

Appendix H – CVOR Formula

Collision Points Threshold

A collision points threshold value is determined for each carrier, based on its “kilometric rate of travel per month” in Canada (in Ontario, for US-plated carriers), by all the commercial motor vehicles operating under the carrier’s CVOR certificate. All carriers with the same rate of travel, therefore, will have the same “collision points threshold”. The collision violation rates of a large sample of carriers were analysed and a threshold curve was established which identifies those carriers with unacceptably high collision rates relative to other carriers of similar rate of travel.

The collision points threshold formula is:

	For rate of travel, R < 120,000 km/month	For rate of travel, R = or > 120,000 km/month
Collision Points Threshold	$T_{col} = (1.363 \times R^{0.217}) \times (n \div 24)$	$T_{col} = (0.000144 \times R) \times (n \div 24)$

Where: T_{col} = collision points threshold
 R = rate of travel (km/month)
 n = number of months in the analysis period (maximum of 24)

For ease of calculation, collision point threshold values have been calculated and presented in a “look-up” table. See Appendix D for the Table of Threshold Values. (Otherwise the above calculations will require a scientific calculator)

Conviction Points Threshold

A conviction points threshold value is determined for each carrier, based on its “kilometric rate of travel per month” in Canada (in Ontario, for US-plated carriers), by all the commercial motor vehicles operating under the carrier’s CVOR certificate. All carriers with the same rate of travel, therefore, will have the same “conviction points threshold”. The conviction violation rates of a large sample of carriers were analysed and a threshold curve was established which identifies those carriers with unacceptably high conviction rates relative to other carriers of similar rate of travel.

The conviction threshold formula is:

	For rate of travel, R < 120,000 km/month	For rate of travel, R = or > 120,000 km/month
Conviction Points Threshold	$T_{con} = (2.54 \times R^{0.235}) \times (n \div 24)$	$T_{con} = (0.000331 \times R) \times (n \div 24)$

Where: T_{con} = conviction points threshold
 R = rate of travel (km/month)
 n = number of months in the analysis period (maximum of 24)

For ease of calculation, conviction point threshold values have been calculated and presented in Appendix D.

Inspection Points Threshold

An inspection points threshold value is determined for each carrier, based on its frequency of CVSA inspections. The number of “units” inspected is determined by adding the total number of vehicles inspected to the total number of drivers inspected. All carriers with the same number of units inspected, therefore, will have the same “inspection points threshold”. The inspection violation rates of a large sample of carriers were analysed and a threshold curve was established which identifies those carriers with unacceptably high CVSA inspection “out-of-service” rates relative to other carriers with a similar number of units inspected.

The inspection points threshold formula is:

	For “U” units inspected
<u>Inspection Points Threshold</u>	$T_{ins} = 7.789 + 0.139 \times U$

Where: T_{ins} = inspection points
 U = # of units inspected in the analysis period

For ease of calculation, inspection threshold values have been calculated and presented in Appendix D.

CVOR Calculations

How is a carrier's monthly rate of travel calculated?

A carrier's monthly rate of travel in Canada during a specific time period is used to determine the collision and conviction points threshold for that time period. Carriers must report a significant change in their rate of travel. Consequently a determination of the carrier's collision or conviction violation rate may contain multiple assessment time periods. The following procedure is followed to calculate monthly rate of travel.

1. Carrier Reports the total number of commercial motor vehicles operated in Ontario under the carrier's CVOR certificate.
 - Include power units plated in Ontario that are owned, leased or rented by the carrier and any plated in Ontario that are operated under contract with Owner/Operators.
 - Include power units plated in the USA or Mexico that operate in Ontario.
 - Exclude power units operated by the carrier that are plated in other Canadian jurisdictions.
 - Exclude all trailers.

