

GREEN SHEET

California Department of Forestry and Fire Protection and Contra Costa County Fire Protection District

Joint Investigation Summary of a Fire Engine Rollover



**Fire Engine Rollover
July 1, 2004**

**Kirker Pass Fire
CA-SCU-003601**

CA-CNR-000029

A Board of Review has not approved this Summary Report. It is intended as a safety and training tool, an aid to preventing future occurrences, and to inform interested parties. Because it is published on a short time frame, the information contained herein is subject to revision as further investigation is conducted and additional information is developed.

SUMMARY

Contra Costa County Fire Protection District (CON Fire) E-384 is a 2001 Type 3 (wildland) 4WD engine manufactured by West-Mark, and similar in design to a CDF Model 14 engine. While working on a vegetation fire, E-384 drove down a steep (58%; 30 degrees) draw.¹ Captain 384 walked down the draw ahead of the engine to look for hazards, and Firefighter 384 took his seat behind the driver. As the engine started the descent, gravity caused it to quickly accelerate. About 30 feet down the slope, the occupants felt a “jolt” and the engine seemed to “break loose”, eliminating engine compression braking, and accelerating “out of control.” Engineer 384 believed that service brake application would cause the engine to slide and/or roll; therefore, no brake pressure was applied at that time.

In an effort to bleed off speed, Engineer 384 turned the engine slightly to the right, climbing up the right side of the draw, bringing the engine to a stop on a steep side slope. Within seconds, as water shifted through the tank baffles, the engine began a slow roll onto the left side, completing six revolutions before it came to rest on the driver’s side.

Engineer and Firefighter 384 were extricated from the engine and flown by air ambulance to a local hospital. They were treated and released several hours later.

CONDITIONS

The fire originated on the southeast side of Kirker Pass Road, near Hess Road, between Concord and Pittsburg. It burned in grass covered hills with scattered oak trees, ranging from 700 feet elevation at the origin, to 1200 feet elevation at the ridge top. Slopes in the area range from 20% (11 degrees) to 200% (63 degrees). Grass in the upper half of the fire had been heavily grazed, while the lower half had not been grazed.

The slope of the draw in which the accident occurred is uneven, but is generally 58% (30 degrees) at the top, and 47 % (25 degrees) in the area where E-384 came to rest. The sides of the draw range between 50% (27 degrees) and 150% (56 degrees).

SEQUENCE OF EVENTS

At 1642 hours, CON Fire responded to an overturned vehicle and resulting grass fire on Kirker Pass Road. At 1646, responding units observed large columns of white smoke in

¹ draw = a depression between two ridges.

the area and requested a full wildland response. CDF was notified and also sent a full response. The fire was in an unincorporated area of Contra Costa County on the southeast side of Kirker Pass Road, between the cities of Concord and Pittsburg.

CON Fire E-384 met with their Division Supervisor on a dirt road known as Fire Trail 11-3, on the first ridge top southeast of Kirker Pass Road. The right flank of the fire was below them at mid-slope, approximately 1200 feet from the ridge top (horizontal distance). E-384 was directed to an adjacent draw to assess the feasibility of a mobile attack on the right flank. Captain 384 walked down the draw ahead of the engine to look for hazards, and Firefighter 384 took his seat behind the driver. Engineer 384 recalls shifting the transfer case to Low Range 4WD upon leaving the pavement. He further recalls starting down the hill with the automatic transmission in first gear, with the exhaust brake engaged.

As the engine started down the steep slope of the draw (58% or 30 degrees), gravity caused it to quickly accelerate. Initially, E-384 was traveling “under control” at an estimated speed of 5 to 10 mph. About 30 feet down the slope, the occupants felt a “jolt” and the engine seemed to “break loose”, eliminating engine compression braking, and accelerating “out of control.” Engineer 384 and witnesses estimate the engine quickly reached a speed of somewhere between 25 to 45 mph. Engineer 384 believed that service brake application would cause the engine to slide and/or roll; therefore, no brake pressure was applied at that time.

In an effort to bleed off speed, Engineer 384 turned the engine approximately 30 degrees to the right, climbing up the right side of the draw. This action placed the engine on a side slope of 109% (47 degrees). As the engine rolled to a stop, he applied the service brakes to avoid rolling backward. Within seconds, as water shifted through the tank baffles, the engine began a slow roll onto the left side, completing six revolutions over 259 feet before it came to rest on the driver’s side.

At 1732 hours, Captain 384 and Kirker Air Attack simultaneously reported a roll over of a type 3 engine with firefighters trapped. The Engineer and Firefighter were extricated from the engine and flown by air ambulance to a local hospital.

The fire was contained at 1815 hours after burning 20 acres of grass.

INJURIES/DAMAGES

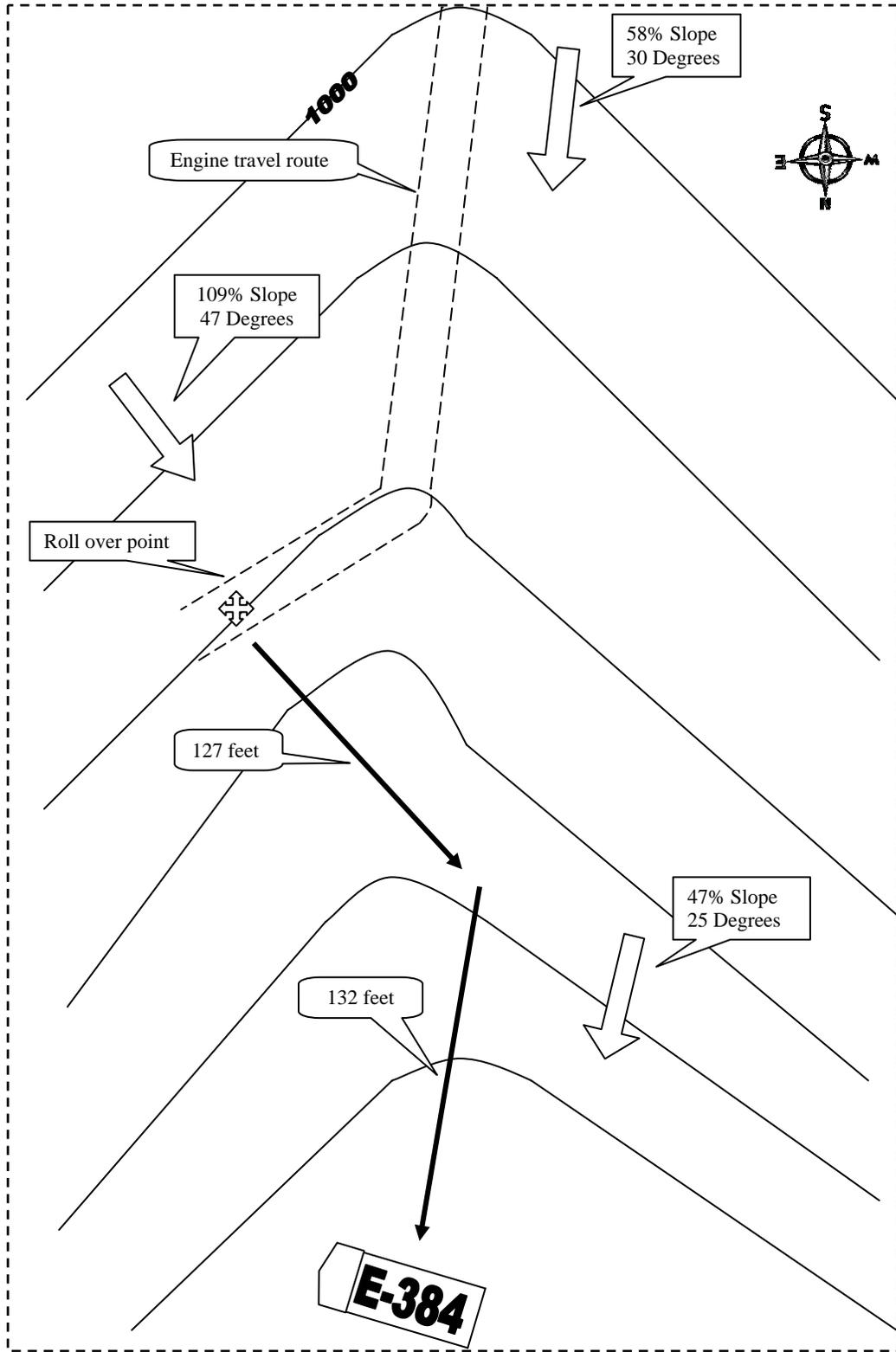
Engineer and Firefighter 384 were treated and released from the emergency room several hours later. Their injuries were limited to bruises and a sore shoulder; both had been wearing seat belts.

Engine 384 was a total loss.

SAFETY ISSUES FOR REVIEW

1. When driving off road and downhill in vehicles equipped with an automatic transmission:
 - a. The service brakes are the primary means of controlling vehicle speed.
 - b. Engine compression braking is not dependable as the sole means of controlling vehicle speed.
 - c. Auxiliary braking systems such as exhaust brakes and transmission retarders are designed to supplement, not replace, use of the service brakes.
2. When operated off road, down steep slopes, most fire apparatus equipped with Allison automatic transmissions:
 - a. May reach speeds of 10-12 mph in first gear, even in Low Range 4WD.
 - b. May upshift to second gear if RPMs exceed governed limits, even if the transmission selector is in "1".
 - c. May reach speeds of 25-30 mph once shifted to second gear.
3. When driving any fire apparatus off road and downhill:
 - a. Speed quickly creates trouble. Creep down steep slopes at 1 to 2 mph.
 - b. Service brakes should be applied to maintain rolling friction. Anti-lock brakes reduce potential for service brakes to lock when applied.
 - c. Rollover potential is least when the vehicle is pointed straight up or straight down the hill.
 - d. Grass is often slippery and may cause tires to lose traction.
4. The CDF "Off Road Driving Course" specifies the maximum slope for engines is 40% (22 degrees). Apparatus drivers must maintain proficiency at estimating slope. A clinometer is an effective handheld measuring device for verifying estimates.

End of report. See Map 1 (attached).



MAP 1. Descent and rollover paths of E-384.