

## Chapter 5

# Basic Signal Leader Information

This chapter contains six sections. Each section provides guidance on performing a different task or area of importance common to signal leaders.

### Section I.

## Profiling Radio Links

Obtaining LOS between two stations is essential when forming a multichannel radio link. For most systems, the LOS planning range is about 40 kilometers, due to the earth's curvature. LOS analysis may be done by automated means, usually by the signal brigade's/battalion's S3. See Figure 5-1.

**To perform a manual radio LOS analysis, obtain the following materials:**

- Grid coordinates of both stations.
- Path profile paper,  $4/3$  earth radius (if possible).
- Map sheet containing both stations.
- GTA 5-2-12 protractor and coordinate scale.

**Perform the following steps:**

- On the map sheet, place a dot at each proposed site location and circle it for ease of finding it later.

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- Draw a line from point A to point B and determine the distance between the two.

- If the distance is greater than 48 kilometers (40 kilometers for MSE), the points exceed maximum planning range and the transmissions may be too weak to receive. A relay may be needed; however, its use is undesirable and should be used as a last resort so that unnecessary assets are not tied up in one radio link.

- Determine the elevation in meters of the originating and destination stations. Plot them the proper distance apart on the profile paper. **Remember to add the antenna heights.**

- Divide the distance between the stations into 1 kilometer increments.

- Determine the highest elevation in meters at 1 kilometer increments. Plot these on the profile chart.

- Connect the points to establish a graphic picture of the terrain along the path between the two stations.

- Draw a straight line between the antenna stations. This line represents the multichannel radio transmission path.

- If the transmission path does not clear the terrain, LOS is not possible. Another terminal site or a relay site should be chosen. Leaders at company, platoon and team level should manually profile radio shots as soon as possible.

***TC 24-21 explains LOS manual profiling methods in detail.***

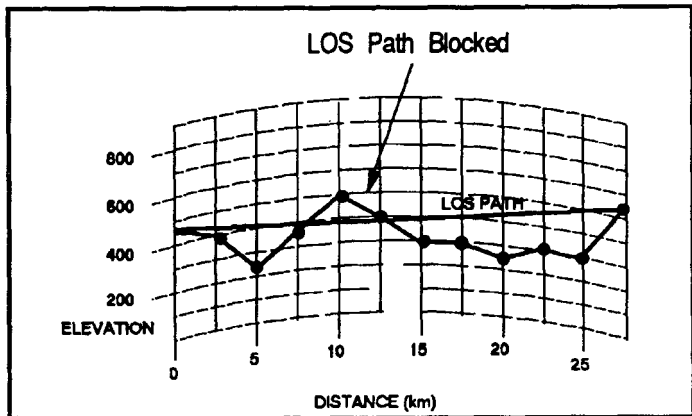


Figure 5-1. Sample LOS study.

## Section II.

### Conducting Convoy Operations

#### 5-1. Convoy Organization

A convoy is a group of vehicles organized under a single commander for movement. It consists of—

- **The march column.** All vehicles involved in a single move along the same route.
- **The serial.** Subdivision of vehicles moving from the same area along the same route.
- **The march unit.** Subdivision of a serial.

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The march unit consists of march unit elements. These are—

- **Advance/Trail Elements.** These are not a part of the main march unit. They are detailed to perform special duties such as quartering and reconnaissance. Some tactical situations may require advance, flank, or rear guards. Heavily traveled routes and busy intersections may require guides, escorts, and patrols.

- **Lead Element.** First vehicle in the column. Contains the pace setter/navigator who ensures proper route and checks for changes to orders at predetermined points.

- **Main Body.** Column of vehicles comprising the bulk of the convoy.

- **Trail Element.** Last vehicle in the column. The trail element contains a trail officer/noncommissioned officer (NCO) responsible for maintenance and medical support.

### 5-2. Convoy Planning Factors

**Interval.** Distance between vehicles depends on many variables.

- Urban areas                      50 meters.
- Rural areas                        150 meters.
- Expressways                       200 meters.

**Convoy Speed.** Convoy speed depends on road conditions, traffic conditions, and the speed of the slowest vehicle.

- Cities/built up areas 24 Km/h (15 MPH).
- Two lane roads 40 Km/h (25 MPH).
- Limited access expressways 66 Km/h (40 MPH).
- Blackout Drive 8 Km/h ( 5 MPH).

