16-FOOT TRANSONIC TUNNEL LANGLEY INSPECTION

By

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LANGLEY AERONAUTICAL LABORATORY

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1. At former Langley inspections we exhibited the 16-foot tunnel as a typical large high-speed tunnel. The drive power then was 16,000 horsepower and top speed was 520 miles per hour. Since that time the tunnel has been altered and the drive power increased to 60,000 horsepower and its speed increased to low supersonic values. It is one of the transonic tunnels mentioned in the introductory talk at the base theater this morning.

<u>CHART 1</u>:

2. This upper chart shows a planview of the 16-foot transonic tunnel. You got off the bus here, entered the tunnel building, and are now seated at this location in one of the shops. These black arrows indicate the direction of air flow through the tunnel. Of the original tunnel most of the steel shell and the air-exchange tower remain. The drive end and test section are new. Adjacent to the wind tunnel are several buildings containing auxiliary equipment: the tunnel drive control building, the 6000-horsepower propeller dynamometer (which can be mounted either here for ground tests, or in the wind tunnel), and the electrical control equipment for the dynamometer.

3. At the drive end the two 30,000-horsepower motors are located on the outside of the tunnel and are directly connected to the fans by shafts about 60 feet long. There are no countervanes of any type in the drive-fan system, but the fans rotate in opposite directions so that no rotation remains in the air stream after it has passed through the fans. This feature provides smooth air flow at the test section and results in a high fan efficiency. The aerodynamic efficiency of the fans is 95 percent.

4. In increasing the tunnel power from 16,000 to 60,000 horsepower we expected some increase in tunnel noise and consequently made considerable effort to minimize noise in the repowered tunnel. The steel shell of the original tunnel has been reinforced and the drive end where most noise is generated has been made very massive. Also, rigid connections between the drive end and the remainder of the tunnel have been avoided to prevent vibration generated in the drive end from being transmitted to other parts of the tunnel. At the inlet and exhaust openings of the air-exchange tower acoustical baffles have been installed to reduce the noise which normally issues from these openings. These measures have proved to be highly effective in minimizing tunnel noise, so that the revised tunnel is more quiet than the original one.

5. The test-section design is such that models can be tested over the entire speed range including the transonic speed range simply by changing tunnel drive power. On the tour you will notice that certain features of the test section walls have been covered with plywood, because details of these features are considered as classified information. We regret that we cannot describe these features to you, but security regulations do not permit it.

6. On this second chart an airspeed calibration is presented to show the excellent uniformity of flow in the test section. The charts shows the variation of Mach number with axial distance through the test section. At all speeds air flow in the test section is uniform over a length of more than twenty feet indicated by the shaded portion on this chart and also on the upper chart. The velocity variation is about ± 1/2 percent as indicated by the scatter of the points; the diameter of the points represents about 1/2 percent on the Mach number scale. I would like to emphasize the fact that the tunnel airspeed can be varied smoothly through the sonic value with no discontinuity in the velocity distribution.

CHART 3:

7. In order to check the validity of the test data obtained in this new transonic tunnel, it was necessary to compare our results with data obtained in free air at transonic speeds. Such data can be obtained by dropping models from high altitudes. We therefore built the model displayed here, which is identical to one used in drop tests. This next chart shows a comparison of the pressure distribution obtained from flight research drop-test data and data obtained from tests of this model in the new 16-foot tunnel test section at Mach number one. The solid line shows the distribution obtained from the wind-tunnel tests, and the points are the data from the free-air drop tests. By pressure distribution we mean the variation of the static pressure

coefficient along the length of the model as measured at these orifices. The vertical scale has been expanded to emphasize differences in the data, and the generally good agreement of the two sets of data indicates the validity of the wind-tunnel results.

8. The 16-foot transonic tunnel is suitable for many types of investigation. A part of our work will deal with investigations of the aerodynamic characteristics of airplane models. You will see mounted in the test section of the tunnel a generalized airplane model with a swept wing for the study of wing-body interference.

CHARTS 4 and 5:

9. Also part of the tunnel time will be devoted to investigations of high-speed propellers such as the one displayed here. This next chart shows a photograph of the 6000-horsepower propeller dynamometer mounted on the outdoor test stand shown here on the upper chart. This ground-stand equipment is used for testing full-scale propellers under conditions which simulate ground and take-off operation. These same dynamometer units can be removed from the ground test stand and installed in the test section of the 16-foot transonic tunnel as indicated in this final chart. With this combined equipment high-speed and supersonic-type propellers can be tested at large scale over the entire speed range up to low supersonic speeds. Preparations are well under way for the investigation of the aerodynamic and vibration characteristics of a supersonic propeller.

