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# SERVICES

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TRACEABLE INSTRUMENTS & SYSTEM CALIBRATION COMPONENTS EVALUATION EQUIPMENT TYPE APPROVAL METROLOGY DC TO BEYOND 18 GHZ EQUIPMENT DEMOS & APPLICATION SEMINARS

NEARLY 2 MILLION TECHNICAL DATA SHEETS INSTRUMENT MARKET &

APPLICATION ADVICE

COMPONENTS CONSULTING

EQUIPMENT LOANS. ACCESSORY AND LIASON SERVICES

INSTRUMENT

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CRC

# UMENT SERVICES BROCHURE

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# 1 OCTOBER, 1976

#### INSTRUMENT SERVICES C. R. C.

#### TERMS OF REFERENCE

Instrument Services is a group of five sections providing consulting, logistic and direct technical support to D.O.C., and to a lesser extent other departments and industrial contractors, in the field of scientific equipment, components and devices. An official policy on the range of services to be provided has never been made and there is no class of equipment which can be unequivocally excluded from the work load. For example, Instrument Services certainly has no responsibility for the up-keep of CRC computers, but regularly handles analog to digital converters and other instruments which are small computers with specific input/output conditioning. Accordingly, the provision of support is predicated on a mixture of competence, expediency, and efficiency. Instrument Services specializes in high calibre non-repetitive work, and avoids entering into areas for which competent agencies exist, and in fact, contracts out routine work when possible.

A natural outcome of this policy, is that the various sections within Instruments Services will have different ranges of activity, but it is hoped that the use of this manual will provide our clientele with an understanding of the quality and varieties of services provided.

J. E. K. hockwood

G. E. K. Lockwood. D/RS.

NOTE: This brochure was prepared under the direction of Mr. G.E.K. Lockwood, but effective November 1, 1976, Instruments Services became the responsibility of Administrative and Technical Services.

J. C. Bouchard,

Chief, Administrative & Technical Services

## FOREWORD

This document, which is intended to be both an information brochure and a guide to the effective use of Instrument Services, has been produced in order to promote awareness of the range of services available.

Because of a positive response to the complex and changing demands of the research scientists and engineers who generate the bulk of the work load, Instrument Services have developed an unusual capability which the adjective "Instruments" fails to encompass.

However, since even this document does not specify all present and latent capabilities, we can only encourage our clients to use it as a guide in assessing the relevance of our facilities to project requirements.

A comprehensive index is provided for the reader who prefers to proceed directly to specific points of interest.

D. W. Burns,

Supervisor, Instrument Services.

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## ORGANIZATION OF SERVICES

This section outlines the most appropriate approach to use when · investigating the availability of service.

For the newer customer, the point of contact will depend upon the accuracy with which he can specify his requirement.

Figure 1 is a functional chart which identifies the general service areas and responsible staff members.



The five functions reporting to the Manager can be roughly divided into two groups, according to the general class of support. One box in each group is identified by a heavier line thickness. The purpose of this is to allow a logical choice of contact. The three possible situations are:-

- (a) The customer can identify the particular section which can help him.
- (b) The customer can resolve his requirements as involving either direct technical or consulting support.
- (c) The customer is unsure of the relevance of our operation to his needs, or has some enquiry involving policy.
- The contact point is the appropriate section head.
- The contact point is one of the identified boxes.

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• The contact point is the Manager.

Please note that the physical issue and receipt of equipment is always carried out at the Instrument Stock Counter.

# CONSULTING AND LOGISTIC SUPPORT SECTIONS

## DESCRIPTION OF SERVICES AVAILABLE

## COMPONENT INFORMATION

M. PSUTKA, LOC. 334, BLDG 2, ROOM 45

Mr. Psutka specializes in the Components field and spends a great deal of his time in Market Research, Device Evaluation, attending demonstrations and related activities.

This background work maintains the expertise on which he draws, in supplying the consulting services discussed below.

The services immediately apparent to the user cover all passive and active devices (including "modular" equipments and small antennae) and related hardware and include:

Advice on: S

Selection - Application - Availability -Price. (This includes Standard Stock Items held by CRC Stores.)

Provision of:

Sample Devices - Technical Literature Liaison with Technical Representatives & Suppliers and convening demonstrations.

Mr. Psutka also serves as Technical Consultant on the CRC Standard Parts Catalog & Quality Control of incoming additions to CRC Standard Parts. However, Mr. Psutka has no responsibility for the procurement process, and scientists are asked to direct queries on stocking problems to the CRC Supply Officer.

# CONSULTING AND LOGISTIC SUPPORT SECTIONS

# DESCRIPTION OF SERVICES AVAILABLE

# INSTRUMENT INFORMATION

S. MILLS, LOC. 334, BLDG 2, ROOM 45

This Section provides a service complementary to that of the Components Section, in the area of complete instruments. There is a small overlap between the sections.

This section is responsible for a variety of information and liaison duties related to the equipment field.

There is no particular restriction to the range of enquiries accepted, and Mr. Mills responds to enquiries ranging from perspiration detectors through optical encoders to facimile links.

In addition to normal Market Research, Mr. Mills maintains close contact with the various projects at CRC, and is a catalyst in bringing together engineering and scientific staff with mutual or complementary interests.

We encourage anybody involved with equinment and small systems to make use of this section, as we have in the past successfully arranged transfers or loans which saved individual projects sums ranging up to \$20,000.

This section offers the following services:

- Advice on equipment selection and application,
  - (a) during the purchasing process, or,
  - (b) on a more casual basis in the optimum selection from Inventory 4 Instrument Pool.
- Liaison in inter-section, or inter-departmental loans.

Liaison in co-operative purchases:

- This is a developing area of activity. Money shortages, coupled with increased prices have brought about situations in which necessary equipment costs exceed the resources of individual projects. Within our own constraints, Instrument Services is interested in assisting in such cases.
- Arranges equipment displays, small seminars and directs representatives to appropriate scientists.
- Provides formal comparisons of commercial equipment specifications. This is a valuable tool in analyzing the sometimes carefully worded performance claims which exist in the industry.
- Performs qualitative evaluations of equipments. This is not as exhaustive as the type approval testing discussed later, but is a productive method of comparison at low cost.

• Correlates and provides commercial technical data.

- Provides Audio-Visual support to seminars held at CRC, and to a limited extent at off-site locations.
- Provides (a) a parameter based catalog of all CRC instrumentation to expedite equipment loans, selection and optimise the use of CRC assets.
  - (b) A complementary Asset Control listing, which serves as a means of locating specific equipment and also as an overall record of CRC Inventories.

This latter feature has been adopted as the model from which D.O.C. will develop an Asset Control system for all D.O.C. stations.

Mr. Mills is currently acting as an advisor to the D.O.C. Steering Committee on Asset Control, and should an agreement be reached on resource allocations, will be involved in the training of Materiel Management staff.

## SPECIAL PROJECTS

Instrument Services offers an unusual blend of technical and organizational skills, which result in periodic involvement in "one-of-a-kind" activities for which no facility exists.

They range from small technical design and development projects to the complete overhaul and relicensing of the CRC VHF communications network.

Mr. Mills is ready to discuss proposals for any technically oriented projects at any time.

# CONSULTING AND LOGISTIC SUPPORT SECTIONS

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DESCRIPTION OF SERVICES AVAILABLE

INSTRUMENT STOCK

D. PAGE, LOC. 254, ROOM 44, BLDG 2

Mr. Page is responsible for control of the Central Pool of equipment (Inventory 4).

His services include:-

- Loan of equipment, issue of accessories equipment supplies such as chart paper, and also receipt and re-issue of
- equipment for repair and calibration.
- Shipping and receipt of equipment sent off-site for repair, and maintains records relating to repair histories and costs.
- Liason work with off-site agencies on behalf of equipment users and also arranges many inter-section loans.

# OPERATIONAL POLICY

Because many of the factors affecting the support supplied by these three sections are similar, the following introductory outline of policy is presented.

## ACCEPTABLE WORK INPUT

There is no arbitrary exclusion of any class of equipment. Equipment, electronic or otherwise, will be considered acceptable work input if it meets the following criteria:-

(a) It has a definite function which can be measured or otherwise assessed, and can be placed into operation expeditiously without the need for excessive simulation of, or searching for, ancillary equipment.

- (b) It is properly documented.
- (c) No alternative support facility is economically available. Some examples of unusual work accepted are:-
- A Titanium Ball Sublimation Unit (part of a semi-conductor fabrication system).
- A Bore Sight Module (used to align telemetry tracking).

## QUALITY - INSTRUMENT CALIBRATION

While recognising that some projects use equipment in non-critical applications, we do insist on the following points:-

- Any user making a measurement should be aware of the limits of accuracy with which the measurement is made.
- All equipment with potential for use in critical measurements should be maintained in properly calibrated condition.
- Although Instrument Services will perform limited calibrations on certain equipments used in "dedicated" applications, this is only done after a specific request from project leaders, and since repeated work of this nature degrades the overall instrument quality, judgement will be used in applying this option.

#### CALIBRATION LEVELS

In order to optimise the various quality control requirements of projects, Instrument Services uses a multi-level calibration system. The standard calibration sticker illustrated in Fig. 2 informs the user of all pertinent data on the status of his instrumentation. The absence of such a sticker indicates that equipment has received no attention from Instrument Services for several years. Such equipment is unsuitable for meaningful measurements unless the user has other reasons to believe the equipment to be in good condition.

## OPERATIONAL POLICY

Indicates final level of authority to which calibration is performed, in CALIBRATION LEVEL (orange background indicates some cases may be blank. equipment is modified or otherwise "non-standard". C.R.C. INSTRUMENT GROUP TRACEABLE TO LEVEL 9 75 CALIBRATED RECAL Date of last calibration Final date for which calibration may be assumed valid.

<u>Fig. 2</u>

# INSTRUMENT CALIBRATION LEVELS

Level A The user is justified in assuming that measurements made in normal room environments will be within manufacturer's specified limits.

Level B The user is justified in assuming that the instrument is quite adequate for non-critical measurements, and that deviation from the salient specifications will not affect measurements greatly.

Typical deviations tolerated are:

Rise Time Frequency Calibration √2
 100% of spec.

(e.g. 1% to 2% degradation)

Level C

This is a utility grade of equipment; repair quality is not relaxed, but very few quantitative performance tests are made. Typical members of this group are: simple audio equipments, power supplies, and older equipment which is still useful on an "as is" basis.

# OPERATIONAL POLICY

## NON STANDARD UNITS

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A small percentage of units are modified, or otherwise need special comment. These units are identified by an orange background to the "Calibration Level" section on the calibration sticker. Instrument Maintenance maintains a file on these units, and users should inform themselves on the nature of the comments on file. They are not necessarily negative.

## DOCUMENTATION

In order to minimize paper work, Instrument Services normally use an "inverted" document system in which technicians merely certify that instrument condition conforms with the requirements of a Test Schedule maintained on a central file.

When documentation is required, a Performance Report is prepared in whatever detail is required. Although the format of the report body will vary according to the section involved and the nature of the data, the first page is standardised, and contains a summary which in some applications will obviate the need for a detailed study of the data.

# DESCRIPTION OF SERVICES AVAILABLE

## MAINTENANCE & CALIBRATION

# S. KEMP, LOC. 453, BLDG 2, ROOM 40

This section provides the following services:

- 1. Maintenance and Traceable Calibration of instrumentation from D.C. to beyond 18 GHz.
- 2. Quality Control of incoming contract repairs and newly purchased equipment.
- 3. Type approval testing.
- 4. Special Calibration Reports to optimise measurements in specific areas of interest.
- 5. Small development jobs and modification of existing equipment.

The above services are performed using working standards supplied by the two standards sections. This practice ensures traceability to internationally acceptable standards. This is important to any project entering into co-operation with other agencies, and is also essential in eliminating time consuming debate with industrial agencies during quality control of contract repairs.

• The section also performs detailed type approval testing of equipments proposed for addition to C.R.C. inventories to ensure that manufacturers claims are in fact justified. It is not unusual to find that equipment which seemed to perform adequately during vendor controlled demonstrations do not measure up to a quantitative assessment.

• Special Calibrations are occasionally an important factor in project activity. Instrument parameters are usually optimized over a wide range, and it is frequently possible to enhance the accuracy or resolution of a unit for specific applications. A second aspect of this service which has proved useful, is the "after the fact" provision of special data to scientists who have made detailed measurements, and drawn conclusions without consideration of equipment limitations.

Finally, the section performs a limited number of development jobs, when economic factors, work pressures, and individual technicians abilities or interests combine to favour the decision. The most recent example is the development of two local oscillator assemblies in the millimetre portion of the spectrum. In this particular application, because there was no commercial alternative, the systems were duly constructed and documented.

#### CRC INSTRUMENT SERVICES - REFERENCE STANDARDS SECTION

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## OVER-ALL ORGANIZATION OF REFERENCE STANDARD TRACEABILITY



Fig. 3

## DESCRIPTION OF SERVICES AVAILABLE

## REFERENCE STANDARDS

# R. ATKINSON, LOC. 453, BLDG 2, ROOM 38

The first responsibility of this section is to ensure the validity of all calibrations (other than frequency) leaving Instrument Services. This is accomplished by the maintenance of a wide range of secondary standards, from which working references are supplied for use in instrument calibration. Because these skills in metrology have proved to be of direct value to scientific projects, we now perform a variety of measurements on demand.

For example, we have custom calibrated existing devices to allow projects to perform measurements for which no commercial instrumentation exists; a brief list of measurements already performed for projects follows:

D.C.

Sub-standard certification Ultra-precise D.V.M. certification Current Shunt certification Resistance certification

A.C.

Sub-standard certification
 Custom calibration of A.C, meters
 Impedance/Reactance certification
 Thermal transfer device certification

Micro-Wave

Calibration and Certification of:

Detector mounts (to allow enhanced precision of power calibration

Power heads

of oscillator output).

Attenuators (0-100 dB)

Co-ax. Cable and waveguide losses

Noise Standards

Cross Couplers

Directional Couplers

Isolators and Circulators

Swept and Single point measurement of:

V.S.W.R. & Related parameters on above devices and active amplifiers.

Because the many factors affecting metrology preclude any concise narrative description of limits of accuracy, a summary is presented in Fig. 3 to provide a general idea of the scope and capabilities of this operation. Each parameter is numbered and users wishing specific statements of capability and accuracy will find correspondingly numbered detail charts in the appendix.

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# DESCRIPTION OF SERVICES AVAILABLE

#### FREQUENCY STANDARDS

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R. ATKINSON, LOC. 453, BLDG 2, ROOM 38

This service provides certification of precision frequency standards and other high calibre time and frequency sources. Measurements are traceable to NRC standards. Because the impact of different components of oscillator frequency modulation noise and drift varies accordingly to the particular application, and in order to supply the particular data required by different projects, the Frequency Standards Section offers the following options:

## ATOMIC AND CRYSTAL STANDARDS

(Frequencies •	Certification of Frequency Offset from Universal
of 100 kHz,	Co-ordinated Time. Routine accuracy is + 1X10-11
<u>1, 5, &amp; 10</u> •	Certification of Frequency drift rate. Accuracy
MHz)	$is \pm 1X10^{-11}$ .
•	Certification of short term stability, over
	averaging times from 10 msec upwards.
-	Resolution = $10^{-9}$ X (Averaging Time).
•	Spectral Analysis of signal purity.
Synthesizers •	All of the above, with the qualification that
and Other High	accuracy is maximum at the normal standard frequencies.
Calibre Sources	At other frequencies, the offset synthesizer techniques
	used degrade accuracy, but typically, (+ 10 <sup>-8</sup> ) is achieved
	to 500 MHz and resolution of $\pm 1$ Hz is attained at
	18 GHz.
High Calibre •	Certification of internal ovens and certification of
Frequency Meters	accuracy to 18 GHz.

# MEASUREMENT METHOD

and Counters

The basic system is illustrated in Fig. (4). The 5016A House Standard is operated jointly by Instrument Services and the Radio Propagation Group. Due to a fortunate combination of interests Dr. A. G. Mungall of N.R.C. Time and Frequency Division, monitors the V.L.F. transmissions of the Radio Propagation Group, and supplies Instrument Services with data on absolute frequency.

The frequency Comparator uses an iterative process of multiplication and subtractive mixing, to perform multiplication of frequency offset,  $(\Delta f)$ , while maintaining an easily manageable output frequency of: 100 kHz  $\pm$  n $\Delta$ f.

This signal is then counted by a H.P. 5326B frequency counter whose Time Base is controlled by the 5061A House Standard.

The system resolution is a function of averaging time, and is expressed by:

Resolution =  $10^{-9}$  X (averaging time in seconds). For averaging times of more than a few hours, the system is easily capable of resolving the offset (typically 3 in  $10^{-13}$ ) between the 1 MHz outputs of our two CEASIUM BEAM standards. Output data is available in both analog and digital forms.

While there is no conceivable need to improve upon long term resolution some experimental work has been done which permits short term resolution of  $10^{-12}$  sec. at a one second averaging time. However, we are not currently in a position to assess the effects of system noise, and for applications requiring data on extremely short term fluctuations, we provide results in terms of Spectral Power Density.



BASIC SYSTEM FOR FREQUENCY STABILITY MEASUREMENTS

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Fig. 4

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#### CRC INSTRUMENT SERVICES





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## CAPACITANCE CALIBRATION & TRACEABILITY CHART