**Convoy Security.** Military police (MP) units may provide convoy security on a continuous or intermittent basis. MP support depends on the threat in the area of operations. If MP units do not provide support, the convoy commander must plan for security. This includes—

- Noise and light discipline.
- Front, flank, and rear security.
- Security during halts.
- Air cover.
- Fire support.
- Communications.
- Checkpoints.

#### **Start and Release Points.**

- **Start point (SP).** This is where all elements of a column come under the control of the convoy commander. The SP must be a place along the route easily recognized on both maps and ground.

- **Release point (RP).** This is where elements of the column are released to their individual control. The RP, like the SP, must be a place along the route easily recognized on both maps and ground. The RP should have multiple exits to prevent congestion.

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### **Halts.**

- **Time.** Plan 10 minute rest halts every 2 hours. Plan longer halts for dining, refueling, and bivouacking.
- **Location.** Choose halt locations in advance and identify good characteristic for dispersion and concealment according to operational conditions.

### **Personnel Duties During a Halt.**

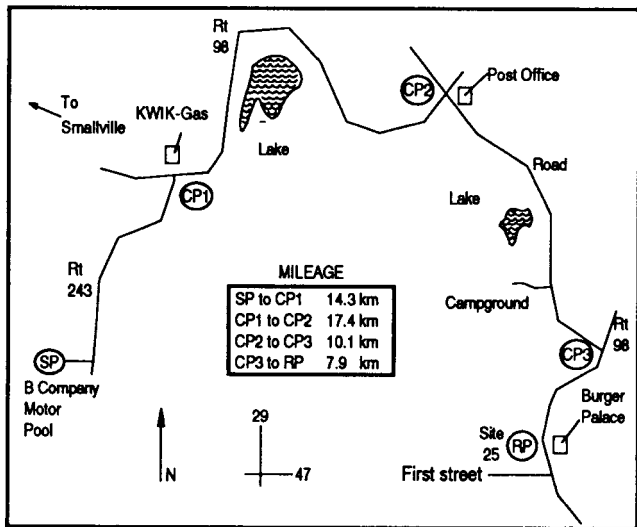
- Officers and NCOs check the welfare of the soldiers, the security of loads, vehicular performance, fuel levels, and the performance of maintenance.
- Control personnel should inspect and give instructions to ensure the column begins with minimal confusion.
- Drivers should inspect their vehicles and loads.
- Drivers should perform preventive maintenance checks and services (PMCS)/during operations check.
- Assistant drivers must stay alert and be able to fill in for the driver when needed.

### **Additional planning factors.**

- Route reconnaissance.
- Tactical situation.
- Strip map preparation and distribution.
- Obtaining convoy clearance.
- Contacts along route for medical, decontamination, and vehicular support.
- Status of trained drivers.
- Number of vehicles involved.
- Types of loads.
- Traffic conditions.
- Communications for convoy control.

### 5-3. Convoy Commander's Brief

Before departing, the convoy commander should issue strip maps and conduct a briefing for all convoy members. Figure 5-2 shows a typical strip map.



*Figure 5-2. Typical strip map.*

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Recommended briefing subjects that should be covered are shown in the outline below.

### **Situation**

- Friendly forces.
- Support units.
- Enemy situation.

### **Mission:**

- Origin.
- Route.
- Destination.

### **Execution:**

- General organization of the convoy.
- Time schedule.
- Night operations.
- Risk assessment.

### **Route:**

- Convoy speed.
- Catch-up speed.
- Control personnel.
- Security forces commander.
- Fire support commander.
- Medical evacuation support and safety.
- Hazards of route and weather conditions.
- Defensive driving principles.
- Interval between vehicles.
- Decontamination points and contaminated routes.



**Emergency Measures:**

- Breakdown/accident procedures.
- Use of highway warning kits.
- Separation from convoy procedures.
- Ambush (actions taken).
- Contingency plans.

**Administration and Logistics:**

- Billeting arrangements.
- Messing arrangements.
- Refueling of vehicles.
- Supply support, Class I-IX.

**Command and Signal:**

- Primary and backup radio frequencies.
- Location and call sign of convoy commander.
- Location and call sign of assistant convoy commander.
- Location and call sign of medical support personnel.

***NOTE: Appendix O of FM 55-30 provides a sample convoy commander's checklist.***

### **Section III.**

## **Signal Site Selection/Set Up**

Select sites and routes using ground reconnaissance when possible. Use an aerial or map reconnaissance when a ground reconnaissance is not possible.

