

**NATIONAL
ACOUSTIC LABORATORIES
AUSTRALIAN DEPARTMENT OF HEALTH**



**INTERNAL REPORT NO 7
JUNE 1978**

TECHNICAL SERVICES INVESTIGATION

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NATIONAL ACOUSTIC LABORATORY
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Technical Services Investigation by E. Leighton - April 1978

The purpose of this investigation was to examine the technical areas in the branch laboratories with regards to improving the efficiency and quality of the technical service to Hearing Centre clients.

Guidelines set for this investigation were as follows:

1. The essentiality of duties at present undertaken by technical staff in the Hearing Centres.
2. Repair of aids by replacement of major assemblies.
3. Centralised NAL or contractor repairs of aid assemblies and costs involved.
4. Time required for carrying out various technical tasks to enable development of a new formula for staff determination.
5. Effect on technical workload of any proposed changes in audiological procedures.

With the above guidelines in mind, I decided to concentrate the main investigation to the N.S.W. area, where a detailed examination can be economically made and verify my findings, with visits to the nearer major States, Victoria and Queensland.

In all Centres visited technical staff were interviewed with regard to:

- (a) Normal duties carried out.
- (b) The major faults found during repair of current production aids.
- (c) Suggestions for improving the quality of the hearing aid.
- (d) Times involved in minor and major hearing aid repairs.
- (e) Instrument calibration and repair times.

The Psychologist in charge of each Centre when available was also approached with regard to related problems due to the quality

Each of the guidelines will be treated separately with the essential points related to these matters as sub-headings.

1. The Essentiality of Duties at Present Undertaken by Technical Staff in Hearing Centres

1.1 Aid Repair Waiting Time:

The situation currently existing in this area is not entirely satisfactory, the waiting time for repairs of Pensioner and repatriation cases is often far too long. This is due to a number of reasons:

- (a) Priority system for childrens repairs. While I see the urgency for this concept, it is one of the major reasons for aid repair build up. The children's aid, due to the rough usage, has a higher repair rate than other categories. As most of these aids are RE type, which take two to three times as long as other aids to service, it places an abnormal load on centres associated with this function. Serviceability should be given a high priority in any future aids designed to fill this need.
- (b) Critical time for deaf school repairs is always after school holidays, when a large influx of aids are received, which require immediate attention. There is insufficient staff in most centres to cover these peak load periods without incurring a waiting time.

1.2 Non Standardization of Repair Procedure:

The assembly procedure of components in production aids is based on the information available with regard to reliability. This assumption is not always correct, as effectiveness can only be gauged a number of months after the unit has been issued.

Investigations indicated there is room for improvement in component replacement procedures, but the information has to be co-ordinated and quantified by the individual States and fed back to the **services** section of NAL. As there are numerous procedures used by the technicians to replace the same component, e.g.,

TO 1 in each centre to ascertain the optimum method of replacement of each type of component used in aid repair. The effectiveness of this method should be proved by adequate records and the results forwarded to the Technical Officer in charge of the State, who would co-ordinate the findings from each Centre and send the information to NAL Central.

When the information gathering is completed, the standardization of repair procedures could be implemented at a Technical Officers conference held at NAL Central.

1.3 Aid Modifications:

The introduction of aid modifications and the inability of NAL Central to supply sufficient modified aids to meet the State requirements, has resulted in a large proportion of technician's time being used in these adjustments.

The original estimate for modified aid quantities was based in some cases on the types of aids used and not on the actual aids prescribed; apparently this caused irrelevant information being fed to NAL Central. A more accurate way to obtain these statistics would be to carry out a survey of patients audiograms over a set period and ascertain which modifications would best match these prescriptions. It should be realised that changes in modification requirements usually take from 2-4 months to meet due to the manufacture and processing time involved.

Investigations revealed some States have introduced additional non-standard modifications causing an extra workload for the technicians in these centres. It is suggested the effectiveness of all modifications be evaluated and only those deemed to be effective be produced and made available Australia wide.

