Part IV

Staff Planning Factors and Considerations

4001. Casualty Rate Estimation

The following method of casualty estimation provides only a rough figure. It is not as accurate as the official Marine Corps computer models (https://osprey.manpower.usmc.mil/web/manpower/manpower.nsf/mp/MPP-60+Main+Frames) and simulations that are available. This model uses an eight step process.

a. Step 1: Determine Combat Intensity Level

Use the METT matrix to determine the appropriate level for each of the four categories (mission, enemy, terrain, and troops).

Intensity Level	Mission	Enemy	Terrain	Troops
No Combat: Available forces are not committed. **(Index = 0)**	The MAGTF/Force level objective is clearly attainable. **(Score = 0)**	Enemy forces, regardless of size are not involved in combat operations. **(Score = 0)**	Terrain aspects of combat operations are not considered a factor. **(Score = 0)**	Friendly forces, regardless of size or composition, are not engaged in combat operations. **(Score = 0)**
Light Combat: Sporadic combat involving less than 30% of all forces' maneuver elements and less than 50% of all fire support means. **(Index = 1-36)**	Minimum risk involved in attaining the MAGTF objective. **(Score = 10)**	Overall enemy forces are inferior to friendly forces in strength, supporting arms, and tactical disposition with respect to the MAGTF objective. **(Score = 9)**	Weather severe and restricts operations. Visibility very poor. Minimum number of manmade/natural obstacles. Soil stability and trafficability facilitate maneuver. Topology dense and compartmented, offering cover and concealment for friendly forces. **(Score = 3)**	Less than 33% of friendly maneuver forces are involved in combat and less than 50% of the supporting arms are engaged. Friendly forces are significantly superior to enemy forces with regard to strong supporting arms and tactical disposition. **(Score = 8)**
Moderate Combat: Continuous combat during which employment of higher echelon resources to ensure accomplishment of the force mission is not required. 30-60% of all force maneuver echelons and over 50% of all fire support means are engaged. **(Index = 37-53)**	Moderate degree of risk in attaining the MAGTF objective. **(Score = 15)**	Enemy forces are inferior to friendly forces in strength, supporting arms, and tactical disposition with respect to the MAGTF objective, but are capable of delaying the MAGTF's accomplishment of the mission. **(Score = 14)**	Weather is marginally clear. Visibility allows limited view of forces. Limited number of manmade/natural obstacles. Soil stability and trafficability allow maneuver. Topology is rolling and partly wooded. **(Score = 4)**	About 33-50% of friendly maneuver forces are involved in combat and 50% of the supporting arms are engaged. Friendly forces are clearly superior to enemy forces at the objective area with regard to strength, supporting arms, and tactical disposition. **(Score = 12)**
Heavy Combat: All-out combat demanding total strength application such that possible employment of next higher echelon resources may be necessary to ensure accomplishment of the force mission. All fire support means and more than 60% of all force maneuver echelons are engaged. **(Index = 54-80)**	Attainment of the MAGTF objective is a high risk. **(Score = 21)**	Overall enemy forces are sufficient in strength, supporting arms, and tactical disposition to create a highly significant risk of not attaining at least one MAGTF preliminary objective. **(Score = 19)**	Weather is mostly clear. Visibility allows for almost unlimited view of forces. Terrain aspects of the objective area facilitate significant combat operations between enemy and friendly forces. Significant manmade/natural obstacles channel forces and concentrate supporting fires. Soil stability and trafficability limit maneuver. Topology is flat and open. **(Score = 5)**	Majority of the friendly maneuver forces are involved in combat and all supporting arms are engaged. Commitment of the reserve is imminent. Friendly forces are superior to enemy forces within the objective area with respect to strength, supporting arms, and tactical disposition. **(Score = 26)**
Intense Combat: Heavy, highly exposed forces to ensure accomplishment of the force mission. All fire support means and all force maneuver echelons are potentially engaged. **(Index = 81-100)**	A severe risk of not attaining the MAGTF objective. **(Score = 34)**	Enemy forces are equal to or superior to friendly forces in strength, supporting arms, and tactical disposition with respect to the MAGTF objective area. **(Score = 31)**	Weather is clear. Visibility is unlimited. Terrain aspects of the objective area facilitate maximum combat operations between friendly and enemy forces. Significant manmade/natural obstacles to channel forces and concentrate supporting fires. Soil stability and trafficability limit maneuver. Topology is flat and open. **(Score = 9)**	All friendly maneuver forces are involved in combat, reserve forces are committed. All supporting arms are engaged, commitment of the reserve of the next higher level of command is imminent. Friendly forces are equal to or inferior to enemy forces at the objective area with regard to strength, supporting arms, or tactical disposition. **(Score = 26)**

Table 4-1. METT matrix.

Next, locate the “score” within each selected box and record it on the worksheet. After recording all four scores, total them up and compare the total score to the “Intensity” column of the METT Matrix. Find the range of numbers that has the total score within and record the corresponding intensity level on the worksheet.

Mission Score	_____
Enemy Score	_____
Terrain Score	_____
Troops Score	_____
Total Score	_____
Intensity Level	_____

Table 4-2. Determine combat intensity level.

b. Step 2: Estimate Casualty Range for Ground Forces

After the combat intensity level has been determined in Step 1, locate the intensity level on the chart in Step 2 and record the corresponding casualties/thousands/day number into the worksheet.

Intensity	Low	Average/Mid	High
Light	1.03	1.98	2.93
Moderate	2.94	4.4	5.86
Heavy	5.87	8.37	10.86
Intense	10.87	14.05	17.22

Low	_____
Average/Mid	_____
High	_____

Table 4-3. Estimate casualty range for ground forces (thousands per day).

c. Step 3: Estimate Aviation Combat Casualties

Select the aviation combat intensity level per the following categories:

- **Intense**. All threat anti-aircraft systems are capable of engaging MAGTF aircraft at maximum rates of fire.
- **Heavy**. All threat anti-aircraft systems are capable of engaging MAGTF aircraft at sustained rates of fire (fewer MAGTF aircraft are exposed).
- **Moderate**. A moderate number of threat anti-aircraft systems are anticipated vs. MAGTF aircraft.
- **Light**. A minimum number of anti-aircraft systems are anticipated.

After choosing the aviation combat intensity level, select the appropriate column in the worksheet and record the figure. Transfer these figures to the "B" column of the second worksheet. The aviation planners should provide the estimated number of sorties per day which the MAGTF will fly in each mission category. Insert this information into the "C" column of the second worksheet. Multiply columns "B" and "C" and enter the product into column "D" to get aviation casualties in each mission category. Sum the figures in column "D" to get total aviation casualties.

	Combat Intensity Level			
Mission Category	**Intense**	**Heavy**	**Moderate**	**Light**
Close Air Support	0.04	0.03	0.02	0.01
Deep Air Support	0.18	0.12	0.07	0.02
Troop Transport	0.4	0.28	0.17	0.06
Resupply	0.12	0.08	0.05	0.02

Close Air Support	_____
Deep Air Support	_____
Troop Transport	_____
Resupply	_____

Table 4-4. Estimate aviation combat casualties per sortie.

A **Mission Category**	B **Casualty Rate**		C **Sorties per Day**		D **Totals**
Close Air Support	_____	X	_____	=	_____
Deep Air Support	_____	X	_____	=	_____
Troop Transport	_____	X	_____	=	_____
Resupply	_____	X	_____	=	_____
			Total Aviation Casualties	=	_____

Table 4-5. Estimate total aviation combat casualties.

d. Step 4: Estimate Casualties in Combat Service Support Forces

Casualties in the CSS are usually significantly lighter than those of the ground element. To account for them accurately, they must be separated from the ground combat elements and assigned a different casualty rate. Assess the risk to the CSS as either high, medium, or low. Transcribe the ground combat casualty rates from Step 2 onto the lines provided in line (a) of the Step 4 worksheet. Circle the assessed risk to the CSS on line (b). Select the corresponding formula and enter the corresponding ground casualty rate from line (a). Use the formula to determine the CSS (non-maneuver) casualty rate and the ground combat element casualty rate.

a.	_____ Low (a)	_____ Middle (b)	_____ High (c)	
	(Copy the ground casualty rates from Step 2)			
b.	Assessed Overall CSS Risk:	Low	Middle (circle one)	High
Low:	0.015 X _____ =		_____ Non-maneuver casualties (per thousands per day)	
	0.985 X _____ =		_____ GCE Casualties (per thousands per day)	
Middle:	0.047 X _____ =		_____ Non-maneuver casualties (per thousands per day)	
	0.953 X _____ =		_____ GCE Casualties (per thousands per day)	
High:	0.047 X _____ =		_____ Non-maneuver casualties (per thousands per day)	
	0.953 X _____ =		_____ GCE Casualties (per thousands per day)	
Note: Use only one of the three formulas				

Table 4-6. Estimate casualties in combat service support forces.

e. Step 5: Determine Total Battle Casualties

Total battle casualties can now be calculated. First, transcribe the number for GCE and Non-Maneuver Casualties from Step 4, and place them on the appropriate lines, (a) and (b), of the Step 5 worksheet. From the G-1, obtain the total strength of the MAGTF. Indicate this number in thousands. To calculate the total battle casualties per day, multiply (a) by (c), then (b) by (c), and add the results. This provides the Ground and Non-Maneuver elements, then move the results obtained in Step 3 (total aviation casualties) to line (2), and add lines (1) and (2)., entering the total on line (3). This is the total MAGTF casualties per day for the MAGTF.

a. Number of ground casualties (from Step 4) (per thousand per day) _____ (a)

b. Number of non-maneuver casualties (from Step 4) (per thousand per day) _____ (b)

c. The estimated MAGTF troop strength (per thousands per day) _____ (c)

d. Total battle casualties per day:

(1) _____ [(a) x (c)] + _____ [(b) x (c)] = _____ (Ground + non-maneuver casualties)

(2) Aviation casualties (from Step 3) = _____ (Aviation casualties)

(3) Total battle casualties: [(1) + (2)] (per thousand per day) = _____ (TOTAL)

Table 4-7. Determine total battle casualties for the MAGTF.

f. Step 6: Allocation of Type of Casualty

Once the total number of casualties has been determined, they have to be distributed by type (killed in action (KIA), wounded in action (WIA), or died of wounds (DOW)). Part of the determination is speed of evacuation. In most cases the medical evacuation policy is "rapid." However, circumstances may require a delay in transporting casualties rearward. The longer the evacuation, the greater the increase in KIAs and DOWs. Once evacuation policy is determined, transfer the rates in the Step 6 Allocation of Type of Casualty table to the lines provided in the Step 6 worksheet. Copy the total battle casualty figure from Step 5 and apply it to each of the rates for KIA, WIA, and DOW (Note: The total of KIA, WIA, and DOW should equal the number from Step 5).

Type of Casualty	Rapid	After 6 Hours	After 24 Hours
KIA	0.195	0.26	0.32
WIA	0.789	0.7	0.6
DOW	0.016	0.04	0.08

Table 4-8. Anticipated casualty evacuation.

a. Casualty evacuation is anticipated to be: Rapid 6 + Hours 24 + Hours (circle one)

b. Rates from Step 6 Table based on casualty evacuation plan:

_____ KIA _____ WIA _____ DOW

c. Allocation of casualties by type:

KIA _____ (total from step 5) x _____ (KIA Rates) = _____ (KIA)

WIA _____ (total from step 5) x _____ (WIA Rates) = _____ (WIA)

DOW _____ (total from step 5) x _____ (DOW Rates) = _____ (DOW)

Total Casualties = _____

Table 4-9. Allocation of type of casualty.

g. Step 7: Disease, Non-Battle Injury, Battle Fatigue, Missing in Action, Captured, and Administrative Losses

To calculate the disease, non-battle injury (NBI), battle fatigue (BF), missing in action (MIA), captured (CAP), and administrative loss (AL), use the total MAGTF strength in thousands (from Step 5c). Use the intensity level from Step 1. Multiply the numbers out to give the DNBI, BNI, BF, MIA, CAP, and AL casualties. The top two charts contain approved rates.

East Asia					
	Combat Intensity Level				
	None	Light	Moderate	Heavy	Intense
Disease	0.98	0.98	0.98	1.21	1.29
Non-Battle Injury	0.2	0.23	0.26	0.37	0.44
Battle Fatigue	0	0.13	0.29	0.63	0.9
Missing in Action	0.005	0.02	0.03	0.06	0.09
Captured	0.005	0.02	0.04	0.06	0.09
Admin Losses	0	0	0	0	0

Southwest Asia					
	Combat Intensity Level				
	None	Light	Moderate	Heavy	Intense
Disease	0.98	0.98	0.98	1.21	1.29
Non-Battle Injury	0.26	0.29	0.31	0.44	0.54
Battle Fatigue	0	0.24	0.53	1.09	1.57
Missing in Action	0.005	0.02	0.03	0.06	0.09
Captured	0.005	0.02	0.04	0.06	0.09
Admin Losses	0	0	0	0	0

Note 1: In tropical climates, the disease rate is approximately 1.35 times the average for temperate climates.
Note 2: In northern climates, disease rate is twice as high in early winter as in summer.

