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COMMONWEALTH OF AUSTRALIA

POSTMASTER – GENERAL's DEPARTMENT
HEADQUARTERS

ENGINEERING WORKS DIVISIONS

NATIONAL BROADCASTING SERVICE

PROGRAMME LEVEL CONTROL

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E.T.S. 7/1004

SECTION 1

SOUND BROADCASTING

PROGRAMME PRODUCTION

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DISCREPANCIES IN VOLUME OF TRANSMISSIONS.

During the past few years, the A.B.C. has received a number of complaints from listeners about disparities in the volume of our broadcasts. The majority of the complaints fall broadly into four categories:-

(i) Music bridges in spoken word programmes too loud;
(ii) Announcements in serious music programmes too loud;
(iii) A jolting change in level at the change of programme;
(iv) Some programme units broadcast in their entirety at too low a level.

It is apparent that some of these variations are intentional, arising from the acceptance of the principle of a dynamic range in transmission to meet artistic requirements, while other variations are accidental, arising from shortcomings in presentation and level checking or lining up techniques, although even these latter are due in some part at least to the existence of the dynamic range. In dealing with the problem of level discrepancies, therefore, it is important to have a clear appreciation of the problems associated with the dynamic range.

DYNAMIC RANGE

Stated simply, the dynamic range is the ratio between the loudest and the softest components of a programme. The maximum dynamic range for comfortable listening varies very considerably with different listening conditions, and is seldom equal to the natural dynamic range of the programme being broadcast. In these cases, the maximum loudness is limited to that available, permitted, or comfortable; while the minimum loudness is limited to that which permits comfortable hearing despite the presence of noise, other distractions, or even a degree of deafness of the listener.

"Some like it Loud, Some like it Soft"

Where listening conditions are bad, such as in very noisy surroundings, in a travelling motor car, on the beach, or listening to distant or weak stations under bad reception conditions, it is clearly desirable in the interests of intelligibility and also of general listening comfort, that the programmes notably news and other service bulletins, and some modern types of music, do not suffer from this flat, even transmission; but on the other hand, serious music and dramatic presentations suffer very seriously if they are not broadcast with at least a significant part of the natural dynamics of the performance.

The dynamic range in the broadcast of these latter types of programmes must therefore, of necessity, be a compromise, and should normally be biassed in favour of the type of listener who could claim to have greatest interest in the particular programme. For example, the majority of listeners to a symphony concert could be expected to have reasonably good listening conditions, and it would be unreasonable to compress such programmes unduly for the benefit of a much smaller group of listeners, who might have difficult listening conditions. Nevertheless, in these serious music and dramatic programmes, it is generally desirable to effect some degree of compression, either by adjusting the actual performance, where this can be achieved without artistic loss, or by microphone placement or by actual adjustment of the gain controls in the various programme circuits.

BALANCE OF THE INDIVIDUAL COMPONENTS WITHIN A PROGRAMME.

This is a particular aspect of dynamic range, but as it is responsible for such a high proportion of the complaints we receive, it is clear that there is some disparity between the judgments of the programme producers and the listeners as to what constitutes a good balance between the component parts of a programme. It is important, therefore, that the programme producers should be aware of the factors affecting these judgments, and make reasonable allowance for them in their own assessments.

These factors are as follows:-

(i) The listening level: The majority of listeners will have their receivers adjusted to a much lower level than the control room speakers. This means that quieter components will be inaudible, or scarcely audible to them although clearly audible in the control room speakers.

(ii) The listening conditions: The average listener will have a great deal more background noise and distraction than will the production team in their soundproof control booths. The consequence of this again is to render inaudible to the listeners many of the lower level components of the programme which are quite clearly audible in the control room.

"Listening Conditions are Sometimes Difficult".

(iii) Shortcomings and defects in the technical system and in the listeners hearing: These generally tend to reduce the higher frequency components in relation to the lower, thereby adding to the difficulty of understanding speech, the intelligibility of which depends so much on the higher frequencies for the reproduction of the consonants. This reduction of intelligibility is very pronounced if the speech level is too low.

(iv) The nature of the programme: Some programmes are difficult to transmit because in the performance they have strong but relatively infrequent peaks of level, which cause the general level of the programmes to be somewhat lower than would otherwise be the case. Certain singing and speaking voices and some piano and orchestral compositions, have this difficulty.

