



Presentation Outline

- Premier history
- Instance with a Premier customer in Saskatchewan
- Highlight Premier's Opinions
- Review Dynamic Stability Literature
 - Woodrooffe and Associates Draft Report for Saskatchewan Ministry of Highways and Infrastructure
 - The TAC (Transportation Association of Canada) Report
 - UMTRI Trucks Involved in Fatal Accident (TIFA) Factbooks
- Conclusion & Recommendations

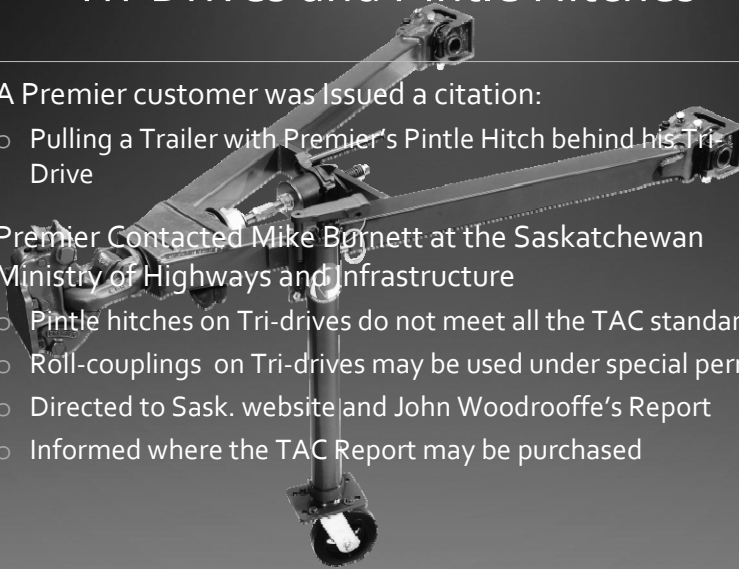
Premier Manufacturing Co.

- Founded 1924
- Tualatin, OR
- Produce Pintle Hitches (couplings), Drawbar eyes (lunettes), Hinge & Front End Assemblies and Jacks
- Safety first!



Tri-Drives and Pintle Hitches

- A Premier customer was Issued a citation:
 - Pulling a Trailer with Premier's Pintle Hitch behind his Tri-Drive
- Premier Contacted Mike Barnett at the Saskatchewan Ministry of Highways and Infrastructure
 - Pintle hitches on Tri-drives do not meet all the TAC standards
 - Roll-couplings on Tri-drives may be used under special permit
 - Directed to Sask. website and John Woodrooffe's Report
 - Informed where the TAC Report may be purchased





Premier's Findings & Opinions:

- Load Transfer Ratio (LTR) was initially developed as a roll-coupled combination vehicle stability measure. In our opinion it should not be used as a standard by which all vehicle configurations are measured
- A vehicle's LTR does not correlate with current published fatal accident records
- The Static Rollover Threshold (SRT) and Rearward Amplification (RA) ratio should be the dominant vehicle dynamic stability measures as they more accurately relate to recorded accident data
- Draft report for Saskatchewan ignores the SRT results
- Electronic Roll Stability is the next step in safer heavy truck operations



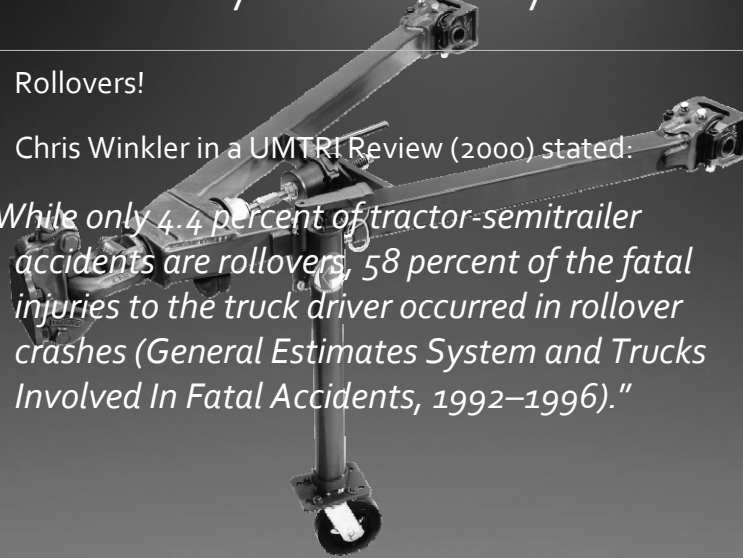
Saskatchewan Ministry of Highways and Infrastructure Website

- *"Tri-drive trucks and tri-drive tractors with semi-trailers are currently not recognized by provincial regulations; however, recognizing the industry demand to use these vehicles, the province is currently accommodating these vehicles by permitting them under the Transport Partnership Program"*
- *"Tri-drive trucks are **NOT** allowed to pull full trailers or pony trailers due to dynamic stability concerns"*
- *"Tri-Drive trucks are not allowed to pull pintle hitch trailers in Saskatchewan"*

Dynamic Stability

- Rollovers!
- Chris Winkler in a UMTRI Review (2000) stated:

"While only 4.4 percent of tractor-semitrailer accidents are rollovers, 58 percent of the fatal injuries to the truck driver occurred in rollover crashes (General Estimates System and Trucks Involved In Fatal Accidents, 1992–1996)."



Dynamic Stability



UMTRI Campbell and Sullivan Report: "Existing cab structures above the plane of the dash are not sufficient to withstand the forces produced during rollover."
(Picture from Renfroe Eng. Inc.)

TAC Performance Measures

- Static Rollover Threshold (SRT):
 - Maximum level of lateral acceleration (g's) beyond which the vehicle will suffer a rollover in a steady turn (TAC = 0.40g-min)
- Load Transfer Ratio (LTR):
 - Ratio of the absolute value of the right to left wheel load difference to the total sum of all wheel loads except the steering axle (for roll-coupled combinations only) (TAC = 0.60 max)
 - ❖ However, for non roll-coupled units, only the wheel loads of the rear most trailer are used
- Rearward Amplification (RA):
 - Ratio of peak rear trailer lateral acceleration to peak tractor lateral acceleration in a sine-steer maneuver (TAC = 2.0 max)

Woodrooffe & Associates Draft Report: "The Influence of Tri-Drive Power Units on the Stability Performance of Various Vehicle Combinations."

- Examined tri-drive tractor-trailers, B-train doubles straight truck, straight truck and pony trailer, and straight truck and full trailer
- Used UMTRI Yaw/Roll program to assess each combination's performance measure including:
 - Static Rollover Threshold (SRT)
 - Load Transfer Ratio (LTR)
 - Rearward Amplification (RA)

Woodroffe & Assoc. Draft Report

Tractor –semi trailers Performance Measure	TAC Target Value	4S2 45,500 kg	4S3 51,500 kg
Static roll threshold (ideal)	0.40g (ideal)	0.36g	0.36g
Load transfer ratio	0.60 (max)	0.45	0.41
Rearward amplification	2.00 (max)	1.2	1.1
High speed dynamic offtracking	0.80 m (max)	0.12m	0.11m
High speed offtracking	0.46 m (max)	0.25m	0.25m
Low speed offtracking	6.00 m (max)	6.2m	6.2m
High speed friction utilization			
Tractor axle 1		20%	20%
Low speed friction utilization			
Tractor axle 1		48%	50%

Tractor Semi-Trailers: "The vehicle is in compliance with all of the TAC performance measures except for low speed offtracking..." & "low speed offtracking isn't considered significant"

Woodroffe & Assoc. Draft Report

9-Axle and 10 Axle B-Trains Performance Measure	TAC Target Value	4S3S2 68,500 kg	4S3S3 76,500 kg
Static roll threshold (ideal)	0.40g (ideal)	0.36g	0.36g
Load transfer ratio	0.60 (max)	0.45	0.48
Rearward amplification	2.00 (max)	1.5	1.6
High speed dynamic offtracking	0.80 m (max)	0.29m	0.35m
High speed offtracking	0.46 m (max)	0.37m	0.40m
Low speed offtracking	6.00 m (max)	5.2m	4.8m
High speed friction utilization			
Tractor axle 1		25%	28%
Low speed friction utilization			
Tractor axle 1		53%	53%

9-axle and 10-axle B-trains: "Both of these vehicles are in compliance with the TAC performance measures..."