_____ Total MAGTF Strength (in thousands)	x	_____ Disease Rate	=	_____ Disease Casualties (per thousand per day)
_____ Total MAGTF Strength (in thousands)	x	_____ Non-battle Injury Rate	=	_____ Non-Battle Injuries (per thousand per day)
_____ Total MAGTF Strength (in thousands)	x	_____ Battle Fatigue Rate	=	_____ Battle Fatigue Casualties (per thousand per day)
_____ Total MAGTF Strength (in thousands)	x	_____ Missing in Action Rate	=	_____ Missing in Action (per thousand per day)
_____ Total MAGTF Strength (in thousands)	x	_____ Captured Rate	=	_____ Captured (per thousand per day)
_____ Total MAGTF Strength (in thousands)	x	_____ Admin Loss Rate	=	_____ Admin Losses (per thousand per day)

Table 4-10. Disease, non-battle injury, battle fatigue, missing in action, captured, and administrative loss casualties.

h. Step 8: Total Personnel Casualties

Sum up all the MAGTF casualty figures as indicated in the Step 8 worksheet.

Battle Casualties:

KIA – Killed in Action (from Step 6): _____

WIA – Wounded in Action (from Step 6): _____

DOW – Died of Wounds (from Step 6): _____

Other Casualties:

DNBI – Disease Casualties (from Step 7): _____

NBI – Non-Battle Injuries (from Step 7): _____

BF – Battle Fatigue (from Step 7): _____

MIA – Missing in Action (from Step 7): _____

CAP – Captured (from Step 7): _____

AL – Admin Losses (from Step 7): _____

Table 4-11. Total MAGTF personnel casualties summary.

4002. Enemy Prisoner of War Evacuation

1. COLLECTION POINTS - Area where EPWs are held temporarily while awaiting evacuation to the rear. EPWs are sometimes interrogated for intelligence information. Sick or seriously wounded EPWs can be cared for by corpsmen or transferred to the closest medical facility. From collection points, EPWs are transported to various transfer points and from there to an MP-operated MAGTF holding facility.

- **Company-level Collection Point** - Tactical troops guard EPWs.
- **Battalion-level Collection Point** -
  - Collection points are usually established at the battalion level.
  - Established at a central location designated by the GCE commander.
  - Usually operated by MPs.

2. HOLDING AREAS - Holding areas can accommodate more captives and maintain captives longer than can collection points. Like collection points, holding points are temporary and must be able to move with little or no notice. Holding areas usually are located near a base or base cluster. An MP platoon or company usually operates a MAGTF holding area.

- A platoon can guard up to 500 captives.
- A company can guard up to 2,000 captives.

NOTE: In most cases, EPWs captured by Marines will be transferred to the U.S. Army for processing and internment. In the event the U.S. Army is not involved in the operation, the Marines will have to process the EPWs and guard them until they either are authorized to release the EPWs, or higher military authority makes arrangements to take charge of the EPWs.

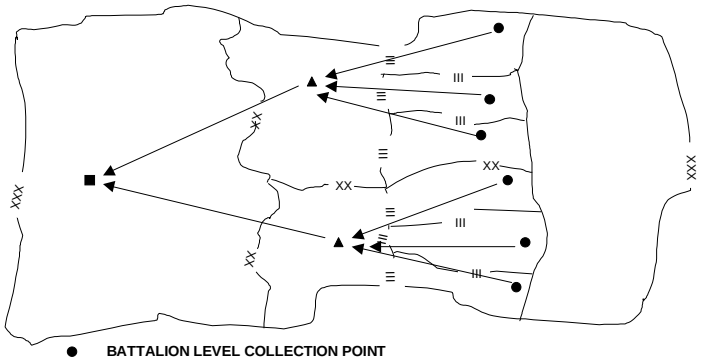


Figure 4-1. Enemy prisoner of war evacuation diagram.

4003. Medical Regulating Concept

a. Initial Concept

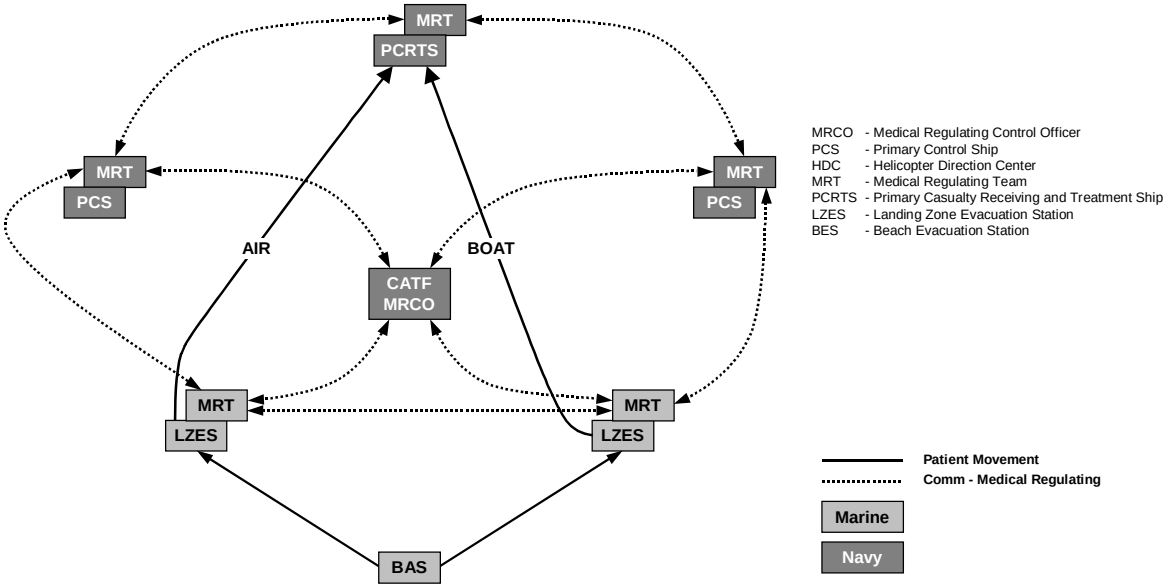


Figure 4-2. Initial medical regulating concept.

b. Mature Concept

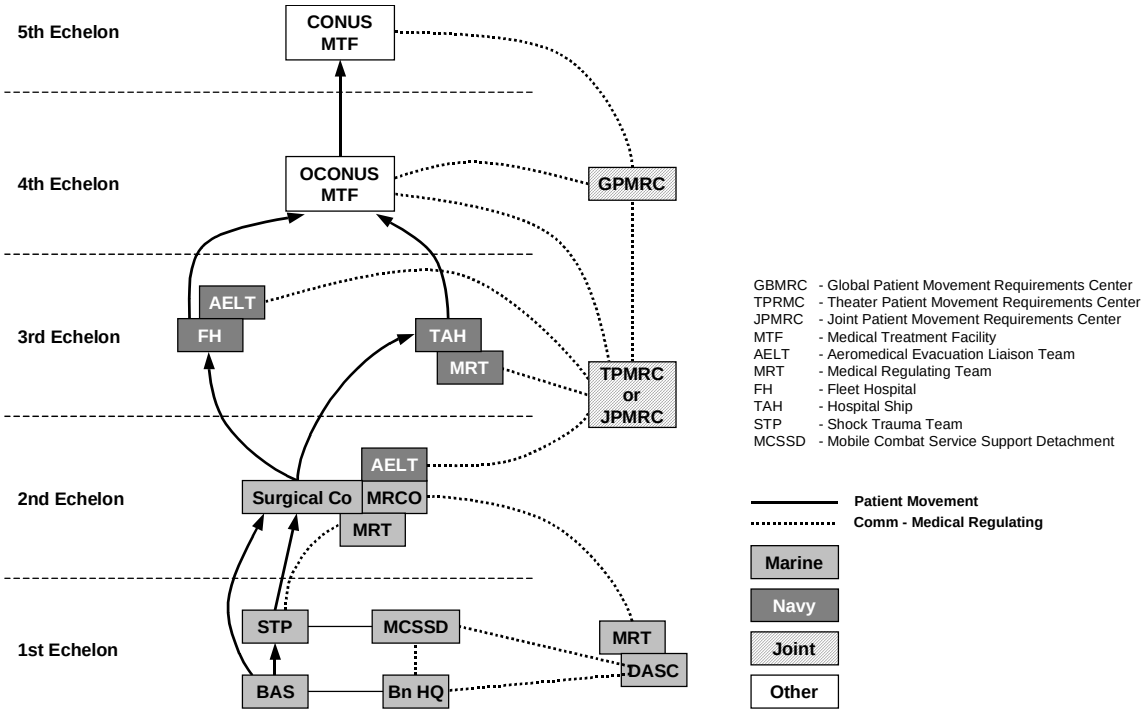


Figure 4-3. Mature medical regulating concept.

4004. Return to Duty Estimate Considerations

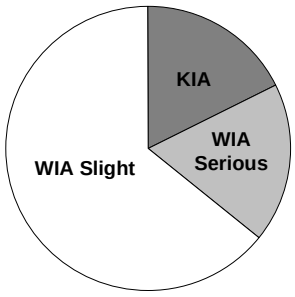


Chart shows breakdown of results of hits by enemy fire. Roughly 10% of the wounded can be returned to duty from 1st and 2nd Echelon facilities.

When figuring in DNBI the RTD rate increases significantly. Will normally average around 40% from 1st and 2nd echelon facilities.

Longer evacuation policy will increase the number RTD but will require greater logistic support. Shorter evac policy will reduce RTD, require less logistics, but place more demand on evacuation assets.

Figure 4-4. Return to duty estimate considerations.

4005. Human Waste and Solid Waste Planning Factors

Port-a-John Planning Factor	6 Port-a-johns are required for each 150 persons and one additional for each 40 extra
Solid Waste Production (Trash) Planning Factor	On average, each person will produce 5.3 lbs of solid waste per day.

Table 4-12. Human and solid waste planning factors.

4006. Intelligence Considerations

a. Planning and Direction

Are the priority information requirements based on threat and environmentally-related commander's critical information requirements? Are they prioritized according to the commander's priorities? Are they specific with regard to time, location, and enemy (or weather) event or activity? Is event templating used to drive and sequence the collection plan? Are organic collection assets employed to answer these requirements in a prioritized manner? Are information requirements on which MEF is unable to collect forwarded to higher headquarters as RFIs in a logical, prioritized manner? Are MEF collectors aware of the higher headquarter's CCIRs, and are the MEF's major subordinate commands aware of the MEF's CCIRs?

b. Collection

Have external agency liaisons been identified/requested?

A. External Intelligence Collection Assets:
   1. E-8 Joint Surveillance Target Attack Radar System (JSTARS):
      a. Common Ground Station: 1 CGS, 2 CGS teams planned per I MEF & II MEF; near-real time reporting of wide area surveillance/moving target indicators (WAS/MTI), synthetic aperture radar/fixed target indicators (SAR/FTI).
      b. WAS/MTI: *Capabilities:* Range: 155 miles; coverage 386,100 sqmi during one 8-hour sortie. Indicates ground vehicles moving >3 mph (esp. convoys, vehicular choke points, operational bridges & causeways based on analysis); logistics and CP sites; classifies traffic by wheeled/tracked/unknown; locates slow-moving aircraft *Limitations:* JSTARS MTI cannot: 1) identify types of wheeled/tracked vehicles; 2) locate or identify static positions; 3) locate/identify/describe human activities; 4) detect or track rockets or ballistic missiles; 5) operate optimally in rugged terrain (due to terrain masking).

c. SAR/FTI: *Capabilities*: Can: image defensive positions; support BDA; confirm occupation of artillery/defense sites; *Limitations*: Cannot: identify types of vehicles; independently detect mobile SSMs.

2. Imagery:
   a. Guidelines for National Imagery Interpretation Ratings Scale (NIIRS): Targeting, BDA, and equipment identification: 5.0 or better; general terrain orientation, etc.: 3.0 or better.
   b. Tactical Exploitation Group (TEG; 1 planned per FIIU in Intel Bn) interoperable with Theater JIC/JACs, MCISU, U-2R/S (SAR), and F/A-18D ATARS (infrared & electro-optic); capable of exploitation of HUD/FLIR and gun-camera tapes.
   c. National Imagery. Minimum Time factors: Time-over-target parameters: standard (contingency), 48 hours; MEU(SOC) (contingency), 24 hours; absolute (contingency): 6 hours; routine request for national imagery to support peacetime exercise: 90 days.
   d. Commercial Satellite Imagery: SPOT, RADARSAT, IKONOS, etc.

