slowed gradually through a series of very weak oblique shock waves to a speed just above sonic velocity. Then the subsequent normal shock to subsonic could be quite weak. Such a combination of the weakest possible waves would result in the least waste of energy and the highest pressure recovery. The efficiency of various types of diffusers is shown in figure 3.20 and illustrates this principle.

An obvious complication of the supersonic inlet is that the optimum shape is variable with inlet flow direction and Mach number. In other words, to derive highest efficiency and stability of operation, the geometry of the inlet would be different at each Mach number and angle of attack of flight. A typical supersonic military aircraft may experience large variations in angle of attack, sideslip angle, and flight Mach number during normal operation. These large variations in inlet flow conditions create certain important design considerations.

(1) The inlet should provide the highest practical efficiency. The ratio of recovered total pressure to airstream total pressure is an appropriate measure of this efficiency.

(2) The inlet should match the demands of the powerplant for airflow. The airflow captured by the inlet should match that necessary for engine operation.

(3) Operation of the inlet at flight conditions other than the design condition should not cause a noticeable loss of efficiency or excess drag. The operation of the inlet should be stable and not allow "buzz" conditions (an oscillation of shock location possible during off-design operation).

In order to develop a good, stable inlet design, the performance at the design condition may be compromised. A large variation of inlet flow conditions may require special geometric features for the inlet surfaces or a completely variable geometry inlet design.

SUPERSONIC CONFIGURATIONS. When all the various components of the supersonic airplane are developed, the most likely general configuration properties will be as follows:

(1) The *wing* will be of low aspect ratio, have noticeable taper, and have sweepback depending on the design speed range. The wing sections will be of low thickness ratio and require sharp leading edges.

(2) The *fuselage and nacelles* will be of high fineness ratio (long and slender). The supersonic pressure distribution may create significant lift and drag and require consideration of the stability contribution of these surfaces.

(3) The *tail surfaces* will be similar to the wing—low aspect ratio, tapered, swept and of thin section with sharp leading edge. The controls will be fully powered and irreversible with all movable surfaces the most likely configuration.

(4) In order to reduce interference drag in transonic and supersonic flight, the gross cross section of the aircraft may be "area ruled" to approach that of some optimum high speed shape.

One of the most important qualities of high speed configurations will be the low speed flight characteristics. The low aspect ratio swept wing planform has the characteristic of high induced drag at low flight speeds. Steep turns, excessively low airspeeds, and steep, power-off approaches can then produce extremely high rates of descent during landing. Sweepback and low aspect ratio can cause severe deterioration of handling qualities at speeds below those recommended for takeoff and landing. On the other hand, thin, swept wings at high wing loading will have relatively high landing speeds. Any excess of this basically high airspeed can create an impossible requirement of brakes, tires, and arrest ing gear. These characteristics require that the pilot account for the variation of optimum speeds with weight changes and adhere to the procedures and techniques outlined in the flight handbook.