

TABLE 5 - FUEL CONSUMPTION REGRESSION EQUATION FOR NEGATIVE GRADES

Volkswagen and Kombi Unpaved

$$F = -.87 + (1+1.88(C + .5) (e^{(-.214 G)})) .009 V$$

$$S = .04$$

Volkswagen and Kombi Paved

$$F = -1 + (1 + (.065 + .042 C) (e^{(-.016 G^2)}) + .003(3-G)\frac{L}{C}) .107 V$$

$$S = .07$$

Ford-400 Unpaved

$$F = \frac{1.77}{(1+G)^{.5}} -1 + (1 + e^{(.814 + .07(L+1)^2 (.827-G))}) .0178 V$$

$$S = .56$$

Ford-400 Paved

$$F = \frac{1.91}{(1+G)^{.5}} -1 + (1 + e^{(1.38 + .1(L+1)^2 (1.26-G))}) .01 V$$

$$S = .27$$

MB-1113 Unpaved

$$F = \frac{1.264}{(1+G)} -1 + (1 + e^{(.597 + .253(L+1)^2 (.684-G))}) .02 V$$

$$S = .11$$

MB-1113 Paved

$$F = \frac{1.09}{(1+G)} -1 + (1 + e^{(.519 + .213(L+1)^2 (1.08-G))}) .0181 V$$

$$S = .14$$

Scania Unpaved

$$F = \frac{2.068}{(G+1)^{.5}} (e^{(1.765 + .522(L+1) (.863-G))}) .0091 V$$

$$S = .36$$

Scania Paved

$$F = \frac{2.343}{(G+1)^{.5}} (e^{(.879 + (L+1) (.79-G))}) .0086 V$$

$$S = .14$$

where C = Class, 1=Volkswagen, 2=Kombi
 G = Grade in percent
 V = Velocity in km per hour
 L = Load 0=Empty 1=Full
 F = Fuel in ml per second
 S = Standard error of the equation

Scania data. In general all of the equations reflect an increase in fuel consumption per second with increasing speed. The speed influence reverses itself for the Scania operating on negative grades.

On the negative unpaved sections the influence of speed reverses for grades of four percent. At the four-percent level, the empty vehicle consumes more than the laden vehicle and increasing speed causes decreasing fuel consumption. On the negative paved sections, the influence of speed reverses for grades of two percent. At the two-percent level, increasing speed causes decreasing fuel consumption, and the empty vehicle consumes more than the laden vehicle. Table 5 contains the equations for the trucks for negative grades. Each of the functions is a nonlinear form with the exception that the Scania equation is intrinsically linear. Figures 20 through 28 present the equations for fuel consumption on negative grades in graphical form.

Summary of FC-1 Analysis - Eighteen regression models are presented. They are the result of preliminary analysis of 20,000 steady-state fuel-consumption measurements. The equations are not in final form since the analysis reflects only a portion of the overall steady-state fuel-consumption experiment. The preliminary analysis using nonlinear regression techniques offered a range of possible regression models. However, further refinements and modifications are required on the equations. For lack of actual analysis time, many possible improvements could not be accomplished. Certain problems with high coefficient correlations and large coefficient errors have not been satisfactorily eliminated from some of these preliminary nonlinear equations. Such problems should be addressed before any of the functions are utilized for predictions.

Fuel Consumption on Curves (FC-3)

It has been demonstrated in previous literature (Sawhill, Ref. 2) that small radius curves can significantly affect fuel

