Abstracts of Papers

PROPULSION SYSTEM REQUIREMENTS FOR DUAL-MODE VEHICLES

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Optimum dual-mode system performance and efficiency require that the vehicle propulsion system be properly sized and rated. In addition to the general requirements of speed, acceleration, and environmental factors, specific requirements such as velocity profile and vehicle characteristics must be established to obtain complete definition. Mission-dependent torque-time profiles must be generated from these combined requirements. Load lines can then be established, and the propulsion system can be sized in the conventional way.

In choosing a propulsion system, one must consider both the on- and off-guideway performance requirements. In general, the acceleration and cruise thrust requirements are not compatible for each of the operating modes and, therefore, would lead to independent sizing criteria. The preferred approach is to develop an initial site-independent design based on worst case acceleration and speed-maintaining requirements as prescribed by the design guidelines. This provides adequate propulsion data for development of the mission characteristics including the site-dependent velocity and grade profiles. The propulsion design is then iterated, making use of the profiles to generate a torque-time profile. This profile provides short-term and continuous performance requirements that can be compared to short- and long-term ratings of the propulsion system. When the short-term ratings from specific regimes of operation size the propulsion system, consideration should be given to modification of the mission profile within the limits of the design guidelines. Once the mission profile has been fixed, propulsion design proceeds in a conventional way.

COMPARISON OF ENERGY AND POLLUTION CHARACTERISTICS OF PROPULSION SYSTEMS OF DUAL-MODE TRANSIT VEHICLES AND THE AUTOMOBILE

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A significant factor in the public acceptance of any transit system is the efficient use of energy, preferably with low pollution and cost. A typical dual-mode trip was selected on which to base a comparison of energy consumption, energy cost, and pollution levels associated with the following vehicles and vehicle-transporter combinations: all electric bus on- and off-guideway, all electric bus using electric transporter on-guideway, diesel bus, diesel bus using electric transporter on-guideway, private automobile using conventional streets and freeways, private automobile on electric transporter on-guideway, and gasoline bus on- and off-guideway.

Energy consumption and cost were calculated by using a typical 20-passenger vehicle load characteristic for the bus configurations and a midsized sedan for the automobile. The energy consumption was related to the energy source, that is, natural resources used to generate power at the powerplant with its related efficiencies and petroleum products related to the refinery and its efficiency. The cost was assessed at the rate paid by the transit system operator. Pollution levels were determined by using the allowable limits according to the federal standards for heavy-duty diesel, automobile, heavy-duty gasoline, and coal-burning generating plants.

The energy consumed in terms of raw energy sources (crude oil and coal) does not vary significantly among the transit methods evaluated, since the overall system energy conversion efficiencies for these processes are approximately equal. Electrically powered transit methods operate at a lower cost and at much lower pollution levels than the petroleum-fueled internal combustion engine methods. Generating plant emissions are relatively easily controlled, and a lower cost fuel can be used in addition to having flexibility of fuel selection. Trip speeds were 12 mph (19.3 km/h) average off-guideway in the suburbs; 7 mph (11.3 km/h) average downtown; and 50 mph (80.5 km/h) cruise on the guideway. Comparisons based on a passenger trip are as follows: