Chapter II

MEASURING TECHNIQUE.
I. INTRODUCTION

It has already been indicated that the object of the present investigation is to measure the atmospheric noise interference to one specific service, viz. broadcasting in the 25 and 31 metre bands. It has also been stated that the method described by Aiya is being adopted for the purpose of these measurements and the reasons for adopting the method have been given.

The method of Aiya is an objective method developed on the basis of subjective considerations and the procedure given for the collection and assessment of data has a statistical basis which as explained earlier, is very necessary because atmospheric noise is itself a statistical phenomenon. These several features and the method itself are being described in detail in this chapter as this method has been adopted for measurements.

(a) Subjective Basis of the Method :- The method is based on the results of listening experiments. Such experiments cannot be always considered very satisfactory. But, since the ultimate judge of the quality of a broadcast programme is the ear and the most realistic approach to the problem is to rely as far as possible on the average ear as the final instrument for assessment of annoyance.

Subjective experiments revealed that the median value
of the duration of the impulse as heard through the loud-
speaker of a union was 0.2 seconds. Further, it was
found that the majority of the listeners feel the annoy-
ance of atmospheric noise when there are at least ten
impulses per minute. Therefore, it appears that noise
which exceeds for 3% of the time (0.2 x 10 = 2 seconds per
minute) has an annoyance value. This criterion is for
speech, in which the annoyance of noise is more felt than
in music.

Impulses of the highest magnitude obviously cause
the maximum annoyance. Therefore, when a large number
of impulses are received, the average of the ten highest
impulses per minute is taken as the noise value. In the
large majority of cases it has been found that arithmetical
averaging of the ten highest impulses is adequate. There-
fore, arithmetical averaging is adopted. In Chapter III,
a typical set of readings as recorded and the arithmetical
averaging of ten highest peaks per minute is given for a
typical case as an illustration.

(b) Classification of Noise :- Several attempts have
been made to classify noise. But, in the paper referred
to (AIYA) a new classification has been adopted and this
again is based on the results of long period listening
experiments. When the atmospheric noise is heard through
the loud speaker of a receiver, it is possible to dis-
tinguish individual impulses from each other and so long
as this is possible, the type of noise is called type B noise. When this type is due to local thunderstorms, the magnitude of the impulses show wide variations in magnitude from impulse to impulse and the impulses themselves are very sharp. This special form of type B noise is called type C noise. As the number of impulses per minute goes on increasing the ear finds it difficult to distinguish each impulse separately. The resolving power of the average ear is crossed when the number of impulses per minute exceeds about fifty. When impulses are received at this rate or higher, the ear gets the impression of continuous noise similar to fluctuation noise. This type of noise is called type A noise. It is necessary to point out that even type A noise arises from impulses and therefore, must be measured by the same standards as other types of noise.

Since the classification of noise has importance with reference to standards of satisfactory service, it is useful to listen to noise while measurements are being carried out.

(c) The Noise Meter :- The most important aspect of the noise meter is its charging and discharging time constants. These time constants have been chosen for the noise meter as follows:

Charging time constant 10 milli-seconds
Discharging time constant 500 milli-seconds
These time constants make the noise meter of the rapid charge slow discharge type. Justification for the same arises from the investigations of Studel (STUDEL).

The choice of the time constants was made on the basis of listening experiments. Subjective tests were taken by listening to noise and observing the noise meter kicks. It was found that the meter does relate satisfactorily the reading to the annoyance for at least 50 percent of the impulses.

For engineering evaluations, it is necessary to work with equipment which confirms to the normal types. Therefore, a communication receiver having a band width of 6 Kc/s at 6 db. down is used. This choice of bandwidth is in conformity with those met in the commercially mass produced receivers.

The use of automatic recording is not suitable. There are frequent changes of noise intensity especially when noise is received from a local thunderstorm which require changes of sensitivity range, if the readings are to be accurate. Otherwise observations get recorded when the receiver or the amplifier is working under overload conditions and this leads to inaccuracy in the measurements. Further, the problem of interference is most serious. Therefore, observations are recorded manually. A complete circuit diagram of the receiver together with the noise
meter is being given in the next chapter.

(d) **Calibration** :- Atmospheric noise is a form of interference. The noise source should be considered a form of radiator and its field strength should be measured in micro-volts per meter. The noise meter thus becomes a noise field strength meter. A standard signal generator should be used for calibration purposes. Since measurements are made on the audio frequency side, the question of a suitable audio frequency and a suitable percentage modulation arises. 30 per cent modulation by a 400 c/s note is usually used for receiver testing, etc. The same should also be used in this case. All the results can be given on this basis. In addition, it is useful to provide conversion data for converting these results to what would be obtained with 15 per cent and 50 per cent modulation. While carrying out the calibrations it is necessary to feed the output of the signal generator through the equivalent impedance of the aerial at the point at which the aerial is connected. For maintaining calibration accuracy, the power to the receiver must be supplied through a constant voltage transformer and the calibration periodically checked.

