Section 684.12

(a) Furrow Design Assumptions

It is necessary to make a certain number of assumptions or approximations in order to prepare design equations and tables for furrow systems. These assumptions must be sufficiently valid so that designs based on them will result in irrigation systems that can be irrigated efficiently and uniformly, with only the requirement of seasonal adjustments in stream size and application time. Design assumptions are made for intake-time relationships, rate of advance, time for recession, opportunity time, retardance coefficient, and intake as related to furrow wetted perimeter. Figure 684-1 illustrates these factors.

(b) Intake-Time Relationship

To theoretically obtain complete intake uniformity along the entire length of a furrow, it would be necessary for the opportunity time for intake at all points along the furrow to be equal. This is not possible with furrow irrigation where water is applied at the upper end and progresses down the furrows over a period of time. The time that water is on segments of the system is, therefore, of different duration at points along the furrows or corrugations. For acceptable uniformity and adequacy of application, the minimum time that water should be on any point along the furrow length should not be less than required for intake of the desired net application. Also, the maximum application time should be such that excessive deep percolation losses will not occur.

The time that water is on a given segment of the furrow is defined as the opportunity time
(T_o). This "T_o" is the time duration between the time the furrow stream reaches the furrow stations and the time when water disappears from the surface at these points. This time is defined as the time increment between the advance and recession curves. These two curves are of prime importance in the design of a furrow or corrugation irrigation system as they describe the intake opportunity time for the various segments along the furrow length.

(c) Rate of Advance

The rate of advance is a function of the water flow rate entering the furrow, the soil intake rate, furrow shape, grade length and the roughness of the furrow surface. The relationships involved in the flow of water in furrows are complex. During the irrigation process, water is entered into the upper end and advances along the length of the furrow. The flow rate is largest at the head of the furrow and becomes successively smaller at each point downstream because of the water lost to infiltration into the soil. The result is a reduction in the rate of advance at successive points downstream. If the length is such that the entire stream is absorbed by the soil, the advance stops. For efficient irrigation, a rapid rate of advance throughout the entire length must be obtained.