B. Organic Intelligence Collection Assets:
1. Ground R&S: Has the MAGTF Staff allowed sufficient time for proper, detailed ground R&S planning, including insert/extract, no communication, go/no go criteria, emergency extract, time/mission priority? Are ground R&S assets over committed; i.e., is there an adequate reserve for sustained operations? [General rule: 1/3 committed, 1/3 planning/rehearsing, 1/3 resting/reconstituting; Surge: ½ committed]; communication relay sites required/planned?
2. Radio Battalions: Limitations on range, power of ground-based EW; exposure of MEWSS.
3. Unattended Ground Sensors:
   a. Requirements/limitations: radio frequency line-of-sight link to monitoring site; air delivery: relatively inaccurate, limited to rotary-wing aircraft; max quantity per MEF: 200 strings @3-4 sensors/string; lifetime up to 30 days (relay systems up to 45 days).
   b. Detection range: Seismic: 25m for personnel, 100m for vehicles; magnetic: 3m for personnel, 25m for vehicles; cannot air insert; infrared: 15m for personnel, 100m for vehicles; unidirectional.
   c. Weight (Encoder Transmitter Unit/Seismic Intrusion Detector) (basic without additional components): 5.5 lbs.
   d. Employment considerations: hand-emplacement (accurate) vs. air-delivered (rapid).
4. EA-6B/TERPES: organic RT/NRT SIGINT/ELINT collection/analysis.
5. Armed Reconnaissance: Ensure that armed reconnaissance missions capable of fulfilling MEF/MSC CCIRs (and/or PIRs) are identified, indicators briefed to aircrews.
6. Manpack SIDS: Capabilities: 3) Outstations per base station w/ night vision device, 3 lenses, encryption capability; interoperable w/ PRC-104, PRC-113, SINCGARS, various SATCOM.
7. Unmanned Aerial Vehicles:
   a. General/C2: Video/IR: visible moisture degrades optics; light precipitation will structurally damage the vehicle.
   b. Portable Control Stations (PCS): allow launch & recovery up to 40km from the ground control station (GCS).
   c. Remote Receive Stations (RRS): allow for video monitoring up to 30km from the UAV through directional antenna.
   d. Pioneer: payload: day/night FLIR & daylight TV camera + airborne data relay; max range 200km; max duration 8 hours.
   e. Standard UAV FRAGO (in advance of ATO): 48 hours.
   f. Recommended positive altitude separation between aircraft and UAVs: 500’.
   g. Improved surface launch/recovery space required: launch—300m rolling, 0 assisted; recovery 400m rolling, 70m arrested.

c. Processing and Exploitation

Battle damage assessment (BDA) planning horizons:

- Phase I (Physical Damage Assessment): *organic MEF capability*: RT/NRT/24 hours
- Phase II (Functional Damage Assessment): *organic/Joint Force*: 24+ hours
- Phase III (Target System Assessment): *Theater BDA Cell*: 48+ hours

Are processing and exploitation priorities established to facilitate timely use by the MEF/MSCs?
Joint Service Imagery Processing System (JSIPS) National: Deployment requirements--ground: 46) pallets & 10) flatbed tractor-trailers; air: 1) C-5 and 1) C-141 as well as a 10k forklift at either end; Circuits required: 1) simplex 1.544 Mbs lease line (Ft. Belvoir); 1) full duplex 56 Kbs lease line (Ft Belvoir); 1) full duplex 2.4 Kbs lease line (Ft McClellan); JWICS/SIPRNET connectivity; Power requirement: 4) MEP 007 generators.

d. Production, Dissemination, and Utilization

A. Are all subordinate commands represented in dissemination concept, including the relevant rear area commands? Is the MEF G-2 cognizant of the CCIRs of both higher headquarters and MSCs?
B. Are analysis and production priorities established to enable the AFC to produce and disseminate the most critical and relevant intelligence products first?
C. Is the MEF OPT supported by up-to-date, predictive intelligence products for use in developing and war gaming future enemy and friendly COAs?

4007. Aircraft Sortie Rates

SQUADRON TYPE	AIRCRAFT per SQUADRON	SUSTAIN RATE	SURGE RATE	SORTIES (70% FMC)		SORTIES (80% FMC)		SORTIES (90% FMC)	
				SUSTAIN	SURGE	SUSTAIN	SURGE	SUSTAIN	SURGE
VMFA (F/A-18A/C)	12	2.5	4.0	20	32	23	36	27	44
VMFA(AW) (F/A-18D)	12	2.5	4.0	20	32	23	36	27	44
VMA (AV-8B)	16	2.5	4.0	27	44	32	52	35	56
VMAQ (EA-6B)	5	1.2	2.0	4	6	5	8	5	8
VMGR (KC-130)	12	1.2	2.0	9	16	11	18	13	22
HMH (CH-53E)	16	2.5	4.0	27	44	32	52	35	56
HMH (CH-53D)	8	2.5	4.0	12	20	15	24	17	28
HMM (CH-46E)	12	2.5	4.0	20	32	23	36	27	44
HMLA (AH-1W)	18	2.5	4.0	30	48	35	56	40	64
HMLA (UH-1N)	9	2.5	4.0	15	24	17	28	20	32

SURGE PENALTY				
Days of Surge	1	2	3	4
Surge Rate	4	3.5	3.0	2.5
Sustained Rate	2.5	2.0	1.5	1.0

Notes:
1. Sortie rates will fluctuate based on the types of missions flown, duration of missions, aircrew availability, and maintenance sustainment capability
2. Surge penalties: For each day of surge, the next day's surge and sustained sortie rates are reduced by 0.5. Additionally, the number of surge days will result in an equal number of sustained rate penalty days.

   For example: If the MAW surges its F/A-18s for three days, it will only be able to fly its F/A-18s at a sustained rate of 1.5 sorties a day for three days following the completion of the surge.

SURGE DAYS			PENALTY DAYS			RETURN TO NORMAL OPERATIONS
Day 1 Surge 4.0	Day 2 Surge 3.5	Day 3 Surge 3.0	Day 4 Sustained 1.5	Day 5 Sustained 1.5	Day 6 Sustained 1.5	Day 7 Sustained 2.5

Table 4-13. Aircraft sorties.

		200	500	1,000	2,000	3,000
Sorties Required	CH-46	9	21	42	84	126
	CH-53	4	11	21	42	63

Notes:
1. Sortie requirements based on legs less than 90 nmi.
2. Lift Requirements—
   - CH-46: 12 Marines.
   - CH53D/E: 24 Marines.
3. Vehicles not included. If vehicles are to be lifted, assume one CH-53E per vehicle not available for troop lift.
4. Sorties shown should be combined to determine total sorties required (i.e., to lift 200 Marines, 13 sorties must be flown: 9 CH-46 and 4 CH-53).

Table 4-14. Number of Marines to be lifted.

4008. Marine Air Command and Control System

a. Forms of Control

	TACC	TADC	TAOC	EW/C	DASC	MATCD	MMT	FAC	FAC(A)	ASC(A)	TAC(A)
Command	X										
Air Control	X	X	X	X	X	X	X	X	X	X	X
Positive Control			X	X		X	X				
Procedural Control			X	X	X	X	X	X	X	X	X
Radar Control			X	X		X	X				
Terminal Control			X	X		X	X	X	X		
Air Direction	X	X	X	X						X	X

Table 4-15. Forms of control exercised by Marine air command and control system agencies.

b. Movement and Set Up

	TACC	TAOC	EW/C	DASC	MATCD	MMT
Time to Set-Up (Hours)	24	24	4	2	18	2
Number of C-141Equivalents	TBD	TBD	2	3	TBD	1

Table 4-16. Marine air command and control system agency planning factors.

c. Service Function Comparisons

MARINE	NAVY	AIR FORCE	ARMY
TACC	TACC	AOC	DOCC
TAOC	FAWC	CRC	ADA TOC
EW/C	SAWC	CRE	ADA TAC
	CG/DDG		ADA
FSCC	SACC		FSE
DASC	ASCS	ASOC	G-3 AIR
DASC(A)		ABCCC	
TACP		TACP	FIST
TAC(A)		TAC(A)	FO
FAC(A)		FAC(A)	FO
	HAWKEYE	AWACS	

Table 4-17. Service function comparisons.

d. The Theater Air-Ground System

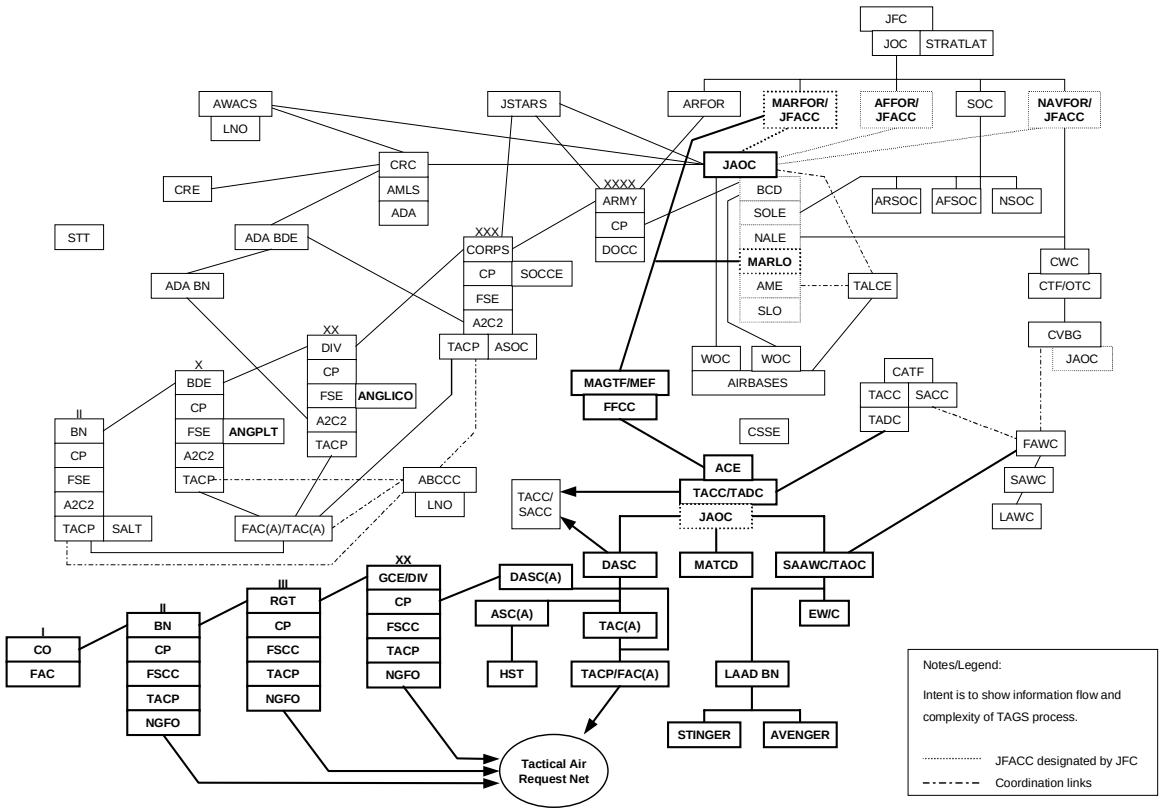


Figure 4-5. Theater air-ground system.

A2C2	Army airspace command and control
ADA	air defense artillery
AME	air mobility element
ASC(A)	assault support coordinator (airborne)
ASOC	air support operations center
AWACS	Airborne Warning and Control System
BCD	battlefield coordination detachment
CATF	commander amphibious task force
CP	command post
CRC	control and reporting center
CRE	control and reporting element
CVBG	carrier battle group
CWC	composite warfare commander
DASC	direct air support center
DOCC	deep operations coordination cell
EW/C	early warning/control
FAC	forward air controller
FAC(A)	forward air controller (airborne)
FAWC	fleet air warfare coordinator
FFCC	force fires coordination center
FSCC	fire support coordination center
FSE	fire support element
GLO	ground liaison officer
HST	helicopter support team
JAOC	joint air operations center
JFACC	joint force air component commander
JFC	joint force commander
JOC	joint operations center
JSTARS	Joint Surveillance Target Attack Radar System
LAAD	low altitude air defense
LAWC	local air warfare coordinator
MARLO	Marine liaison officer
MATCD	Marine air traffic control detachment
NALE	naval and amphibious liaison element
NGFO	naval gunfire officer
SAAWC	sector antiair warfare coordinator
SACC	supporting arms coordination center
SALT	supporting arms liaison team
SAWC	sector air warfare coordinator
SLO	space liaison officer
SOC	special operations command
SOLE	special operations liaison element
STRATLAT	strategic liaison team
STT	special tactics team
TAC(A)	tactical air coordinator (airborne)
TACC	tactical air command center
TACP	tactical air control party
TADC	tactical air direction center
TALCE	tactical airlift control element
TAOC	tactical air operations center
WOC	wing operations center

e. Notional Aviation Communications Architecture

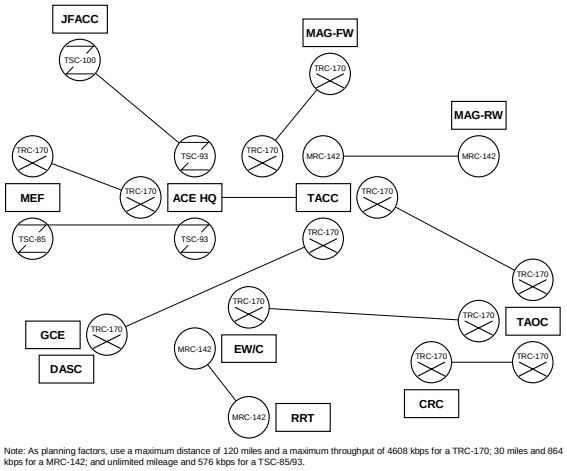


Figure 4-6. Notional aviation communications architecture.

4009. Artillery Planning Factors and Considerations

a. Artillery Organization for Combat

Organization for combat is a two-step process—

- Place units in a tactical organization to establish command relationships.
- Give units a tactical mission.

b. Fundamentals of Organizing for Combat

The fundamentals of organizing for combat include—

- Adequate support for committed maneuver units.*
- Weight the main attack in the offense or the most vulnerable area in the defense.*
- Facilitate future operations.*
- Ensure immediately available artillery support for the commander to influence the action.
- Maximum feasible centralized control.

* May be achieved by mission, ammunition, and positioning.

c. Establishing Command Relationships

- Strategic tailoring.
- Tactical tailoring.
- Command relationships include—
  - Organic.
  - Assigned.
  - Attached.
  - OPCON.

d. Tactical Missions (Inherent Responsibilities)

Arty Unit with Mission of:	Answers Calls for Fire in Priority from:	Establish Liaison with:	Establish Comm with:	Has as it's Zone of Fire	Furnishes Forward Observers	Is Positioned by:	Has its Fires Planned by:
Direct Support	1. Supported unit 2. Own observers 3. Higher artillery HQ	Supported unit (down to Bn level)	Supported unit	Zone of action of supported unit	To each company sized maneuver unit of supported unit	Unit commander as needed or ordered by higher artillery HQ	Develop own fire plan in coordination with supported unit
Reinforcing	1. Reinforced unit 2. Own observers 3. Higher artillery HQ	Reinforced unit	Reinforced unit	Zone of fire of reinforced unit	Upon request of reinforced unit	Reinforced unit or as ordered by higher artillery HQ	Reinforced unit
General Support	1. Higher artillery HQ 2. Own observers	No inherent requirement	No inherent requirement	Zone of action of supported unit	No inherent requirement	Higher artillery HQ	Higher artillery HQ
General Support Reinforcing	1. Higher artillery HQ 2. Reinforced unit 3. Own observers	Reinforced unit	Reinforced unit	Zone of action of supported unit to include zone of fire of reinforced unit	Upon request of reinforced unit subject to prior approval of higher artillery HQ	Higher artillery HQ or reinforced unit subject to prior approval by higher artillery HQ	Higher artillery HQ

Table 4-18. Artillery tactical missions (inherent responsibilities).

e. Essential Fire Support Tasks

Information	Example
Purpose: The friendly maneuver reason for the effects. Identifies friendly maneuver formation that will leverage the targeting effect and describes in space and time what the effect will accomplish.	Allow 5th Marines to destroy 1st echelon MRR in EA Red prior to the arrival of 2nd echelon MRR
Task: Descries the effects against a specific enemy formation's function or capability. Memory Aid: Task = Effect, Formation, Function	Delay 2nd echelon MRR for 30 minutes at TAI 1.
Method: Who does the task and when it's accomplished. Ties the detect function to the executor in space and time	STA TM 1 calls for FA delivered FASCAM after 1st echelon MRR passes through TAI 1. 2/11 emplaces medium density FASCAM minefield (AE 6000)
End State: The definition of success for the task. Attempts to quantify successful accomplishment of the task. Also provides the basis for the assess function and the decision to reattack or not.	2nd echelon MRR delayed at TAI 1 until 1st echelon MRR is destroyed

Table 4-19. Artillery essential fire support tasks.

f. Artillery Cannon and Rocket Characteristics

Asset	Max Range (m)	Max Rate of Fire	Sustained Rate of Fire	Ammunition Available
SP 155-mm Howitzer M109A5/A6	23,500 (RAP) 18,100 (w/o RAP) 28,100 (BBDPICM) 17,900 (DPICM)	4 rounds per minute	1 round per minute	HE, RAP, ICM, HE, ILLUM, DPICM, ADAM, NUC, WP, RAAMS, CPHD, SMK
SP 203-mm Howitzer M110A2	30,000 (RAP) 22,900 (w/o RAP)	1.5 rounds per minute	0.5 rounds per minute	HE, ICM, NUC, DPCIM, RAP
SP 227-mm MLRS M270	Basic Range 32,000 (DPICM) ER MLRS 45,000 (DPICM)	1 round per 1.5 seconds	1 round per 4.5 seconds	DPICM, APAM
Towed 105-mm Howitzer M119A1	19,500 (IRAP) 11,500 (w/o RAP)	10 rounds per minute	3 rounds per minute	HE, WP, ILLUM, APICM, SMK
Towed 105-mm Howitzer M101A1	14,500 (RAP) 11,600 (w/o RAP)	10 rounds per minute	3 rounds per minute	AP, HE, ICM, RAP, HEP-T, ILLUM, HC, WP
Towed 105-mm Howitzer M102	15,100 (RAP) 11,400 (w/o RAP) 10,500 (BBDPICM)	10 rounds per minute	3 rounds per minute	AP, HE, ICM, RAP, HEP-T, ILLUM, HC, WP
Towed 155-mm Howitzer M114A1	14,600 (w/o RAP)	4 rounds per minute	1 round per minute	HE, ICM, ILLUM, NUC, HC, WP
Towed 155-mm Howitzer M114A2	19,300 (RAP) 14,600 (w/o RAP)	4 rounds per minute	1 round per minute	HE, RAP, ICM, ILLUM, DPICM, ADAM, HC, WP, NUC, RAAMS, CPHD
Towed 155-mm Howitzer M198	30,100 (RAP) 18,100 (w/o RAP) 28,200 (BBDPICM) 18,000 (DPICM)	4 rounds per minute	As indicated by thermal warning device	HE, RAP, ICM, WP, ILLUM, DPICM, ADAM, NUC, RAAMS, CPHD, SMK

Legend:

HEP-T	High explosive plastic tracer	SMK	Smoke
HESH	High explosive squash head	APAM	Anti-personnel anti-material
ILLUM	Illumination	CPHD	Copperhead
RAP	Improved rocket assisted projectile	WP	White phosphorous
MLRS	Multiple launch rocket system	NUC	Nuclear
TGW	Terminally guided warhead	DPICM	Dual purpose improved conventional munitions
BBDPICM	Base bleed dual purpose improved conventional munitions		

Table 4-20. Artillery cannon and rocket characteristics.

g. Indirect Fire Characteristics

Caliber	155mm	203mm	155mm	155mm	227mm
Model	M109A6	M110A2	M198	M114A2	MLRS
Max Range (m)	18,200	22,900	18,300	14,600	30,000
Ammunition	HE, DPIC, APCIM, SMK, NUC, RAP, FASCAM, CPHD, WP, ILLUM	HE, APICM, NUC, DPICM	HE, DPICM, APICM, SMK, NUC, RAP, FASCAM, CPHD, WP, ILLUM	HE, DPICM, APICM, SMK, NUC, RAP, FASCAM, CPHD, WP, ILLUM	DPICM, APAM, ATACMS
Max Rate of Fire (rds per min)	4	1.5	4	4	1 rd/1.5sec
Sustained Rate of Fire (rds per min)	1	0.5	2	1	1 rd/4.5sec
Range of RAP	30,000	30,000	30,100	19,300	45,000 (ER) 165,000 (ATACMS) 300,000 (ATACMS Block 1A)
Minimum Range (m)	Direct Fire	Direct Fire	Direct Fire	Direct Fire	Direct Fire
Fuzes	PD, VT, MT, MTSQ, MT, Delay	PD, VT, MT, MTSQ, MT, Delay	PD, VT, MT, MTSQ, MT, Delay	PD, VT, MT, MTSQ, MT, Delay	ET
Illum Time (sec)	120	N/A	120	120	N/A
HE Eff Casualty Radius (1 rd in m)	50	80	50	50	100
FPF	6 guns 300m	N/A	4 guns 200m	4 guns 300m	N/A

Legend:

APERS	Antipersonnel	CHEM	Chemical
CPHD	Copperhead	ET	Electronic time
HE	High explosive	HEP	High explosive plastic
ILLUM	Illumination	MT	Mechanical time
NUC	Nuclear	PD	Point detonating
VT	Variable time	WP	White phosphorus
APICM	Antipersonnel improved conventional munition	DPICM	Dual-purpose improved conventional munition

Table 4-21. Indirect fire characteristics.

h. Infantry-Heavy Threat

DODIC	NOMEN	Offense		Defense	
		Quantity	Weight (lbs)	Quantity	Weight (lbs)
D003	Chg Spotting 155mm	57	135.3	13	30.8
D501	Proj 155mm ADAM-L M692	13	1420.2	24	2622
D502	Proj 155mm ADAM-S M731	26	2840.5	20	2185
D505	Proj 155mm ILL M485A2	13	1268.8	6	585.6
D510	Proj 155mm CPRHD M712	2	452.6	1	226.3
D514	Proj 155mm RAAM-L	11	1212.7	8	882
D515	Proj 155mm RAAM-S	5	551.2	12	1323
D528	Proj 155mm SMK WP M825	107	11101.2	113	11723.7
D532	Chg Prop 155mm RB M203	729	11882.7	248	4042.4
D533	Chg Prop 155mm RB/WB M119A1/A2	363	5916.9	144	2347.2
D540	Chg Prop 155mm GB M3A1	190	3106.5	68	1111.8
D541	Chg Prop 155mm WB M4A1	936	15303.6	386	6311.1
D544	Proj 155mm HE M107	593	59077.6	209	20821.6
D550	Proj 155mm SMK WP M110A1	36	3712.5	38	3918.7
D563	Proj 155mm HE DPICM M483A1	568	62054	132	14421
D579	Proj 155mm HERA M549A1	233	24173.7	55	5706.2
D864	Proj 155mm DPICM-ER M864	410	NA	150	NA
N285	Fuze ET M577	1211	3504.3	490	1417.9
N286	Fuze ET M582	103	345.6	50	167.8
N291	Fuze Proximity M732A2	148	380.1	52	133.5
N340	Fuze PD M739A1	654	2370.7	215	701.4
N532	Primer, Percussion M82	2219	275.1	864	104.9
N659	Fuze PD CP Mk399-1	12	39.6	4	13.2

Table 4-22. Infantry-heavy threat.

Notes:

- All quantities and weights are totals based upon an 18-gun M198 battalion.
- All quantities are amounts required per day.
- Quantities for offense are also the battalion's "basic allowance". Basic allowance is the ammunition recommended to be carried within the means normally expected to be available for combat operations.

