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## Entrapment – Arizona

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<b>ADOT</b>	Arizona Department of Transportation

It is all about the length of the yellow lights. The laws of physics require a yellow light to be at least a certain amount of time so that drivers can stop or go safely and legally. Human factors such as perception and reaction add to that time. Mechanical factors such as air-brake lag time also add to that time. When the yellow light is short, drivers run red lights without choice. The main problem is the federal standards themselves. When a city sets its yellows to the federal standards, those standards guarantee a large volume of drivers running red lights unintentionally. The federal standards violate the laws of physics<sup>1</sup>. This paper is not about the physics but rather about how the State of Arizona exacerbates the existing yellow duration problem by teaching drivers the wrong way to respond to yellow lights, and the fact that Arizona sets its yellow light times in opposition to its own requirements for commercial truck drivers.

The State of Arizona entraps drivers. Entrapment is illegal in the United States<sup>2,3</sup>. The Arizona Driver's Manual directly contradicts the ITE provisions and guidelines on how to respond to yellow lights. The Arizona Driver's License Handbook says you must stop and that it is illegal for you to speed up to get through the intersection. But ITE, the institution that sets the engineering parameters of a yellow light, says that sometimes you can safely stop while other times you must proceed to and through intersection at the speed limit. ITE even further instructs you that it may be necessary at times to beat the light. Therefore obeying the Arizona Driver's Manual forces you to break Arizona law, to receive unjust penalties or to crash.

The Arizona Driver's License Handbook:<sup>4</sup>

If you have not entered the intersection, you should come to a safe stop. If you are already in the intersection, you should continue moving and clear it safely. Speeding up to "beat the light" is illegal and could cause a crash.

Arizona uses ITE's yellow change formula to set yellow light durations.<sup>5</sup> ITE says some drivers upon seeing a yellow light *must* continue at the speed limit and some *must* even accelerate to beat the light.<sup>6</sup>

At the termination of a green phase, motorists approaching a signalized intersection are advised by a yellow signal indication that the red interval is about to commence.<sup>35</sup> The speed and location of some approaching vehicles will be such that they can stop safely at the stop line; others will have to continue at their speed or even accelerate into or through the intersection.

## Commercial Truck Drivers

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For commercial truck drivers in Arizona, the *Arizona Commercial Driver License Manual* opposes the *ADOT Traffic Engineering, Policies, Guidelines and Procedures*. Arizona sets the yellow light durations two seconds shorter than what all commercial truck drivers require. Because Arizona DOT's right hand does not know what its left hand is doing, Arizona entraps all commercial truck drivers at signalized intersections.

### Different Perception-Reaction Times

The Arizona Commercial Driver License Manual states:

1. That the "average perception time for an alert driver is 1.75 seconds."<sup>7</sup>
2. That the "average driver has a reaction time of 0.75 seconds to 1 second."<sup>7</sup>

Therefore the minimum Arizona combined perception-reaction time for the average driver is  $1.75 + 0.75$  seconds = 2.5 seconds.

- Arizona sets the perception-reaction time of yellow lights according to the *ADOT Traffic Engineering, Policies, Guidelines and Procedures*. To 1.0 second.
- The *Arizona Commercial Driver License Manual* requires 2.5 seconds. The American Association of State Traffic Highway Officials (AASHTO) recommends 2.5 seconds perception-reaction time for all drivers<sup>8</sup>.

### Commercial Manual Mistakenly Gives Dangerous Deceleration Rate

When computing the braking distance, the *Arizona Commercial Driver License Manual* gives dangerous advice to truck drivers. Without saying it explicitly, the Manual is computing the braking distance using a deceleration rate normally associated only with emergency braking. It is a deceleration rate achieved only when a truck driver slams on his brakes as hard as he can. But the context of this chapter and others in the Manual is not emergency braking.