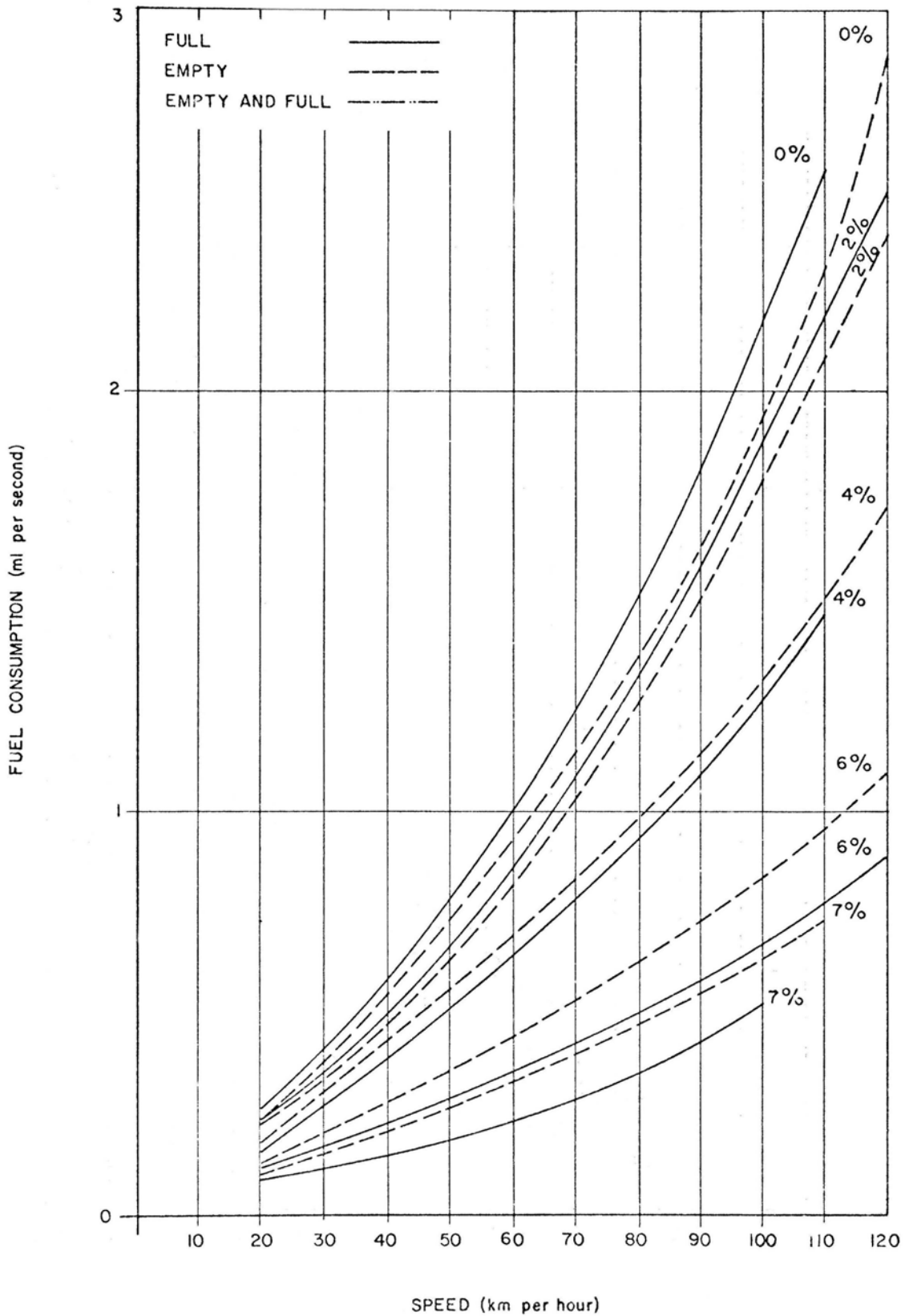


Figure 20 - Fuel Related to Speed for a Full and Empty Volkswagen 1300 Operating on Negative Paved Grades Between Zero and Seven Percent

