

CHAPTER XI

RADIO COMMUNICATION (VHF)

11.1 RADIO COMMUNICATION

11.1.1 “ Communication by Radio” means the transfer of intelligence from one point to another through space using radiated electromagnetic energy (Radio Waves) (in the FREQ spectrum of from about 10khz to about 30,000 Khz.)

Radio Frequency Spectrum

Class	Freq. Range	Wave length
VLF	10-30 kHz	30,000-10,000 m
LF	30-300 kHz	10,000 - 1,000 m
MF	300-3000 kHz	1,000-100m
HF	3-30 MHz	100-10m
VHF	30-300 MHz	10-1m
UHF	300-3000MHz	100-10cm
MW	3 to 30 GHZ	10-1 cm

11.1.2 The objective of any communication is to pass information from one place to other. Radio Communication consists of generation, propagation and reception of electromagnetic waves. Modes used in Indian Railways are-

- H.F. Communication
- VHF Communication
- UHF Communication
- M/W Communication

11.1.3 VERY HIGH FREQUENCY (VHF) COMMUNICATION

The frequency band of VHF Communication is 30 to 300 MHz. The frequency allotted by WPC (Wireless Planning and Coordination wing of ministry of communication) in VHF for Indian Railways are in the band (a) 85.5 to 86.5 MHz (b) 146.2 to 167.95 MHz. Communication in this range of frequencies is mainly due to line of sight, reflection and scattering of waves.

11.1.4 Uses of VHF :

VHF Communication is used (now a days) for many applications as :-

- Traffic Control
- Police Duties.
- Mobile Communication
- Point to point communication
- Multy - Rural Radio (MARR) Application
- Disaster management

Possible uses of VHF Communication on IR are

- Communication during Maintenance and Constructional Blocks
- Yard communication
- Communication in the train in between Guard & Driver
- Mobile Communication in between moving train/vehicle with fixed location(Station) or another moving train/ vehicle.
- Emergency Communication:
 - ART equipped with hand held and base station VHF sets.
- Duplex VHF Sets are utilised for
 - extension of exchange number to distant place.
 - control working.(Train Traffic Control)/Patching.
 - Universal Emergency Communication for communication between driver, guard, station master & Cabin.

11.2 SPECIFICATION & PERFORMANCE PARAMETERS

11.2.1 High Frequency Radio Communication:

i) . Frequency Range- 3 MHz to 30 MHz

- Spot Frequencies are used,
- Separate for transmission & Reception.
- Different pair of frequencies used for Day & Night communication.
- Grouping of Frequencies is done to economise the frequencies
- maxi. 5 stations are grouped in each group.

ii) Mode of Propagation:

The frequency band of HF Communication is 3 to 30 MHz. Waves in HF range are propagated through ionosphere and are known as sky waves.

iii) Type of Antenna used:

- Dipole

- Folded dipole
- Rhombic
- Log Periodic
- T. Type
- Inverted L type
- Doublet

iv) Use:

- May be used as a supplement to the Land Line Communication, to meet increased Traffic requirements..
- For Emergency Communication

11.2.2 LIMITATION OF HF COMMUNICATION

1. HF Communication is rather difficult for the range of 50 Kms to 250 Kms and normally, the planning of fixed-to-fixed services is not done for such distances.
2. Variation in Levels
 - The ionosphere characteristics vary diurnally, seasonally and yearly.

The communication during sunrise and sunset is always subjected to great fluctuations in levels, due to changes in ionospheric layers.

3. Choice of Frequencies
 - A reliable HF communication depends on the correct choice of frequencies and proper type of aerials. A minimum of three frequencies per station is required for round the clock operation.
 - Based on the ionospheric information provided by the committee of Council of Scientific and Industrial Research, as published by National Physical Laboratory New Delhi, the working frequencies for the wireless links can be computed.
4. Reliability:

The reliability of an HF communication circuit depends on the working frequency and the take off angle of the beam.

5. Optimum Working Frequency:

The optimum, working frequency is normally 85% of the maximum usable frequency.

11.2.3 VHF PARAMETERS

1. Frequency Range

-30 MHz to 300 MHz

- Frequency Band allotted for Railways are 85.5 MHz to 86.5 MHz and 146 MHz to 174 MHz.
- One spot frequency is used for each channel

2. Mode of Propagation:

- Line of sight waves
- Reflection & scattering of waves

3. Type of operation: Simplex
Duplex

4. Channel capacity:- Single channel/Four channel/Sixteen channel
- Voice or Low speed Data or both.

[Sets are equipped for more than one channel i.e. upto 16 channels or so. Crystal controlled or synthesised version, out of them one channel can be used at a time.]