Offense		Defense	
32	Battalion Mass Killing Missions (Bn 3 rnds)	11	Battalion Mass Killing Missions (Bn 3 rnds)
26	Minutes of Illumination	12	Minutes of Illumination
10	500m Smoke Screens (10 min duration)	10	500m Smoke Screens (10 min duration)
2	Point Targets Destroyed	1	Point Target Destroyed
3	200 x 200 Low Density Minefields (1SD, 2LD Low Angle)	3	200 x 200 Low Density Minefield (1SD, 2LD Low Angle)
1	200 x 200 Med Density Minefield (1LD Low Angle)	1	200 x 200 Med Density Minefield (1LD Low Angle)

Table 4-23. Artillery battalion infantry-heavy mission equivalents.

i. Armor-Heavy Threat

DODIC	NOMEN	Offense		Defense	
		Quantity	Weight (lbs)	Quantity	Weight (lbs)
D003	Chg Spotting 155mm	46	109.2	24	57
D501	Proj 155mm ADAM-L M692	9	983.2	24	2622
D502	Proj 155mm ADAM-S M731	23	2512.7	18	1966.5
D505	Proj 155mm ILL M485A2	6	585.6	5	488
D510	Proj 155mm CPRHD M712	3	578.9	1	226.3
D514	Proj 155mm RAAM-L	15	1653.7	12	1323
D515	Proj 155mm RAAM-S	2	220.5	7	7717
D528	Proj 155mm SMK WP M825	10	1037.5	10	1037.5
D532	Chg Prop 155mm RB M203	997	16251.1	502	8182.6
D533	Chg Prop 155mm RB/WB M119A1/A2	278	4531.5	144	2347.2
D540	Chg Prop 155mm GB M3A1	92	1504.2	47	7684.5
D541	Chg Prop 155mm WB M4A1	652	10660.2	340	5559
D544	Proj 155mm HE M107	393	39152.6	163	16238.8
D550	Proj 155mm SMK WP M110A1	3	309.3	438	412.5
D563	Proj 155mm HE DPICM M483A1	464	50692	240	26220
D579	Proj 155mm HERA M549A1	350	36312.5	214	22202.5
D864	Proj 155mm DPICM-ER M864	554	NA	240	NA
N285	Fuze ET M577	1138	3293	586	1695.7
N286	Fuze ET M582	92	308.7	54	181.2
N291	Fuze Proximity M732A2	98	251.7	41	105.3
N340	Fuze PD M739A1	593	1934.6	305	995
N532	Primer, Percussion M82	2009	249.1	1033	128.1
N659	Fuze PD CP Mk399-1	8	26.4	3	9.9

Table 4-24. Armor-heavy threat.

Notes:

- All quantities and weights are totals based upon an 18-gun M198 battalion.
- All quantities are amounts required per day.
- Quantities for offense are also the battalion's "basic allowance". Basic allowance is the ammunition recommended to be carried within the means normally expected to be available for combat operations.

Offense		Defense	
32	Battalion Mass Killing Missions (Bn 3 rnds)	14	Battalion Mass Killing Missions (Bn 3 rnds)
12	Minutes of Illumination	10	Minutes of Illumination
1	500m Smoke Screens (10 min duration)	1	500m Smoke Screens (10 min duration)
3	Point Targets Destroyed	1	Point Target Destroyed
1	200 x 200 Low Density Minefields (1SD, 2LD Low Angle)	3	200 x 200 Low Density Minefield (SD, Low Angle)
1	4200 x 400 Med Density Minefield (LD High Angle)	1	400 x 400 Med Density Minefield (LD, High Angle)

Table 4-25. Artillery battalion armor-heavy mission equivalents.

j. Composite Infantry/Armor Threat

DODIC	NOMEN	Offense		Defense	
		Quantity	Weight (lbs)	Quantity	Weight (lbs)
D003	Chg Spotting 155mm	52	123.5	19	45.1
D501	Proj 155mm ADAM-L M692	11	1201.8	25	2731.2
D502	Proj 155mm ADAM-S M731	25	2731.2	19	2075.8
D505	Proj 155mm ILL M485A2	10	9766	5	488
D510	Proj 155mm CPRHD M712	2	452.7	1	226.3
D514	Proj 155mm RAAM-L	13	1433.2	10	1102.5
D515	Proj 155mm RAAM-S	4	441	10	1102.5
D528	Proj 155mm SMK WP M825	64	6640	62	6432.5
D532	Chg Prop 155mm RB M203	848	13844.4	375	6112.5
D533	Chg Prop 155mm RB/WB M119A1/A2	325	5297.4	144	2347.2
D540	Chg Prop 155mm GB M3A1	146	2387.1	58	948.3
D541	Chg Prop 155mm WB M4A1	810	13243.5	362	5918.7
D544	Proj 155mm HE M107	504	50211	186	18530.2
D550	Proj 155mm SMK WP M110A1	21	2165.5	21	2165.5
D563	Proj 155mm HE DPICM M483A1	522	57028.5	186	20320.5
D579	Proj 155mm HERA M549A1	286	29672.5	135	14006.2
D864	Proj 155mm DPICM-ER M864	474	NA	195	NA
N285	Fuze ET M577	1178	3408.8	538	15556.8
N286	Fuze ET M582	98	328.9	52	174.5
N291	Fuze Proximity M732A2	126	232.6	46	118.1
N340	Fuze PD M739A1	126	232.6	46	118.1
N532	Primer, Percussion M82	2125	263.5	940	116.6
N659	Fuze PD CP Mk399-1	10	33.1	4	13.2

Table 4-26. Composite infantry/armor threat.

Notes:

- All quantities and weights are totals based upon an 18-gun M198 battalion.
- All quantities are amounts required per day.
- Quantities for offense are also the battalions “basic allowance”. Basic allowance is the ammunition recommended to be carried within the means normally expected to be available for combat operations.

Offense		Defense	
32	Battalion Mass Killing Missions (Bn 3 rnds)	13	Battalion Mass Killing Missions (Bn 3 rnds)
10	Minutes of Illumination	5	Minutes of Illumination
2	500m Smoke Screens (10 min duration)	2	500m Smoke Screens (10 min duration)
2	Point Targets Destroyed	1	Point Target Destroyed
1	200 x 200 Med Density Minefield	1	200 x 200 Med Density Minefield

Table 4-27. Artillery battalion infantry/armor mission equivalents.

k. Ammunition Transportation

General information—

- High explosive projectiles, copperhead projectiles, white bag, red bag, and green propellants, all fuzes and small arms ammunition can be stored and transported together. A576 .50 cal 4&1 link incendiary rounds are not to be stored or transported in this category.
- Illumination projectiles, primers, CS capsules, all pyrotechnics, and A576 .50 cal 4&1 link incendiary rounds can be stored or transported together.
- White phosphorous projectiles and felt wedge white phosphorous screening projectiles can be stored or transported together

Nomenclature	DODIC	No. per Skid	Dimension	Weight
HE	D544	8	27.12 x 13.62 x 32	798.072
Illumination	D505	8	27.13 x 13.63 x 23	782.64
White Phosphorous	D550	8	27.13 x 13.63 x 31	828.937
DPICM	D563	8	29.13 x 13.63 x 38	873.03
Copperhead	D510	1	61 x 11 x 11.38	205.03
RAP	D579	8	29.12 x 14.62 x 38	815.709
WP Screening	D528	8	27.12 x 13.62 x 31	881.848
M3, Green Bag	D540	80	49.5 x 37.5 x 36	1306
M4A1, White Bag	D541	50	55 x 40 x 44.5	1766
M119, Red Bag	D533	24	45.63 x 38.75 x 42.12	1172
M203A1, Red Bag	D532	24	48 x 38 x 36.63	1370
M825 Smoke	D528	8	27.12 x 13.62 x 31	830
RAAMS-L	D503	8	29.12 x 14.62 x 39.38	822
ADAM-L	D501	8	29.12 x 14.62 x 39.38	874
ADAM-S	D502	8	29.12 x 14.62 x 39.38	874

Table 4-28. Ordnance classification data.

Vehicle	Caliber	Projectiles	Propellants
M813/923 Prime Mover[1]	155mm	48	48
M813/923 Ammo Truck	155mm	96	(GB) 366 (WB) 180 (RB & M119) 40
M105A2 Ammo Trailer	155mm	24	(GB) 112 (WB) 60 (RB & M119) 40
M190A3	155mm	36	36
M110A2	8-inch	2	2
M813/932 Ammo Truck	8-inch	42	(WB) 160
M105A2	8-inch	12	(WB) 32
[1] Combat-loaded. May be reduced by safety restrictions (net explosive weight) and vehicle load plan.			

Table 4-29. General ammunition transportation.

Notes:

- Based on pure loads and single-type items (e.g., GB propellant) on skids.
- Based on cross-country capacities. Data may be reduced by road conditions and vehicle hardening requirements.
- Based on high explosive projectiles.

Vehicle	Projectiles	Propellant		
		GB	WB	RB/119
M813/923 Prime Mover	48	48	48	48
M813/923 Ammunition Truck	96	336	180	120
M105A2 Ammunition Trailer	24	112	60	40
Mk48 LVS	288	640	400	192
Mk48W/Mk14 LVS Table Combo	576	1280	800	384

Table 4-30. 155mm ammunition transportation.

Notes:

- Combat loading for a prime mover is just that, all components for a complete round are transported together as per the unit's SOP.
- Without a forklift, one Marine, on average, can offload one HE projectile per minute. For example, three Marines can offload 96 HE projectiles in an average of 32 minutes.

l. Artillery Employment Considerations in Built-Up Areas

Organization for Combat	Movement/ Positioning	Delivery of Fire	Security	Command and Control
Centralized control is required during initial phases; decentralized control is required during later phases to support semi-independent actions of small units	Movement should occur during night or periods of reduced visibility when possible. There are few displacements, often by platoon or section. Positions should be selected that minimize masking, provide several routes of escape, and afford as much cover and concealment as possible. Use of existing structures (garages, office buildings, highway overpasses) is recommended. Special techniques for emplacing howitzers, such as spades against a curb when the ground is not suitable for emplacement, may be required. Explosives may be required to soften emplacement of howitzers. Reconnaissance, selection, and occupation of position (RSOP) elements should be well armed because they may have to clear areas to be occupied. Extensive route reconnaissance is required. Target acquisition devices are somewhat degraded. Radars should be emplaced to cover likely areas of enemy indirect-fire weapon employment. Radars should not be placed in the midst of an urban area because of masking.	Both direct and indirect fires are delivered for supported units. Destruction of fortifications may require assault fire techniques. High-angle fires may be required. Need for accurate meteorological (MET) and survey data increases because most targets are point targets. Improved conventional munition and variable time (fuze) effects are reduced by structures, although they are effective against personnel on rooftops. HE delay is used for penetration effects. Illumination, chemical incendiary ammunition, and smoke are effective. Ammunition expenditures will be heavy. Lasers and PGMs permit destruction of targets with minimal rubbling of adjacent buildings. Tall building may hamper laser use. Batteries must be prepared for hasty survey techniques. Magnetic instruments are impaired.	Positions must be fortified.	Radio communications are impaired by buildings. Wire can usually be run overhead. Make use of civilian communications A greater use of messengers and prearranged audio and visual signals is required. MCWP 3-35.3

Table 4-31. Artillery employment considerations in built-up areas.

4010. FASCAM and Other Type Mine Information

a. Types of FASCAM and Self-Destruct Times

Type	Arm	Short	Long
ADAM/RAAM 36/9	2 min/45 sec	4 hrs M731(A1)/M741(A1)	48 hrs M692(A1)/M718(A1)
GEMSS (Flipper) Variable	45 min		5 or 15 days (set by operator)
Volcano 5AT/1AP	2 min	4 hrs (set by operator)	48 hrs or 15 days (set by operator)
MOPMS	2 min	4 hrs (set by operator)	Recycle to 15 days up to 4 cycles
GATOR AF: CBU89/22AP Navy: CBU78B 45A/15AP	2 min	4 hrs	48 hrs or 15 days (set by operator)
PDM	50 sec	4 hrs	
NOTES: 1. Mines begin self-destruct at 80% of laid life (i.e., 4 x 0.8 = 12 min). 2. At least 20% of mines have anti-handling devices.			

Table 4-32. Types of FASCAM and self-destruct times.

b. Situational FASCAM Employment Planning Time

Identify Enemy Actions	5 min
Make Execution Decision	2 min
Pass to Execute	2 min
Change Mission	5 min
Execute Obstacle	7-60 min
Arming	2 min
Total	**23-76 min**

Table 4-33. Situational FASCAM employment planning times.

Depends on minefield size, density, size firing unit, unit/MF angle, range, and number of rounds. Example: 4 guns, .003 density, 550 x 200 m, low angle, 15,500 m, BMA > 800 mils, 78 rounds = 20 min to fire

c. FASCAM Fire Planning

The standard size of a FASCAM minefield is 400 x 400 meters for high-angle, and 200 x 200 meters for low-angle.