**Site Reconnaissance.** As soon as the team knows where it will deploy, it conducts a thorough reconnaissance. For an NC, this usually includes the platoon leader, platoon sergeants, LOS supervisor, security and NBC team. The NC's reconnaissance must be extremely detailed as site selection and layout are critical to network success. NC reconnaissance is considered complete when the platoon leader can fill out the NC diagram showing--

- Antenna and LOS(V3) placements.
- RAU locations.
- NC switch/NMF locations.
- Hasty defensive sites and security plans.

The LOS has first priority of placement, the local RAU second, and the NC switch/NMF last. The platoon leader also determines if the database needs modifying and back briefs his command on his site layout and initial security procedures.

**Site Selection.** Select the site that best meets the following criteria:

- Site should be level and allow sufficient space for tactical dispersion of communications equipment in addition

to subscriber space requirements.

- Site must have a clear LOS path for radio systems, must be free of obstacles that prevent transmissions, and away from interference sources such as power lines, generators, or other antennas.

- Site should be accessible in all weather conditions.
- Site should provide overhead cover and concealment with adequate dispersion of assets, be defensible, have more than one exit, and not attract enemy attention.
- Site should have a helicopter landing zone for emergencies or supplies.

**Site Planning.** Once a site has been chosen, do the following in accordance with the unit SOP:

- Estimate equipment placement, subscriber location, initial observation post, sleeping, dining and latrine areas, dismount points, parking space, and restricted areas.
  - Draw a site sketch including the above items.
  - Coordinating for the site with higher headquarters, subscriber units, and other appropriate elements.
  - Prepare strip map with primary and alternate routes to the site.
  - Distribute strip maps to appropriate personnel.

**Site Set-up.** The following are points to consider when setting up a signal site:

- Maintain a tactical configuration and position the operations van in a central location. This allows easy control of the site.
- Position the radio vans on the edge of the site in the direction they will be shooting. This allows the antennas

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to have the most direct shot without crossing anything on the site. Generators and power lines must be kept as far away from the antennae as possible.

- Maintain switches in a central location to allow ease of installing cables to multichannel and other radio vans.
- Allow easy access to generators.
- Back vehicles into designated parking areas to allow for rapid displacement.

### Section IV. Signal Site Security

#### 5-4. Types of Signal Sites

Signal sites must be able to defend against sabotage, ground forces, and airborne/air assault forces with little or no outside help. They must also be prepared to survive enemy air, artillery, and NBC attack.

There are different signal sites and different considerations must be made when planning a site defense for each. Current threat status/situation is an important factor when planning and committing assets and personnel to defend a site. Use mission, enemy, terrain, troops and time (METT-T) considerations and order priorities accordingly.

**Remote Sites.** These are small teams located in isolated positions, usually for relay or retransmission purposes. They cannot hope to defeat a large enemy force. Teams should try to remain concealed and report enemy activity

to higher headquarters. Conduct risk assessment for remoted sites to determine the probability of mission success. Leaders must carefully track specific threats and move quickly when in danger.

**Collocated Sites.** These are usually teams that deploy to support a unit CP, such as an extension node. Usually, the team members are responsible for a portion of the perimeter defense. Careful coordination must be done with the collocating units. All defense matters for the site should be the responsibility of one central authority.

**Node Sites.** This is usually a platoon-sized signal unit that may or may not collocate with another unit. Based on the +6 enemy threat level, the signal site commander must plan a site defense and coordinate with nearby units for mutual support.

## 5-5. Site Defense Tasks

The following list provides guidelines for planning a site defense and should be prioritized according to the mission.

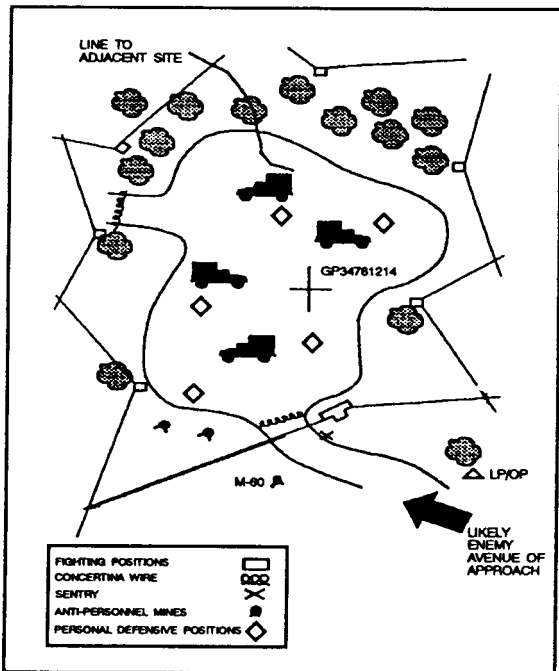
- Set up a dismount point and a blackout drive line.
- Park vans at least 50 meters apart or as dictated by the tactical situation and/or environment to allow minimum damage from indirect fire.
  - Camouflage tents, vehicles, and equipment.
  - Set up defensive positions with interlocking fields of fire.
  - Ensure aiming stakes are in place and place antipersonnel mines along probable foot approaches.
  - Set up personal defensive positions within the site.