For theoretical purposes, it is necessary to appreciate the significance of this calibration. The noise field strength is due to the noise source operating as a radiator at a particular frequency within the limits
of the defined bandwidth of the receiver. This radiator is considered as equivalent to a radiator at the same frequency carrying a 30 per cent modulation by a 400 c/s note.

2. READING AND ANALYSIS OF OBSERVATIONS

Observations are taken continuously for ten minutes period three times an hour. All impulses are generally recorded, but when the number of impulses exceeds twenty per minute about twenty of the highest during the minute are recorded. The general practice is to record about 600 impulses per hour. The continuous background noise, here called type A noise, is recorded by reading the meter twice in each ten minute interval. This is done very carefully when the number of impulses per minute, due to type B noise, is less than ten. Higher values will be recorded for type A noise, in the noise meter described in this paper, when a large number of impulses due to type B or type C noise is also present. But this is of no significance, as the type A noise which appears as a background is never stated when the number of impulses due to type B or type C noise exceeds ten per minute.

Type A noise which is read twice in each ten minutes interval gives six readings for an hour. They are arithmetically averaged to give the average for the hour. A similar procedure is adopted for averaging type B or type C
noise. The 300 highest values recorded during the 30 minutes in any hour of observation are arithmetically averaged to obtain the average value of the ten highest peaks per minute. This is stated as the quasi-peak value of type B or type C noise for the hour.

The hourly values so obtained are tabulated for the whole month. The twenty-four hours of the day are divided into four divisions:

- 06.00 to 12.00
- 12.00 to 18.00
- 18.00 to 24.00
- 00.00 to 06.00

This division has been made having regard to broadcasting as a utility service and the use of the Indian Standard Time is found convenient in India. Separate tables of hourly values for the whole month are prepared for the whole divisions. The monthly table of one division is examined at a time. During some months, the number of impulses per minute due to type B or type C Noise is less than five throughout. In such cases, analysis of only Type A noise is resorted to and observations of type B or type C noise, if any, are ignored. During some months, the number of impulses due to type B or type C noise always exceeds the rate of ten per minute. In such cases type A noise is ignored. During a few other
months, however, the number of impulses per minute due to type B noise varies and has the value below ten also. For such months, the median value of the number of impulses per minute is computed for the whole month. If this is less than five, type B noise is ignored. If it is more than five and less than ten, values of both type A and type B noises are computed and given. If it is more than ten, only type B noise is computed.

The following procedure is adopted in all cases for obtaining the magnitude of the noise in one division of the day for the whole month. The hourly average readings for the month are sorted into groups and a graph is drawn - percentage of readings exceeding a value against the value. From the graph, the median value for the month and the value that is exceeded during only 10 per cent of the hours of observation, the higher decile value, are both obtained. In giving noise figures for the month, it should be adequate to state the median value of the hourly average for each of the four divisions of the day, but, if a higher figure is required it is best to state the higher decile value also for each division of the day.

Sometimes when hourly values are sorted into groups, it is found that they fall into more than one set. In such cases, the median value, etc. are obtained for each set separately as each may have a different source of origin. Monthly values are obtained by weighing the
value of each set in proportion to the frequency of its occurrence. Under no circumstances are the results of type A, type B and type C noises mixed up.

Before proceeding to compute the results, the following general principles are observed. To compute the hourly average, there must be at least two ten minute periods of continuous observations, the two ten minute periods to lie in the two halves of the hour. For any six hour division of the day, there must be at least three hourly averages and these hours must be alternate. For computing monthly averages, there must be readings for at least ten days of the month and the days must be spread over the whole month. In actual practice observations should be obtained far in excess of these minima.

3. SPECIFIC TEST AND MODIFICATIONS

The noise meter described above was first utilized by the author for a preliminary check to find out how far the classification of noise, the relating of the meter kick to the annoyance, etc. was satisfactory in the 25 and 31 meter bands. It was found that all these were entirely satisfactory and hence systematic measurements were undertaken at the frequencies by the method of AIYA.

Owing to the fact that noise at the frequencies 9 and
13 Mc/s could change rapidly, a slight modification in the method of analysis of the data was adopted. Thus certain sources of noise could go into skip. When this happened, sometimes the type of noise changed. To give an example, one would be receiving impulsive noise up to a certain time. This is probably due to one set of sources. When this went into skip, the noise received became type A noise only. In view of some of these considerations it was felt that using each twenty minute unit in the hour separately and taking the noise value of that unit for computations was more helpful than averaging the noise value of two or three such twenty minute units in the hour and using hourly values. This method offered an additional advantage in the fact that a large number of noise values were available for analysis.
### 4. REFERENCES

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