The major modification currently being used is a base cut effected by either a capacitor change and/or a microphone replacement, as this caters for approximately 60-70% of all aids, considerable production and technician's time would be saved in the future if a continuously variable base cut was included in all new proposed hearing aids.

1.4 Aid Calibration:

This has always been a problem with regard to new aids received from NAL Central. Even when no further work has been carried out all new aids are recalibrated before issue.

Standardization of calibration systems is essential. While it is realised we are in the process of developing a new system, I cannot see sufficient quantities being available to equip all laboratories in less than two years.

As the need is urgent and as most laboratories have been equipped with the Fonix 5500 unit, I suggest the purchase of two additional units for the processing area of NAL for use in the calibration of low and medium powered aids. If this suggestion is implemented and providing sufficient modified aids are made available, no further calibrations of new aids need be carried out by State centres.

1.5 New Aid Selection:

The emphasis placed on accuracy in meeting prescription requirements varies from State to State and centre to centre. The tolerances in selection should be modified to take into account the errors that can be introduced by the operator, audiology equipment and hearing aid calibrations.

Tight tolerances or requests for non-standard aid response variations can greatly reduce the technical time available for aid repair.

1.6 Deaf School Visits:

The services provided in this area vary greatly from State to State. A comparison can best be made by describing the individual systems:

New South Wales - The main city areas are serviced by a mobile van fully set up with a Fonix 5500 unit for aid calibration and facilities for carrying out (except for RE type) major and minor repairs. This State is evaluating a replacement aid principle for RE aids. It appears to have improved the service to the deaf child while eliminating the problems found with loan aids. Every aid on issue is checked and calibrated over a three week period and no child has been left without an aid since the introduction of the mobile van in September 1977. Major repairs on H, C, G and T type aids are carried out in the van if sufficient time is available. Moulds are checked by an audiometrist once every six weeks.

Queensland - Visits are made to the schools on the Friday of each week. Suspect faulty aids supplied by the teachers are picked up and returned to the laboratory for service. No on-site repairs are carried out.

Repaired aids are returned to the school on the following Friday. Although most children have two aids, some would be without an aid for one week due to insufficient loan aids being available. If staff is available, arrangements are made to check and calibrate all fitted aids once every school term. Moulds are inspected every visit.

Victoria - The time table for the visits to the Victorian schools are as follows:

Glen Donald)	Weekly visits 1 day/school
St. Kilda Rd)	
P.E.J.S.)	
Jayne Field)	4 weekly visits 1 day/school
St. Albans)	

St. Mary Dalgheny - 3 weekly visits 1 day
Mt. Eliza - 3 weekly visits $\frac{1}{2}$ day
Ballarat/Bendigo - 4 weekly visits (country trips)

All aids in use are checked at each visit. On site aid calibrations are not performed. Minor repairs are carried out, major repairs are returned to the city centres for rectification. Repaired aids are returned within 1-2 days. If loan aids are not available, the child could be without the aid for this period. On site aid calibrations are carried out when deaf school equipment is available. Moulds are inspected each visit.

South Australia - Deaf schools are visited on a monthly basis. All aids are seen and minor repairs carried out. Major repairs are returned to the city laboratories for service. Aids are calibrated on site when equipment is available at the school. Aids are repaired within 1-2 days. Child could be without aid for 2-4 days as insufficient loan aids are available. Moulds are inspected each visit.

Western Australia - No deaf schools are visited in this State. Faulty aids are received and returned after repair by courier service. At present no visits are made to the schools to check the performance of all aids fitted. Child could be without aid for up to two days when insufficient loan aids available. Moulds are inspected by the teachers each week.

Tasmania - Deaf schools are visited weekly and highschoools monthly. Other classes are seen every two weeks. On site minor repairs are are performed; major repairs are returned to the laboratory for service. Aids are repaired and returned to the schools on a daily basis. Child could be without the aid for 1-2 days. Moulds are inspected each visit.

