Table 1 Property values

	Gold	Nickel	Platinum
Density, g/cm	19 3	8 9	21 45
Specific heat, cal/°C-g	0 0317	0 1095	0 0320
Temperature coefficient of resistivity, 1/°C	3 42 × 10⁻³	6 × 10⁻³	3 92 × 10⁻³
Thickness, in	0 002	0 002	0 001

hypervelocity shock tube A range of velocities and initial pressures comparable to that of Ref 1 were covered as indicated in Fig 1

No major difference was indicated in the measured heat transfer due to gage material for the test conditions specified

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Supersonic Pitot Tube Measurements at an Angle of Attack

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In a recent series of $M = 3$ wind-tunnel tests at the Boeing Company, it was necessary to measure the total pressure in the flow in a region where the flow and the pitot probe were at a relative angle of about 20° Although it was believed that the results would still be ieasonably accurate, no data could be found for a pitot tube at angle of attack in supersonic flow Consequently, at the end of the test, a series of runs were made with two probes bent at various angles of attack up to 35° to determine the variation of pitot pressure with angle of attack

After the tests had been run, data were found[1] relating to probes of considerably greater dimensions than those used in the present test (o d 0 25–1 00 in) and for Mach numbers of 1 62 and 2 40 As might be expected, for probes having a much greater mouth-to-wall area than those reported in this note, the results of Ref 1 showed that even at 30° there was a decrease of only 1–5% in the pitot pressures

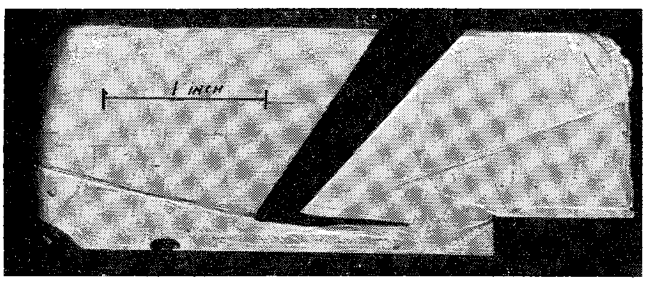

Fig 1 Side view of probe and strut with backward-facing step model

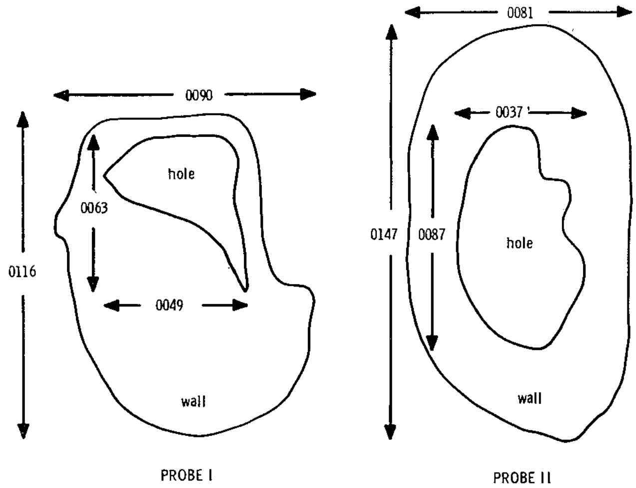

Fig 2 Shapes and dimensions of the probe mouths

The tests weie run in the Boeing model supeisonic tunnel, which has a 4 8-× 4 8-in test section, and the probes were mounted as shown in Fig 1 (This shadowgraph shows the probe with a backward-facing step model mounted as a splitter plate, but during the probe calibration the model was removed, and the probe was by itself in the tunnel) The probe mouths were made elliptical to reduce surface interaction effects by flattening some stainless-steel tubing (0 006-in i d and 0 002-in walls) and then honing the tip by hand After the runs, and also after much handling by tunnel personnel, a microscopic examination of the probe mouths revealed how far from ideal the actual configurations were (see Fig 2) Probe I was continued back for a small distance as a 6° semi-vertical angle cone, and probe II as a 10° cone, but then the details of the tubes and their strut supports were very similar Both probes were mounted with the long axes of their mouths vertical To achieve angles of attack, each probe was bent by hand upwards (toward the sting) from its junction with the sting, and the angles were measured before and after each run Slight deflections of the probes were noticed during the runs, particularly at tunnel staıt, but they appeared to be less than 1°

The tunnel conditions were a stagnation pıessure of 80 psi and a stagnation temperature of about 75°F At the actual test Mach number of 2 98, this gave a freestıeam Reynolds number of approximately 10⁶/in

