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# MTB - 127

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## 1.0 INTRODUCTION

The purpose of this report is to outline the procedures used in calibrating and installing the wake survey rake, presently used by AVMRI for carrying out wake survey tests. The procedures for carrying out the experiments themselves are described in Reference 1.

## 2.0 DESCRIPTION OF APPARATUS

The equipment used for the wake survey tests is described in Reference 1. A chassis on which twenty pressure transducers are mounted is fitted inside the model. Each transducer is numbered with the default channel number used for data logging with the program WAKE run from the carriage computer, described in Reference 1.

The transducers are mounted on the chassis in sets of four, one set for each head of the wake survey rake, as shown in Figure 1.

Each transducer measures the pressure differential between the centre hole and the hole connected to the particular transducer. This pressure differential, together with calibration data on the pitot tubes, is used to compute the three dimensional flow components for each head of the rake.

In order to measure these differential pressures, the four transducers all have a common high pressure side, and the low pressure sides are each connected to the appropriate hole on the rake.

It is usual in wake survey experiments to record the highest pressures at the centre hole of the wake survey rake. The centre hole on each rake head is therefore the high pressure side of the transducer. This convention is used throughout this report.

Some features to assist in setting up the equipment are included in the design. Screws for bleeding air out of the lines are fitted on both sides of the transducer membranes. Also, valves are fitted to each group of transducers to enable a constant static head to be applied to all transducers in each group, to check each transducer during experiments. The valves are also used in calibrating the equipment.

## 3.0 CALIBRATION OF PRESSURE TRANSDUCERS

Before calibration is started, the equipment must be filled with water and all air bubbles removed. This process is difficult and tedious, but care taken here saves much more trouble later on! Figure 2 shows a schematic diagram for the calibration of the pressure tranducers. Be very careful not to apply differential pressure in excess of 50 cm of water during calibration as higher pressures may destroy the membranes in the transducers.

### 3.1 Filling Low Pressure Tubes

Theses tubes, 3.2 mm diameter, attached to the low pressure side of each transducer, are best filled with a glass funnel, fitted with a special

adaptor to join the small pipes to the funnel. The funnel is used to eliminate surface tension effects and to minimise the effects of movement of the membrane on the water level. The calibrated stands used to support the funnel should be close to the level of the transducer to minimise the risk of damage to the transducer.

## 3.2 Filling the High Pressure Tubes

The high pressure tubes, 3.2 mm in diameter, may be filled with a syringe. Care should be taken not to apply too much pressure, to minimise the risk of damage to the pressure membrane. Once filled, the free end should be temporarily secured above the level of the transducer.

## 3.3 Filling the Check Tubes

The check tubes, 9.5 mm in diameter, also attached to the high pressure side are best filled using a glass funnel, as 3.1.

Once the system is full of water, it should be bled to remove air from the whole system. Before doing this, all free surfaces should be raised to create a good pressure head above the transducer. Then the screws on either side of the membranes may be loosened. It is also important to bleed the system with both the high pressure tubes and the check tubes attached to the transducer. This is because air gets stuck in the valve. It may take several attempts to get all the air out of the system.

Once all the air is out of the system, the calibration may start. The high pressure tube is fixed at some convenient height above the transducer with the valve set to the check tube, the low pressure tube is set up such that it may be moved over the range of the calibration (cm of water). The zero point should have the two free surfaces approximately level, but this is not essential. The positive direction for calibration is to move the low pressure tube down. Each transducer is then calibrated with program CAL.

The pressure tranducers should be accurate to within +-2mm, so anything less than that as a maximum error is acceptable in a calibration. Should this figure be exceeded, repeat the calibration after bleeding the appropriate lines to that transducer.

It is intended to modify the program CAL to calibrate more than one channel, enabling each head to be calibrated (or all five heads) in one attempt.

## 4.0 INSTALLATION OF WAKE SURVEY GEAR IN MODEL

Once satisfactory calibrations have been obtained, the chassis may be installed in the model.

The chassis should be located as low as possible inside the model, preferably below the waterline. This allows the system to be bled effectively inside the model during testing.

Individual holes are located by syringing water through the metal tubes protruding through the stern tube of the model. These are then connected to the appropriate transducer with the aid of Reference 1. Before the transducer is connected, the plastic tube should be completely full of water to avoid air getting into the lines.

When all the tubes are connected, the system should then be bled again. To ensure a good flow through the tubes, a head of water must be put over each head of the rake. This may be done by a plastic tube attached to a measuring cylinder as shown in Figure 3. Once the system has been successfully bled, the tubes should be taped to the model with the free surface above the level of the transducers to keep the system air tight before the model is put in the tank, as in figure 4.

The ends of the check tubes should be fixed in the model so that the free surface is the same on each tube, and as high as sensibly possible inside the model without exceeding the limit of 50 cm above the waterline.

## 5.0 CHECKING SYSTEM BEFORE STARTING TEST

Once the model is installed under the carriage, some checks should be made prior to running program WAKE to start the actual test.

1. All channels should be rezeroed using program REZERO.

2. Run program WAKE and initialize the test.

3. The valves should be switched to the check tube position. All pressures on one head of the wake survey rake should read the same (Use CHECK command). If they do not, then check the transducers by bleeding them until all pressures are the same for each hole on one head (within the calibration tolerance).

4. The stepping indexer must be rezeroed before starting tests. The zero position is 360° and the indexer should be set to this before the rake is connected to the indexer. After testing, return the rake to the zero position to check the position of the rake.

5. Testing may now start. Checks using the check tubes may be carried out at any time during experiments.

6. Run program REZERO after the last experiment is finished to check total drift of each tranducer.

REFERENCES

1. Miles, M.D. Users Manual for DAS-11 Towing Tank Data Acquisition System (Revision 1-March, 1982) LTR-SH-270 AVMRI, NRC

Figure 1
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FIGURE 2
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# CALIBRATION OF PRESSURE TRANSDUCERS
(SINGLE HOLE ARRANGEMENT)

HIGH PRESSURE SIDE

LOW PRESSURE SIDE

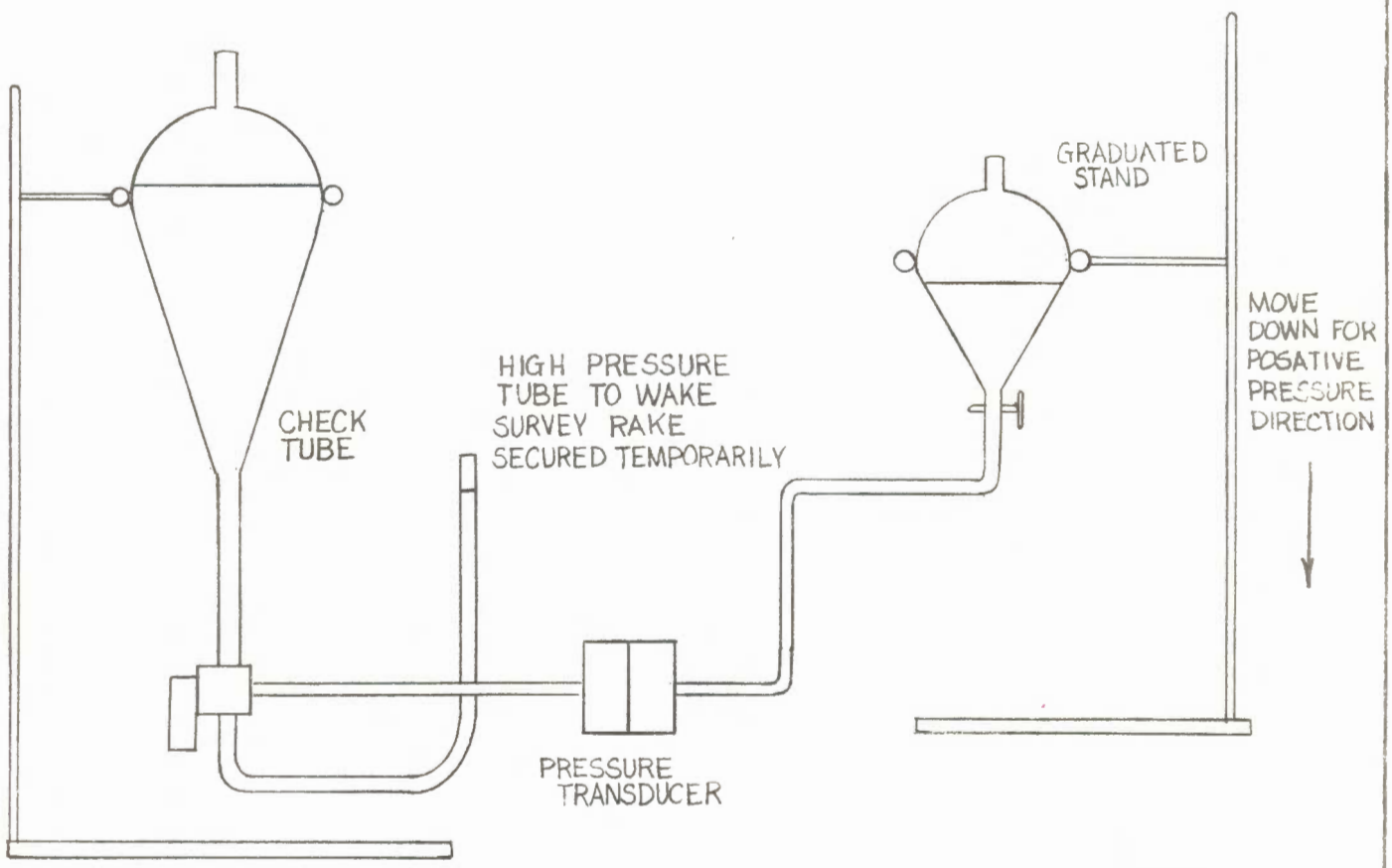

FIGURE 3
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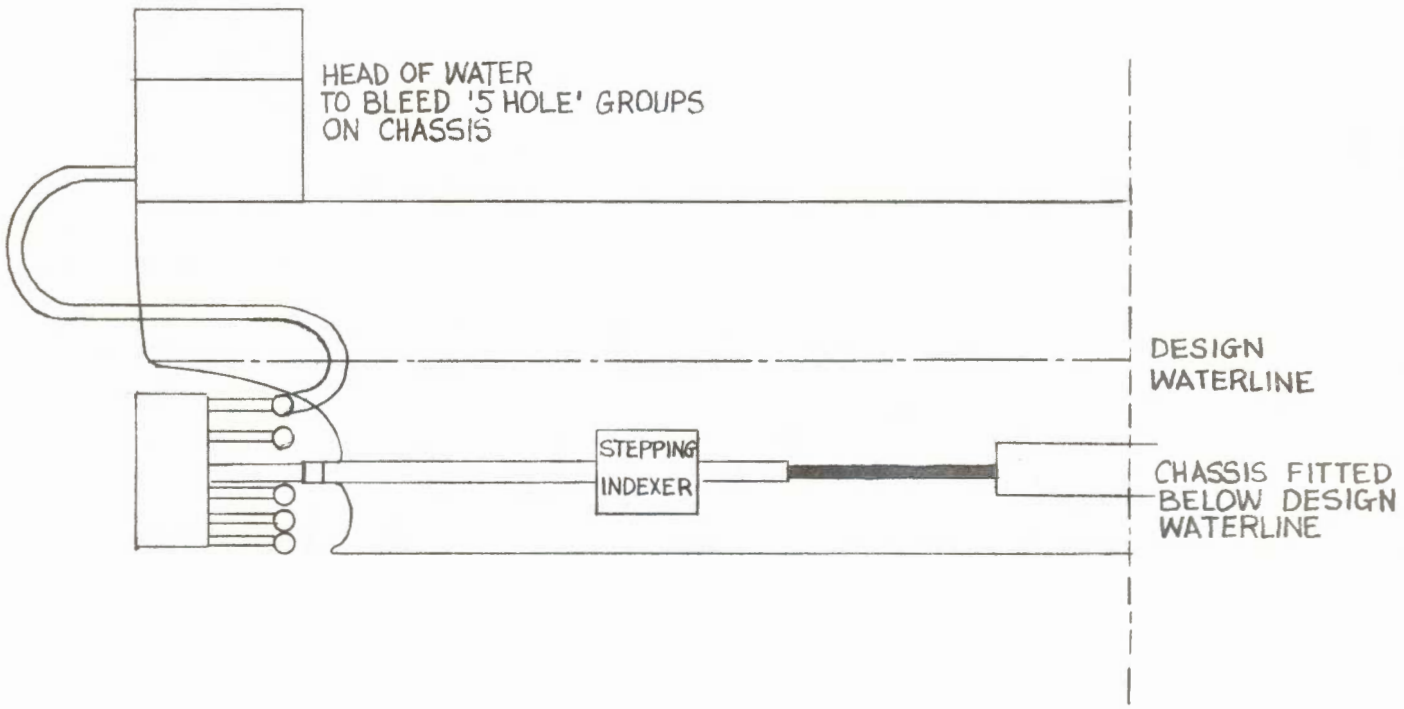


ARRANGEMENT FOR BLEEDING AIR
FROM TRANSDUCERS WHEN INSTALLED IN MODEL

FIGURE 4
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