COMPARISON OF SERVICES SUPPLIED TO DEAF SCHOOLS

State	Number of Schools	Aid in use in Schools approx.	School Visited Every	All aids checked during visit	On site minor repairs performed	On site major repairs performed	All aids calibrated once every	Moulds inspected every	Child could be without aid for up to
S.W. city Bilongong Newcastle	29 2 8	1,350 54 204	3 weeks 2 weeks 1 to 3 mths	Yes Yes Yes	Yes Yes Yes	Some Yes No	3 weeks 2 weeks 1 month	6 weeks month month	- 1-2 days -
vic.	3 2 4	415 76 77	week 3 weeks 4 weeks	Yes Yes Yes	Yes Yes Yes	No No No	No No No	week 3 weeks 4 weeks	1-2 days 1-2 days 1-2 days
ld. risbane pswich ownsville	4 1 1		week month week	No No ?	No No ?	No No No	Term Term Term	month week	1 week 1 week 1 week
.A.	3	456	No Courier	All aids repaired in Lab			No	week	1-2 days
.A.			month	Yes	Yes	No	No	month	1-2 days
AS. eaf School igh School ther classes	1 1 2	52 18 11	week month 2 weeks	Yes Yes Yes	Yes Yes Yes	No No No	week week 2 weeks	week month 2 weeks	- 1 day 1 day

NOTE: Waiting times indicated for repairs mainly refer to RE aids due to insufficient loan aids being available.

The introduction of "major assemblies" for use in the repair of RE aids at deaf schools would greatly improve the service and reduce the technical and clerical workload involved (see comparisons with loan aids made under guideline 2 "Repair of Aids by Replacement of Major Assemblies").

It is estimated the implementation of this concept would require the purchase of 500 major unnumbered assemblies.

1.7 Allocation of Technical Duties in Centres:

In most centres visited (excepting NSW) no specific aid repair or associated duties were allotted to individual staff, most staff performed the general aid repair function, with a few individual technicians involved in instrument calibration and servicing.

I see a possible improvement in efficiency and motivation if the procedure, as being introduced in NSW, is tried and evaluated by other laboratories. The duties should be implemented on a weekly rostered basis to ensure the involvement of all personnel capable of efficiently carrying out the function. Assuming the Clerical assistant checks for battery or cord problems, the aid would then pass into the technical area. The areas of works concerned are

Counter Duties

The person carrying out these duties should be located in view of the public but not at the counter. He would be responsible for-

- (i) Ascertaining if the aid requires minor (closed case) or major (open case) repair.
- (ii) Perform all minor repairs.
- (iii) Answer technical counter enquiries.
- (iv) Assist in performing major repairs if workload of (i) to (iii) is insufficient.

Note it is not intended that this person should carry out the duties

issue of batteries, cards etc.

The involvement of the technician on rotating basis with the hearing aid user provided more motivation to ensure the repair is effectively carried out. While some laboratories have insufficient space to locate the technician near the counter, he could work, though less effectively from the general technical area. Consideration could be given when planning new laboratories to accommodate a technician in the counter area.

Technical Services to Clinical Staff

This function is carried out in the aid repair area.

It is essential that any psychologist requiring any technical service is quickly accommodated by the technician responsible for this function. This was not the case in a number of laboratories visited.

All staff should be kept informed by the TO of the person responsible for carrying out these duties. The main functions are

- (i) Aid modifications
- (ii) Aid checks
- (iii) Mould adjustments
- (iv) Normal aid repairs if insufficient work available from functions (i) to (iii).

Aid Repair and Testing Duties

Staff not previously allotted other duties would perform open case repairs on the priority basis existing at that time

Equipment

While all functions cannot be carried out by certain of the inexperienced staff, I see certain aspects of the duties as a means for providing equipment familiarization training for TA1 personnel. The Duties are:

- (i) Morning routine function - check on all clinical equipment in

- (ii) Repair of equipment found faulty during the morning checks or as notified by the psychologist.
- (iii) Monthly routine calibration of equipment.
- (iv) Yearly full calibration of equipment.

While the above allocation of duties mainly apply to a three man station or above, I see advantages in staff relations in nominating a person to assist clinical staff in a two man situation.