Density	RAAM	ADAM	Anti-Tank Mines	Anti-Personnel Mines
.001 (low)	24	6	216	216
.002 (med)	48	12	432	432
.004 (hi)	96	24	864	864

Table 4-34. Fire planning FASCAM.

d. FASCAM Characteristics

Delivery System	Length (m)	Depth (m)	Self-arm Time	Self Destruct Time	Rounds or Canisters	Basic Load
Artillery 155MM (AP/AT) ADAM/RAAM M731/741 (4 hr) ADAM/RAAM M692/M718 (48 hr)	400 800	400 200	2 min or 45 sec (NOTE)	4 hr 48 hrs	DISRUPT: 24R + 6A FIX: 48R + 12A TURN: 48R + 12A BLOCK: 96R + 12A	155 battalion: • 180R (4 hr) • 90A (4 hr) • 162R (48 hr) • 36A (48 hr)
M38 Flipper (AP/AT) M74/M75	DISRUPT: 245 FIX: 245 TURN: 490 BLOCK: 490	70 70 245 245	45 min	5 days or 15 days	DISRUPT: 70 AT FIX: 70 AT TURN: 280 AT BLOCK: 280 AT/140 AP	5 mines per sleeve
GATOR A-10, F-16, or F/A-18	650	200	2 min	4 hr, 48 hrs, or 15 days	FIX: Two dispensers	FIX: Two dispensers per sortie
GEMMS (Trailer Dispensed)	DISRUPT: 250 FIX: 250 TURN: 500 BLOCK: 500	60 60 210 210	45 min	5 days or 15 days	DISRUPT: 105 AT FIX: 150 AT TURN: 600 AT BLOCK: 500AT	700 AT or 100 AP per dispenser
MOPMS (Box Perimeter Security)	70	35	2 min	4 – 12 hr	1 suitcase	2 per Engineer squad
VOLCANO (Helicopter)	DISRUPT: 1100 FIX: 1100 TURN: 550 BLOCK: 550	120 120 320 320	2 min	48 hrs, 5 days, or 15 days	160 canisters (one full load)	2 loads of 160 canisters per VOLCANO
NOTE: ADAM/RAAM mines identified by an “A1” suffix have a 45 second arming time. Older models have a 2 minute arming time.						

Table 4-35. FASCAM characteristics.

e. FASCAM Life Cycle

This chart is taken from FM 20-23, *Mine/Countermine Operations*.

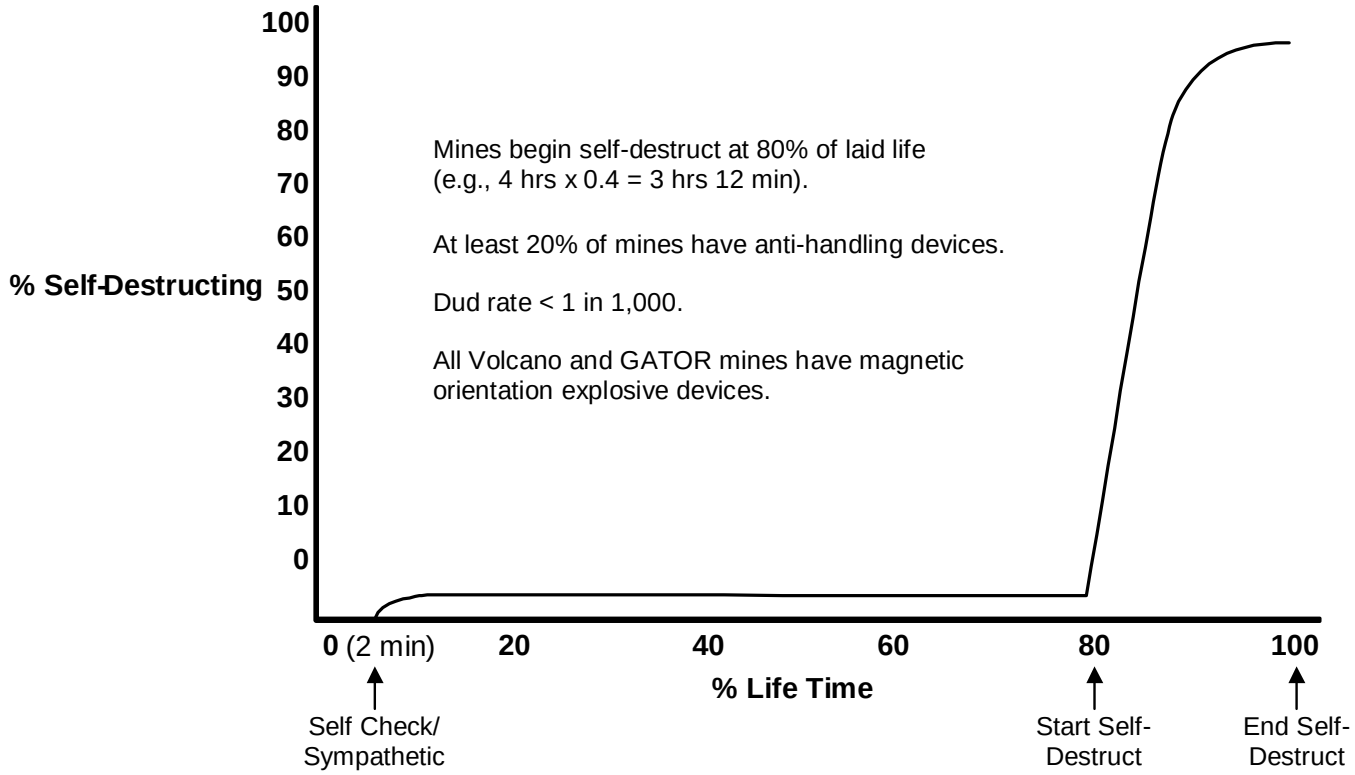


Figure 4-7. FASCAM life cycle.

f. Recommended Minefield Density

Purpose of Minefield	Harassment	Minefield Covered by Heavy Direct Fire	Minefield Covered by Light Direct Fire
Density Designation for Minefield Planning Sheet	Low	Medium	High
Density Mines	0.0001	0.002	0.004

Table 4-36. Recommended minefield density for shell RAAMS.

Purpose of Minefield	Used with RAAMS or Other at Obstacles or Harassment	Minefield Covered by Heavy Direct Fire	Minefield Covered by Light Direct Fire
Density Designation for Minefield Planning Sheet	Low	Medium	High
Density Mines	0.001	0.002	0.004

Table 4-37. Recommended minefield density for shell ADAM.

4011. Counterfire Radars

a. AN/TPQ-46A and AN/TPQ-37 Characteristics

		AN/TPQ-46A WLR	AN/TPQ-37 WLR
Range	Min	750 m	3,000 m
	Max	24,000 m	50,000 m
Search Sector	Min	230 mils	300 mils
	Max	1,600 mils	1,600 mils
		Extended azimuth search function up to 6,400 mils	
Accuracy		1st round fire-for-effect	1st round fire-for-effect
Emplacement Time		20 min *	30 min *
March Order Time		10 min or less *	15 min or less *
Transportation		Air external CH-53E (without vehicle)/ internal KC-130	Air external CH-53E/ internal KC-130
Screening Crest		15 – 30 mils	5 – 15 mils
Positioning		METT-T dependent	METT-T dependent

* Emplacement and march order times are a function of crew proficiency and may be shorter. The times shown are the ARTEP Standards.

Table 4-38. Counterfire radar characteristics.

b. AN/TPQ-46A Probabilities of Detection

	Range Bands (km)									
	0-8	8.1-12	12.1-16	16.1-20	20.1-24	24.1-28	28.1-34	34.1-40	40.1-46	46.1-54
Lt/Med Mortars (81mm)	0.9	0.78	0.67	0.56	0.46	0.35	0	0	0	0
Heavy Mortars (120mm)	0.94	0.84	0.78	0.73	0.7	0.65	0	0	0	0
Lt/Med Artillery (122/155mm)	0.84	0.67	0.57	0.47	0.37	0.27	0	0	0	0
Heavy Artillery (8 inch)	0.88	0.74	0.64	0.53	0.45	0.32	0	0	0	0
Rocket/SSMs	0.88	0.74	0.64	0.53	0.45	0.32	0	0	0	0
Mortar/Artillery Avg	0.89	0.76	0.66	0.57	0.49	0.4	0	0	0	0

Table 4-39. AN/TPQ-46A probabilities of detection.

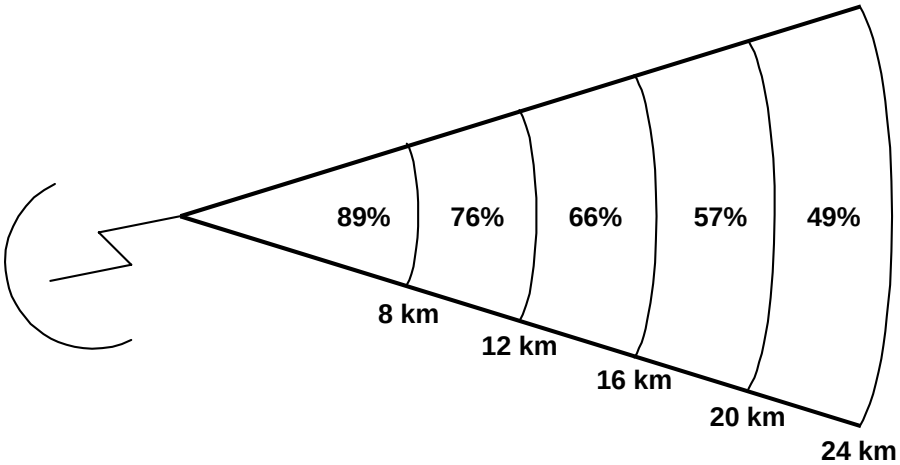


Figure 4-8. AN/TPQ-46A mortar, artillery, and rocket detection averages.

c. AN/TPQ-37 Probabilities of Detection

	PROBABILITY OF LOCATING	50% CIRCULAR ERROR PROBABLE	90% CIRCULAR ERROR PROBABLE
81mm Mortars	No specific data exists. Data indicates the AN/TPQ-37 can be expected to track mortars 4-19 km if mask angle allows for track visibility, and track velocity requirement is met.		
105mm Artillery Muzzle velocity: 207-684 m/s Quadrant elevation: 200-1100 mils	85%; 4-20 km 1600 mil coverage	35 m or 0.35% range, whichever is greater	90 m or 0.9% range, whichever is greater
155mm Artillery Muzzle velocity: 207-684 m/s Quadrant elevation: 200-1100 mils	85%; 4-25 km Center 1067 mils	35 m or 0.35% range, whichever is greater	90 m or 0.9% range, whichever is greater
175mm Artillery Muzzle velocity: 511-915 m/s Quadrant elevation: 200-1100 mils	85%; 4-30 km Center 1067 mils	35 m or 0.35% range, whichever is greater	90 m or 0.9% range, whichever is greater
8 inch Artillery Muzzle velocity: 249-594 m/s Quadrant elevation: 200-1100 mils	85%; 4-30 km Center 1067 mils	35 m or 0.35% range, whichever is greater	90 m or 0.9% range, whichever is greater
114mm Rocket Velocity at burnout: 381 m/s Quadrant elevation: 300-800 mils	85%; 4-20 km Center 1067 mils	70 m or 0.4% range, whichever is greater	175 m or 0.1% range, whichever is greater
762mm Rocket (Honest John) Velocity at burnout: 854 m/s Quadrant elevation: 300-800 mils	85%; 4-50 km Center 1067 mils	70 m or 0.4% range, whichever is greater	175 m or 0.1% range, whichever is greater
NOTE: This matrix is for planning in the absence of a 0803 target acquisition officer only. Whenever possible use a target acquisition officer and Firefinder Position Analysis System (FFPAS) which will take into consideration weather, terrain mask, target angular elevation rate, target angular azimuth rate, range, and track volume.			

Table 4-40. AN/TPQ-37 probabilities of detection.

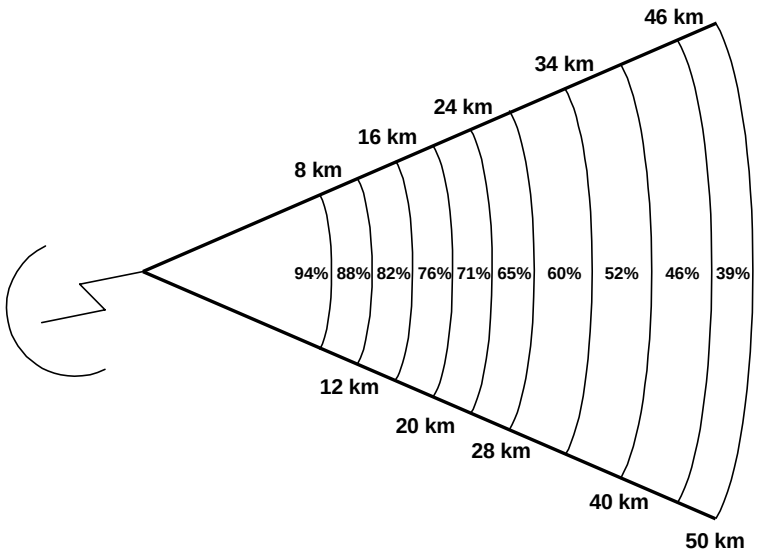


Figure 4-9. AN/TPQ-37 mortar, artillery, and rocket detection averages.