For Example:

Bob owns 10 highway tractors, of which 8 are plated in Ontario and 2 are plated in Manitoba. He leases 5 trucks, all plated in Ontario. He also employs 5 Owner/Operators, all with Ontario plates. The total number of commercial motor vehicles that Bob operates under his CVOR certificate is:
 $8 + 5 + 5 = 18$ commercial motor vehicles

2. Calculate the total kilometres traveled per month by the fleet in Canada, by specific time periods that reflect different rates of travel in Canada:
Total kilometres travelled in a specified time period in Canada by the carrier's fleet divided by the number of months in the time period = monthly rate of travel in Canada (km/month).

For Example:

Period 1: (2007 07 01 to 2007 12 31) - 6 months

Total kilometres travelled in Ontario by the fleet of 18 vehicles = 516,000 km.

Total kilometres travelled in the rest of Canada by the fleet of 18 vehicles = 324,000 km.

Total kilometres travelled outside Canada by the fleet of 18 vehicles = 216,000 km.

Monthly rate of travel in Canada = $(516,000 + 324,000) \div 6 = 140,000$ km/month.

Period 2: (2008 01 01 to 2009 06 30) - 18 months

Total kilometres travelled in Ontario by the fleet of 18 vehicles = 1,296,000 km.

Total kilometres travelled in the rest of Canada by the fleet of 18 vehicles = 324,000 km.

Total kilometres travelled outside Canada by the fleet of 18 vehicles = 1,944,000 km.
Monthly rate of travel in Canada = $(1,296,000 + 324,000) \div 18 = 90,000$ km/month.

How are the Collision Violation Rate and Percentage of Threshold calculated?

Using the data collected from police accident reports, collision demerit points are assigned according to the [Collision Weighting Table](#).

A collision is considered to have “impropriety” if the accident report indicates something other than “normal” under vehicle condition (fields 31 and 32), driver action (fields 33 and 34) or driver condition (fields 35 and 36). See the Motor Vehicle Accident Report and Template in Appendix F for more details.

For Example:

A carrier with a monthly kilometric rate of travel of 144,000 km/month in Period 1 (6 months) and 90,000 km/month in period 2 (18 months) had the following 4 collisions in the past 24-month period (*Note: The 24-month period does not include the most recent 30 days*):

- 1 involving property damage and no impropriety in period 1 (0 points),
- 1 involving personal injury and impropriety in period 1 (4 points),
- 1 involving a fatality and no impropriety in period 2 (0 points) and
- 1 involving property damage and impropriety in period 2 (2 points).

The Collision Violation Rate would be calculated in the following manner:

Step 1:

Calculate the total collision points, in each period.

Period 1: $0 + 4 = 4$ (total collision points in period 1)

Period 2: $0 + 2 = 2$ (total collision points in period 2)

Step 2:

Determine the collision threshold points for each rate of travel, for a 24-month period. Consult the Table of Threshold Values (see Appendix D) to determine the threshold points for a 24-month period for a carrier with a travel rate of 140,000 km/month and 90,000 km/month.

Rate 1: At 140,000 km/month The collision threshold points value is 20.16 for a 24-month period.

Rate 2: At 90,000 km/month The collision threshold points value is 16.20 for a 24-month period.

Step 3:

Prorate the points for a 24-month period by the number of months in each period to determine the threshold value for that period.

Collision threshold points in period 1 = $20.16 \times (6 \div 24) = 5.04$ points.

Collision threshold points in period 2 = $16.20 \times (18 \div 24) = 12.15$ points.

Step 4:

To calculate the percentage of threshold for each period, divide the points assigned in the period by the collision threshold points (x 100%).

Period 1: Percentage of threshold = $100\% \times (4 \div 5.04) = 79.37\%$.

Period 2: Percentage of threshold = $100\% \times (2 \div 12.15) = 16.46\%$.

Step 5:

To calculate the overall collision violation rate for the 24-month period, prorate the period violation rates in proportion to the time in each period.

$$\begin{aligned} \text{Overall collision violation rate (24-month period)} &= (79.37\% \times 6) + (16.46\% \times 18) \div 24 \\ &= (476.22\% + 296.28\%) \div 24 \\ &= \underline{\underline{32.19\%}} \end{aligned}$$

How are the Conviction Violation Rate and Percentage of Threshold calculated?

