

FINAL REPORT

CALIBRATION OF COMBINATION PRESSURE PROBES

J. A. NICHOLLS
D. R. GLASS
M. FLEISCHMAN

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FORD MOTOR CO.
SCIENTIFIC LABORATORY

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FOREWORD

The work reported herein was conducted under University of Michigan Engineering Research Institute Project Number 2221 for the Scientific Laboratory of the Ford Motor Company. All the work was done at the Aircraft Propulsion Laboratory.

CALIBRATION OF COMBINATION PRESSURE PROBES

INTRODUCTION

The Ford Motor Company had two combination pressure probes which required suitable calibration. It was requested that the University of Michigan perform this calibration. Each probe is capable of detecting the yaw of the air stream, static pressure, and total pressure. The probes were to be tested over a Mach-number range of 0.2 to 0.8.

EXPERIMENTAL ARRANGEMENT AND PROCEDURE

The air supply utilized for these tests was the Aircraft Propulsion Laboratory blowdown system. This system is capable of storing about a ton of air at 3,000 psi. At these high pressures the air is very dry and hence condensation was no problem. The flow rates were controlled by two valves in series. Coarse settings were affected by a Nordstrom valve, while fine adjustments were made by a Foster valve.

A schematic drawing of the experimental arrangement is shown in Fig. 1. Downstream of the regulating valves the air was diffused to a settling chamber which was fitted with screens for reducing turbulence. A smooth, spun-aluminum, convergent nozzle then served to accelerate the stream to the desired Mach number. The settling chamber and nozzle were part of a subsonic tunnel belonging to the Aeronautical Engineering Department and were borrowed for use in these tests.

A flush pressure tap was provided in the wall of the nozzle close to the discharge plane. Pressure at this tap was recorded for all runs so as to insure that the probe was not choking the flow. The combination probe was mounted rigidly and was placed approximately two inches downstream of the discharge plane. All pressure measurements were made visually by reading U-tube manometers. The following measurements were taken: total pressure in

the inlet pipe, total temperature in the inlet, wall pressure of the nozzle discharge, yaw on the probe, static pressure on the probe, and total pressure on the probe. For each run the flow rate was adjusted to a desired level and then the probe adjusted so as to give zero yaw. The remainder of the readings were then taken simultaneously by utilizing one person per manometer.

EXPERIMENTAL RESULTS

One free-jet test was run with the static wall pressure determined as a function of flow rate. On succeeding runs in which a probe was tested, this wall pressure was compared with that of the free-jet test. This served as a check as to whether the probe was unduly influencing the flow.

The results of the calibrations of the two probes are shown in Fig. 2. The symbols indicated in this figure are defined as follows:

- Ps - static pressure of the probe
- P_T - total pressure of the probe
- Ps - atmospheric pressure.

