Recent Developments in Hovercraft Performance Testing

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SYNOPSIS

Performance testing of hovercraft is necessary for a number of reasons and the spectrum of hovercraft to be tested extends from small hovercraft such as the Pindair Skima 2 to the large British Hovercraft Corporation (BHC) SR.N4.

Recent instrumentation developments include a craft trim indicator which utilises a sensitive accelerometer, water speed indication using Doppler and automatic data recording systems; examples of these developments are described. Hovercraft performance trials often require accurate measurement of environmental conditions, in particular wave measurement; the use of the Datawell Waverider is outlined.

The Decca Seafix Solent and Nab Chains operated by the Interservice Hovercraft Unit for the Department of Trade and Industry and hovercraft-borne equipment are described, together with the computer programmes developed in conjunction with BHC. Seafix and associated automatic data recording equipment result in benefits to performance testing in increased accuracy and convenience. Examples of such benefits in measuring acceleration, deceleration, speed, manoeuvres, controllability and accuracy of navigation are quoted.

Final remarks include brief descriptions of role evaluation and future developments.

Introduction

There are many factors that will influence the degree of performance testing to which a manufactured article is subjected: the complexity of the article, the job it will do eventually, whether the performance of similar articles has been tested previously, safety factors, the verification of performance to the customer, etc.

Transport vehicles are usually relatively complex, they may be used for many purposes, performance evaluation may be carried out on a prototype with the testing of production vehicles at some reduced level, and the structural safety factors may be small, as in aircraft. The amount of testing may be further influenced by customer requirements and the predictability of the performance. The hovercraft is no exception to these premises, except that structural safety margins are not so exacting as on aircraft. However like all passenger-carrying vehicles the safety of the hovercraft in all conditions likely to be encountered in service needs to be established.

Having measured the basic performance of the hovercraft, the ability to perform certain roles may follow. For example if a hovercraft is to be used as a commercial ferry a route-proving evaluation would follow verification of the manufacturer's specification and the hovercraft's ability to operate safely.

In this paper the author has drawn largely on his experience at the Interservice Hovercraft Unit (IHU) whilst evaluating large and small hovercraft for military or government purposes. Some of the instrumentation described has been in use at IHU for many years. However in order to give a complete picture some of the equipment recently developed for hovercraft testing by civilian firms has been outlined. Most of the tests and instrumentation described are adaptable to other marine vehicles, minor technique changes or differing instrument characteristics being all that is required. For example the instrumentation used by the National Physical Laboratory's Division of Maritime Science for their trials on MV Miranda and VIC 62 included Seafix equipment.

Types of hovercraft

Before looking in detail at the instrumentation, techniques and evaluations that may be used in the conduct of hovercraft performance testing, the types of hovercraft that may be tested will be briefly discussed.

The spectrum of hovercraft that have been tested by manufacturers, commercial or military agencies is as broad as the spectrum of hovercraft produced. The three types of hovercraft are well known: amphibious, non-amphibious and hybrid. However, though the differences between these types of hovercraft are significant they merely limit the testing of the last two types to overwater. It is other variations that cause more significant differences in test methods and the instrumentation employed. For example the size and payload of the hovercraft will determine the instrumentation that is necessary and indeed can be carried. If an overwater performance assessment of three craft out of the many available are considered the major differences should become more apparent.

A typical example of the small hovercraft is the 3m long two-seater Pindair Skima 2 which weighs 90kg and is shown in Fig 1. The basic simplicity of the craft, limited cockpit space and lack of electrical power supplies preclude the fitting of any other than very simple self-contained instruments such as a 'car-type' compass. The overwater performance assessment will be largely qualitative with possibly speed being obtained by timing the hovercraft passage between fixed markers.

In a medium sized hovercraft such as the British Hovercraft Corporation's 14.8m long SR.N6 which weighs 6 tonnes, the complexity of the craft is increased, there is adequate space, payload capacity and electrical power supplies for most instrumentation and data logging requirements. In any overwater performance assessment, the hovercraft speed may be measured by Doppler or position fixing aid, lift and propulsive powers will be measured or determined and craft motions and other parameters may be continuously recorded. During manoeuvres the hovercraft track may be monitored on radar or some other navigation aid such as Decca Main Chain. Thus the assessment is becoming more quantitative.

In large hovercraft such as the 39.7m long 609 seater (all-passenger version) BHC SR.N4 which weighs 185 tonnes and is shown in Fig 2, sophisticated recording methods are generally necessary. This is because the complexity of the craft has reached the stage where manual recording is both impractical and inappropriate. The overwater performance assessment therefore will be mainly quantitative.

Although the examples chosen are all amphibious hovercraft, the same philosophy would be true if the range of craft considered had been non-amphibious or hybrid. Some of the instrumentation and recording techniques will now be described.

Hovercraft-borne instrumentation

In all but the very simplest craft, instruments to enable the pilot to monitor engine performance and conditions, fuel state, system conditions, craft attitude and speed will be fitted. In some cases these alone will be sufficient for a performance assessment.

However additional instrumentation is usually required if increased accuracy or continuous monitoring is required. Indeed for some of the more sophisticated assessments the data are recorded in a computer-compatible form, with the data reduction executed using computing facilities.

The measurement of temperature, pressure, rotational speed, torque and accelerations all use familiar well-used techniques and instruments, and consequently will not be described in this paper. Only those instruments that are relatively recent innovations to hovercraft or use techniques of particular interest will be described.

Craft trim

The indication of hovercraft trim is usually only necessary in the medium or large hovercraft, pilot assessment being sufficient in small hovercraft. Two types are in current use, 'spirit levels' or vertical-seeking gyros, usually of the aircraft artificial horizon type. Both are basically unsatisfactory, the former because of inability to provide inputs to recorders and the latter because of high costs.

An attitude indicator based on the use of a sensitive accelerometer to measure the fractional component of gravitational force experienced at small angles about the horizontal plane has been produced to an IHU specification.

The accelerometer used is a Smith's Aviation ± 0.6*g* FSD giving ± 3 volts full scale for a nominal supply voltage of 6 volts dc. A dc amplifier having an FET input stage is used to supply adequate drive to a meter and external recorder. The meter is provided with selectable damping to obtain a steady indication when craft motion is present. Provision is made for input voltage stabilisation, temperature stabilisation, accelerometer protection in the event of component failure and accelerometer interchangeability without loss of accuracy. Further description is contained in ref 1.

The attitude indicator has been used in all IHU hovercraft, SR.N5, SR.N6, SR.N3 and BH.7 to give *mean* trim indication as a pilot's instrument and for trials purposes. Comments on accuracy, suitability and repeatability in sea states from calm to severe have been favourable.

The equipment is being currently loaned to other hovercraft users for their reactions.

Water Speed

There are two main types of instruments used to measure hovercraft waterspeed: impeller logs and Doppler logs.

Three typical examples of the former are the Brookes and Gatehouse Harrier log, the Chernikieff log and the Walker log.

In the Harrier log the water flow induces rotation of an impeller, and a magnet contained in the impeller induces current pulses in a coil mounted close to the impeller. These pulses are amplified and fed to a frequency-measuring circuit which converts the rate of arrival of pulses to a proportionate dc to operate speed indicators. Models are available in speed ranges from 0.5–10 knots to 3–60 knots. Accuracy is ± 5% and speed changes of 0.1 knot can be detected.

The operation of the Walker log is purely mechanical, rotation of a towed impeller driving a system of gears and a counter. Thus this log only gives distance gone.

Both the Harrier and Walker logs have been used on amphibious hovercraft, but generally for low-speed operation. For instance a Harrier log was mounted in a streamlined sword and supported at the bow of an SR.N6 MK2 during a towing trial to determine the hovercraft's drag/speed relationship. However logs are more easily employed on hybrid or sidewall craft.

In a Doppler, reliance is not placed on physical contact with the water. An aerial system, mounted on the hovercraft, transmits a high-frequency signal which is reflected off the water surface, the beat frequency between transmitted and received signals giving a measure of hovercraft speed.

The Doppler that was used on some of the earlier BHC craft, and is currently in use at IHU and 200 Hovercraft Trials Squadron RCT, was a development of a police radar by Marconi. Production was, however, limited and alternatives are now being investigated. There are two possible replacements: the Frowd Doppler, which is currently available or the MEL (lately EKCO) which is under development.

Frowd Doppler type 8–35C This Doppler has been fitted to the more recent BHC hovercraft.

The aerial is a 5° beam width 35 mm diameter hard anodised aluminium parabola, in the centre of which is mounted a waveguide feed to the Gunn source. The aerial system is protected by a laminated glassfibre radome and for convenience is designed to fit into the original Marconi Doppler housing. The processing unit and indicator complete the equipment. Further details are given below and in ref 3.

Operating frequency	10.687 GHz
Frequency tolerance	± 12 MHz
Transmitting power	10mW
Power consumption	6W maximum at 28 volts dc
Output	0 to 1ma equivalent to 0–100 knots
Bench accuracy	± 2%

MEL Doppler The MEL Doppler is currently under evaluation at IHU and has been fitted to SR.N3, SR.N5, SR.N6, VT1, HM-2, AV2 and SH-2 hovercraft.

The aerial is a dielectric rod protected by a cylindrical fibreglass radome filled with foam. The aerial beam width is 20° and a tracker unit and indicator complete the equipment. For trials purposes an integrator is incorporated to provide distance-gone pulses to operate a digital counter or other recording systems.

Operating frequency	10.867 GHz
Gunn diode power output	10mW
Power supply	24 volts dc
Output	0 to 10 volts equivalent to 0 to 100 knots.
Bench accuracy	± 2%

Decca Doppler 71 The two Dopplers previously described can be used in all sizes of craft but to date the Decca Doppler 71 has only been used on IHU's SR.N3 and BH.7 hovercraft.

The Doppler 71 is a three-beam helicopter Doppler, with the aerial system and electronics contained in the same 400mm x 400mm x 12.7mm waterproof box weighing 16kg. In the BH.7 this box is mounted either on a boom at the bow of the craft or in a hole in the plenum chamber. Ground speed may be displayed digitally or by pointer and a second pointer registers drift angle, on a combined meter. Further details are given below and in ref 4.

Transmitting power	100mW
Transmitter frequencies	13.325 GHz and 13.314 GHz
Power supply	115V, 400 Hz, 1ϕ
Speed	Range – 0 to 100 knots
	Accuracy better than ± 1½% over range 0–80 knots
Drift angle	Range ± 30°
	Accuracy ± 0.5°

Position fixing

Hovercraft speed could of course be determined by fixing the hovercraft position at known time intervals. Methods available include: reference to fixed points on land; hovercraft borne radar ranges and bearings of buoys; optical tracking using kinetheodolites; radio position fixing aids; shore-based radar; inertial platforms; and dead reckoning.

A survey conducted by IHU in mid 1968 to meet a requirement for BH.7 performance testing suggested that the Decca Seafix system would be the most suitable to meet the requirement. The price of the Seafix system was lower than most other equipments. Additional projected advantages included flexibility, low maintenance and the ability to be used by a number of hovercraft or ships at the same time without mutual interference.

Decca Seafix – chain operation Having selected the test area in which water depth, distance from land and environmental conditions meet requirements, positions for the shore stations must be found.

The IHU requirement was fulfilled by commissioning two Seafix chains – one covering the Solent and area north of the Nab Tower and the second covering an area which was 10 miles from land, south of Nab Tower. The geographical layout of the Seafix chains is shown in Fig 3.

Like Decca Main Chain, Seafix is a hyperbolic type system. However Decca is a continuous wave system with a different frequency for each station and Seafix uses time sharing of a common frequency. This lack of lane identification means that if the signal from a station is lost due to interference or transmitter breakdown, the whole lane count is lost but the Seafix receiver re-establishes the fractional lane value. This phenomena is known as 'lane slip' and results in corrections having to be made to the Seafix indications or re-alignment of the Seafix indicators at some reference position. Also Seafix offers a greater degree of resolution.

Each Seafix Chain consists of a master and two slave stations. The master station is at Bembridge with slaves at Selsey and Calshot for the Solent Chain and Selsey and Luccombe for the Nab Chain.

The station transmitters emit continuous wave signals in sequence at 1.935 MHz. The master station transmits a trigger signal for 20 milliseconds at a frequency 60 Hz below the chain frequency. There is a break for 10 milliseconds, then the master (Bembridge), Luccombe, Calshot and Selsey slaves each transmit at the chain

4. The step distance travelled in a straight line between successive points is also computed. This is presented primarily for assessing stopping distances, but can also be used to supplement the speed data.
5. When compass bearing has been recorded, the yaw angle is also computed as the difference between the track bearing and the compass bearing.

If required the corrected Seafix data can be plotted by means of an automatic plotter. Decca Main Chain data can be computed, a rectilinear conversion being executed. The vessel's position may then be expressed with respect to a reference point or in terms of latitude and longitude. The Decca lanes are approximately eight times as wide as Seafix lanes, so the computed data will not be so accurate.

Recording methods

Recording techniques used during hovercraft performance trials include manual logging of meter indications, use of autographic recorders — ink, photographic or UV, and more recently data loggers and FM tape recorders. All these techniques have a place in current trials either separately or in combinations. For example manual logging of instruments enables quick on-the-spot assessments or limited data recovery in the event of recorder failure. However with the increasing cost of hovercraft operation it is becoming more important to make full use of a sortie, which entails the use of automatic data recording and analysis.

The BHC twin-propeller SR.N6 Mk6 clearly demonstrates this evolution, use being made of a Sangamo-Weston FM tape recorder, and a Dynamco data logger driving a Facit Punch, the latter items being shown in Figs 5 and 6. The FM tape recorder was purchased for IHU by the Department of Trade and Industry and was used for an SR.N6 motion trial before the more recent loan to BHC for the SR.N6 Mk6 trials.

Dynamco data logger. The Dynamco data logger is a sixty channel logger 482 mm x 590 mm x 187 mm in size and weighing 25 kg. Input levels may vary from 0—40 mV to 0—40 V in discrete blocks of ten channels, all inputs being fully floating. The maximum sampling rate is six channels/second when operating with a Facit Punch. The digital voltmeter which forms the basis of the logger also provides an indication for calibration purposes. A print-out of selected single channels can be achieved at a lower sampling rate on an internal printer. Alarms can be triggered by any channel exceeding pre-set limits.

Use of the Dynamco data logger, which executes an analogue-to-digital conversion, has meant a change in certain transducers: for instance, bridge networks for pressure measurement and platinum bulb thermometers with amplifiers for temperature. In the Mk6 the logger is triggered by the Seafix print log allowing correlation of all hovercraft events. Engine and system performance and conditions are recorded by the data logger.

The data logger has only recently been installed in the SR.N6 Mk6 and computer analysis of the results is in the embryonic stage; however it would be possible to carry out sophisticated computations such as spectral analysis of the results.

Sangamo-Weston FM tape recorder. This recorder is 640 mm x 485 mm x 305 mm in size and weighs 41 kg. There are fourteen channels but in the Mk6 one channel is used for tape survey. Fifty-six transducer outputs are brought to a patch panel, thirteen being selected for recording at any one time. Recording is at 4¾ cm/sec giving a bandwidth of 200 Hz. Input levels are normally at 1 V RMS, but for convenience ± 1 V is used. Two edge tracks are available for speech or tape identification. Further details may be found in ref 5. System operation can be monitored on an oscilloscope or UV recorder, a test signal being used to check channel functioning.

Inputs from structural vibration monitoring strain gauges and accelerometers are tied to a common earth, so the strain gauges are fed in discrete bunches to limit losses in the event of component failure. Although this recorder had been satisfactorily employed on SR.N5 and VT1 hovercraft an initial problem was encountered on the SR.N6 Mk6 due to shock loads causing transient signals to the recording head. Mounting the recorder on 1¼ cm thick foam rubber gave sufficient mechanical isolation.

Computer analysis yields such values as maxima, percentage occurrences, or spectral analysis as required.

Instrumentation for measuring environmental conditions

For some trials it will be necessary to monitor environmental conditions. Air temperature, humidity, tide flow, wind and sea state may be recorded.

Temperature, humidity and sometimes wind will be obtained from fixed stations on shore or from such places as the Nab Tower or light vessels. Tidal information may be obtained from tide tables and Admiralty charts or by monitoring drift in the boating mode, by Seafix. In some special trials it may be necessary to measure tide-flow with a fixed log. Wind information is usually obtained from a windvane and anemometer fitted to the hovercraft.

Sea state information

There is some evidence to indicate that reasonably accurate visual estimates of waveheights may be made; the same is not, however, true of wavelengths. In trials such as contractural clearance trials visual estimates may be insufficiently accurate, or spectral information may be required.

Thus it is often necessary to measure the sea state and record the information in a computer-compatible form. Ref 6 describes some of the devices that were previously used, but recent years have seen increasing use of the Datawell Waverider buoy shown in Fig 7.

The Waverider contains an accelerometer mounted on a pendulous system, so that it measures predominantly the vertical component of acceleration as the buoy responds to the waves. Two electronic integrators in cascade transform the accelerometer output into a voltage which represents the vertical displacement of the buoy. This voltage controls the frequency of an audio oscillator which switches the 200mW crystal-controlled transmitter on and off. Transmission is via a 2.1m whip aerial and the buoy is fitted with a flashing light for identification purposes at night.

The accelerometer, batteries, transmitter and electronics are housed in a 700 mm diameter stainless steel sphere, total weight being 90 kg. The buoy can either be used free-floating, with a 10 kg weight underneath to maintain the required pitch/roll stiffness, or moored. To enable the moored buoy to follow the circular motion of the waves the mooring contains a rubbercord. Further details of the Waverider are given in ref 7.

The Reflok-write unit (combined receiver and chart recorder) consists of an HF crystal-controlled receiver, a demodulator and a chart recorder. The demodulator compares the receiver output with a signal from a voltage-controlled oscillator such that the two inputs are maintained in phase by a feedback system. As the buoy produces a varying frequency output proportional to wave height the control voltage to the oscillator is also proportional to wave height. This voltage is fed to the chart recorder and is also available for external use. If the demodulator becomes unlocked the chart recorder pen drive is switched off.

In order to obtain a spectral analysis from the chart record a tedious time-consuming hand measurement would be required. To bypass this, Datawell provide a Preflock Punch system which uses a teletype punch. However because of possible cost saving the system chosen for use at IHU consisted of a Solartron data transfer unit and digital voltmeter. In this system a record of the Reflok-write voltage output sampled at ½ second intervals is punched on paper tape by a Facit Punch. This tape is then computer analysed to give an energy spectrum, significant waveheight and average apparent period. A recent extension to the results obtained from the computer analysis is the automatic plotting of the energy spectrum. Further details of IHU's experience with the Waverider may be found in refs 8 and 9.

Development of a hovercraft

As the result of a specification or requirement a hovercraft will be designed, recourse being made to calculations and experience. Further development will proceed along three main parallel paths: system (electrical, hydraulic, instrument, etc) design and testing, propulsion and lift systems design and testing, and model testing.

The types of models used are well known:

1. Aerodynamic models for wind tunnel flow tests.
2. Towing tank models for investigation of drag/speed relationships to assist in performance estimates.
3. Free flight models for control, performance and handling assessments.
4. Models for skirt and lift fan development.

A recent development by BHC is the investigation of plough-in characteristics over ship's wakes. The model is mounted under a free-to surge carriage and at the required test speed, propeller thrust is adjusted so as to balance the drag forces. Hovercraft accelerations, trim, etc, are then continuously recorded during passage over three main waves generated in the towing tank. This technique enables developments such as anti-plough bags to be tested more easily than with the free flight models previously used.

Having finalised the design and incorporated any changes that the model tests may have shown to be desirable the prototype craft will be manufactured. System tests and engine runs will be followed by static overland performance tests.

Static overland performance tests

The first overland tests conducted will be to check the hovercraft skirt. Rise-heights, cushion and skirt pressures will be measured, and stiffness checks at various hovercraft conditions executed. These tests and visual inspections may indicate that skirt modifications are necessary before proceeding.

Static thrust and control forces may be measured and propeller strain gauge measurements may be conducted at this stage. During this static overland work the pilot will be gaining initial handling experience before proceeding to the overwater performance-testing phase.

Overwater performance testing

Well in advance of the time that the overwater performance testing is scheduled to start, the instrumentation and trials schedules will be promulgated. An instrumentation package will be designed and installed in the hovercraft. Recent installations have been designed to ease the tasks of the trials personnel. The major factor involved is the positioning of the instrumentation package. In the past, the most convenient position was chosen, but more recently attempts have been made to reduce the chance of motion sickness, usually resulting in a position close to the hovercraft's centre of gravity. A double benefit can result because not only are the trials observers able to retain concentration even in rough seas, but the shock loads on instrumentation may be reduced. The advent of automatic data recording systems has meant that the trials team is able to devote more thought to the conduct of the sortie and is not engaged on time-consuming manual logging. Instrument panels, recorders, etc, will be laid out so that controls easily come to hand, without the need for the operator to leave his seat. The installation in the SR.N6 Mk6 shown in Figs 5 and 6 is an excellent example of these developments.

The first overwater sortie will be primarily to check out the hovercraft, to give the pilot handling experience and to 'shakedown' trials instrumentation. However even during this initial sortie, which will be conducted at low engine powers, performance data will be collected.

During overwater performance trials, which may last for several months, tests will be conducted in environmental conditions ranging from calm to craft-limiting conditions. Tests will include accelerations, decelerations, maximum speed runs, performance in waves, turns and performance in shallow water and in the boating mode. Particularly important facets of the overwater performance trials will be investigation of system failure cases and safety during wallowing and drifting. Comparison with techniques previously used highlights advantages that result from using a position fixing aid such as Seafix, the main advantage being reliable track data, compatible with automatic data recording and processing, resulting in greater accuracy and the ability to use sortie time more effectively.

Acceleration, deceleration and speed. Hovercraft acceleration was usually measured by noting the time taken for air or water speed to increase by given amounts, and deceleration by reference to a buoy or line of buoys. Speed indication is often provided by a Doppler whose indication can be reasonably interpreted in calm conditions, but hovercraft motion in a seaway makes interpretation of meter indications difficult and incorrect.

By using Seafix and associated automatic data recording of time and hovercraft position, acceleration, deceleration and speed may be accurately computed for even the roughest sortie conditions. Sortie time may be more efficiently used in that an acceleration may be followed by a speed run and deceleration, there being no need to position the craft adjacent to reference objects for each phase. Calibration of speed indicators can be executed without using measured distances.

The speeds computed from Seafix data are of course ground speeds, tidal flow obtained from tables and Admiralty charts being used to obtain water speeds. At hovercraft speeds above 20 knots tidal prediction errors are generally negligible, but problems can arise at lower speeds, particularly where the speed of the hovercraft is comparable to the tide rates and where tidal data is only available for specific geographic points. In order to obtain increased accuracy it may be necessary to position a tidemeter in the trials area.

For small hovercraft, however, the lack of room precludes the installation of Seafix equipment and reference to buoys or measured distances is still necessary.

Manoeuvres. The ability to monitor hovercraft position and hence track by Seafix has meant that the hovercraft's manoeuvring capabilities can be assessed easily and accurately. The methods previously employed included visual estimation and recording of radar range and bearing of a fixed object at known time intervals. Use of Seafix enables not only complete manoeuvres to be monitored, but also the response to step inputs of controls can be more readily assessed.

Controllability. A recent technique evolved to test the controllability of hovercraft and to assess the relative merits of different control systems, involves the pilot in 'following' a Seafix lane. The outputs of potentiometers contained in the Seafix pattern displayed are scaled and used to drive a meter in front of the pilot. The meter is adjusted to indicate zero when the hovercraft is 'on track'.

The Seafix data is processed using the BHC 1456 computer programme. The results obtained include mean and maximum errors, RMS, standard deviation and error percentage occurrence information.

Accuracy of navigation. A similar test is also employed to check the effectiveness of navigation equipments or techniques, such as the Sealane equipment in the BH7 or radar parallel indexing. When using Sealane the pilot follows a command steering indicator, error data similar to that for Seafix lane following being obtained.

In radar parallel indexing the hovercraft navigator commands the pilot so that the hovercraft proceeds along an imaginery line running parallel to buoys, points of land or other targets. The 1456 computer programme is extended to calculate errors about the achieved and intended track.

External noise measurement. External noise measurements have become increasingly important for the following reasons: the need to monitor present hovercraft noise levels to assist in setting the standards for any future controls. With the increasing demand for noise abatement the sources of noise (propeller, fan, etc) need defining and modifications designed to reduce noise need testing.

Noise measurement tests overland at realistic hovercraft operating speed are difficult to conduct. Consequently more accurate results and a truer assessment may be obtained if the tests are conducted overwater. A line of marker floats is attached to a buoy and the noise-measuring instruments and personnel positioned in a boat at the end of the float line. The hovercraft is then driven over a marker float at the required distance from the microphone. Runs are executed in both directions and over a range of distances from the microphone.

Role evaluation

All the techniques and equipments so far described relate to testing the performance of the hovercraft as a vehicle. The assessment will confirm to the manufacturer and customer how the hovercraft compares with the original specification or if modifications have had the desired results or have affected performance or safety in an unexpected manner. However some further evaluation will be required before the hovercraft can be used to perform certain tasks.

Apart from specialised applications, such as Hoverwork's modified geological survey hovercraft, ferries are the main commercial use of hovercraft. A route-proving exercise will probably follow a performance assessment conducted independently or in conjunction with the manufacturer.

The hovercraft roles in the military field are much more exacting, role evaluation sometimes extending over a much longer period than the preceding performance evaluation. Role evaluations may be conducted as a trial or in conjunction with other national or international forces on exercises. Some of these roles may require the development of specialised equipment or instrumentation.

Army evaluations have included using hovercraft in the following roles:

- Tactical and logistic transportation of vehicles and troops
- Amphibious landings — the ability to land troops dryshod from hovercraft being particularly important
- Independent raids and patrols
- Reconnaissance
- Surveillance
- Command and control

Role evaluations for the Royal Navy have included the following:

- Logistic support of conventional ships
- Patrol craft
- Fishery protection
- Anti-submarine warfare
- Mine counter measures
- Search and rescue, including the recovery of disabled craft as shown in Fig 8.

A recent role, in which the BH.7 was employed, involved assisting the Coast Guards in the Dover Straits to identify shipping not observing the IMCO recommendations on routing. In this role the abilities of the hovercraft to proceed at speeds significantly faster than ships, to cross shallow water and sandbars and quick reaction time were being exploited. Also the all-weather capability of operating in low visibility gives the hovercraft an advantage over alternatives such as helicopters.

Future developments

Future developments in performance testing will depend on what use is made of existing and projected hovercraft. There are unlikely to be significant changes in performance tests that are conducted, use of present techniques merely being consolidated.

On the instrumentation side the trend will be towards using existing automatic data recording equipment and in extending the analysis of results. The next major development is likely to be the use of an onboard digital computer. Thus the future will see a further progression from the manual logging of indications to completely automatic data recording and analysis, with a consequent shift of effort from data analysis by hand to equipment installation and calibration.

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Disclaimer

The opinions contained in this paper are those of the author and are not intended to reflect those of his employing department, or any Government agency.

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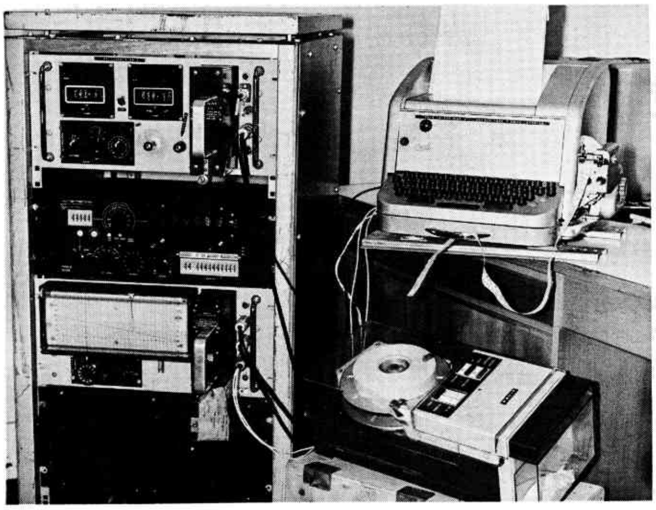


Fig. 4 Seafix hovercraft equipment

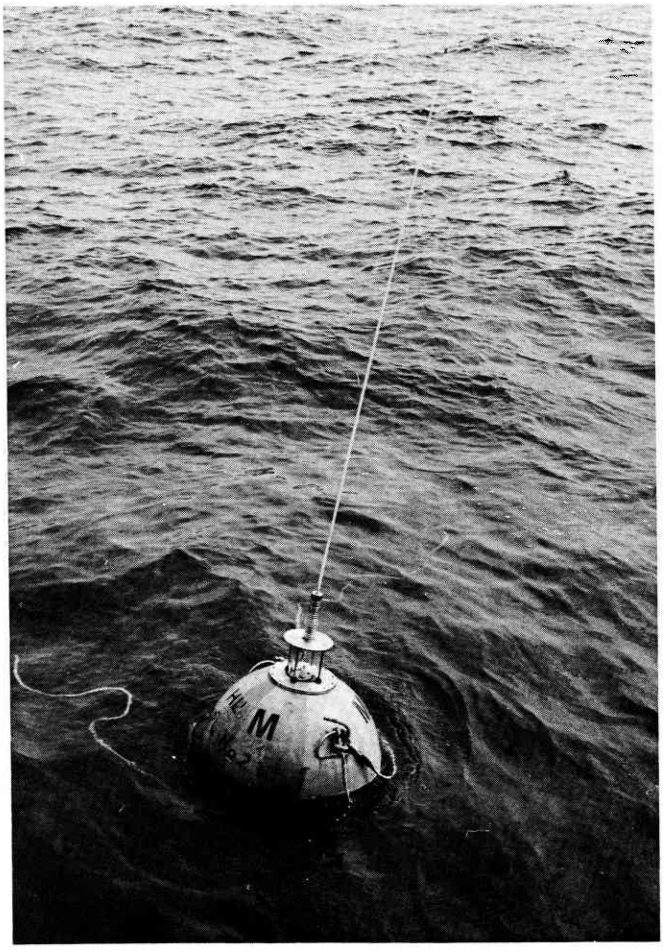
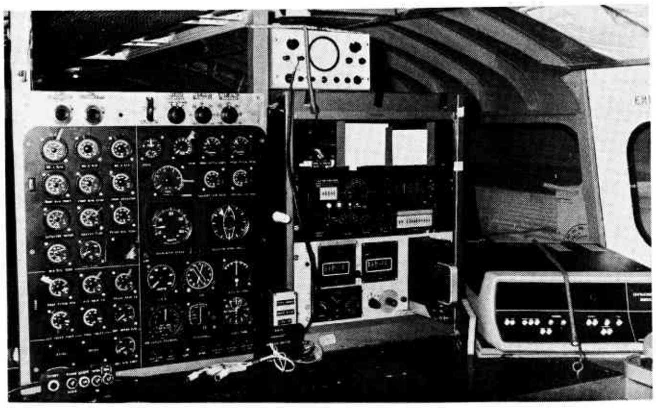


Fig. 7 Waverider



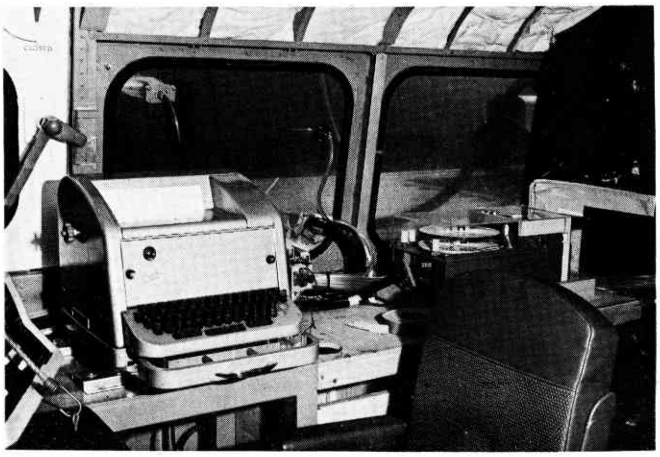


Fig. 5 & 6 SR.N6 Mk6 instrumentation layout

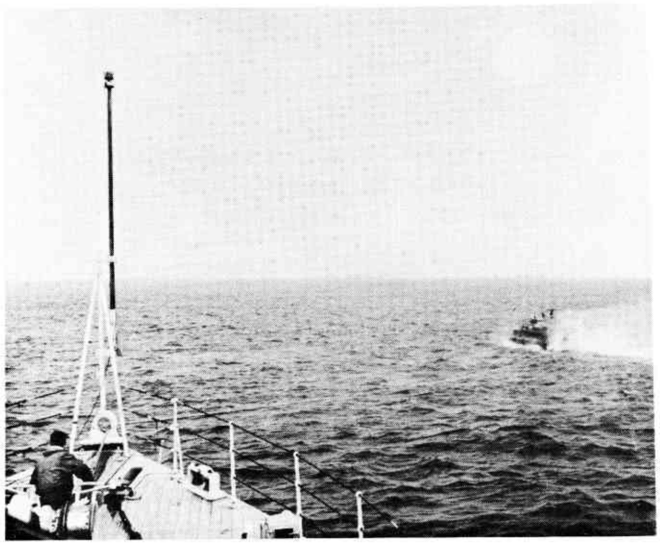


Fig. 8 SR.N6 Mk2 towing a disabled craft

Fig. 1 Pindair Skima 2

Fig. 2 British Hovercraft Corporation SR.N4

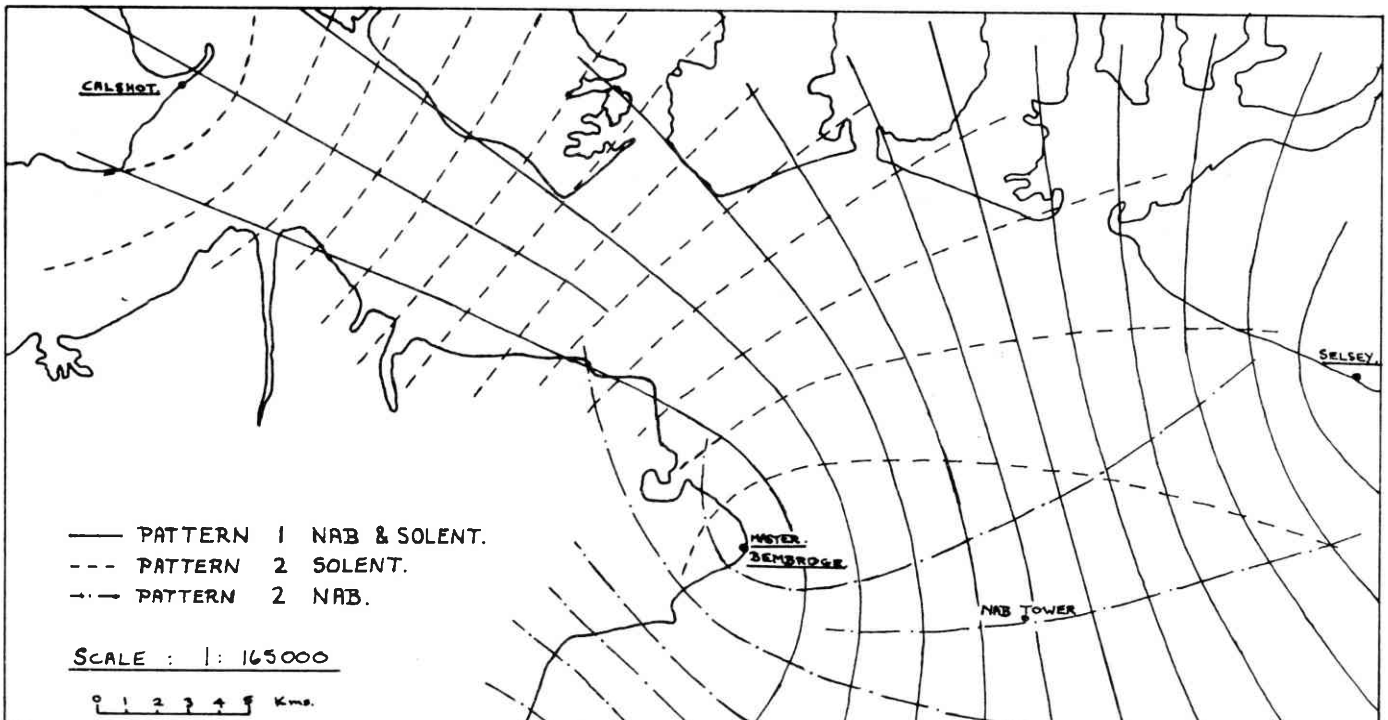


Fig. 3 Geographical layout of Interservice Hovercraft Unit Seafix chains