The *Arizona Commercial Driver License Manual* says that under ideal conditions, “At 55 mph on dry pavement with good brakes, it can take about 216 feet”<sup>7</sup> to come to a stop. 216 feet represents a deceleration rate of 15.1 ft/s<sup>2</sup>. That’s an emergency braking deceleration. Here is how you compute that:

The braking distance formula from the laws of physics is:

$$d = \frac{v^2}{2a}$$

where v is the initial speed of the vehicle and a is the deceleration rate. The *Commercial Driver License Manual* gives values for d and v. The question is, “What is the deceleration rate the *Arizona Manual* implies? Algebraically isolate a:

$$a = \frac{v^2}{2d} = \frac{(55 * 1.47)^2}{2 * 216} = 15.1 \text{ ft/s}^2$$

15.1 ft/s<sup>2</sup> is the *Manual’s* implied deceleration rate. A rate which can cause a truck to fishtail and can only be achieved under emergency braking conditions<sup>9</sup>.

- The *Arizona Commercial Driver License Manual* says out of context that the deceleration rate of a heavy truck is 15.1 ft/s<sup>2</sup>.
- The comfortable safe-braking deceleration rate of commercial trucks<sup>10</sup> is 8.0 ft/s<sup>2</sup>.
- *The ADOT Traffic Engineering, Policies, Guidelines and Procedures* sets the deceleration rate to 10.0 ft/s<sup>2</sup>. This is more aggressive than what a truck can comfortably do.

### Yellow Duration Does Not Accommodate Air Brake Lag Time

The *Arizona Commercial Driver License Manual* states that trucks with air-brakes require an additional 0.5 seconds to stop because it takes a minimum of 0.5 seconds for the air to flow through the lines to the brakes<sup>11</sup>.

- *The ADOT Traffic Engineering, Policies, Guidelines and Procedures* yellow light duration does not provide yellow time for air-brake lag time.
- The *Arizona Commercial Driver License Manual* requires trucks with air brakes to have at additional minimum of 0.5 seconds.

## References

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- <sup>1</sup> Brian Ceccarelli, Joseph Shovlin, [\*Misapplied Physics in the International Standards that Set Yellow Light Durations Forces Drivers to Run Red Lights\*](#), <http://redlightrobber.com>, (visited January 13, 2013)
- <sup>2</sup> Arizona Revised Statutes, [Title 13 Criminal Code, 13-206 Entrapment](#), Justia US Law, (2012)
- <sup>3</sup> Danny Glover, Jr., et. al, [Entrapment in North Carolina](#), (2012).
- <sup>4</sup> Arizona Department of Transportation Motor Vehicle Division, [Arizona Driver License Manual and Customer Service Guide](#), Arizona Department of Transportation, **37** (2012).
- <sup>5</sup> Arizona Department of Transportation, [ADOT Traffic Engineering Policies, Guidelines , and Procedures](#), **621-2** (2011).
- <sup>6</sup> Institute of Transportation Engineers, [Transportation and Traffic Engineering Handbook, Second Edition](#), Institute of Transportation Engineers, **759** (1982)
- <sup>7</sup> Arizona Department of Transportation, Motor Vehicle Division, [Arizona Commercial Driver License Manual](#), Arizona Department of Transportation, **24** (2011).
- <sup>8</sup> American Association of State Highway and Transportation, [A Policy on Geometric Design of Highways and Streets](#), **50-56, 110-111** (2004).
- <sup>9</sup> Fawzi P. Bayan, et. al, [Brake Timing Measurements for a Tractor-Semitrailer Under Emergency Braking](#), Publication 2009-01-2918, Scientific Expert Analysis Limited, **5** (2009).
- <sup>10</sup> Maryland Division of State Documents, Annotated Code of Maryland, Title 11 Department of Transportation, Subtitle 04 State Highway Administration, Chapter 14 Traffic Control Signal Monitoring Systems—[Duration of Yellow Signal Indications, Section 02](#) (2012).
- <sup>11</sup> Arizona Department of Transportation, Motor Vehicle Division, [Arizona Commercial Driver License Manual](#), Arizona Department of Transportation, **64** (2011).