CONTROL LINE FACILITY

In the 1950s Langley embarked on a major research program on radical new vertical takeoff and landing (VTOL) airplanes designed to takeoff and land from hovering flight similar to a helicopter, but having the ability to convert to high-speed conventional flight like conventional aircraft. The scope of this program was very large including wind-tunnel testing, flight testing of research aircraft, free-flight model tests, and piloted simulator studies. One of the critical flight conditions for VTOL aircraft is the transition from and to hovering flight. During the transition, aerodynamic instabilities may occur that severely degrade the flying qualities of the airplane. The Langley Full Scale Tunnel was initially used for transition studies of free-flight VTOL models. After a vertical take off was made to a hovering position in the tunnel test section, the tunnel drive motor was started and the attitude of the model was varied by remote pilots as the airspeed was increased during the transition to conventional forward flight. Unfortunately, the airspeed in the full scale tunnel could not be rapidly accelerated and the transition maneuver required an unrealistic amount of time to accomplish. During the extended maneuver, instabilities were encountered that resulted in loss of control; however, it was recognized that if the time required to complete the maneuver was more realistic the instabilities may not have time to affect the flying qualities of the model. Therefore, the staff conceived and built a new facility specifically to simulate rapid transitions of VTOL flying models. The facility, known as the Langley Control Line Facility, was constructed in 1955 in a wooded area near the Langley flight hangar in the West Area and was designated Building 1244-B. The fundamental principle involved in tests at the facility was similar to that in which a model is flown in circling flight at the end of a tethering line, known as the "U-control" scheme used by hobbyists.

The Control Line Facility consisted of a standard crane with its circular track mounted on concrete pillars. The crane was placed in the center of the 130-foot-diameter circular concrete pad within a wooded area that served as a wind break and permitted testing even when it was fairly windy outside the woods. In order to provide control stations for four operators of the facility (pilot, thrust controller, safety cable operator, and crane operator), the standard cab on the right side of the crane was enlarged and a duplicate cab was added to the left side of the crane. The crane, which had a standard four-speed transmission, could be rotated at speeds up to 20 revolutions per minute, and even when in high gear could accelerate from a standing start to top speed in approximately 1/4 of a revolution. In addition to having excellent acceleration, the crane could also be rotated smoothly and accurately to follow VTOL models during rapid transitions from hovering flight to forward flight.

An overhead safety cable, power, and control cables were used to attach the model to the end of the crane jib at a distance of 50 feet from the center of rotation of the crane. Before any transition test was started, a VTOL model took off vertically and was stabilized in steady hovering flight. A pitch pilot in the crane cab operated the model controls to change its vertical attitude and begin the transition to forward flight while a model power operator simultaneously adjusted the model's thrust to maintain a desired altitude of about 15 feet above the ground. The crane operator rotated the crane so that the end of the crane jib was above the model at all times. The crane followed the model so that the crane rotation and the flight cables had virtually no effect on the model motions. Test data were obtained in the form of motion-picture records of the model motions, speed, and control positions. The models used on the control-line facility were either propeller-driven (powered by compressed-air motors or electric motors) or turbojet-type (powered by hydrogen-peroxide rocket motors).

The Langley Control Line Facility was used over 5 years in a series of investigations of VTOL airplane models during rapid transitions from hovering to cruise flight and back to hovering. It was especially valuable for studying very rapid landing maneuvers and studying the short takeoff and landing (STOL) characteristics of models of the aircraft designed for short-field operations.

Results from the facility were used in conjunction with results from the Langley Full Scale Tunnel, the Langley V/STOL Tunnel (now the Langley 14- by 22-Foot Tunnel), and flight tests to guide designers of future V/STOL aircraft.

After the Langley V/STOL program ended in the mid 1960s the facility was mothballed and operations were terminated.