Woodroffe & Assoc. Draft Report

Straight Truck and Straight Truck Pony Trailer Performance Measure	TAC Target Value	Straight Truck 29,250 kg	Straight Truck & Pony Trailer 50,000 kg	Straight Truck & Pony Trailer 53,000 kg
Static roll threshold (ideal)	0.40g (min)	0.41g	0.41g	0.41g
Load transfer ratio	0.60 (max)	0.38	0.75	0.80
Rearward amplification	2.00 (max)	1.0	1.7	1.7
High speed dynamic offtracking	0.80 m (max)	0.10m	0.31m	0.36m
High speed offtracking	0.46 m (max)	0.15m	0.32m	0.34m
Low speed offtracking	6.00 m (max)	2.0m	3.4m	3.4m
High speed friction utilization				
Tractor axle 1		21%	33%	43%
Low speed friction utilization				
Tractor axle 1		43%	35%	35%

"When a pony trailer is added, the dynamic performance becomes unacceptable as the load transfer ratio fails to meet TAC standards of minimum performance. Of all performance measures, load transfer ratio is the most critical. Vehicles that cannot comply with this measure should not be permitted to operate."

Woodroffe & Assoc. Draft Report

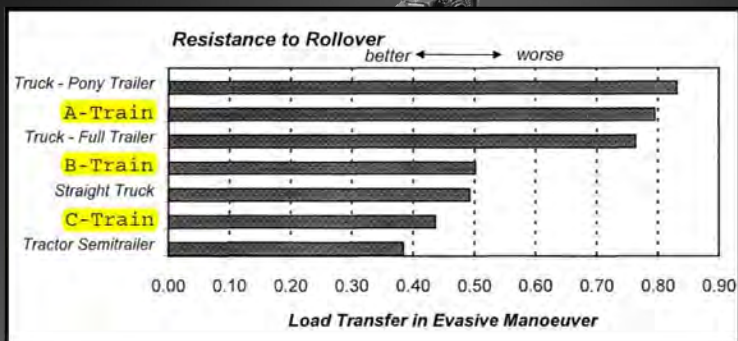
Straight Truck and trailer Performance Measure	TAC Target Value	4S3S2 53,250 kg	4S3S3 63,250 kg
Static roll threshold (ideal)	0.40g (min)	0.41g	0.37g
Load transfer ratio	0.60 (max)	0.72	0.83
Rearward amplification	2.00 (max)	1.7	1.8
High speed dynamic offtracking	0.80 m (max)	0.35m	0.49m
High speed offtracking	0.46 m (max)	0.37m	0.42m
Low speed offtracking	6.00 m (max)	3.9m	3.9m
High speed friction utilization			
Tractor axle 1		33%	34%
Low speed friction utilization			
Tractor axle 1		38%	38%

Straight Truck and Full Trailer: "...the load transfer ratio fails to comply with the TAC standards. Therefore this vehicle combination in its current layout is not suitable for use."

TAC Report Highlights

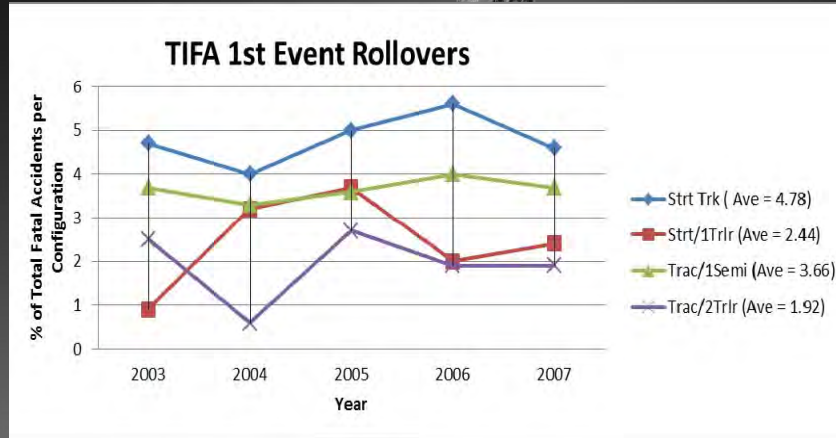
- For evaluating roll-coupled combinations such as B-trains and C-trains, the authors developed the LTR measure. LTR of 0.6 is "achieved only by roll-coupled vehicle combinations" *
- "The load transfer ratio measure is used to indicate the potential for amplification-induced rollover."
- "The classical measure used to define the tendency toward rollover deriving from rearward amplification in a rapid path-change maneuver is the amplification ratio."
- "The performance of A-train combinations can be suitably evaluated by means of the rearward amplification ratio." **
- SRT "measure has been shown to correlate in a profound manner with rollover accidents" and that "there is a clear, powerful relationship between rollover threshold level and the likelihood of involvement in rollover accidents."

Report to the Land Transportation Standards Subcommittee (Oct. 1997)



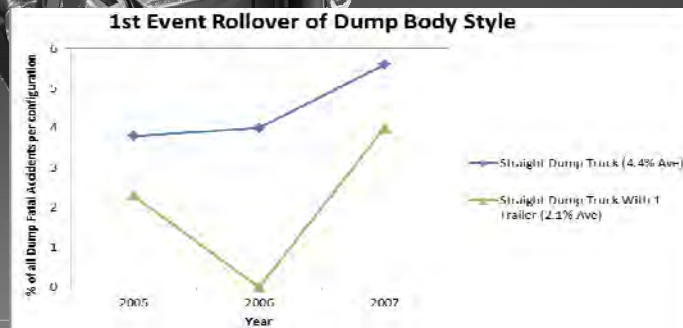
Council of Ministers Responsible for Transportation and Highway Safety Website

UMTRI Trucks Involved in Fatal Accidents Factbooks 2003-2007



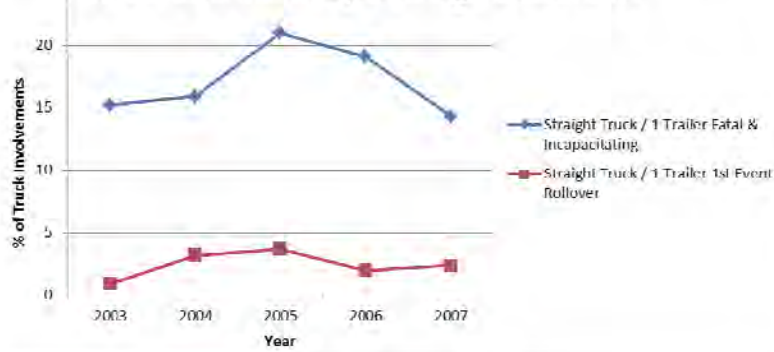
UMTRI TIFA Factbook (2005-2007)

FATAL INVOLVEMENTS BY ROLLOVER STATUS OF <u>DUMP</u> BODY STYLE								
2005	STRAIGHT TRUCK		STRAIGHT TRUCK WITH 1 TRAILER		TRACTOR WITH 1 TRAILER		TRACTOR WITH 2 TRAILERS	
	N	%	N	%	N	%	N	%
NO ROLLOVER	299	81.0	40	93.0	280	83.8	37	90.2
FIRST EVENT	14	3.8	1	2.3	12	3.6	0	0.0
SUBSEQUENT EVENT	56	15.2	2	4.7	42	12.6	4	9.8
TOTAL	369	100.0	43	100.0	334	100.0	41	100.0



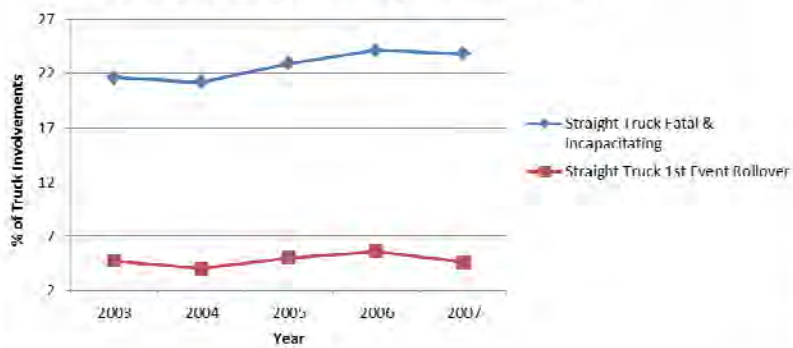
UMTRI TIFA Factbook (2003-2007)

Straight Truck w/1 Trailer 1st Event Rollover and Truck Driver Fatal and Incapacitating Involvements



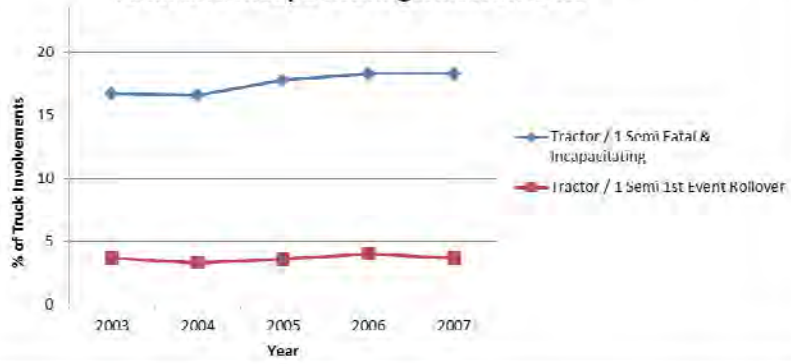
UMTRI TIFA Factbook (2003-2007)

