm (*Photograph 25*). The conditions were satisfactorily held for 5 minutes. A small amount of water leaked from the pump seals during the test (*Photograph 30*). The test was terminated after the 5 minute holding period. The transmission was shifted to NEUTRAL and the Dean pump power shift was commanded to ROAD.

Test #2B

After the pumper sat at idle for approximately 5 minutes, the author had Chief Stevens and Fire Fighter Snape repeat the test sequence of *Test #2A*.

When Firefighter Snape positioned the Dean pump power shift to the PUMP position, the two green illumination lamps illuminated to 1/4 to 1/2 of normal brightness (*Photograph 26*). The single green lamp on the pump deck control console also illuminated to 1/4 to 1/2 normal brightness (*Photograph 27*). Firefighter Snape selected the automatic transmission to DRIVE.

As Chief Stevens advanced the pump deck throttle, pump pressure was reportedly increasing. *At 1,300 rpm, the truck suddenly and unexpectedly accelerated forward.* Chief Stevens immediately decreased engine speed with the pump station throttle control, which caused the truck to stop. The transmission was shifted to NEUTRAL and the Dean pump power shift was commanded to ROAD.

No further testing was performed.

DISCUSSION/CONCLUSIONS

The subject 2000 Pumper sustained substantial damage caused by uncommanded, unexpected, and uncontrolled forward motion while firefighters were combating a fire. The collision resulted in substantial front bumper, cab, and chassis damage. A full regimen of diagnostic testing to detect latent damage (e.g., pump imbalance and bearing damage) was not conducted during the September 2003, testing.

The driver at the time of the event, volunteer Firefighter Victor Matthews, reported that the two green illumination lamps on the Dean pump power shift panel and the single green illumination lamp on the pump deck console did in fact illuminate during the evening of the event. The dark environmental conditions at the fire scene most probably contributed to a bright appearance, even if the lamps only operated at 1/4 to 1/2 of normal illumination, as witnessed during the author's testing on September 2003.

It is believed that the author reproduced the conditions of the pumper immediately preceding the subject collision event during the September 2003, testing in Tests #2A and #2B. Furthermore, it is believed that at the time of the event, the pumper exhibited the same uncommanded, unexpected, and uncontrolled forward motion that was witnessed during the September 2003 testing in Test #2B.

Specifically:

- 1) It is believed that on the evening of the event and during the author's September 2003, testing, the Dean transfer gearbox (reference Photograph 22) achieved an improper operating mode that resulted in input power being directed to both the Dean pump and the rear drive axle.*
- 2) It is believed that the improper operating mode of the Dean transfer gearbox occurred when the Dean pump power shift lever was placed in the PUMP position.*

Upon recognition of the abnormal operating mode, the author performed no further data collection with regard to the condition of the pumper systems due to the potentially destructive nature of the inspections. Therefore, no determination of individual component failure(s) was made during the September 2003, inspection.

It is believed however that the events on the day of loss were caused by uncommanded, unexpected, and uncontrolled forward motion of the subject pumper due to one or more defects in the design, material, and/or workmanship of the subject pumper. It is therefore believed that the manufacturing agent of record, Fire Truck Manufacturer #1 of Florida, (reference Photograph 1) is responsible for the conditions leading to the subject event.

The author discovered no National Highway Transportation Administration (NHTSA) recalls pertaining to the 2000 Fire Truck Manufacturer #1 vehicle or the Chassis Manufacturer #1 incomplete chassis.

(Author's note: It is recommended that no further operational or diagnostic testing be performed on the subject pumper unless a test protocol is developed in coordination with all involved parties.)

The analysis and conclusions are based upon information reviewed to date, plus general engineering knowledge and experience. Information reviewed at a later date may warrant modifying or augmenting the conclusions.

We appreciate the opportunity to work with you on this evaluation. Pending further direction, this file is considered closed. Please let us know whether we can be of further assistance to you.

Sincerely,

Investigation Company #1

Scott A. Jones, P.E.
Mechanical Engineer

cc: Mr. Richard Guerrero
Mr. Kyle Corningstone
Subrogation Company #1