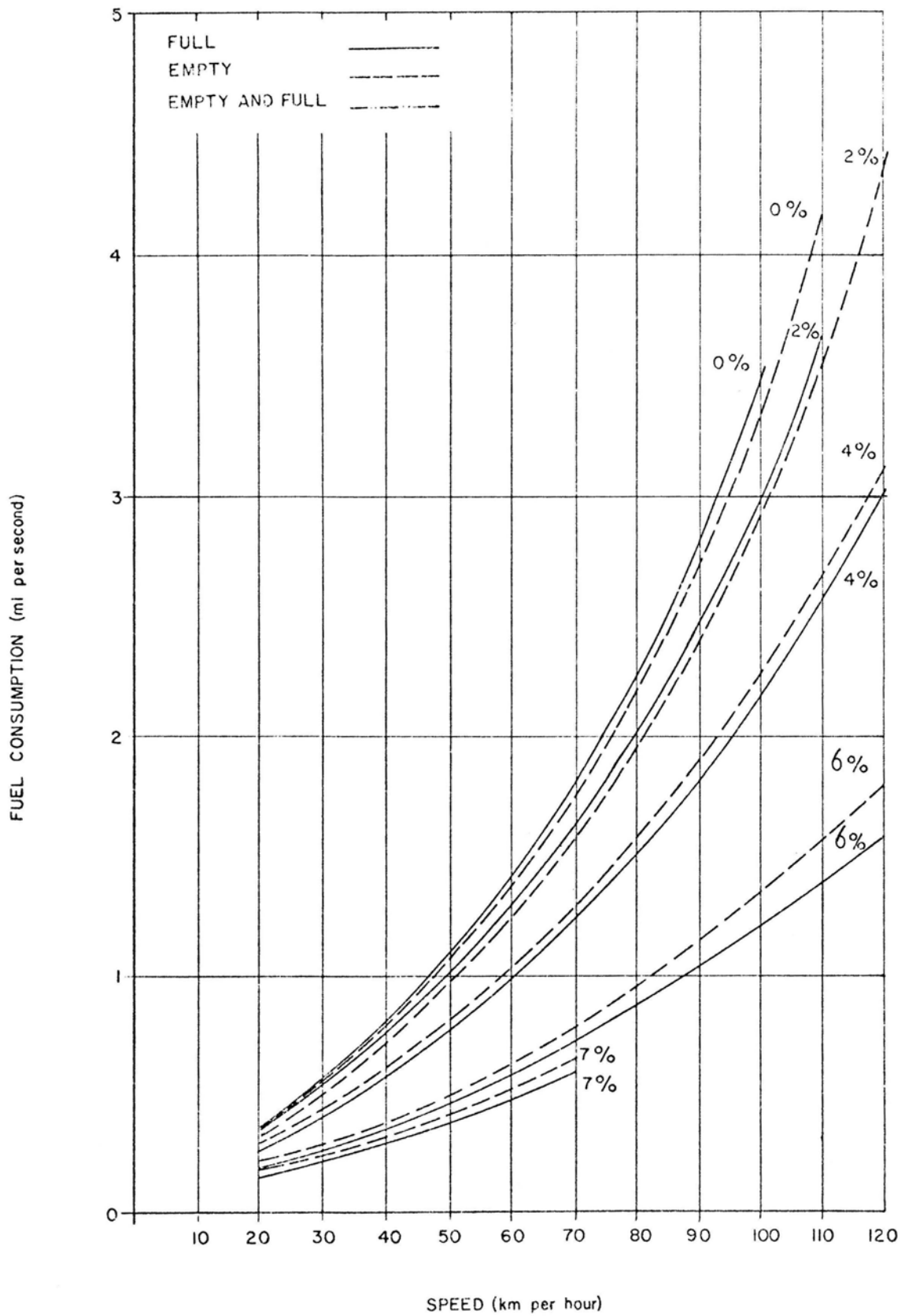


Figure 21 - Fuel Related to Speed for a Full and Empty Kombi Operating on Negative Paved Grades Between Zero and Seven Percent

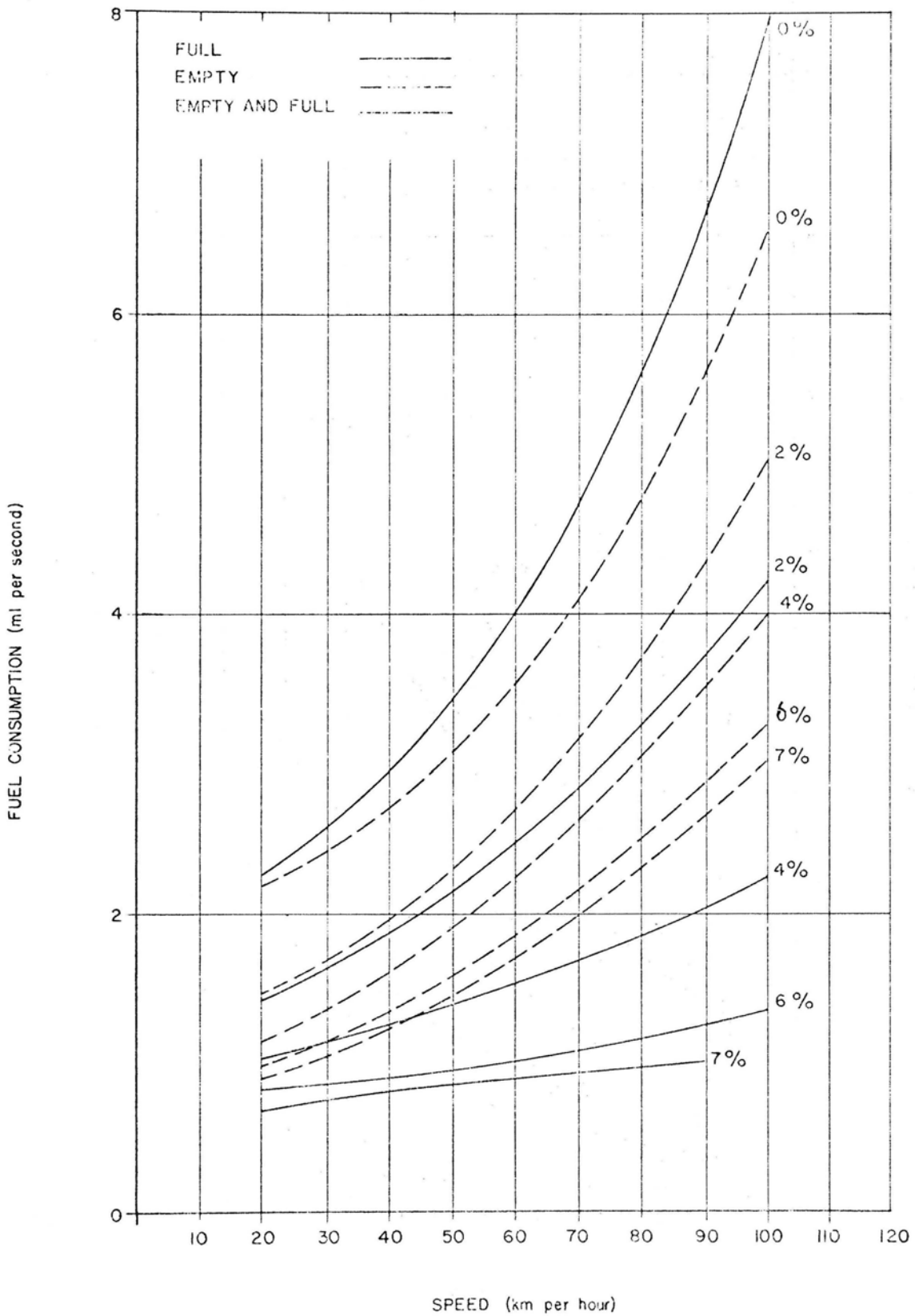


Figure 22 - Fuel Related to Speed for a Full and Empty Ford 400 Operating on Negative Paved Grades Between Zero and Seven Percent

