

Rear Underrun Protection Test (ECE R58) using CAE Simulation

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ABSTRACT

The regulatory requirement in Economic Commission for Europe (ECE R58) regulation applies to the Rear underrun protection devices which are intended to be fitted to commercial vehicles of N categories. The purpose of this regulation is to offer effective protection against underrunning of vehicles. This paper describes Computer aided engineering (CAE) methodology for testing rear underrun protection devices with loading sequences to be decided by Original equipment manufacturer. A sample model is prepared and analyzed to represent actual test conditions. Constraints and boundary conditions are applied as per test of vehicle. Finite element simulation is carried out using LS DYNA solver. Structural strength and integrity of Rear under protection device assembly is observed for different regulatory load requirement.

CITATION: Jaju, S. and Pandare, S., "Rear Underrun Protection Test (ECE R58) using CAE Simulation," *SAE Int. J. Commer. Veh.* 9(2):2016, doi:10.4271/2016-01-8098.

Many times it is observed that a passenger car struck the heavy commercial vehicle (like truck or trailer) either from rear, front or side. It is necessary to have protection device at front rear and side of vehicle. During a collision between such a truck and a passenger vehicle, there is a risk that the passenger vehicle will penetrate under (run under) the front or rear part of the truck and thus be jammed between the road surface and the underside of the frame or load carrier of the vehicle.



Figure 1. Car impacting rear side without rear under protection device



Figure 2. Car impacting rear side with rear under protection device

Figure 1 and Figure 2 shows rear accidental case studies. Figure 1 shows accident case where truck not have rear under protection device where car get more damaged and risk for injury. For case 2 as shown in Figure 2 it is with rear under protection device. Safety of vehicle is more in case 2. Currently the heavy commercial vehicles are equipped with under-run protection devices to enhance safety of occupants in small vehicles (like passenger car, SUV's) in the event of under-run. It is mandatory to have under run protection devices on commercial vehicles. The fact that a truck normally has a relatively large road clearance constitutes a to road traffic safety.

REAR UNDER PROTECTION DEVICE TO BE FITTED TO

Rear underrun protection devices (RUPD) are intended to be fitted to vehicles of category M1, M2, M3, N1, N2, N3, T1, T2, T3, and T4.

This is not applicable to the tractive units for articulated vehicles and vehicles where Rear underrun protection device (RUPD) is incompatible with their use.

CLASSIFICATION VEHICLE CATEGORY M AND N TYPE

To clarify vehicle category M category A Motor vehicle with at least four wheels used for carrying passengers further it is classified M1, M2 and M3 classified as per passenger capacity and their Gross Vehicle Weight (GVW). N category means a Motor vehicle with at least four wheels used for carrying goods. These vehicles can carry persons in addition to the goods subject to the conditions. Further such vehicle catageroised N1, N2 and N3 depending there Gross Vehicle Weight (GVW). Category T- Towed Vehicle (Trailers) means A non-selfpropelled driven road vehicle having at least two wheels which on account of its design and technical features is used to transport persons or goods and is intended to be towed by a motor vehicle; semi-trailer is included in this category. A full trailer means a towed vehicle having at least two axles, and equipped with a towing device which can move vertically in relation to the trailer and controls the direction of the front axle(s), but which transmits no significant static load to the towing vehicle. Further it is classified as T1, T2 T3 and T4 depending on their tonnage capacity.

LEGAL LOADING REQUIREMENT FOR REAR UNDER PROTECTION DEVICE

The purpose of ECER 58 is to offer effective protection over their whole width against underrunning from the rear by vehicles of categories M1 and N1 and scooters, motorcycle or three wheeler with low height.

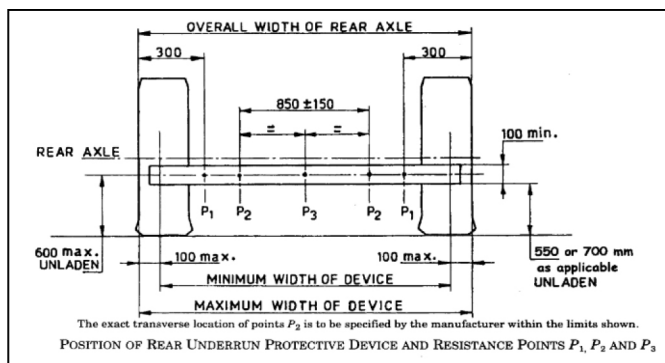


Figure 3. Regulatory loading location for rear under protection device

Figure 3 explains regulatory requirement of Rear under protection device regulation. The minimum section height of the UPD beam should not be less than 100mm. The Test Ram should not exceed 400 mm in the direction of applied forces and the area above 3m above the ground when the vehicle is unladen shall be excluded. The device maybe so designed that its position in rear of vehicle can be varied. In this event, there shall be a guaranteed method of securing it in the service position so that unintentional change of position is precluded. It shall be possible for the operator to vary the position of the device by applying a force not exceeding 40daN. Vehicles of category M1, N1, T1, T2 shall comply only with ground clearance requirement 500 mm set out in this regulation. The maximum ground clearance with respect to the underside of the Rear underrun protection device shall be no more than 500 mm for N2, N3, T3, T4 and 700mm for M2, M3 category. The vehicles shall be so constructed and/or equipped as to offer effective protection over their whole width against underrunning from the rear by vehicles of categories M1 and N1 and two and three wheelers with low height. The device shall offer adequate resistance to forces applied parallel to the longitudinal axis of the vehicle, and be connected, when in the service position with the chassis side members or whatever replaces them. This requirement shall be satisfied if it is shown that both during and after the application, the horizontal distance between the rear of the device and the rear extremity of the vehicle does not exceed 400 mm at any of the points P_1 , P_2 and P_3 . In measuring this distance, any part of the vehicle which is more than 3 m above the ground when the vehicle is unladen shall be excluded. Point P_1 are located 300mm with tolerance of 25 mm from the longitudinal planes tangential to the outer edges of the wheels on the rear axle. Point P_2 which are located on the line joining point P_1 , are symmetrical to the median longitudinal plane of the vehicle at a distance from each other of 700 to 1000 mm inclusive, the exact position being specified by the manufacturer. The height above the ground of points, and P_2 shall be defined by the vehicle manufacturer within the lines that bound the device horizontally. The height shall not, however, exceed 600 mm when the vehicle is unladen. P_3 is the center point of the straight line joining point P_2 .

The Rear underrun protection device (RUPD) for vehicle must offer adequate resistance to the forces as mentioned below points.

- $P_1 = 12.5\%$ of the GVW (gross vehicle weight) but not more than 25,000 N
- $P_2 = 50\%$ of the GVW (gross vehicle weight) but not more than 100,000 N
- $P_3 = 12.5\%$ of the GVW (gross vehicle weight) but not more than 25,000 N

TEST CONDITIONS FOR VEHICLES

The vehicle shall be at rest on a level, flat, rigid and smooth surface. The front wheels shall be in the straight-ahead position. The tires shall be inflated to the pressure recommended by the vehicle manufacturer. The vehicle may, if necessary to achieve the test forces required, be restrained by any method, this method to be specified by the vehicle manufacturer. Vehicles equipped with hydro pneumatic,