10. On the tour through the tunnel which follows, we will enter the air-exchange tower and proceed upstream through this set of turning vanes to the fans at the drive end. From there we will go through another set of turning vanes to the test section here. We will leave the test section through a hatch in the floor and go through the control room. From the control room we go downstairs and outside where you will again board the bus.

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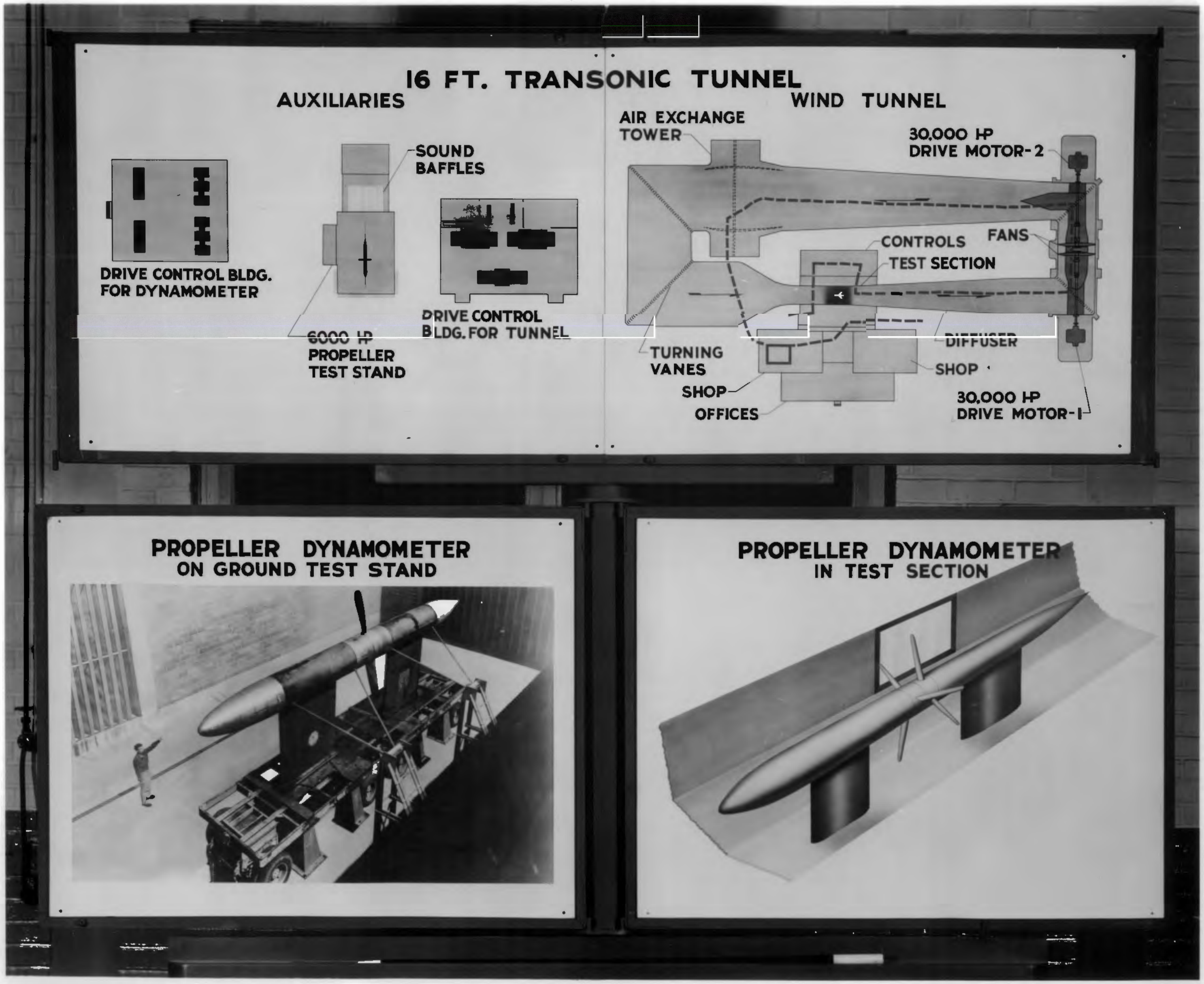