1.8 Instrument Calibrations and Maintenance:

Internal instruments - while regular calibration schedules are maintained in most of the larger laboratories throughout the three States, quite a large number of centres, due to staffing and repair loads, perform this service only when notified of a fault in the equipment. It is essential a calibration and maintenance program be implemented to ensure the audiology test instruments be functional at all times and the downtime due to repair is kept to a minimum.

The following suggested procedure ensures adequate preventative maintenance:

- (i) Daily routine - this is a subjective function check of all clinical equipment and twice daily calibration of hearing aid test systems. Any defects found are detailed on a fault docket, from which the instrument is scheduled into the repair load for that day. This type of check takes no more than one hour for the largest laboratory. Once weekly each instrument is cleaned, adding an extra half hour to the particular day involved.
- (ii) Monthly checks - the above instruments are calibration checked using the appropriate measuring equipment.
- (iii) Yearly check - each instrument is given a full performance check using necessary measuring instruments.

As only some of the NSW centres are currently performing the above tests, one of these laboratories was selected to assess the workload statistics which could be applied to the general technical area in this State (see Staff Estimates).

Instruments on Loan - these instruments are currently only calibrated or maintained on demand. Records in certain centres indicate a number have not been serviced over the past two years.

A regular twice yearly calibration program should be initiated to ensure effective testing of the subjects involved. In certain cases, particularly where great distances are involved (W.A.), additional loan units should be made available to ensure the release of the equipment for service.

General Repair of Equipment - Repairs are carried out on all equipment within the limits of staff experience and testing instruments available to each centre. No past records of man hours spent in performing this function were available, but an estimate was provided by a number of centres.

1.9 New Instrument Selection:

The system currently being used to select new audiology equipment results in a proliferation of types and models, which creates extra workloads for all sectors of the laboratories. Each new type of equipment purchased requires:

- (i) Technical and psychology staff training in maintenance and use.
- (ii) Preparation of adequate manuals.
- (iii) Stocking of adequate spare parts to ensure the instrument can be maintained.

It would be much more efficient use of existing staff to control the purchase of equipment from NAL Central, standardising on the types of equipment Australia wide to perform each required test.

Estimates and instrument replacement could be based on a five year interval, or such a period as to keep pace with the developments in the particular field. Such a policy if implemented would considerably reduce the technical time involved in calibration and maintenance and effectively increase the efficiency of the clinical staff as they would be more familiar with the equipment, no matter which centre they were attending.

1.10 Main Hearing Aid Faults found during Servicing:

The problems listed below are a summary of the faults as indicated by the 56 technicians interviewed. Only the major problems are indicated and these are listed in order of importance with regards to the number of repairs received.

H Aids

1. Broken transducer leads. Microphone leads fail more frequently than earphone leads usually in the ratio of 2:1.
2. Volume controls often replaced within 6 months after issue.
3. Transducers loss of of sensitivity.
4. Battery contact wiring.
5. Tubing replacement rate is high but time involved is low.
6. Switches.

E Aids

1. Acoustic problems.
2. Earphone moisture problems
3. Battery contact corrosion (gold contacts).

RE Aids

1. Microphone wire breakage, mainly the red wire.
2. Earphone replacements low sensitivity.
3. Coating on P/C Board, too hard to remove while servicing.
4. Switch breakages.

C/G Aids

1. Volume controls intermittent.

T. Aids

1. No great problems except for stripped case screws.

1.11 New Staff Proposals:

The influx of new clinical staff without recruitment of technical support is a contributing factor in build-up of aid repairs. The technical staff workload will be effected by any increases in clinical staff or changes in fitting or changes in technology used in aids & in aids.

Proposals for the recruitment of Psychology, Technical and Clerical staff should be combined and presented as a whole, if adequate service is to be provided to the hearing aid user. It is an inefficient marketing concept to provide hearing aids if the aids cannot be maintained.