The results are shown in Fig 3 They show that the errors introduced by having the probe and freestream out of line are indeed small, even up to 20° Probe I has a greater enor than probe II; it is felt that this is because the hole is in the upper portion of the tube mouth and thus always further from the stagnation point and exposed to lower pıessures

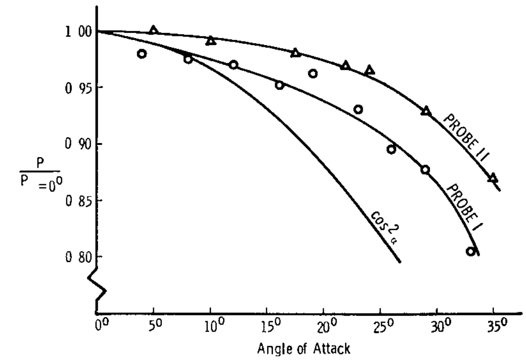

Fig 3 Ratio of probe pressures at angles of attack to their values at zero angle of attack

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It is surmised that because of the generally similar character of supersonic blunt-body pressure distributions these results will also be valid for other probe shapes and Mach numbers, provided the area of the hole is a reasonable fraction of the total frontal area, and, further, that it is symmetrically placed as probe II rather than probe I

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Chemical Scavenger Probes in Nonequilibrium Gasdynamics

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DIRECT, local measurements of atom, free radical, excited molecule, and/or ion concentrations are required in the experimental study of nonequilibrium flow fields and for calibrating high enthalpy test facilities In attempts to simulate the conditions of hypervelocity flight it is necessary to know whether the test gas composition (e g , population of excited states) is not, in some sense, singular, particularly when an electrical discharge is used to heat the gas Although gas-sampling techniques have been successfully applied to the study of local stable species concentrations both in subsonic and supersonic steady flows,[1–3] rapid heterogeneous and homogeneous reactions in the sampling system have precluded their direct use for unstable species We wish to point out here that this difficulty can frequently be eliminated by introducing a "scavenger" gas immediately inside the probe The scavenger rapidly and quantitatively reacts with the unstable species in the sampled gas to form one or more stable products, which can then be analyzed downstream by any one of a number of conventional techniques The authors have successfully applied this principle in sampling nonequilibrium supersonic streams of active nitrogen for both atoms and excited molecules Details of the experimental technique, and the implications of this work to our understanding of the chemistry of active nitrogen will be found in a forthcoming paper [4] Here we confine our attention to some of the implications for aerodynamic testing

The measurement of local excited molecule concentrations is made possible by the existence of scavengers that are selectively attacked by atoms and/or excited molecules Thus, nitrogen sampled from a Mach 3 plasmajet was reacted with nitric oxide, ammonia, or ethylene, and measurements were made of scavenger gas destruction (NO, NH_3), a gas-phase chemiluminescence titration end point (NO), and product formation (HCN from C_2H_4) An interesting conclusion of this work is that electronically excited nitrogen molecules can be present in concentrations comparable to that of ground-state atoms, and can thereby exceed the importance of atoms as energy carriers in nonequilibrium plasmajets Absolute atom and excited molecule concentrations determined using scavenger-probe techniques can now be used in conjunction with catalytic detector measurements[5 6] made under identical experimental conditions to determine the contribution of individual energetic species to gas/solid energy transport

Scavenger probes lend themselves to use in high-temperature systems since they can be (water) cooled and/or the scavenger gas can be mixed with an inert diluent The technique is generally useful for quantitative studies of the energetic species of interest in aerodynamic and chemical propulsion applications and may also be used to distinguish between various excited states of the same molecule It is relevant to point out that Fristrom has recently reported on an independent application of the scavenger-probe concept in subsonic, low-pressure flame studies [7 8] Oxygen atom, hydrogen atom, and methyl radical concentrations have been determined using, respectively, NO_2, chlorinated diffusion pump oil vapor, and iodine as the scavenging gases

Although a considerable amount of research has yet to be done, particularly with regard to analyzing mixtures of energetic species in supersonic streams, we feel that scavenger probes are destined to play an important role in the future of nonequilibrium flow diagnostics

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Temperature Distributions Downstream of a Moving Heat Sink

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Nomenclature

a = half-width of the heat sink, ft
h = heat transfer coefficient, Btu/hr-°F ft²
k = thermal conductivity of the plate, Btu/hr-°F ft
l = thickness of the plate, ft

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