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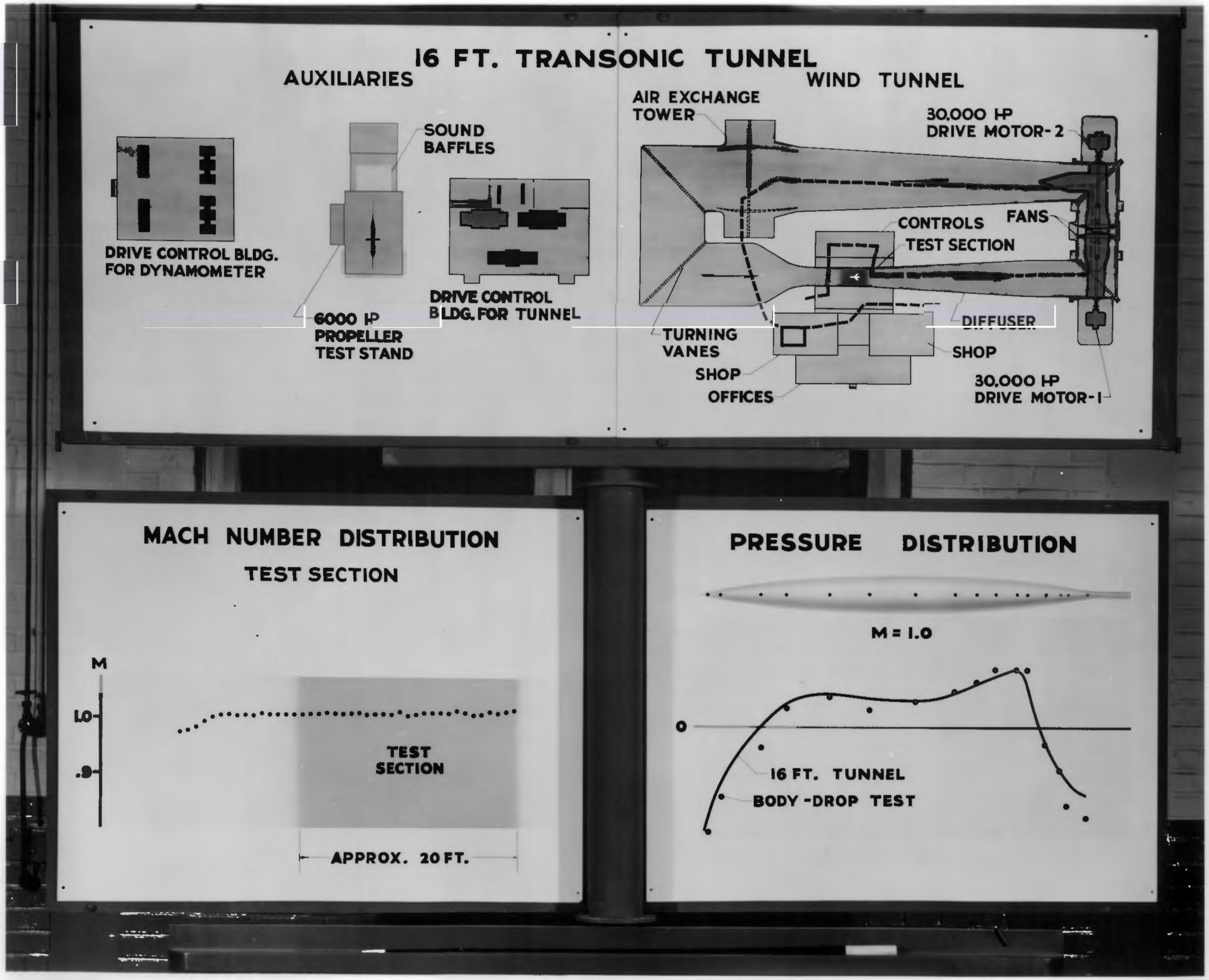
16 FT. TRANSONIC TUNNEL
AUXILIARIES
SOUND BAFFLES
DRIVE CONTROL BLDG. FOR DYNAMOMETER
6000 HP PROPELLER TEST STAND
DRIVE CONTROL BLDG. FOR TUNNEL
WIND TUNNEL
AIR EXCHANGE TOWER
30,000 HP DRIVE MOTOR-2
CONTROLS
FANS
TEST SECTION
DIFFUSER
TURNING VANES
SHOP
SHOP
OFFICES
30,000 HP DRIVE MOTOR-1
MACH NUMBER DISTRIBUTION
TEST SECTION
M
1.0
.9
TEST SECTION
APPROX. 20 FT.
PRESSURE DISTRIBUTION
M = 1.0
0
16 FT. TUNNEL
BODY-DROP TEST

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AUXILIARIES
DRIVE CONTROL BLDG. FOR DYNAMOMETER
DRIVE CONTROL BLDG. FOR TUNNEL
PROPELLER DYNAMOMETER
ON GROUND TEST STAND

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