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- Establish overhead cover.
- Establish a site defense command center.
- Establish listening points outside earshot of generators.
  - Establish a roving guard force to cover the perimeter and check on fighting positions.
  - Establish external patrols to periodically sweep the immediate area outside the perimeter.
  - Position and over-watch obstacles, mines, and trip wires.
  - Position light antitank weapons (AT-4) along vehicle approach routes.
  - Establish perimeter control.
  - Ensure communications exist to observation/listening posts, dismount points, fighting positions, and casualty evacuation points.
    - Establish an additional line between collocating units and the signal command center.
    - Set up NBC monitoring equipment.
    - Establish rally points and reactionary force plan.
    - Coordinate a call for fire plan.
    - Inventory sensitive items often to provide an accurate battle status.
    - Plan for medical support and evacuation.
    - Set up ammunition resupply points.
    - Set up a viable sleep plan that integrates into the work/defense plan.
    - Control weapons employment and ensure each soldier has adequate ammunition (with magazines).
    - Rehearse your plan according to the standards outlined in the appropriate Army Training and Evaluation

Programs (ARTEPs), soldiers manuals, and/or SOPs. (See Appendix C.)

Figure 5-3 gives a typical signal site defence diagram.



*Figure 5-3. Signal site defence diagram.*

## Section V. Communications Under Special Conditions

The environment can take a severe toll on communications. This section addresses a few specific problems involved in six environments: cold weather, desert, jungle, mountain, urban, and nuclear.

***NOTE: The operator must perform PMCS to maintain all equipment in an operational status.***

### 5-6. Cold Weather Operations

Soldiers must be trained on cold weather safety. Extra precautions must be taken with heaters and open fires. Carbon monoxide poisoning is a constant danger. Snow and ice build-up on tents and vehicle canvas can cause tearing.

**Generators and Vehicles.** Grounding is difficult in frozen earth. Gloves must be worn when handling all metal objects. If possible, use existing underground pipes or above ground structures to get an adequate ground. Antifreeze and lightweight oil must be used for all vehicles during cold weather operations. Liquid cooled generators also need antifreeze. Maintenance personnel must check antifreeze levels often. Water may appear in fuel and fuel lines. Do not use contaminated fuel. The fuel must be



drained from the vehicle and new fuel added before operating the vehicle. Keep dry batteries warm and charge wet-cell batteries. Vehicles must be started at least once a day and operated for 10 minutes at a high revolutions per minute (RPM) to charge the battery. Keep tire chains tight to avoid damage to vehicles.

**Radios.** Water vapor from the breath can freeze and make a microphone useless. Use de-icing shields to prevent this. Ice on antennas can cause damage and make it hard to extend or lower the antenna. Ice can be melted from the mast using a hose attached to the exhaust pipe of a vehicle. Direct the hot air on the ice until it melts.

**Wire.** Condensation and ice on connectors make connecting the cables difficult and can degrade the signal path. Care must be taken to keep connectors dry. Extreme care must be taken in handling cables at low temperatures. When the rubber jackets become hard, the cables must be protected from stretching and bending to prevent short circuits caused by breaks in the covering. If cables are to be bent, they must first be warmed.

## **5-7. Desert Operations**

Two of the biggest problems involved in desert operations are dust and extreme heat. Dust and sand particles damage equipment. The heat can take its toll on generators, wire, communications equipment, and personnel.

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**Generators and Vehicles.** Grounding equipment is difficult and can be accomplished by burying grounding plates in the sand and frequently pouring salt solutions on them. Special attention must be taken to ensure air filters are cleaned daily to prevent equipment damage.

**Radios.** Keep all radios cool and clean. Keep them in a shaded or ventilated area whenever possible. Cover hot radios with a damp towel without blocking the air vents. Evaporation will cool the radio. After dark, rapid temperature drops can cause heat inversion that can disrupt radio communications until the atmosphere stabilizes. Desert terrain can cause excessive signal attenuation making planning ranges shorter.