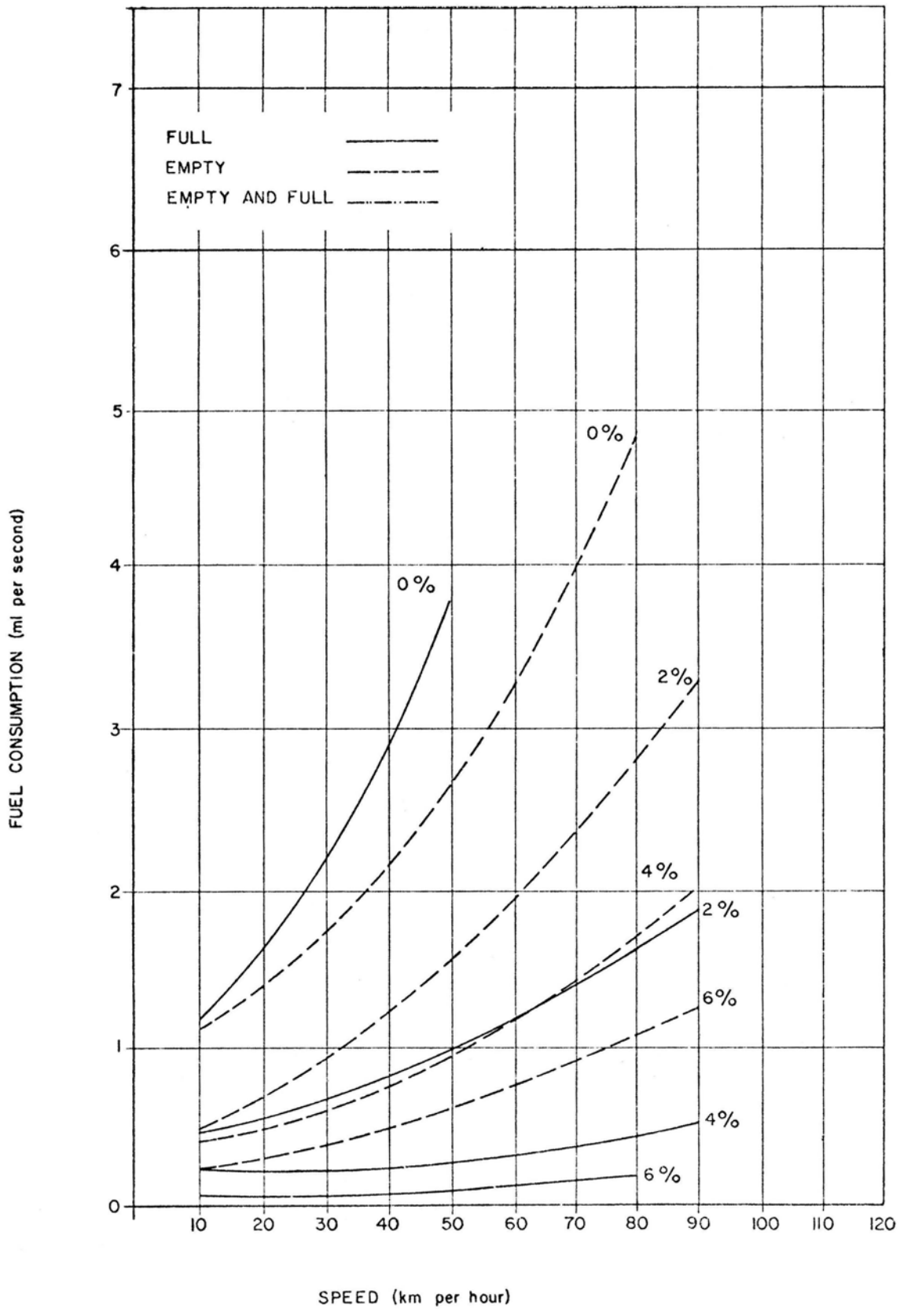


Figure 23 - Fuel Related to Speed for a Full and Empty Mercedes Benz 1113 Operating on Negative Paved Grades Between Zero and Six Percent