Another problem that has arisen in this area is the lack of adequate chain of command being maintained in certain States. This appears most evident in Queensland where the senior officer in charge of the technical areas (T02) due to the lack of a T01 in the Brisbane city centre, is relieved by a TA2 when absent due to sickness or recreation leave. A similar situation exists in NSW and Victoria where the ST01 is relieved by a T01. As these officers act as State spokesmen for the laboratories with regards to technical matters, future staff estimations should ensure relief is provided at a suitable level.

1.12 Workload Statistics:

The number of problems that arise from time to time in the various centres could be reduced if adequate workload statistics were maintained. While some records are being kept, I see the need to standardise on a common system to effectively extract the required information. The main advantages to be gained from such a system are:

- (i) Allows the Technical Officer in charge to keep a check on the loading of each centre and assists in the efficient movement of staff to problem areas.
- (ii) Extraction of useful information to assess the durability of components or methods.
- (iii) Up to date workload statistics for inclusion in new staff proposals.

The record keeping system should be kept simple to ensure no great additional loading is placed on the individual technician. These sheets would be returned at set intervals to the Technical Officer in charge of each State, who could compile the results and extract any necessary information required by NAL Central.

1.13 Standardisation of Procedures:

The movement of administrative control of aid distribution and repair centres to the various State has resulted in a variety of standards of service being maintained by the various centres. Each officer in charge runs his laboratory to best suit the problems in his centre.

If a uniform standard of service is to be supplied Australia wide, it is necessary that more rigid directions be given by NAL Central in such areas as staff usage, aid fitting and maintenance and instrument calibration.

It appears the main upgrading of standards in testing procedures in the psychology areas are introduced during the training of new staff. More personal visits by psychology training officer to provide refresher courses for existing staff could improve this problem.

Personal visits by the Technical Liaison Officer has been sadly neglected in the past, some States such as Queensland and Perth have not been visited for the past five years and some centres in NSW, Canberra and Fairfield, have never been seen. If adequate technical control is to be maintained all centres should be visited twice per year.

If adequate supervision is to be maintained, the officer in charge of the technical services in each State should visit all centres under his control at reasonably frequent intervals. Although this procedure is followed in most States, I was told the Townsville laboratory has not been visited by supervising technical personnel for the past five years.

1.14 Internal Communication in Individual Centres:

Communication between psychology, technical and clerical areas could be improved in a number of centres. The main problems seem to arise in the larger laboratories, where the three sections often operate as independent units.

During the period of this secondment, I have seen a number of problems develop that could have been minimised if more direct contact and control was exercised by the officer in charge.

It is essential that the officer in charge has a better understanding of the problems in the various areas so the three sections can be combined into an efficient unit. While it has been suggested some form of management training would be helpful, it would be a great improvement if greater interest and understanding was shown by the officer in charge in the technical and clerical sections.

Some of the laboratories hold regular meetings between the officers controlling these sections which I believe effectively control the problems before they reach crisis level.

1.15 Batteries:

The emphasis placed on the fitting of behind-the-ear hearing aids, particularly in the medium and high power ranges, has escalated battery costs to the current figure approaching \$1,000,000 per year. While as new aids are designed, improvements will be made in current drains, there are possibilities of immediate savings if we could ensure:

- (i) Maximum life is extracted from the batteries currently issued.
- (ii) Records are kept on the batteries issued to the individual to ensure the hearing aid is working efficiently.

While the first point is difficult to police without a replacement battery for battery principle, some improvements may be made by instigating a publicity program to make the customer aware of the mounting costs and how to ensure the maximum life is obtained from each battery.

In all centres visited, batteries were being issued on demand, with no records being kept of the individual customer usage. On instructions from NAL central a number of centres have just commenced date stamping the equipment card when batteries are issued.

I see the most effective way to improve efficiency in this area is to make the customer aware of the necessity of NAL to monitor the battery usage in his or her aid to ensure the aid is working satisfactorily.

A record of individual battery usage should be kept, but the use of the equipment card for this function creates clerical workloads. A more efficient way would be to add these usage figures to a customer carried "Battery Entitlement Card" on the back of which the batteries issued would be recorded by the clerical assistant.

Individuals requesting batteries by phone could state the name, aid number and type to make them aware that some check is being kept. As the cards would be returned and replaced every 12 months the completed record would indicate effective aid usage.

While a number of these cards would require replacement because of loss, I feel the advantages to be gained warrants the introduction of some such system.

1.16 Service Records:

The current system of recording aid service details on equipment cards involves a fair proportion of clerical time in selection and filing and the card itself is not always available to the technician due to the repair being carried out at an alternative centre to that of issue.

Currently we have the aid issue details duplicated in various record systems such as "Patients file", equipment card and in the case of Queensland also in the "Hearing Aid Service Record" carried by the patient. I suggest the universal use of the latter system could negate the need to maintain the Equipment Card.

The possible advantages of this system are:

- (i) Service details are available with the aid no matter which centre the repair is carried out at.
- (ii) Possible elimination of the equipment card.
- (iii) A battery usage format could be included on the record as an alternative to the previous suggestion for monitoring battery issues (see Batteries).
- (iv) Customer awareness of service provided.

The main disadvantages for the customer held record card is the loss or failure to present the card when the aid is serviced. While the past service record would not be available, the technician could still maintain the aid by having access to the patient's

areas around the laboratories, should have a bright coloured file cover to ease identification.

Summary of Suggested Improvements with regards to Hearing Aid Services

As the preceding pages covered a broad range of topics, a summary of the suggestions made for improving efficiency and service are listed below:

1.1 Aid Repair Waiting Time:

Ensure all newly designed aids are easily maintained, particularly when these are issued to deaf schools.

1.2 Non Standardisation of Repair Procedure:

A survey be undertaken to enable standardising of repair procedures, if the results were evaluated systematically, and implemented Australia wide, efficiency and aid reliability would be increased.

1.3 Aid Modifications:

- (i) Rationalise the current modifications to those which are known to improve the effectiveness of the aid to the user.
- (ii) Eliminate non-standard modifications.
- (iii) Include a variable low cut control in all newly designed aids to eliminate the majority of modifications.

1.4 Aid Calibrations:

Purchase of additional Fonix 5500 units for the hearing aid production areas to ensure standardisation of calibration systems Australia wide.

1.5 New Aid Selection:

Standardise the procedure for new aid selection to eliminate "tight tolerances" as stipulated by a number of psychologists.

1.6 Deaf School Visits:

- (i) Introduction of a mobile service van in States which have the necessary workload.
- (ii) Purchase of major assemblies for assistance in repair of aids at deaf schools.

1.7 Allocation of Technical Duties in Centres:

Allot and rotate set duties to all technical personnel to improve motivation and efficiency.

1.8 Instrument Calibration and Maintenance:

- (i) Introduce daily preventative maintenance inspections to improve effective use by the psychologist.
- (ii) Maintain regular instrument calibration schedules to improve the accuracy of the hearing tests involved.
- (iii) Provide additional loan screening audiometers in certain areas to allow release of loan equipment for service.

1.9 New Instrument Selection:

- (i) Purchase of all hearing test equipment to remain the responsibility of NAL central.
- (ii) Equipment purchases to be based on 5 year estimates.
- (iii) Standardise on one type of instrument to perform one job.

1.10 Main Hearing Aid Faults found during Servicing:

Further investigation is required to ascertain improved methods to increase the reliability of the components and assembly procedures.

1.11 New Staff Proposals:

Proposals for new staff should combine the requirements for psychology, technical and clerical areas if the laboratories are to perform efficiently. Ensure future staff proposals allow for the maintenance of adequate chain of command.

1.12 Workload Statistics:

Standardise on a universal workload record system to be

1.13 Standardisation of Procedures:

More control to be assumed by NAL Central to ensure a uniform standard of service is maintained Australia wide and adequate supervision is carried out.

1.14 Internal Communication in Individual Centres:

More emphasis to be placed by the OIC in each centre on supervision and control of the various sections within his laboratory.

1.15 Batteries:

- (i) Introduce a customer held battery issue record card to monitor usage and aid efficiency.
- (ii) Educate the patient in more efficient use of batteries by the use of more instructional advertising.

1.16 Patient Service Records:

- (i) Introduction of a patient held record card to combine service details records with the battery issue card as suggested in 1.15.1
- (ii) Elimination of the equipment card.
- (iii) The use of the patient's file by the technician to ascertain fitting information if the patient's held record system is lost.
- (iv) The use of bright coloured file covers for the patient's record file to minimise it being mislaid.

Suggestions for including in proposed new aids

Although this subject was not discussed earlier, the main suggestions as indicated by the various staff interviewed are indicated below:

1. P/C board should be located in the case body, track side up, to ease repair and replacement of transducer and auxiliary wiring.
2. Reliability of transducer leads should be improved.

3. Ensure P/C board coating can be soldered through or easily removed.
4. Plug in facility for amplifier testing be provided.
5. Continuously variable controls for base cut be included internally to eliminate the need for the majority of modifications.

I recommend the holding of a Technical Officers Conference, say three months after the publication of this investigation, to discuss the suggestions made and ways of implementing those deemed to be an improvement, by a majority decision.

2. Repair of Aids by Replacement of Major Assemblies

This concept is not seen as a means of staff reduction but as an aid to even out the peak repair loads that occur from time to time in every centre. This approach to repair would reduce the customer waiting time during peak periods and allow a more accurate estimation of yearly technician work load, when staff assessments are made.

In the past it has been possible to effect quick repairs on body aids by the replacement of the amplifier. It is now proposed to extend this facility to H type aids by making available a major assembly for this unit. Providing additional modifications were not required, the changeover time for an assembly would be from five to ten minutes. All technicians were told that the assembly should only be used when the following conditions were satisfied:

- (a) Aid repair wait load existed;
- (b) The estimated repair time on the customer's aid would exceed a predetermined time.

It was intended the repair of the replaced customer's aid which now becomes an assembly, would be undertaken by the

technicians within the centre, during the off peak periods. If the staffing was such that insufficient time was available to perform this function, two alternative methods are suggested:

- (a) Repair by NAL central staff;
- (b) Contractor repair.

These two possibilities will be examined under Item 3, of the guidelines. Notwithstanding the possible assembly repair problem, most technicians agreed the provision of assemblies would be of great assistance in overcoming peak load periods.

2.1 The introduction of major assemblies would eliminate the necessity to maintain the current "Loan aid" system as far as H aids are concerned. This would provide a number of advantages as indicated below:

<u>Replacement Assembly</u>	<u>Loan Aid</u>
1. Replacement of faulty aid immediately.	Replacement of faulty aid immediately.
2. Replaced aid has same characteristics as original.	Loan aid has different characteristics to original.
3. Same serial number is maintained	Loan aid different serial number. Issue has to be recorded and accounted for.
4. Client does not have to return the aid.	Loan aid has to be returned involving double mailing for NAL.
5. The repair of the customer's aid which now becomes an assembly can be maintained in off peak periods.	When loan aid is issued, high priority has to be given to customers repair to ensure the loan aid is returned.

2.2 The following figures give an indication of the cost of the introduction of H major assemblies:

First Year Cost:

Quantities were estimated by the individual States and

Component Cost 3,500 x \$25	\$87,500
Assembly Cost 3,500 x \$7.50	<u>\$26,250</u>
Total Cost	<u>\$113,750</u>

Second Year Cost:

The estimated quantity for replacement of assemblies which would be discontinued averages to 50% of the original estimate.

Second year cost \$56,875

The total numbers of assemblies indicated above would be supplied in the most used modification types, as requested by the various States.

3. Centralised NAL or Contractor Repair of Aid Assemblies and Cost Involved.

The only repairs that could at present be considered under this category would be current H and C/G series aids, as both NAL and manufacturer's staff are not familiar with other aid types.

3.1 Contractor Repairs

Both our current hearing aid contractors displayed interest in this type of operation, providing the one type assembly modification was required in each batch and the quantities involved were available in no less than 100 units.

In order to minimise possible problems, it would be necessary to control this type operation from NAL Central where the necessary sorting, adequate standards of acceptance and stock control of sufficient tested units could be maintained.

Assuming a large proportion of these repairs would have amplifier problems and that the volume control and switch would require replacement, I decided to first evaluate the procedure by replacement of the amplifier with a newly constructed unit.

A trial batch of 100 selected assemblies was despatched to Crystalaid with the necessary calibration equipment to ensure the

To provide an acceptable standard of repair, the manufacturer found it necessary to dismantle the unit, repolish the case and replace all wiring during reassembly. Calibrations and all necessary repairs were carried out to ensure our acceptance. This method of repair by the manufacturer resulted in a high overall cost per unit.

The manufacturers re-cycling procedure indicated below is orientated to a production line technique:

1. Assembly of amplifier from new components.
2. Dismantling of the assembly for repair.
3. Inspection and salvaging components.
4. Rewiring battery contacts.
5. Rewiring microphones and receivers and renewing suspensions and tubing.
6. Cleaning and/or polishing of case bodies.
7. Reassembly with new and salvaged parts.
8. Subjective testing of units after assembly.
9. Calibration of aids and repair of units which failed to meet requirements.

Costs to NAL are indicated below:

Amplifier component cost	\$9.00
Amplifier assembly cost	2.64
Costs of reassembly Items 2 to 8	7.96
Testing, repair and calibration	1.10
Cost of transducers replaced	2.66
	<hr/>
Total unit cost	\$23.36

If the charge for "re-pair and calibration" is disregarded, the cost becomes \$22.20, as compared to a new replacement aid of \$32.50.

Although the standard of the finished unit would be high, the manufacturer being production line orientated, has a tendency to replace a number of components which could be reused. This adds additional costs to this exercise.

The period involved in this secondment did not allow sufficient time to evaluate the economics in the repair, if possible, of the replaced amplifier, but it is assumed it would approach the assembly cost of the new unit, as fault finding is involved.

3.2 NAL Repairs

This function could not be handled by NAL ~~processing~~ staff unless a proportion of the current workload was eliminated.

Given sufficient staff time I believe the ~~processing~~ section could perform assembly repairs in an efficient manner and provide some additional advantages as indicated below:

1. Handle repairs in lots of 20 units providing a quick turnaround of assemblies.
2. Improving the economy of the operation of repair of a number of the units, without replacing amplifiers and reuse of a larger proportion of used components.
3. Access to information regarding typical field repairs, which could be used in improving the manufactured product.

In order to relieve the workload pressure in the ~~processing~~ area and so allow consideration of the use of NAL staff to carry out assembly repairs, I investigated the feasibility of the manufacturer performing new aid calibrations.

3.3. Calibration of Production Aids by the Manufacturer

Due to the wide use of the Fonix 5500 unit in branch laboratories, consideration can now be given to the calibration of low powered H type aids by the contractor. For an additional charge

distortion readout at various frequencies for the two tone positions and an overload readout at 1kHz.

If this information was provided and as evidence from past records at least 50% of these aids could be processed without internal work being carried out by NAL processing personnel.

Suggested new procedure would be:

1. On receipt of the aids from the contractors they would first pass through the normal quality assurance sampling check to ensure the batch quality is maintained.
2. If the batch was not rejected, the calibration figures would be checked against the standard response.
3. Aids that passed test 1 and 2 would be despatched direct to store for issue.
4. Only the units which failed to meet calibration requirements would be repaired and processed by production staff.

I have arranged for the manufacturer to calibrate 1,000 ~~current~~ aids to assess the feasibility of this idea. If successful, it would result in considerable workload being eased from the processing area and a quicker turn around of aids to meet issue demands.

The total capital cost to implement this scheme would be the purchase of two additional Fonix 5500 calibration systems (\$3,000 each) (This would be increased if additional contractors were employed). These units would be placed on loan, one to each contractor.

If the current staffing difficulties are not improved, consideration could be given to modifying the tender specifications for aid assembly to place the responsibility on the contractor for calibration repairs. If this scheme was implemented the workload in the production area would be further reduced. On current