(v) The main programme interest: It is important that the main interest of the programme should be the one determining the appropriate levels. In some cases the important interest is clear and unquestioned. For example, clarity of speech is important in a play or a news bulletin, whereas the music is the main factor in an orchestral programme. In some other cases, there will be a clash of interests, such as between the words and the music of opera.

(vi) The discrepancy between loudness and level: This is best illustrated by the fact that a brass band sounds psychologically a great deal louder than a single note amplified to the same level.

Bearing these factors in mind, it is important that the programme producers in the control rooms take into account the following requirements:-

(i) The balance between items and between the components of an item must be natural, as heard by the ear. It is not sufficient merely to see that the meter readings remain within the acceptable range.

(ii) Due to the restricted dynamic range available to the listeners and the distracting and masking effects of the listeners' conditions, it is of utmost importance that all the significant components of the programme must not only be clearly heard in the control room loud speakers, but heard with an additional margin of level to ensure that they can still be heard by the listeners.

(iii) Where speech is the important component of the programme, its general level should not be depressed by the intrusion of loud effects or bridge music because of the damaging effect on the intelligibility of the intervening speech to the listener by this technique. The impression of loudness of the sound effect or bridge music can be achieved without an unduly high level by careful choice of the quality of the sound.

(iv) Where music is the component of important interest in a programme, and it is of a serious nature, the general level will almost always be somewhat depressed due to the dynamic range of serious music. In this instance, it is better presentation to adjust the level of the announcements to correspond with the general level of the music, rather than with the peak level.

(v) Where a serious or artistic programme ends on a quiet note, it is very desirable to contrive some appropriate bridge to soften the shock of the following network announcement which would follow at normal level.

It is difficult to lay down hard and fast rules for these occasions, because the ideal will probably vary with different programmes. However, to summarise the position, it is considered that programme producers will broadcast more generally pleasurable programmes if they observe the following points:-

(i) Do not have the monitoring speakers in the control room set at too high a level.

(ii) Ensure a natural balance of sound as heard.

(iii) Make sure that all the important components of the programme are more clearly audible than is necessary for them just to be distinguished.

(iv) Bias their balancing in favour of the more important components of the programme.

(v) Bias their judgment in favour of the type of listener most likely to be listening to the programme.

"It Depends a Lot on <u>How</u> You Listen".

SECTION 2

SOUND BROADCASTING TECHNICAL

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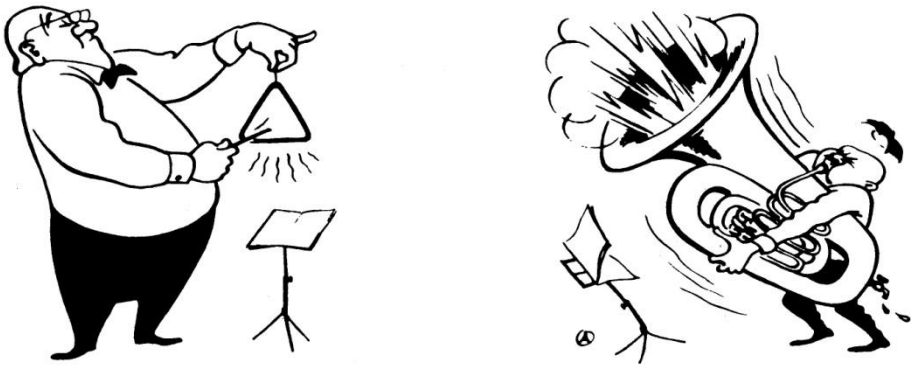
PROGRAMME LEVEL CONTROL

GENERAL.

Volume Range (often referred to as dynamic range).

It is well known that the sound volume range of live broadcast programme material (i.e. the difference in volume between the loudest and softest portions of the performance) is too wide to transmit without control. The upper circuit of level transmitted is fixed by the power handling capacity at 100% modulation of the transmitting stations. The lower limit is necessary in order that the quietest passages of the programme shall not be masked by noise in any part of the circuit between microphone and aerial, or by noise and general interference in or at the listeners receiver.



"Internal Balance is - Not Always Easy".