The CVOR system assigns points to safety related convictions as indicated in the Conviction Code Table (See Appendix E).

For Example:

The same carrier described previously with monthly travel rates of 140,000 km/month (period 1) and 90,000 km/month (period 2) also had the following 4 convictions in the past 24-month period. (*Note: The 24-month period does not include the most recent 30 days*):

- Fail to make daily log, in period 1 (3 points),
- Overweight - dual axle over 2000 kg, in period 2 (3 points),
- Drive motor vehicle - fail to display plates, in period 2 (0 points) and
- Fail to inspect/repair/maintain according to standard, in period 2 (2 points).

The Conviction Violation Rate would be calculated in the following manner:

Step 1:

Calculate the total conviction points, in each period.

Period 1: 3 (total conviction points in period 1)

Period 2: $3 + 0 + 2 = 5$ (total conviction points in period 2)

Step 2:

Determine the allowable conviction threshold points for each rate of travel, for a 24-month period. Consult the Table of Threshold Values (see Appendix D) to determine the threshold points for a 24-month period for a carrier with a travel rate of 140,000 km/month and 90,000 km/month.

Rate 1: At 140,000 km/month The allowable conviction threshold points value is 46.34 for a 24-month period.

Rate 2: At 90,000 km/month The allowable conviction threshold points value is 37.07 for a 24-month period.

Step 3:

Prorate the allowable points for a 24-month period by the number of months in each period.

Allowable points in period 1 = $46.34 \times (6 \div 24) = 11.59$ points.

Allowable points in period 2 = $37.07 \times (18 \div 24) = 27.80$ points.

Step 4:

To calculate the percentage of threshold for each period, divide the points assigned in the period by the allowable points.

Period 1: Percentage of threshold = $100\% \times (3 \div 11.59) = 25.88\%$.

Period 2: Percentage of threshold = $100\% \times (5 \div 27.80) = 17.99\%$.

Step 5:

To calculate the overall conviction violation rate for the 24-month period, prorate the period violation rates in proportion to the time in each period.

Overall conviction violation rate (24-month period) = $(25.88\% \times 6) + (17.99\% \times 18) \div 24$
 = $(155.28\% + 323.82\%) \div 24$
 = 19.96%

How are the “Number of Units Inspected” for a CVSA inspection calculated?

The inspection points threshold value varies with the “number of units” inspected as opposed to varying with the “rate of kilometric travel” which is used to calculate the collision and conviction threshold values. The number of units inspected is the sum of all the vehicles and drivers inspected in all inspections within the analysis period.

For Example:

Level 1, 2 or 4 inspection, tractor & 1 semi-trailer (3 units inspected - 2 vehicles, 1 driver)

Level 3 inspection, with no vehicle defects indicated, straight truck, trailer converter dolly & semi-trailer (1 driver inspected)

Level 5 inspection, tractor & semi-trailer (2 vehicles inspected)

How are the Inspection Violation Rate and Percentage of Threshold calculated?

The CVOR system assigns points to Commercial Vehicle Safety Alliance (CVSA) out-of-service (OOS) inspection categories, as defined by CCMTA. One point is assigned for each category that is out-of-service per unit. If a vehicle (or driver) has multiple categories out-of-service, these additional categories are assigned 2 points each. There are a total of 15 vehicle and 2 driver categories.

Driver out-of-service points are weighted at 68.75% of vehicle out-of-service points, based on the “Predictive Analysis” study that indicated a higher probability of future collisions related to vehicle defects than to driver defects. The violation rate is the total (weighted) points assigned for all inspections divided by the inspection points threshold value and is expressed as a percentage of threshold.