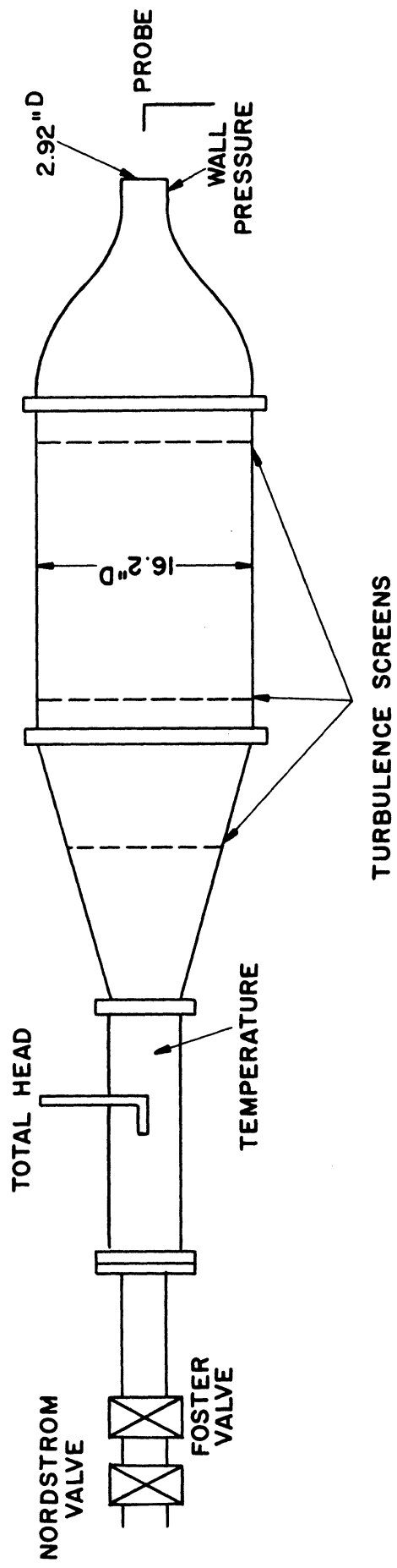


FIG. 1 SCHEMATIC OF CALIBRATION ARRANGEMENT

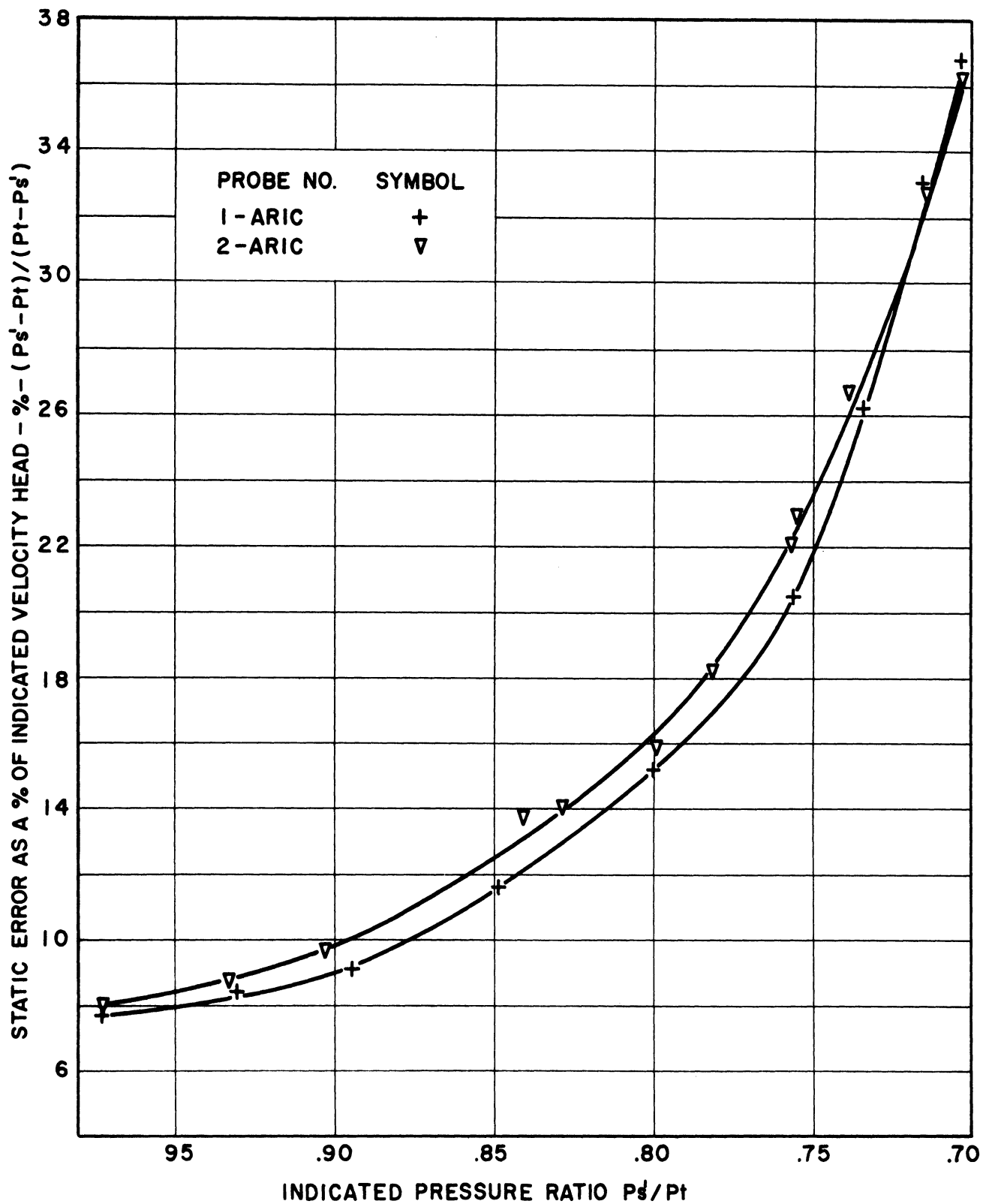


FIG. 2 CALIBRATION OF COMBINATION PROBES