Typical values of volume range of some types of programme material are as follows:-

Large Symphony Orchestra	- Up to 75 db.
Average Orchestra or Band	– 50 db.
Dramatic Speech	- 40 db.
News Reading Speech	- 26 db.

The maximum available dynamic range in the various technical units in the Broadcast chain are approximately as follows:-

Studios and studio equipment	60 db.
Magnetic tape replay equipment	55 db.
Interstate carrier programme channel	45 db.
Physical programme channel	35 db.
Transmitting Station (latest designs)	60 db.
Long playing Records and Acetate Transcriptions	45 db.
Standard 78 R.P.M. Shellac Record	30 db.
Radio receiver (Urban location)	40 db.
Radio Receiver (Country location)	30 db.

It is therefore obvious that for a good deal of programme material, it is necessary for a certain amount of manual level compression or control to be applied during programme production, and if it is to be applied successfully so that the radio listener is not conscious of it, considerable skill, artistic ingenuity, and experience, will be needed by the control booth operator. Normally the manual control of level is performed at the point of origination for live programmes or material being recorded. For programmes originating from tape or disc or being received from a programme line, level control (as distinct from level setting) will be required only in exceptional circumstances, since in all these cases, control has been applied to the programme at the point of origin.

Standard Send Level and Programme Level Monitoring Device.

It is standard practice within the National Broadcasting Service to send broadcast programmes at a programme level of + 8 vu, and the standard instrument used for monitoring the programme level throughout the networks is the Standard Volume Indicator or vu meter. (See Eng. Instruction T.4020 which describes the use of this indicator for both monitoring and measuring programme levels). The vu meters used throughout the N.B.S. networks are therefore set to give reference deflection at a programme level of + 8 vu.

BASIC CONTROL FUNCTIONS.

The control operator's main function in controlling the level of an actual broadcast is to see that the output level range from the studio is as near as possible to the level range of the programme source, subject to the following 3 major restrictions.

(i) The instructions of the A.B.C. officer responsible for the production shall be followed so far as levels of the component parts of the programme are concerned.

(ii) The operator, following the procedure set out in Engineering Instruction T.4020, should continuously observe the programme peaks indicated on the meter and should adjust the master gain control, increasing the level if the meter needle does not peak into the red scale 2 to 3 times over a period of about 10 seconds for speech programmes and 60 seconds for musical programmes, decreasing the level if the needle peaks more often into the red scale.

N.B. This does not mean that the operator should read the meter over each period of 10 or 60 seconds and then make an adjustment to level, repeating the procedure each 10 or 60 seconds.

It does mean that the operator should be observing the meter continuously in the case of live programmes and should read the meter over a period of 10 or 60 seconds when his observation over a longer period of several minutes indicates that level is high or low and needs adjustment.

This restriction to maximum level leaving the studio is intended to avoid overload of the transmitter(s) with consequent increase of distortion above permissible limits and in severe cases, operation of overload circuit breakers bringing the transmitter(s) off the air.

(iii) Whilst observing the meter indications, the operator should increase the level, if, in conjunction with what he hears on the monitoring loudspeaker, he feels that the lower levels of programme are not clearly intelligible above the noise.

In addition, because programme failure alarms are fitted at unattended stations which automatically change over to a second programme source in case of programme failure, the control operator should not allow the level as indicated on the vu meter to remain below the -20vu mark for more than 30 seconds at a time.

N.B. The control room loudspeaker should be at a comfortable listening level, sufficiently high for the operator and producer to be able to distinguish separately the various components of the programme.

DETAILED LEVEL CONTROL TECHNIQUES.

In addition to the 3 basic functions of level control set-out in para. 2 the following points are important to the smooth continuity of level control of broadcast programmes.

(i) Rehearsed Programmes. During rehearsal the control operator should make appropriate notes on the U.P. sheet covering the gain settings agreed with the producer. These notes should cover fading in and fading out levels, points of excessive level and periods of very low level as discussed in the previous paragraph, and in fact any level occurrences which will need manual adjustment on the master gain control. During the actual broadcast every effort must be made to repeat the settings agreed with the producer during the rehearsal.

An important effect which the operator must be ready to take into account during the actual broadcast is that general levels may be as much as 5 db. Higher than during rehearsal. This effect is partly natural and partly psychological in that during rehearsal artists very often holdback and do not exert their full capabilities.