For Example:

Assume the same carrier described above has been inspected 3 times in the 24-month analysis period. There is no need to break the time into the two periods related to different travel rates, since the inspection threshold formula only varies with number of units inspected. (*Note: The 24-month period does not include the most recent 30 days*). For ease of understanding, the inspections shown below describe “category defects” as they will appear on a CVOR carrier abstract.

Inspection 1: Level 1

Unit inspected	Defect - * indicates “out-of-service”	Dr pts.	Veh. pts.
Driver	*Category – Drivers Licences :Drivers Licences – Improper Licence*	1	
	Category – Hours of Work :Cycle – Drive after 70 hours in 7 days	2	
Truck Tractor	*Category – Tires :Tires – Tread Depth* :Tires – Ply Separation*		1
Trailer	*Category – Brakes – Adjustment : Brakes – Adjustment*		1
3 units inspected	Total points assigned	3	2

Inspection 2: Level 3

Unit inspected	Defect - * indicates “out-of-service”	Dr pts.	Veh. pts.
Driver	*Category – Drivers Licences :Fail to produce licence*	1	
	Category – Seat Belt :Fail to wear	0 (not OOS)	
Truck Tractor	(Not applicable)		0
Trailer	(Not applicable)		0
1 unit inspected	Total points assigned	1	0

Inspection 3: Level 5

Unit inspected	Defect - * indicates “out-of-service”	Dr pts.	Veh. pts.
Driver	(Not applicable)	0	
Truck Tractor	*Category – Suspension System :Coil spring broken*		1
Trailer	(no defects recorded)		0
2 units inspected	Total points assigned	0	1

Calculations**Step 1:**

Calculate the total units inspected for the 3 inspections.

Inspection 1, Level 1 = 3 units inspected. (1 driver and 2 vehicles)

Inspection 2, Level 3 = 1 unit inspected. (1 driver)

Inspection 3, Level 5 = 2 units inspected. (1 driver and 1 vehicle)

Total Units inspected = 6

Step 2:

Determine the inspection threshold value from the table in Appendix D. For 6 units inspected, the allowable inspection threshold points = 8.62.

Step 3:

Determine the carrier’s total inspection points, where driver points are weighted at 68.75% of vehicle points.

Total inspection points = 1 x vehicle points + 0.6875 x driver points.
 = 1 x (2 + 0 + 1) + 0.6875 x (3 + 1 + 0)
 = 3 + 2.75
 = 5.75 inspection points.

Step 4:

Determine the carrier’s inspection violation rate, expressed as a percentage of threshold.

Inspection Violation Rate = 100% x (5.75 ÷ 8.62)
 = 66.71%

How does the CVOR system calculate a carrier's Overall Performance?

The carrier's overall performance is determined by combining its collision, conviction and inspection performance values in the proportions of 2 to 2 to 1.

The overall performance measure formula is:

Overall Performance	$P_o = (2 \times P_{col} + 2 \times P_{con} + P_{ins}) \div 5$
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Where:

- P_o = Overall Performance
- P_{col} = Collision Performance
- P_{con} = Conviction Performance
- P_{ins} = Inspection Performance

When a carrier's overall violation rate exceeds 1 (100%), it is said to be "over threshold" and may be subject to sanctioning by the Registrar of Motor Vehicles.

Remember that the Overall Percent of Threshold calculation weights collisions and convictions at double the severity of inspections (2:2:1 ratio).

Step 1:

Multiply both the Percent of Collision Threshold (32.19%) and the Percent of Conviction Threshold (19.96%) by 2 and add the Percent of Inspection Threshold (65.64%).

$$2 \times 32.19\% + 2 \times 19.96\% + 65.64\% = 171.01\%$$

Step 2:

Divide the value in Step 1 (171.01%) by 5 to derive the Percent of Overall Threshold.

$$\begin{aligned} \text{Percent of Overall Threshold} &= 171.01\% \div 5 \\ &= \underline{\underline{34.20\%}} \end{aligned}$$

This value represents the carrier's overall violation rate as a percentage of its overall threshold.

Notes: