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CHAPTER 55

TRUCKS AND TRAILERS

Types of Refrigerated Trucks and Trailers, Body Design and Construction, Auxiliary Equipment, Types of Refrigerating Systems, Mechanical Refrigeration Equipment, Computation of Cooling Loads

THE transportation of perishables in insulated refrigerated trucks and trailers has grown to its present tremendous proportions in about 35 years. The ice cream industry probably pioneered the first successful mechanically-refrigerated trucks, operated by methyl chloride units, electrically operated from a gasoline engine-driven generator. Prior to this, various forms of ice-and-salt tanks, refrigerated barrels and other containers were used to transport frozen items in uninsulated trucks or wagons. Many of the early insulated vehicles were fitted with eutectic-filled refrigerating elements which were frozen by connection to ammonia lines from the plant system when the vehicle was garaged. Present day systems are evolutions of these early basic types and a primary consideration influencing changes has been the weight of the refrigerating mechanism in relation to payload. Petersen described, for ice cream trucks, the changing ratio of truck weight per gallon of ice cream from 43 lb per gallon to 16 lb per gallon as improvements had been made.[1] Today's large ice cream trucks are less than 10 lb per gallon. This is typical for all refrigerated vehicle categories, and successful increase in payload ratio has been a major factor in the growth of refrigerated truck and trailer transportation. References 1 to 5 contain information on early developments in refrigerated truck and trailer transportation.

Stagg estimates that 18,000 trucks and 10,000 trailers were adapted to refrigeration in 1939.[5] Because of the large number of *captive fleet* vehicles today, an exact determination of the number of refrigerated vehicles in service is not available, but one source in the trailer manufacturing industry estimates 250,000 trucks and 50,000 trailers in refrigerated service in 1961.

TYPES OF REFRIGERATED TRUCKS AND TRAILERS

Practically every type of body, from bicycle-mounted and other peddler carts to 40 ft van and tank semi-trailers, has been insulated and equipped with means for refrigeration.

Design temperatures ranging from 70 F and higher for personnel, electronic gear, flowers, chicks, bakery products, etc., to below −100 F for solid carbon dioxide, liquid oxygen and other chemicals, have been used for special purpose vehicles.

The majority of refrigerated vehicles fall into one of three general temperature classifications: 60 to 70 F, air conditioned body; 35 to 40 F, medium temperature or perishable produce body; and 0 F, low temperature or frozen food body.

Each state fixes by law the maximum weight and dimensions of trucks and trailers that may be operated over its highways. A chart of current state size and weight limits for trucks and truck-trailers is issued by the Truck-Trailer Manufacturers Association Inc.[6]

For practical operation, refrigerated truck bodies (carried on a conventional truck chassis) are seldom over 16 ft long, 8 ft wide and 7 ft high. Refrigerated truck bodies used for ice cream delivery range in weight from about 3800 lb for 440 gal to about 7500 lb for 2200 gal. The smaller body, on a medium duty truck chassis, will have a gross vehicle weight, including cargo, of about 10,500 lb and the larger body, on a heavy duty truck chassis, will have a gross vehicle weight, including cargo, of about 25,500 lb. Refrigerated trailers and semi-trailers are up to 45 ft long, 8 ft wide and 13½ ft overall height. A 40 ft low temperature trailer will weigh between 10,000 and 14,000 lb. Cargo space width is determined by the allowance for insulation, the inside and outside wall thicknesses and the depth of the side wall racks. Floor racks may take up to two to four inches of load height, and if a forced air system delivering air from the front end of the body without ducts is used, the load height should be at least 12 in. below the ceiling to permit cold air to circulate to the rear portion of the load. On long trailers various forms of supply or return ducts have been used to improve the temperature distribution throughout the load.[7–11] Some trailers with air distributed from the front end use a bulkhead to force return of air through the side walls and floor. Various designs of *envelope*, *semi-envelope*, or *perimeter* construction, in which the cooling (or heating) air is circulated wholly or partially in ducts contained in the walls, ceiling and floor, are beginning to appear in commercial use, both over-the-road and *piggy-back*.[12,13]

The characteristics of the air distribution system which affect the temperature distribution in a loaded low temperature trailer were discussed by Achenbach.[14] Lentz discussed laboratory and road performance tests of a loaded trailer.[15] *USDA Handbook No. 105* gives recommended loading methods and temperatures for many perishable products.[16]

Although trucks and trailers are usually considered a means of transportation only, the use of refrigerated bodies for terminal storage space is becoming increasingly important in certain industries. The dairy industry first developed the idea for wholesale milk delivery, and later for retail delivery. Many companies found that they could expand their business greatly without going to the expense of building larger coolers by loading the milk directly into trucks after bottling. When this was done in the afternoon or evening, the trucks remained at the plant during the night, and drivers got an early start in the morning without congestion at the dock. This method required much less handling and, consequently, lowered labor costs. The meat packing and ice cream industries soon adopted this same plan.

The entire transportation industry is undergoing many transitions which cut across truck, rail, air and ship transportation fields. For example, at least one operation uses containers in the general size and form of a trailer body which can be attached to a trailer chassis for land hauling, and trans-