

CHAPTER 1
INTRODUCTION

In the composition of the total costs incurred by the users of Brazil's road system for the transport of passengers and freight, almost all the components are, in one way or another, dependent on vehicle operation modes and on standards of road construction and maintenance. Taking components such as spare parts, tyres and labour for repairs into consideration, this dependence may be less important. However, fuel consumption and travel time are responsible for a considerable part of the total cost of transportation, where both vehicle operation modes and standards of road construction and maintenance are factors of significant influence.

Because of this, it has become imperative to define the different modes of vehicle operations as a function of the physical characteristics of the roads, and measure the fuel consumption in each situation, in order to establish the functions of dependence between fuel consumption, on one hand, and operation modes and standards of quality of riding surfaces, on the other. These functions are used in the Model of Time and Fuel Consumption (MTC) which is primarily designed to determine the travel time and the total fuel consumption of a vehicle running in free-flow conditions on a highway with defined characteristics. For this purpose, typical sections were selected which constituted segments homogeneous in geometry and traffic conditions, long enough for the performance of the vehicles to reflect the influence of these parameters. On these road sections, a number of surveys were performed to define vehicle operation modes, as well as fuel consumption measurements under different conditions of weight and speed.

To define the characteristics of the test sections, the following factors were selected: type of road surface (paved, unpaved), vertical and horizontal geometry, and state of maintenance (high and low roughness). These factors varied between limits ample enough to form a sampling matrix that would satisfactorily represent the conditions of traffic on Brazil's highway network (GEIPOT, 1976).

On these test sections, observations of traffic behaviour and experiments of fuel consumption were carried out (described in Vol. 2, Chapter 4 of this Report). These observations and experiments were designed to determine the steady-state speeds of vehicles on straight sections (grades of 0% to 8%), on curves (radius of 20 m to 3000 m),

and in acceleration and deceleration modes (Table 1.1), as well as fuel consumption in each of these situations (Table 1.2).

In this way, correspondence was established between the speed observations of the vehicle population and the experiments on fuel consumption measurement carried out with the PICR test fleet. This correspondence permitted establishing consumption functions for the different modes of vehicle operation, so that for each operational mode (steady-state speed, acceleration or deceleration), determined by the variations in road characteristics, there would be a corresponding consumption function that would establish relationships among the variables that affect the fuel consumption and the travel time of a vehicle on a given route.

The following traffic surveys are described and analyzed in this Volume (Table 1.1): free-flow speeds on positive and negative grades and curves (TB-1, TB-2 and TB-4, respectively), effect of radar (TB-7), and approaches to curves (TBS-3). The experiments on speed calibration (TB-6), speed/capacity (TB-8) and calibration of operating speed (TB-9) provided independent data for the validation of speed-simulation models developed from previous surveys. The remainder was filed for further analysis.

The fuel consumption experiments are also discussed (Table 1.2), with the exception of the experiment which had the specific objective of collecting data for the validation of the Model of Time and Fuel Consumption (FC-4), which is commented in Volume 9 of this report.

Chapter 2 describes the effect of policing the speed limit on driver behaviour. Chapter 3 describes the influence of road roughness on vehicle performance. Chapters 4 to 6 present the traffic behaviour surveys, while Chapters 7 to 11 discuss the fuel consumption experiments. Chapter 12 presents the conclusions of these experiments. The use of the equations derived from these experiments in the Model of Time and Fuel Consumption is described in Volume 8 of this Report.

TABLE 1.1 - SURVEYS FOR THE STUDY OF TRAFFIC BEHAVIOUR

MAIN SURVEYS		
NUMBER	TITLE	OBJECTIVE
TB-1	Free-flow speeds on positive grades	To determine the mode of free-flow speed on positive grades for each class of vehicles
TB-2	Free-flow speeds on negative grades	To determine the mode of free-flow speed on negative grades for each class of vehicles
TB-4	Free-flow speeds on curves	To determine the mode of free-flow speed on horizontal curves for each class of vehicles
TB-6	Speed Calibration	To collect independent data to verify and calibrate the models based on the experiments TB-1 to TB-4
TB-7	Effect of Radar	To determine whether the data on speed are being influenced by the presence of radar equipment on road shoulders
TB-8	Speed/Capacity	To collect data for the development of the relationship between speed and the volume of traffic
TB-9	Calibration of Operational Speed	To collect independent data to verify and calibrate the models of the TB-8 experiment

SATELLITE SURVEYS

TBS-1	Wet/Dry	To define differences in vehicle performance due to rain and wet surfaces
TBS-2	Types of Surfacing	To define differences in vehicle performance due to different types of gravel surfacing
TBS-3	Approaches to Curves	To collect data on deceleration occurring on approaches to horizontal curves
TBS-5	Night Traffic	To determine free-flow speeds at night time

TABLE 1.2 - TRAFFIC EXPERIMENTS PERFORMED WITH THE TEST FLEET

CATEGORY	IDENTIFICATION	OBJECTIVE
MAIN EXPERIMENTS ON FUEL CONSUMPTION	FC-1	To measure fuel consumption in mode of steady-state speed on grades
	FC-2	To verify fuel consumption and mode of deceleration of vehicles on positive grades preceded by steep negative grades
	FC-3	To investigate the influence of small-radius curves on fuel consumption by vehicles
	FC-4	To measure fuel consumption on long sections to validate the Model of Time and Fuel Consumption (MTC)
SATELLITE EXPERIMENTS ON FUEL CONSUMPTION	FCS-5	To measure fuel consumption by large vehicles
	FCS-4 and TB-3	To measure fuel consumption in acceleration mode
	TBS-6	To measure fuel consumption in deceleration mode
	FCS-6	To investigate the effect of adding alcohol to gasoline