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AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF UPPER SURFACE BLOWING ON DYNAMIC STALL

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SUMMARY

This report summarizes the progress made during the time period from June, 1993, to December, 1993. The work was conducted at NASA Ames Research Center by David C. Weaver under the supervision of Kenneth McAlister at NASA Ames and Jin Tso at Cal Poly.

The first six months have been spent mostly in developing test apparatus, including a Vertol VR-7 wing model, a pulse valve, and a wing/load cell junction, as briefly described as follows:

VR-7 wing model

A Vertol VR-7 wing model has been designed. Its construction consisted of four phases: tooling, rough machining, fine machining and polishing, and plating; it is now near completion. The model measures eight inches in span and four inches in chord. Its dimensions are typical of previous models used in the water tunnel facility. The model, as shown schematically in Figure 1, is a three-piece design to allow for precise dimensions of the blowing slot in the upper surface. It consists of a central reservoir, internal diffusers and straightening vanes to ensure uniform blowing along the span. The model is made of stainless steel to prevent corrosion and provide high strength. Since flow visualization is an important part of the experiment, a dull black nickel plating is used to reduce glare in photographing.

Pulse valve

A valve that pulses the upper surface blowing has been designed and built. The valve consists of a rotor and stator contained in a watertight housing. The cylindrical housing, which serves as a large plenum chamber to maintain the internal water pressure, has a large water inlet hole on one end and a small water outlet hole on the other. The rotor has four equally spaced holes and is tightly spaced to the stator of the plenum. The stator has an outlet hole. As the rotor turns, its holes sequentially line up with the stator hole, thus allowing pulses of water out of the plenum chamber. Since the stresses on the valve did not constrain the design, an anodized aluminum construction was used to reduce

manufacturing costs while maintaining resistance to corrosion. The valve is currently being tested to determine the envelope of amplitude and frequency variation possible with the current drive motor.

Wing/load cell junction

A new wing/load cell junction was designed and built after some preliminary testing revealed that the current junction would allow water to enter the force balance's support structure and possibly damage it. The new junction was designed with an integral injection port and lip seal to prevent water from entering the rest of the structure. Several pressure relief ports are also provided in the event of seal failure. The junction is made of stainless steel to resist corrosion and mate with the existing stainless steel structure.

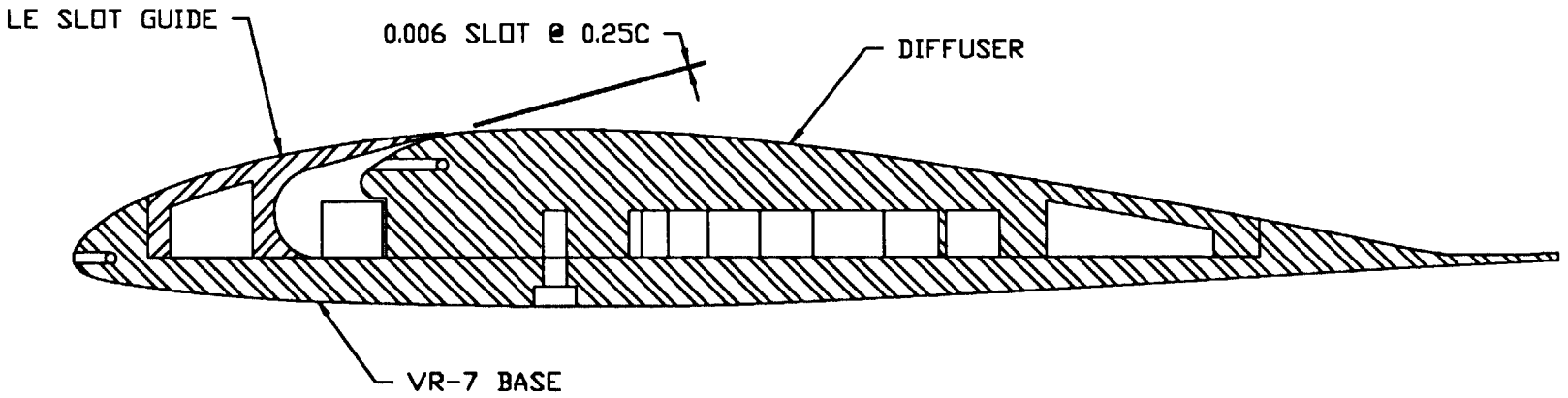
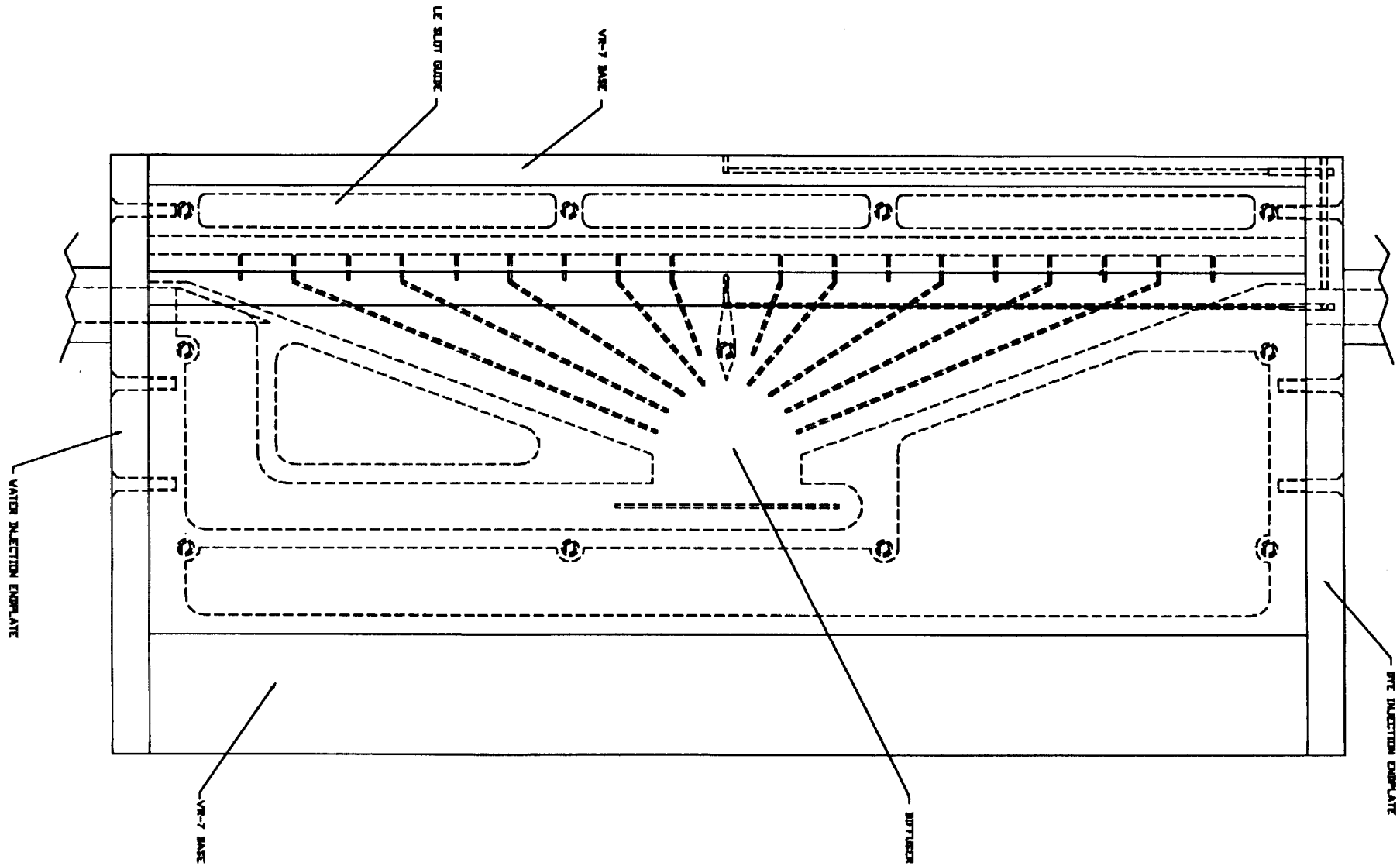


Figure 1. Schematic of the VR-7 wing model.



BLOWING MODEL ASSY
SCALE = FULL

Figure 1. (Continued.)