

Tractor Trailer Jackknife

- Definitions

1. **jackknife:** To place the trailer at a very sharp angle to the tractor. (http://www.twna.org/trucking_terms.htm)
2. **jackknife:** The action of a vehicle (tractor) with a trailer in which the trailer and the vehicle form a "V" instead of normally being pulled in a straight line. Usually this is the result of a skid in which the trailer swings around dangerously and tries to overtake the cab. (<http://www.100megsfree4.com/dictionary/car-dicj.htm>)
3. **trailer jackknife:** When the wheels of a trailer lock up, the trailer will tend to swing around. This is more likely to happen when the trailer is empty or lightly loaded. (<http://www.dmv.dot.state.nc.us>)

- Causes

1. Tractor Rear Wheels Lock: If the tractor drive wheels lock and the fronts are rolling, the tractor wants to spinout just like the single-unit vehicle. It can be shown (that on a single unit vehicle) that if the rear wheels lock and the fronts are rolling, the vehicle wants to spin out 180° so that the rear axle leads. When it does this it hits the trailer. This is a classical jackknife. (<http://www.raibrakes.com/anatomy.htm>)
2. Trailer Wheels Lock: The trailer wants to spinout since the locked wheels are at the rear of the trailer. Because the trailer has a much higher moment of inertia (resistance to rotation) since it is very long, it spins much slower than the tractor. This is called "trailer swing" and although the trailer could come all the way around and hit the tractor, it is much less likely that this will occur. Usually the driver has time to correct the trailer swing by releasing the brakes and counter steering. In the case of the classical jackknife (where the tractor drive wheels lock), the relatively short tractor spins very rapidly and the driver does not have time to react before it is too late. (<http://www.raibrakes.com/anatomy.htm>)
3. Aggravations: If there is side force acting on the vehicle when wheel lock occurs, the instability will occur faster. If, for example, the vehicle is in a curve and the drive wheels lock, the centrifugal force, a side force acting at the rear of the tractor, has very little force at the rear tires to resist it and the spin of the tractor leading to a jackknife will occur more rapidly. Side force can also be produced by a crowned road, a crosswind or any steering activity such as a lane change maneuver. In addition, if the trailer "pushes" the tractor and the trailer is at an angle to the tractor, a side force will result. (<http://www.raibrakes.com/anatomy.htm>) If a jackknife goes beyond a 15-degree angle, it's almost impossible to recover. Also, the faster the angle is reached, the less likelihood of recovery and the greater the severity of the crash. Tests by the National Safety Council with the three-axle tractor-trailer showed it would take 1.5 to 6 seconds to reach a 15-

degree angle with different wheels locked. The fastest was with tractor drive and trailer axles locked. But there was no jackknife when only the steer axle or all axles at once were locked.

(<http://www.navajo.com/safety/jack.htm>)

- Implications to this case

1. Wheel locking is evident based on police reported skid marks recorded and identified on the scale drawing.
2. No road marks are evident from the police information on the right side of the southbound lane prior to the Point of Impact. Skidding appears to be confined to the left wheels, indicating lockup may have occurred on the left wheels of the vehicle only.
3. This would support the relatively “straight” skid prior to the impact. The free rolling wheels would allow for directional control or maintenance.
4. The slight “drift” of the skid marks could have been caused by (1) driver swerving to avoid the impact, or (2) the “drag” or “pull” of the tires skidding only on the left side of the tractor trailer.
5. This movement, rather intentional or unintentional, would aggravate the jack knife situation.
6. At the Point of Impact, the recorded yaw marks indicate complete jackknifing has occurred.
7. The skidding, jackknifed trucked continues until impact with the pickup truck, at which time the trailer rolls over the pickup.
8. Both tractor-trailer and pickup continue their movement until the trailer passes over the pickup, leaving it at the resting point identified in the police report.
9. The tractor-trailer continues its movement to its identified point of rest.

- Avoidance Opportunities

1. Technologies:

- Antilock Brakes – An antilock brake system or ABS, significantly reduces the tendency for a tractor trailer to jackknife because the ABS controls tire slip to maximize braking force while still maintaining a high level of lateral or side force to keep the vehicle under directional control. (<http://www.raibrakes.com/anatomy.htm>)
- The TT600 JACKKNIFE CONTROL SYSTEM is controlled by a dash mounted module which can engage the limiting device by a single switch once you are on the road. This device limits the jackknife articulation angle to 26 degrees while driving. A light on the module indicates when it's engaged. The rig is now safe from jackknife and can bring to bear all the steering and braking control necessary in any driving situation. Adequate range remains for all normal road maneuvers including a double lane change or obstacle avoidance. During a severe panic stop a pneumatic cushion effect

stops the truck from slamming to the stop at the articulation limit, preventing damage or undue stress. A buzzer sounds before you reach the turn limit, allowing you to disengage the unit in seconds with a single switch for backing & docking.