Straight Truck 1st Event Rollover and Truck Driver Fatal and Incapacitating Involvements



UMTRI TIFA Factbook (2003-2007)

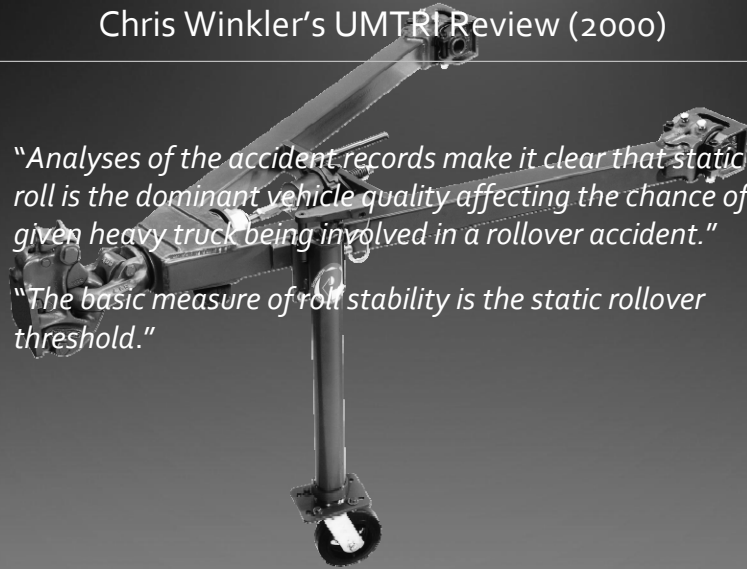
**Tractor / 1 Semi 1st Event Rollover and Truck Driver
Fatal and Incapacitating Involvements**



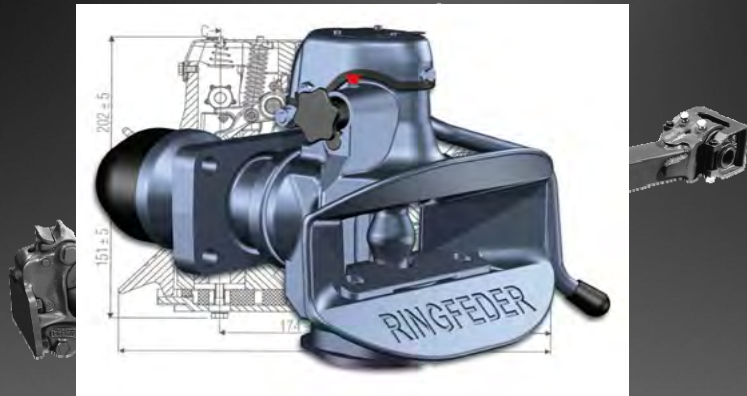
(Picture from Penfroe Eng. Inc.)

Chris Winkler's UMTRI Review (2000)

- *"Analyses of the accident records make it clear that static roll is the dominant vehicle quality affecting the chance of a given heavy truck being involved in a rollover accident."*
- *"The basic measure of roll stability is the static rollover threshold."*



VBG (Ringfeder)



- VBG stated: *"VBG couplings are designed to rotate on their fore-and-aft axis so that if a trailer should roll, the risk of the complete rig overturning would be lessened."*
- VBG purposely designed this product to be non roll-coupled which results in a higher LTR

Conclusions & Recommendations

- The Load Transfer Ratio should NOT be used as a non roll-coupled Performance Measure
 - Comparing the LTR of a trailer to the LTR of an entire unit does not make sense
 - Accident statistics do not quantify it
 - Extremely difficult to calculate
 - New Zealand requires a minimum SRT
 - The SRT is the most critical Performance Measure
- Vehicles in the Draft Report for Saskatchewan that did not meet the SRT should not be permitted to operate
- Electronic Roll Stability has become a proven technology
 - Douglas Pape (Battelle): 53% of speed related cargo tank rollovers could have been prevented
- Roll-coupling does not substantially improve driver feedback
 - John Woodrooffe (Assoc. Press Interview):
 - "A truck driver can be perfectly happy going around a corner thinking everything is ok and suddenly he's over"
 - "Tractor trailer drivers often have no warning they're about to roll over"
 - John Billing (CTEA presentation): "There is only a second or less after trailer wheels lift off to the point where the vehicle is committed to rolling over"
- Increased weight allowances are being granted in some provinces for roll-coupled vehicles. Not a good idea!

Thank you

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