

Table 15. PHMSA pressure tank car incident data from 1971-2014 and equivalent release scenarios based on a sensitivity analysis of spill diameters.

Quantity Released in gallons	Incident Count	Probability	Release Scenario
=< 100	4,937	0.958	No Release
100 < x =< 1,000	73	0.014	½-inch Leak
1,000 < x =< 30,000	127	0.025	2-inch Leak
> 30,000	15	0.003	Catastrophic

The LOC probabilities estimated here are based on data for all pressurized tank car accidents, and it was not possible to differentiate between yard and mainline accidents. It is anticipated that yard accidents will result in a decreased probability of LOC relative to mainline accidents due to lower travel speeds (and, therefore, less kinetic energy and smaller net forces generated during accidents). Based on the rail tank car QRA analysis guidelines published in the Dutch Purple Book, it is expected that the probability of outflow for low speed (i.e., yard) accidents is a factor of 10 less than that for high speed (i.e., mainline) accidents.³³ However, it was conservatively assumed that the LOC probabilities for yard accidents involving ISOs are the same as those on the mainline in the QRA.

As a comparison, Jeong et al. developed a probabilistic puncture model for head impact to general tank cars as a function of wall thickness.³⁴ The authors analyzed proprietary accident data collected since 1960 by the Railway Supply Institute and the Association of American Railroads (AAR). They found that their probabilistic model closely matched historical data reflecting a historical probability of approximately 1-3% for head puncture due to derailment or collision for jacketed vessels and 3-8% for non-jacketed vessels. These statistics are consistent with our analysis of the publicly available HAZMAT data from DOT as listed in Table 15 above.

³³ Table 3.7, Probability of outflow (> 100 kg) given an accident, page 3.13 in *Guideline for Quantitative Risk Assessment, Part Two: Transport* (Dutch Purple Book), Publication Series on Dangerous Substances, Ministerie van Verkeer en Waterstaat (2005).

³⁴ Jeong DY. Probabilistic Approach to Conditional Probability of Release of Hazardous Materials from Railroad Tank Cars During Accidents, Proceedings of IMECE2009, ASME International Mechanical Engineering Congress and Exposition, Lake Buena Vista, Florida, USA (November 13-19, 2009).