(<http://www.jackknifecontrol.com>)

- LanescanIII is product for tractor- trailers and *will give drivers early warning that their trailer or tractor is jackknifing during a braking operation*. The driver will know from a distinct audible sound that the truck is sliding left or right. It will save them valuable time so they can react to the skid of the tractor or trailer and regain control of their vehicle. (<http://www.arcmcorp.com/jackprod.html>)
- The STS Accident Control and Anti-Jackknife System constrains articulation of the trailer in excess of approximately 14 degrees by mechanically limiting the amount of rotation of the tractor relative to the trailer in emergency stop situations. “The effect of the **STS-ACS** System, empowers drivers with the ability and confidence to use the full braking and steering capabilities of the tractor-trailer, without the fear of losing control, rollover or jackknifing.” (<http://www.us-sts.com/4%20product.htm>)

- Training Examples

1. Transportation Center of Excellence: “...Students will learn the fundamentals associated with the operation of commercial vehicles and will acquire basic driving and advanced safety skills. They will be trained in defensive driving, accident avoidance, anti-jackknife, and controlled braking techniques.” (<http://www.tce4cdl.com>)
2. On-Line Testing: Crist CDL Training Center (<http://www.roadwars.com/otc/>)
3. On-Line Testing: DriversTest.Net (<http://www.driverstest.net>)
4. J. J. Keller and Associates, Inc., Neenah, WI.: Video and other training aids specific to accident avoidance and emergency maneuvers. (<http://www.jjkeller.com>)
5. Commercial Driver Training, Inc., 600 Patton Avenue, West Babylon, NY, 11704: A private vocational school founded in 1961 to offer courses in professional tractor-trailer, truck, and bus driving. Commercial Driver Training's curriculum was developed to fill the trucking industries need for well trained highly skilled drivers. (<http://www.cdtschool.com>)
6. The Commercial Driver's License School, Inc., 4101 NW 27th Ave., Miami, FL 33142 (NewYork and Florida Locations): *Extreme Driving Conditions / Hazard Perception / Advanced driving maneuvers - Skid Control*. “What your drivers need to know before the accident occurs. These programs can be tailored for your specific fleets operating requirements. These programs have been well received by insurance underwriters of high accident fleets.” (<http://www.cdlschool.com>)
7. Nationwide Tractor Trailer Driving School, 125 Washington Highway, Smithfield, RI 02917: “Customized Driver Training - for the individual that

- has driven tractor trailers in the past and needs to refresh their training or renew their license. (<http://www.nationwidedrivingschool.com/programs.htm>)
8. CDLPlus : “Located in Fort Wayne, Indiana, CDLPlus is a state licensed institution that offers comprehensive commercial motor vehicle training for inexperienced, intermediate and experienced drivers. The curriculum can be customized to meet fleet requirements.....”. (<http://www.cdplus.com>)
 9. USADriveSafe, Inc., P. O. Box 634, Mechanicsville, Va. 23111: A site focused on safety through books, cassettes, and videos offered for sale, specifically on tractor trailer operation.
(<http://usadrivesafe.safeshopper.com/99/cat99.htm?108>)
 10. Northern Academy of Transportation Training, Ontario, CA.: *Truck Driver Upgrade Training*. Provides a wide range of training that extends to videos and custom videos as well as on site training.
(<http://www.transporthelp.com>)
 11. Texas Motor Transportation Association, East 11th Street, Austin, Texas: Offers many videos on tractor trailer training and safety.
(<http://www.tmta.com/ProductsServices>)
 12. ATDS Prairie Hill Truck Driving School, P. O. Box 41-FM 339 S. at Hwy 84, Prairie Hill, TX 76678: “The tractor/trailer driver program at ATDS is a complete, comprehensive course stressing safety and professionalism. The course involves textbook lessons, classroom sessions, and behind-the-wheel driving on both our private training range and public highways.”
(<http://www.truckingschool.com/atds.htm>)
 13. TRUCKSorg.com : A general listing of many truck driver training organizations (<http://trucksorg.com/Training>)