(ii) Unrehearsed Programmes.

(a) Music. Disc programmes occupy a large proportion of total "on air" programme and in general, rehearsal in the normal sense is not usual for these types of programme. However, most recorded music can be faded in on the channel fader by the C.B. operator, the fade in following immediately the announcer's operation on the gramophone fader. The main advantage of this dual fade procedure is that the second technical fade is useful in quieting the noises that occur in the 'run in' grooves of the disc. However, it is important that this technical fade should be completed before the music starts.

Recorded levels on discs (both average and peak) vary considerably from one disc to another even when recorded by the same manufacturer. Differences of the order of 6 db. Have been experienced although the differences are becoming smaller as techniques improve. The operator must, therefore, take particular care with the level setting at the beginning of records and in co-operation with the announcer should make every effort to ascertain before-hand the initial level of the recording. It should be borne in mind that careful monitoring at the very start of the programme to the timbre and presence of the music will almost certainly give a good indication of the levels likely to be encountered.

(b) Speech Programmes. In the case of speech programmes, because it is vital not to miss the opening and closing words of a programme or the composite parts of a programme mixed from several sources, fading in and out is not normal and it is necessary for the operator to concentrate and to begin the programme at normal level, i.e. (pointer peaking at reference deflection as described in the Engineering Instruction already referred to).

The level of speech programmes not rehearsed so far as the booth operator is concerned, e.g. outside broadcasts, local tape relay etc., is known or can be ascertained from the switchroom or recorder room respectively, as these programmes should be fed into the control booth at normal level, i.e. + 8 vu and the normal setting of the channel and master gain controls can be anticipated.

In many cases, where it is known that a programme is to begin with speech, it is normal practice to pre-set the master gain control and to commence the programme unit by key operation. The operator, however, should always be prepared for other than expected levels.

(c) Programmes whose initial and end content are not known. On occasions, (some inter-state programmes), it will not be known whether a programme is to begin with music or speech. In these cases, where the operator is in doubt concerning the nature of the opening of the programme, as soon as the circuit key is operated, the fader should be advanced to a few db. (in cases of real doubt, up to 15 db.) below normal setting.

The conclusion of an outside broadcast or incoming interstate programme should normally be faded to avoid sudden changes in level but the time taken to fade will depend on the type of programme, e.g. a programme unit scheduled to end with a gong or three gongs, should be faded within, say, one second to avoid any following speech; on the other hand, a concert programme ending with applause or a church service ending with organ music should be gradually faded out over a period of 5-10 seconds.

SPECIAL POINTS CONCERNING THE REALTION BETWEEN LEVELS OF PORTIONS OF A COMPOSITE PROGRAMME.

The following note should be read in conjunction with the notes for guidance of A.B.C. production and balance staff issued by the A.B.C. and approved by the Department for issue also to all Departmental staff concerned with level control.

(i) Musical themes used to introduce speech such as news – the theme being of minor importance – should be held down 4-5 db. below the level of the following speech which would be adjusted to normal level.

(ii) Announcements between items of a symphony orchestra or large band should be held down 4-5 db. below the level of the musical items.

(iii) Announcements, before and after high quality musical items which begin and end on a low level, should be held down 4-5db. below the adjacent music.

(iv) Musical interludes in plays etc. will generally be kept low under direction of the producer. In all these cases, the object of the producer, balance officer, control booth operator team should be to obtain, on behalf of the listener, a smooth natural presentation, ensuring clarity of the essential message or information in the programme and avoiding abrupt, disturbing changes in level which might necessitate the listener's frequent attention to his receiver volume control.

FADING.

The process of fading in or out a programme is normally carried out slowly, at a speed of approximately 1-2 db. per second, however the producer's instructions should be followed wherever given, as quicker fades and abrupt cuts are often required and can be achieved by proper timing of the operation e.g. during breaks of programme where the background noise is low.

CONCLUSION.

Level control of broadcast programmes is and always will be, particularly in large networks, a difficult problem. It is necessary, therefore, for control operators who are responsible for level control and for all other staff who are in a position to monitor levels throughout the system to realise that their duties are very important to the technical and aesthetic quality of the radiated programme. As a consequence, considerable concentration is required by the control operator in particular.