4012. The Targeting Process

Targeting is the process of selecting targets and matching the appropriate response to them, taking into account operational requirements and capabilities. It involves an analysis of the enemy situation, considering the commander's mission (task and intent) and capabilities available, to identify those critical enemy vulnerabilities which, if exploited, deny the enemy resources critical to his ability to resist.

Targeting is a continual decisionmaking process that begins with receipt of the mission and continues through the development and execution of the order. It is based on the friendly scheme of maneuver and tactical plan. It includes an assessment of the weather, terrain, and the enemy situation. This assessment then identifies those enemy units, equipment, facilities, and systems that must be attacked or influences to ensure success. Targeting includes specifying which targets are to be acquired and attacked, when they are to be acquired and attacked, and what is required to achieve the desired effects. Selected crucial targets are also identified for deliberate follow up action and analysis (combat assessment [CA]).

a. Decide, Detect, Deliver, and Assess

The Marine Corps uses the decide, detect, deliver, and assess (D3A) targeting methodology (see figure 4-10). While the following section discusses D3A as it applies to targeting, it is essential to realize how D3A applies to overall fire support planning. Targeting cannot be successful unless it is completely integrated into the fire support planning process. For example, the priorities established by the commander in the decide phase are not for targeting alone, but include his guidance for intelligence collection, fire support planning, and execution of fires. The four phases of D3A are inherently intertwined and overlapping.

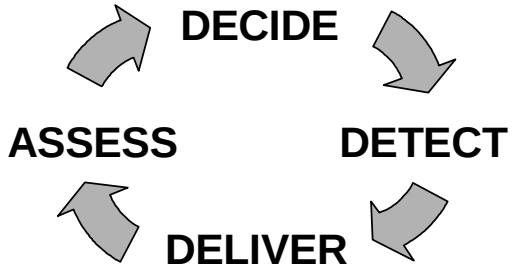


Figure 4-10. Marine Corps targeting methodology.

- **Decide**. The decide phase translates commander's intent into priorities and attack guidance. It provides the overall focus and sets priorities for intelligence collection and attack planning. The commander bases his initial guidance on the IPB. The IPB provides much of the information for the intelligence estimate and the targeting process. IPB is the foundation for the rest of the targeting process. It is a continuous and systematic method for analyzing the enemy, weather, and terrain in a geographical area. Targeting priorities must be established for each phase or critical event of an operation. For targeting to be successful, everyone must understand the unit mission, commander's intent, and the commander's planning guidance.

  A function of the decide phase is target value analysis (TVA). TVA provides a relative ranking of target sets, or categories using the following enemy characteristics: doctrine, tactics, equipment, organizations, and expected behavior. It also identifies high value targets (HVTs)—those assets the enemy commander requires to successfully complete his mission. In addition, fire planners identify high payoff targets (HPTs), a subset of HVTs, whose loss to the enemy will contribute to the success of the friendly COA.

  Some of the products of the decide function are—

  - **High Payoff Target List**. The prioritized list of HPTs used by the targeting board to develop the attack guidance matrix.
  - **Attack Guidance Matrix**. The attack guidance matrix tells how, when, and to what effect a HPT will be engaged. The attack guidance matrix is incorporated into the maneuver and fire support plans. It is the commander's attack guidance and is designed to support his plan. One attack guidance matrix rarely supports the needs of an entire force and may differ between the various echelons of command.

- **Requirements for BDA**. The commander specifies targets of a critical nature that require combat assessment to determine effects and stipulates how that BDA is determined. These requirements are incorporated into his commander's critical information requirements (CCIRs) and the collection plan.

The products from the decide function are incorporated into the fire support annex of the OPORD.

- **Detect**. The detect phase is designed to locate and identify HPTs identified in the decide phase. This is accomplished by executing the targeting collection plan. Target acquisition assets are tasked to collect information for target development. Sensors are focused on the characteristics of relevant targets and specific sensor requirements are established. Target priorities from the decide phase expedite processing of information. The products of this phase are actual targets and suspected targets.
  The G-2/S-2 is the principal figure in executing the collection plan. The commander's critical information requirements (CCIRs) are the goals of the collection plan and should incorporate fire support targeting requirements. The G-2/S-2 must work closely with the FSC to determine TLE, identification, and dwell time requirements for collection systems to produce valid targets. This should result in clear, concise taskings to target acquisition assets. As information for target development is collected, it is forwarded to the target intelligence section (TIS). Targets acquired or developed that are specified for attack are passed to the FSCC to engage under the attack guidance. Suspected targets are forwarded to the FSCC for tracking and correlation with other information for target development.

  A MAGTF generally has a wide variety of assets available to detect and identify targets. These can range from national intelligence collection assets, such as satellite photography, to a squad leader's shelling report (SHELREP). Generally, the FSC, following the guidance in the decide function, will request support from units with target acquisition assets normally employed in general support of the force. These include radio direction finding (radio battalion), counterbattery/counterfire radar (artillery regiment), visual reconnaissance and hand held aerial imagery (primarily UAV squadrons), multi-sensor imagery (UAV and F/A-18D squadrons), electronic reconnaissance (EA-6B squadrons), ground sensors (SCAMP), visual ground reconnaissance (division and force reconnaissance units), and prisoner of war interrogation (Interrogation Platoon, Intel Co). Pilot debriefs conducted by the ACE G-2 also provide a valuable source of targeting information.

  Other target acquisition assets in the MAGTF (artillery FOs, NSFS spot teams, and the surveillance and target acquisition (STA) platoon) are found at the battalion level and below. The primary mission of these assets is to support their parent units. Essential target information for reporting acquired targets consists of the reporting unit, time of acquisition, target location/size/activity, TLE, dwell time, and stationary or moving status. The FSCC can develop targets in their area of operations by monitoring calls for fire. Automated systems collect this information based on inputs received from observers and the supporting artillery FDC.

- **Deliver**. The main objective of the deliver phase is to execute the concept of fires/fire support plan on targets in support the commander’s plan. The deliver phase is comprised of a set of tactical and technical engagement solutions. The decision of whether or not to attack the target is based on the attack guidance matrix and the current situation. If the decision is made to not attack, but to track a target, it is passed back to the TIS. Other tactical considerations are how and when to attack the target. The technical solution specifies detailed attack requirements. Tactical and technical decisions can take place within separate fire support agencies (e.g., a regimental FSC makes a decision to attack an detected enemy command post with artillery and the artillery battalion FDC determines the appropriate ammunition and number of volleys to achieve the desired result). The keys to the deliver phase are well established procedures for execution, prior coordination, and rehearsals.

  When targets are identified by the FSCC for attack, the determination of when and how to attack a target is made considering attack assets available, their capabilities, the desired effects, and rules of engagement (ROE). This refined analysis produces the following tactical decisions: time of attack, desired effect, and the attack system to be used. Another important decision is the employment of combined arms in the attack of certain

targets, to include the employment of lethal and nonlethal fires (e.g., engagement of a target by artillery along with jamming or monitoring may be of greater benefit than simply firing at the target). Any remaining coordination with higher, lower, adjacent units, or other services is conducted at this time.

Once the tactical decisions have been made, the target is passed to the selected supporting arm for technical attack decisions. These decisions include the unit to conduct the attack, number and type of munitions, and response time. The supporting arm's ability to respond based on range, time on station, available munitions, and reaction time cannot be assumed but are functions of the prior coordination and the current situation.

The extent of the deliver function depends on time available, the target type, and attack guidance. Targets attacked immediately are prioritized in accordance with attack guidance. A time sensitive target (moving or short dwell time) may need tracking if it is not attacked within the appropriate response time. Planned targets may be attacked individually or incorporated into the appropriate fire plan; e.g., ATO, schedule of fires. When time is available, a thorough analysis is conducted for detailed consideration of targets. The authority to decide to attack is normally decentralized because of the need for responsiveness. When time is limited, the process may be greatly abbreviated.

- **Assess**. Combat assessment reveals whether or not the commander's guidance has been met and determines the overall effectiveness of force employment. It must be objective and measure the things that are important to commanders, not make important the things that are easily measurable. In the decide phase the commander approves the critical targets on which damage assessment is required and the type of surveillance desired. Fire support planners identify how damage assessment will be collected, considering limited assets and continued requirements for the detect phase. The degree of reliability and credibility of the assessment depends largely upon collection resources. CA will lead to reattack recommendations with the potential to change plans and modify commander's guidance. Combat assessment includes BDA and reattack recommendations.

  BDA is the timely and accurate estimate of damage resulting from the application of military force, lethal or nonlethal, against a target. It is primarily an intelligence responsibility, however, at the tactical level, BDA provides commanders a snapshot of targeting effectiveness and enemy status. In the targeting process, BDA helps to determine if reattack of a target is necessary. It may take many forms, including number of casualties, damage to equipment, target reaction to the attack (e.g., moving, hardening), or deception efforts.

  On the basis of BDA and target assessment, a determination is made whether or not the desired effects were achieved. This may apply to a specific target or to systems. Major factors incorporated into CA and reattack or modified attack guidance recommendations are the unit basic load, the required supply rate, and the controlled supply rate.

  The employment of fire support assets for reattack is coordinated the same way as employment of TA assets for detection. This is most easily done when assessment is planned, coordinated, and, when possible, executed concurrently with the attack. At lower levels, specific targets may be designated for assessment. When the attack of a target is controlled and observed by an FO, FAC, NSF spotter, or any other observer, separate tasking for assessment is not necessary. When active assessment is not possible, other measures can be used to assess effects on a target. For example, if an artillery battery were to be attacked, the appropriate measure of a successful attack might be the termination of firing by the target. If a target is of such importance that its destruction or neutralization must be confirmed before a planned course of action can be initiated or continued, then positive assessment must be accomplished regardless of risk.

b. Joint Targeting Process

The joint targeting process determines the employment of military force to achieve the JFC’s objective. Both operations and intelligence share this function. The joint targeting process includes the steps by which target intelligence and target materials are produced and applied to support operational decisionmaking and force

employment. The joint targeting process is depicted as a “cyclical process” with sequential phases (see Figure 4-11). However, the joint targeting process is really a continuously operating series of closely related, interacting, and interdependent functions. It provides for a logical progression in the development of targeting solutions. It proceeds from the definition of the problem to an assessment of the solution. The cycle allows the targeting officer to test multiple solutions and refine both the understanding of the problem and the proposed solutions.

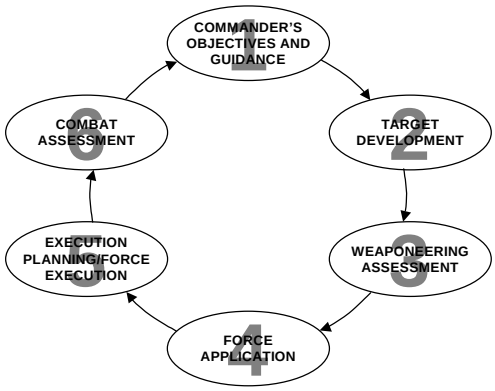


Figure 4-11. Joint targeting process.

Joint targeting is not a static, inflexible process, but rather a dynamic process that must be fluidly applied. Each phase of the process can directly affect other phases of the process. For example, CA directly affects subsequent force application if mission results prove inadequate. Likewise, weaponeering directly affects execution planning as weapons will influence execution tactics.

c. Joint Air Tasking Cycle

The joint air tasking cycle is a systematic process that matches available capabilities/forces with targets to achieve operational objectives. The cycle (see Figure 4-12) provides a repetitive process for the planning, coordination, allocation, and tasking of joint air missions/sorties, within the guidance of the JFC. The cycle accommodates changing tactical situations or JFC guidance, as well as requests for support from other component commanders. The joint air tasking cycle is an analytical, systematic approach that focuses targeting efforts on supporting operational requirements. Much of the day-to-day joint air tasking cycle is conducted through an interrelated series of information exchanges (through designated component liaison officers and/or messages), which provide a means of requesting and scheduling joint air missions.

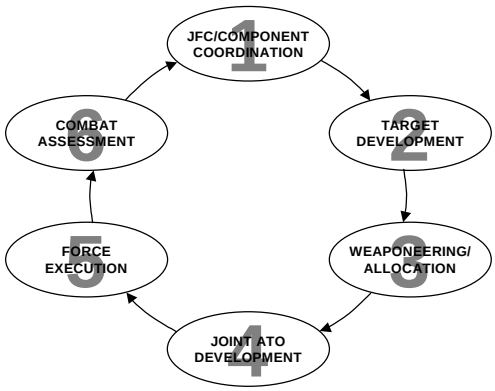


Figure 4-12. Joint air tasking cycle.

There are usually three joint ATOs at any time—

- The joint ATO in execution (today's plan).
- The joint ATO in production (tomorrow's plan).
- The joint ATO in planning (the following day's plan).