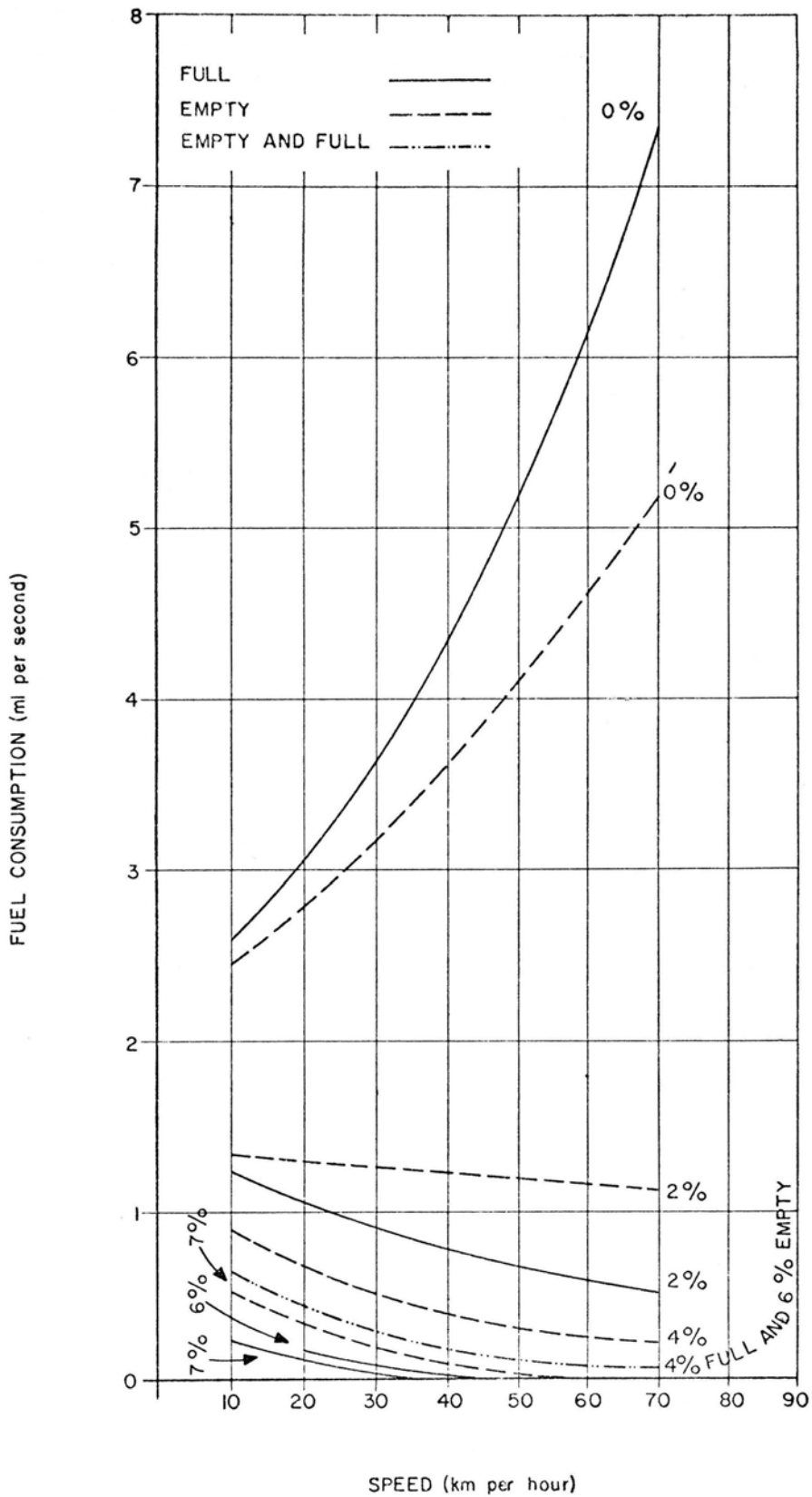


Figure 24 - Fuel Related to Speed for a Full and Empty Scania Operating on Negative Paved Grades Between Zero and Seven Percent

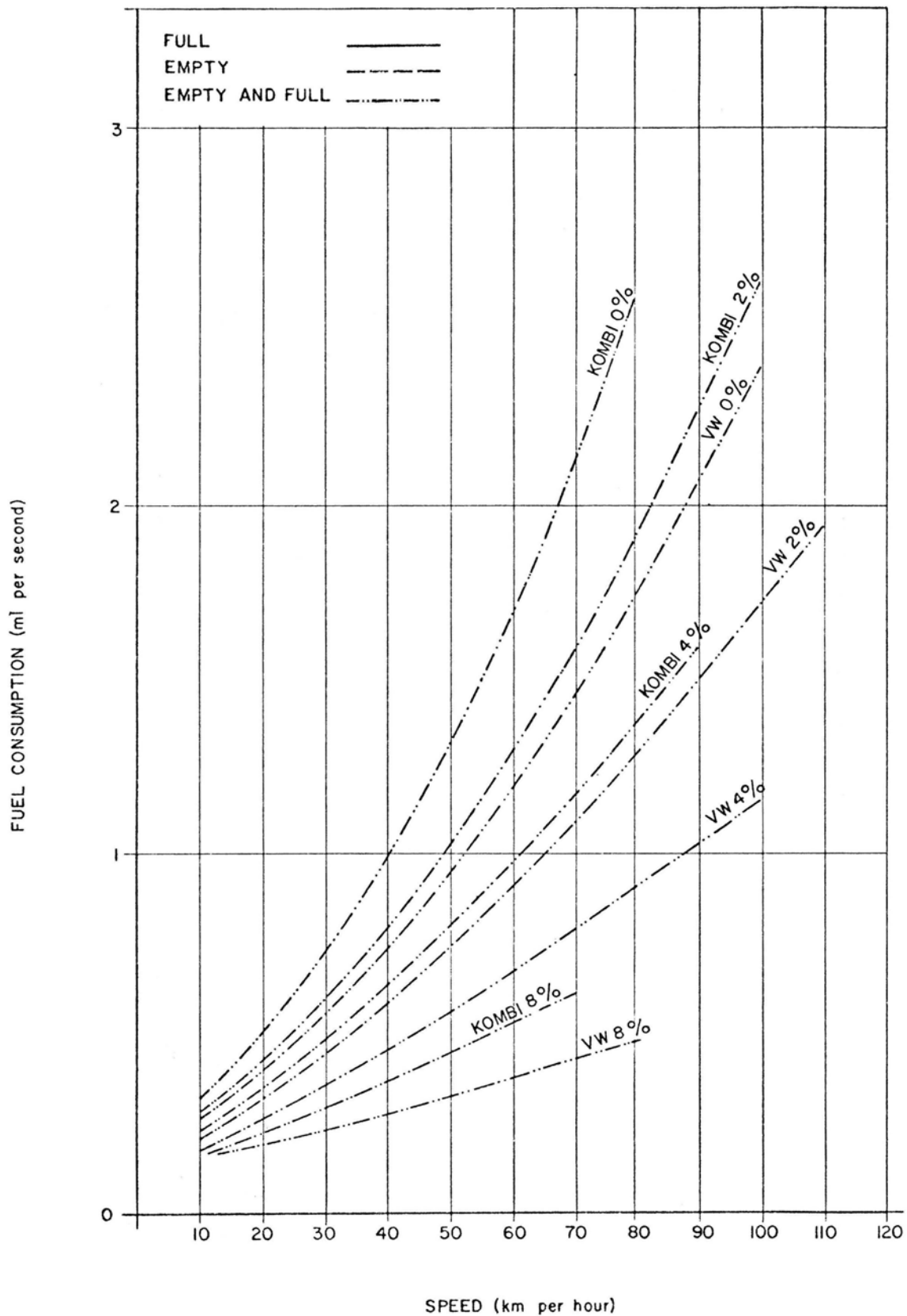


Figure 25 - Fuel Related to Speed for a Full and Empty Volkswagen and Kombi Operating on Negative Unpaved Grades Between Zero and Eight Percent