**Wire.** Bury wire and cables deep in soft sand, if possible. This prevents damage to the cable insulation.

*See FM 90-3 for more information on desert operations.*

### 5-8. Jungle Operations

During jungle operations, movement and visibility are reduced by terrain and heavy foliage. This same terrain and foliage provides adequate cover and concealment. Humidity and heat can cause condensation. Microphones, wires, cables, end gauges are especially susceptible to moisture and fungus. Battery life is shortened. If air conditioning is available, it is very effective against high humidity.

**Radios.** The range of radio communications is reduced. VHF and UHF radios are limited by jungle growth and terrain that absorb transmissions. HF radios are more effective. Airborne radio retransmissions are used to overcome dense vegetation.

**Wire.** Dense vegetation and difficult terrain limit using wire in jungle operations. Aerial wire installation can be used as an alternate dispensing method due to mobility restrictions in jungle terrain.

*See FM 90-6 for more information on jungle operations.*

## 5-9. Mountain Operations

Mobility is difficult in mountainous terrain, and it can be difficult to find a level area for a communications site.

**Generators and Vehicles.** Generators and communications assemblages need level ground to operate properly. It is difficult to drive ground rods and guy wire stakes into rocky, mountainous terrain. The rocky soil provides poor grounds, however, adding salt solutions will improve the electrical flow.

**Radios.** When operating in mountainous terrain, additional retransmission assets will be needed. LOS paths are much more difficult to gain. Use of relays improves communications. Positioning antennas is crucial in mountainous terrain because moving an antenna even a small distance can drastically affect reception.

*See FM 90-6 for more information on mountain operations.*

### **5-10. Urban Operations**

Seizure of cities and towns consume enormous resources, degrade the momentum of offensive operations, restrict maneuver, and are time-consuming.

**Radios.** Large buildings and electrical interference greatly hamper LOS communications. Using retransmission helps to alleviate the problem. Aerial retransmission is the most effective. If this is not available, install antennas as high as possible. Avoid using church steeples and other obvious places. It is better to select a common type of building and install the antenna. Consider the background before camouflaging antennas. Remember to remote radios to separate the operators from the equipment. Position retransmission stations near intersections to provide better coverage.

**Multichannel Radio.** The effectiveness of multichannel radio is reduced in an urban area because the radios require LOS. LOS between units is nearly impassible in built-up areas. Install multichannel radio systems only after the city is relatively secure. Use an SHF radio shot to bring the circuits into the supported headquarters.

**Telephone and Wire.** The prompt seizure of the city and existing communications facilities are very important. Notify parent headquarters of controlled telephone numbers. Public or private telephones coupled with

stationing messengers at the phones can provide excellent emergency communications. Initially, telephone and wire lines have limited use. Installation in sewer systems, subway tunnels, or through intact buildings provides increased protection for the wire. Use aerial or overhead construction when installing wire along city streets.

**Visual Signals.** Pyrotechnics, smoke, and marking panels are means of communications in the city.

## **5-11. Nuclear Environment**

A nuclear environment is very damaging to sensitive signal equipment. Leaders must know how to protect vital assets for future use.

**Electromagnetic Pulse (EMP).** The radiation from a nuclear burst produces EMP. Gamma rays radiate outward from the burst and strip electrons from the atoms in the air. This creates a virtual wall of fast-moving electrons as the radiation sweeps outward in an expanding wave. This process creates a region of high voltage and strong interference.

**Susceptibility.** Signal equipment is very susceptible to EMP. Normally, the smaller the individual component, the more susceptible it is to electronic attack (EA).

**EMP Protective Measures.** All equipment not required in primary systems should remain disconnected and stored within a sealed shelter or other shielded enclosure for protection from the EA. This measure reduces the

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likelihood of all equipment being simultaneously damaged by EMP and provides for backup components to reinstall affected systems.

**Wire and Cable.** Wire and cable should be shielded and properly grounded. The cable length must be kept as short as possible. Shields on all cables connect to the grounding systems where provided.

**Radios.** Antennas should be disconnected from radio sets when not in use. Reduce operational nets to a minimum. Most tactical radios with fully closed metal cases will provide adequate EMP protection if all external connectors have been removed. Placing items in vehicles, vans, and underground shelters provide effective protection.

## Section VI. Power Generation Sources

### 5-12. Batteries

Signal equipment can use two types of batteries:

- **Wet-Cell Batteries.** These contain electrolytes and normally provide greater amperage than dry cell batteries for tasks like starting vehicles. They require special attention to maximize their life span.

- **Dry-Cell Batteries.** These do not need water or acid. They can power smaller equipment such as radios, flashlights, and SB-22 switchboards. They can be ordered

through the supply system and kept on-hand until needed. Dry cell batteries should be refrigerated to increase their life span and should be removed from equipment when not in use.

It is crucial to maintain an adequate supply of batteries for the unit. Use the following guidelines to develop an SOP:

- Determine the unit's battery needs. Refer to the property book to find equipment that uses batteries. Look in the equipment training manuals to determine the type and number of batteries each item takes and how long the batteries will last.

- Determine the unit's battery usage and needed stockage level. Use Supply Bulletin 11-6 to obtain battery stock numbers, compute their storage life, and handling/disposal requirements.

- Ensure PLUS requisition required stock.

- Make a chart to keep track of the information. Table 5-1 shows an example of the chart.

Table 5-1. Sample portion of unit battery storage chart.

BATTERY	EQUIPMENT	HOURS (@ 70°F)	OPERATING TEMP MAX	HOURS (a) MAX OP TEMP	OPERATING TEMP MIN	HOURS (a) MIN OP TEMP	NSN 6135-01-
BA-5112U	AN/PRC-112	20	131°F	20	40°F	6	236-4168
BA-5372U	AN/PRC119	500	125°F	500	-20°F	160	214-6441
BA-5372U	TSECKY-57	2300	130°F	2300	-40°F	1000	214-6441
BA-5372U	TSECKY-68	1800	140°F	1800	-40°F	1000	214-6441
BA-5567U	AN/AVS-6	16	125°F	15.5	-25°F	8	060-5365
BA-5567U	AN/PVS-4	46	127°F	40	-20°F	28	060-5365
BA-5567U	AN/PVS-5 SERIES	32	120°F	32	-20°F	18	060-5365
BA-5567U	AN/PVS-7 SERIES	32	120°F	32	-20°F	18	060-5365
BA-5567U	AN/TVS-5	46	127°F	40	-20°F	28	060-5365
BA-5567U	AN/VVS-2	23	120°F	20	-20°F	12	060-5365
BA-5588U	AN/PRC-126	56	130°F	56	-40°F	19	068-2708
BA-5588U	AN/PRC-68	33	130°F	33	-40°F	12	068-2708
BA-5590U	AN/PRC-119	20	125°F	20	-20°F	12	036-3465
BA-5590U	AN/TAS-4A	5	125°F	5.2	-40°F	2	036-3465
BA-5590U	AN/TAS-6A	5	125°F	5.2	-40°F	2	036-3465
BA-5590U	TSECKY-57	53	130°F	53.2	-40°F	21.5	036-3465
BA-5598U	AN/PRC-77	57	140°F	57	-40°F	30	034-2239
BA-5598U	AN/JGC-74	6	155°F	5.8	-25°F	4	034-2239



### 5-13. Commercial Power

This power is normally very reliable. However, in the event of power failure backup generators and vehicle DC power systems are vital alternatives. As a fail-safe measure, backup power cables should be run to the tactical generators.

### 5-14. Engine-Driven Generator Units

Tactical generators can produce either AC or DC. DC generators can have output capacities from 0.4 to 15.9 kilowatts. AC generators can have output capacities from 0.3 to 1000 kilowatts.

Table 5-2 gives the approximate fuel consumption rates of various generators. When operating at medium to high temperature (50° to 100° F), a generator will consume oil at one quart per eight hours of operation.

*Table 5-2. Fuel consumption rates.*

1.5 kilowatt generator -> 5 gal per 8 hours	
3.0	8
5.0	8
10.0	2.5

### 5-15. Generator Pre-Start Up Checklist

Use the following checklist when employing generators for power:

- Are TMs and PMCS lists available?
  - Is the generator located on a flat surface, not more than 15° from level?
  - Are brakes set and wheels blocked securely to prevent any movement of the trailer?
  - Are all exhaust pipes and air intake filters free of obstructions?
  - Is grounding rod driven at no less than a 45° angle into the ground?
  - Are ground straps securely connected?
  - Does the engine have any loose or missing wiring?
- Any oil or fuel leaks? Are air and fuel filters clean?
- How often is the oil changed or checked?
  - Have fuel containers been placed at least 50 feet from equipment and a fire point set up?
  - Are backup generators completely installed and ready for use?
  - Is the safety leg on the trailer being used?
  - Are drip pans present and being used?