5. Type of Equipment:

- Walkie -Talkie (Hand Held) Set-
1W/2W to 5W switchable output power operated on in-built NI-CD/
NiMH / LiOin batteries.
- Mobile Sets –
Mobile Sets can be carried in a case or bag or can be fitted in a vehicle
 - Weight less than 3 Kg
 - Output Range 25 Watt
 - Operated on 12V car battery
- Base Station –
Installed at desired location
 - Operating on AC Mains or by 12V battery.
 - External antenna with feeder cable connector mounted on a mast (Roof top) needed.

6. Antennas used

- Whip Antenna
- Ground Plane (GP) Antenna
- Dipole
- Low Profile
- Yagi Antenna

7. Feeder cable:

- 50 Ohms Unbalanced Coaxial cable

8. Communication Range:

- Depends upon terrain.
 - Average range
 - Walkie -Talkie (Hand Held set) - 1 to 2 km.
 - Mobile Set- Upto 15 km.
 - Base Station - upto 50 Kms. When antenna used are directional & fixed at the height of 15 to 20 metres.

9. Licence:

- Mandatory

Licence is to be obtained through Railway Board from WPC , Ministry of Communication.

- Such licence shall be applied on prescribed form

10. Frequencies allotment:

-Wireless planning and Coordination wing of Ministry of Communication (WPC) allots different band of frequencies and sport frequencies in the band for different department. According to National Frequency Allocation Plan.

-Major users are -

-30-108 MHz: Rlys., Defence, P&T, Door Darshan, AIR, Police

108-230 MHz : Same except AIR

230-622 MHz : Same except AIR

5000-8500 MHz: Defence, Rlys., P&T

7125-7425 MHz : is exclusive for Railways

- Use of un allotted frequency is prohibited.

11.2.4 LIMITATIONS OF VHF COMMUNICATION :

- Short distance coverage
- Blank Zones occur due to terrain, high rise buildings & other structures, so area must be surveyed for blank zones from where communication is not possible.
- Simplex mode of working
- Maintenance of rechargeable batteries
- AC power supply is required for charging of batteries which may not be available at the sight of use. Charging also needs about 4 to 6 hours. Thus the set requires more than one battery set for continuous operation.
- Interference due to other user having adjacent frequencies .

- Effect of prevailing noise in the surrounding.

11.3 INSTALLATION OF VHF

- For point-to-point communication availability of line of sight is essential
- Antenna height must be decided at both location by measuring minimum field strength needed for satisfactory communication. This can be measured by putting one trans-receiver at one end and mounting antenna at a suitable height (of 15 to 20 metres) and measuring the field strength by field strength meter at other location. VHF set of the same power and frequency can also be installed to check the quality of communication. Antenna height and orientation can be adjusted to get a maximum signal strength or voice.
- Antenna can be mounted on a tower/Mast of approved design or on a pipe on the roof of a building. Feeder cable must be of 50 Ohm. impedance unbalanced of approved design.
- Connectors used must be also of good quality and supplied by approved supplier.
- Power Supply System
 - 230V AC mains operated power supply of rated voltage & current is supplied by the supplier along with VHF set. A 12V/80-120 AH battery must be connected on float to the set to prevent communication failure during mains failure.
- Spark Suppressors must be installed in the Vehicle in case of mobile set is installed in the vehicle and powered by its battery.

11.4 MAINTENANCE OF VHF

- VHF set's transmitting frequency and power are to be measured once in a month.
- Spurious emission squelch operation current drain frequency stability, frequency deviation, sensitivity of receiver & adjacent channel selectivity are to be checked once in a year in the centralised repair centre.
- Power Supply System

Following measurements shall be taken

- Input and output voltage & currents – weekly
- Specific gravity of each cell - weekly

- Care must be taken while using such sets when low battery indication is appearing on the set, it must be charged as specified in the manual.

ANTENNA SYSTEM ALONG WITH FEEDER CABLE & CONNECTOR

- Antenna system Physical and visual inspection once in a week. VSWR, Power handling capacity, frequency band of operation, directivity, radiation pattern must be checked annually.

11.5 TEST METERS REQUIRED AT CENTRALISED REPAIR CENTRE

- Tools
- Test jigs & fixture
- Antistatic work station
- Temperature Control soldering/de-soldering station
- Digital Multi Meter
- Frequency Counter
- Power meter
- Oscilloscope
- Field strength meter
- Insulation Tester
- Programmable frequency scanner
- Communication Radio Test set.

11.6 INSPECTION

- VHF installation must be inspected every month by Section Engineer.
- Sr.DSTE/DSTE/ASTE once in a year

11.7 FAILURE REPORT

- VHF system's failure must be reported to controlling officer daily in the morning.
- Monthly statement of a failure must be reported in the PCDO to Headquarter.
- The VHF sets must not be opened at site as far as possible. Faulty sets must be sent to Repair Centre to prevent further damage at site by Electro Static discharge.
- Spare sets must be kept at site or at suitable location to replace the faulty sets.