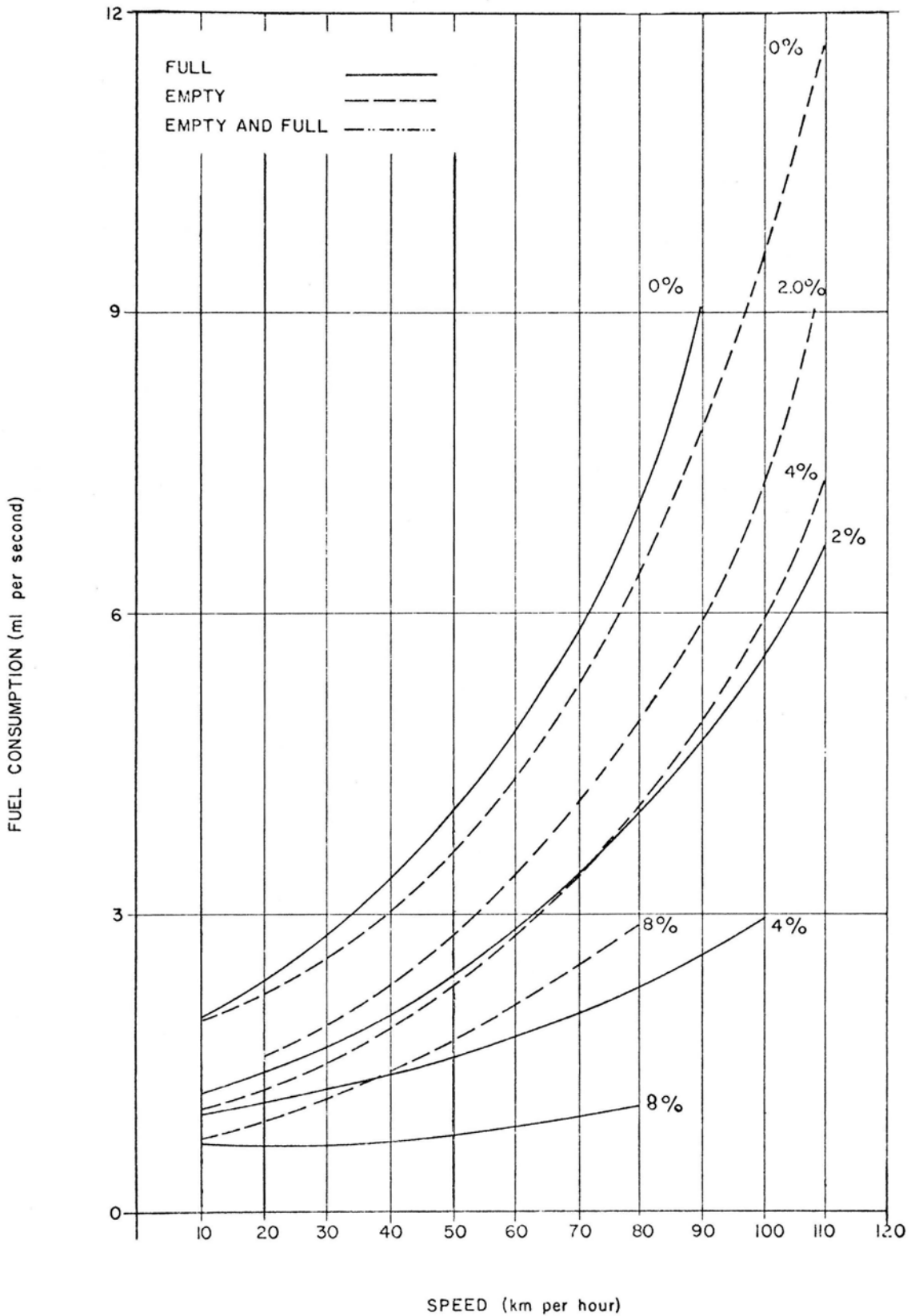


Figure 26 - Fuel Related to Speed for a Full and Empty Ford 400 Operating on Negative Unpaved Grades Between Zero and Eight Percent

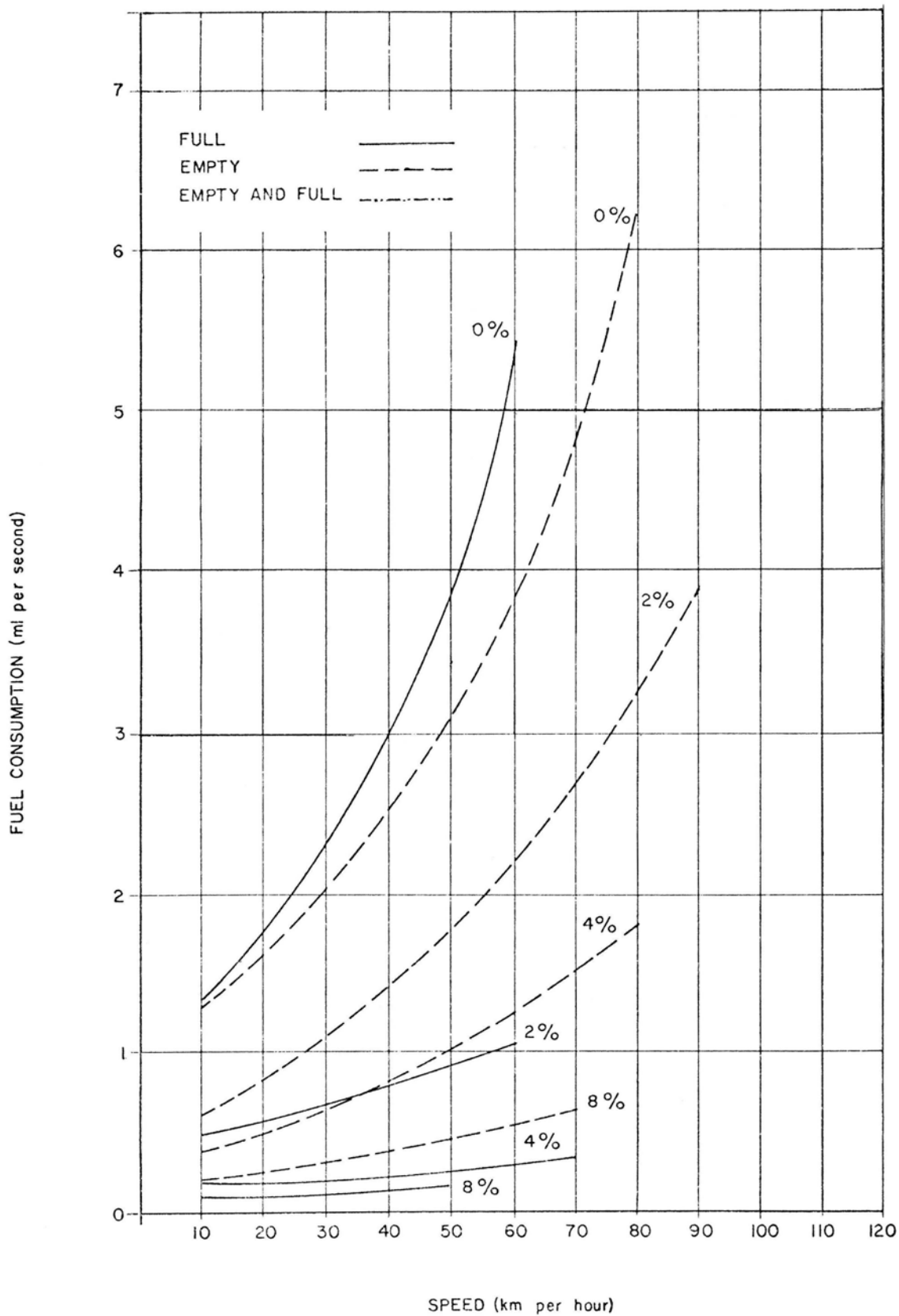


Figure 27 - Fuel Related to Speed for a Full and Empty Mercedes Benz 1113 Operating on Negative Unpaved Grades Between Zero and Eight Percent

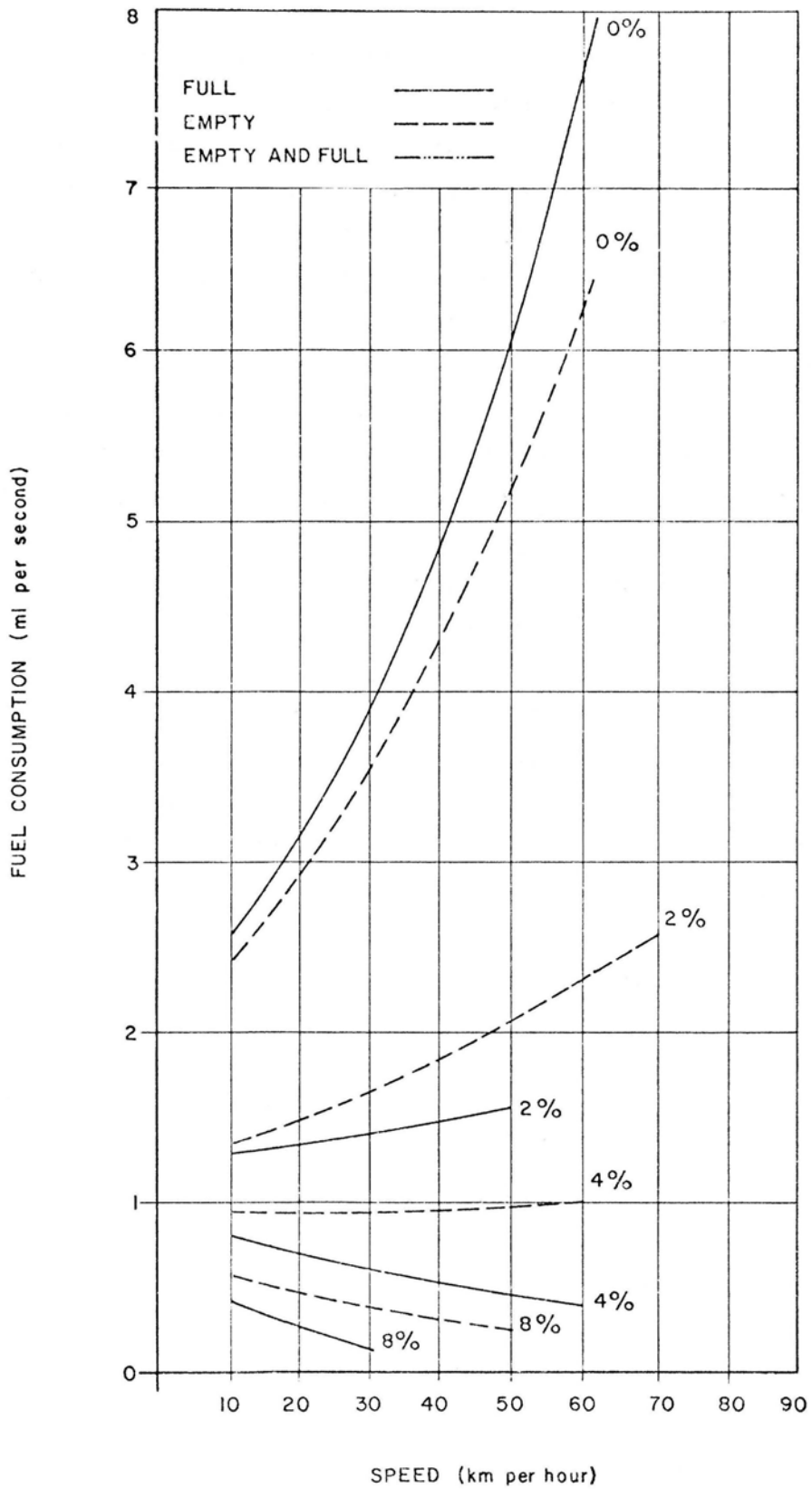


Figure 28 - Fuel Related to Speed for a Full and Empty Scania Operating on Negative Unpaved Grades Between Zero and Eight Percent