The following table shows the actions of the JFC and MAGTF during each of the joint air tasking cycle phases.

Joint Air Tasking Cycle Phase	Joint Task Force	MAGTF
Phase 1: JFC/Component Coordination	JFC's guidance and objectives (36-48 hours prior to air tasking day): • Targeting priorities. • JTL/JIPTL planning guidance. • Fire support coordinating measures. • Rules of engagement. • Definition of component direct support sorties. JFC's apportionment decision: • Total expected effort by percentage and/or priority that should be devoted to the various air operations and/or geographic areas for a given period of time. • Components informed through a guidance and intentions message.	Direct support plan submitted.
Phase 2: Target Development	Joint air operation center (combat plans) processes potential targets from the JIPTL. Components submit TGTINFOREPs: • No later than 26 hours prior to air tasking day. • Nominate targets, submit CA information, recommend no-strike targets, cancel, or renew targets.	The commander determines targeting objectives and priorities. The targeting board: • Receives MSC target nominations for deliberation, deconfliction, and prioritization. • Produces MAGTF target nomination list which includes direct support targets and common sourced target nominations.
Phase 3: Weaponeering/ Allocation	Weaponeering includes turning the JIPTL into the Master Air Attack Plan. During allocation the JFACC translates the apportionment decision into number of sorties. This is done through the exchange of ALLOREQs.	MAGTF submits AIRSUPREQs for preplanned targets for the next day's ATO. This is done no later than 24 hours prior to the air task day.
Phase 4: Joint ATO Development	SORTIEALOT sent by JFACC no later than 12-18 hours prior to air task day. It contains: • Revisions to component allocations. • Approval/disapproval of component requests. • Revisions to mission data. JFC and JFACC guidance, target worksheets, the Master Air Attack Plan and component requirements are used to finalize the joint ATO, SPINS, and airspace control order. The joint ATO is transmitted 12 hours prior to the air task day.	Submit direct support Marine ATO for integration into the joint ATO. Submit critical changes to target requests and asset availability.
Phase 5: Force Execution	JFACC directs execution and/or deconflicts all capabilities/forces made available for the joint ATO. Capabilities/forces not apportioned for tasking, but included in the joint ATO for coordination purposes, will be redirected only with the approval of the respective component commander or designated senior JAOC liaison officer.	Complete transition of joint ATO between future operations and current operations (both at the command element and the aviation combat element. Manage critical changes to target requests, priorities, and asset availability.
Phase 6: Combat Assessment	Done at all levels of the joint force. It determines if the required target effects are being achieved to meet the JFC's overall concept. JFACC/JFC staff continuously evaluate results of joint air operations and provide these results to the JFC for consolidation and overall evaluation of the current campaign.	MAGTF conducts assessment. Submit MISREPs, BDA reports, and TGTINFOREPs to the JFC.

Table 4-41. Actions during the joint air tasking cycle phases.

d. Targeting Process Comparison

While the Marine Corps targeting process differs from the joint targeting process and the joint air tasking cycle, each of the targeting processes achieve the same results. The MAGTF uses the D3A methodology for targeting within its AO using organic forces/capabilities. The MAGTF uses the joint targeting process for targeting outside their AO or when targeting inside their AO using other Services' forces/capabilities (other than joint air). The MAGTF interacts with the joint air tasking cycle during joint air operations. See table 4-13.

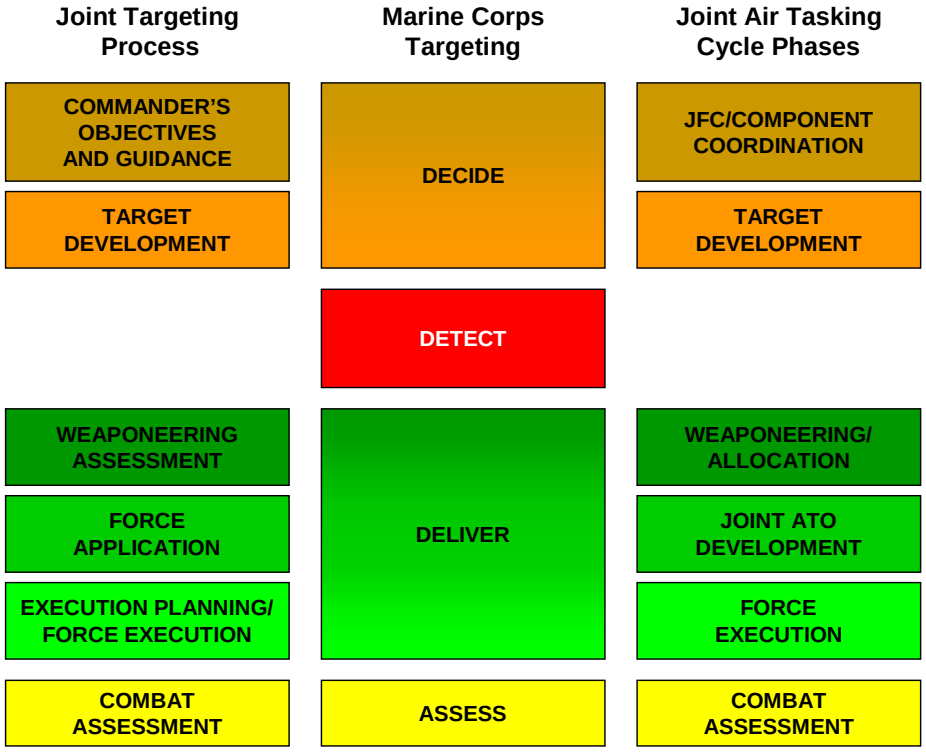


Figure 4-13. Targeting process comparison.

4013. Naval Surface Fire Support Planning Factors

a. Naval Gunfire Weapons Capabilities

	5"38	5"/54 NM 42/MK 45
Max Range (m)	15,900	21,887
Max Range (m) reduced charge	8,100	12,200
Ammo	HE/HC/ILL/WP/RAP	HE/HC/ILL/WP/RAP
Max Rate of Fire (rpgpm)	20	30/20
Sustained Rate of Fire	15	20/16
Fuzes	PD/MT/CVT/VT	PD/MT/CVT/DEL
Danger Close (m)	750	750
	Illumination	**Factors**
Burn Time (sec)	45	45 - 72
Rate of Fall (m/s)	10	10 /- 2

Table 4-42. Naval gunfire weapons capabilities.

b. Ship Armament

Ship Class	Gun Calibers	Number of Guns	Magazine Capacity	HE Bursting Radius (m)
CGN-9	5"/38	2	1,200	30
CG-26/CGN-35	5"/54	1	600	45
CGN-36/38/CG-47	5"/54	2	1,200	45
DD-963/DDG-2/99-'	5"/54	2	1,200	45
DDG-31/37/51	5"/54	1	600	45
DD-945	5"/54	3	1,800	45
FF-1052	5"/54	1	600	45
LHA-1	5"/54	2	1,200	45
FF-1098	5"/38	1	600	30

Table 4-43. Ship armament.

4014. NBC Defense Planning Factors and Considerations

a. Mission-Oriented Protective Postures

MOPP EQUIPMENT	MOPP LEVEL ZERO	MOPP LEVEL 1	MOPP LEVEL 2	MOPP LEVEL 3	MOPP LEVEL 4
Mask	Carried	Carried	Carried	Worn*	Worn
Overgarment	Available	Worn*	Worn*	Worn*	Worn
Overboots	Available	Available	Worn	Worn	Worn
Gloves	Available	Carried	Carried	Carried	Worn
* In hot weather coat or hood can be left open for ventilation.					

Table 4-44. Mission-oriented protective postures.

b. Chemical Agent Persistency at 70 degrees Fahrenheit

	GA / GF	GB	GD / HL	HD	VX
CARC	0.71	2.45	4.64	6.33	634
Sand	1.24	4.28	8.12	11.07	1109.5
Bare soil	3.19	11.02	20.88	28.45	2853
Alkyd paint	0.92	3.18	6.03	8.22	824.2
Information extracted from FMFM 11-17			Numbers = Hours		

Table 4-45. Chemical agent persistency at 70 degrees F.

c. Chemical Agent Persistency at 80 degrees Fahrenheit

	GA / GF	GB	GD / HL	HD	VX
CARC	0.71	2.45	4.64	6.33	634
Sand	1.24	4.28	8.12	11.07	1109.5
Bare soil	2.84	9.8	18.56	25.32	2536
Alkyd paint	0.92	3.18	6.03	8.22	824.2
Information extracted from FMFM 11-17			Numbers = Hours		

Table 4-46. Chemical agent persistency at 80 degrees F.

d. Chemical Agent Persistency at 90 degrees Fahrenheit

	GA / GF	GB	GD / HL	HD	VX
CARC	0.33	1.35	2.36	2.8	241
Sand	1.48	6.07	10.62	12.6	1084.5
Bare soil	1.32	5.4	9.44	11.2	964
Alkyd paint	0.42	1.75	3.06	3.64	313.3
Information extracted from FMFM 11-17			Numbers = Hours		

Table 4-47. Chemical agent persistency at 80 degrees F.

e. Detailed Equipment/Troop Decontamination Water Requirements

Item to be Decontaminated	Number of Items to be Decontaminated	Gallons of Water
Individual	1,000	28,500
Casualty	1,000	1,200 (+28,500)
Small vehicle	50	5,200
Large vehicle	50	7,500
Small jet/helicopter	12	1,800
Large jet	12	7,200

Table 4-48. Equipment/troop decontamination water requirements.

f. NBC Defense First-Aid Equipment

Medicants	Per man
Nerve Agent Antidote Kit (NAAK)	3 kits
Nerve Agent Pretreatment Pyridostigmine (NAPP)	1 blister pack
Convulsant Antidote Nerve Agent (CANA)	1 ea

Table 4-49. NBC defense first-aid equipment (individual issue).

g. NBC Defense Reference Publications

- JP 3-11, Joint Doctrine For NBC Defense, 10 Jul 95.
- FM 3-100, Chemical Operations, Principles, and Fundamental, 18 May 96.
- FM 3-3, Chemical and Biological Contamination Avoidance, 16 Nov 92, C1 29 Sep 94.
- FM 3-3-1, Nuclear Contamination Avoidance, 9 Sep 94.
- FM 3-4, NBC Protection, 29 May 92, C1 28 Oct 92, C2 21 Feb 96.
- FM 3-4-1, Fixed Site Protection, 16 Aug 89.
- FM 3-5, NBC Decontamination, 17 Nov 93.
- FM 3-6, Field Behavior of NBC Agents (Including Smoke and Incendiaries), 3 Nov 86.
- FM 3-7, NBC Handbook, 29 Sep 94.
- FM 3-9, Potential Military Chemical/Biological Agents and Compounds, 12 Dec 90.
- FM 3-11, Flame, Riot Control Agents and Herbicide Operations, 19 Aug 96.
- FM 3-14, NBC Vulnerability Analysis, 12 Nov 97.
- FM 3-18, Special NBC Reconnaissance (LB Team), 7 May 93.

- FM 3-19, NBC Reconnaissance, 19 Nov 93.
- FM 3-21, Chemical Accident Contamination Control, 23 Feb 78.
- FM 3-50, Smoke Operations, 4 Dec 90, C1 11 Sep 96.
- FM 3-101, Chemical Staffs and Units, 19 Nov 93.
- FM 3-101-1, Smoke Squad/Platoon Operations Tactics, Techniques, and Procedures, 20 Sep 94.
- FM 3-101-2, NBC Reconnaissance Squad/Platoon Operations TTP.
- FM 3-101-4, Biological Detection Platoon Operations Tactics, Techniques, and Procedures,1 Sep 00.
- FM 3-101-6, Biological Defense Operations, Corps/Company Tactics, Techniques, and Procedures, 1 Sep 00.
- FM 8-9, NATO Handbook on the Medical Aspects of NBC Defense Operations, 1 Feb 96.
- FM 8-10-7, Health Service Support in a Nuclear, Biological, and Chemical Environment, 26 Nov 96.
- FM 8-285, Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries, 22 Dec 95.
- TC 3-4, Chemical Battle Staff Handbook, 3 Oct 95.
- TC 3-4-1, Chemical Agent Monitor Employment, 17 Dec 91.
- TC 3-41, Protection Assessment Test System, 14 Jan 95.
- TC 3-8, Chemical Training, 29 Sep 94.
- TC 3-10, Commander's Tactical NBC Handbook, 29 Sep 94.
- Force XXI Doctrine. ANBACIS TTP and Tri-Mission Chemical Battalion/Company developed and used during the Nov 97 Advance Warfighting Experiment. FM 3-xx, Interim Digital Division NBC Operations will be developed to support fielded digital divisions. A Training Support Package (TSP) supporting both institutional (USACMLS) and unit training is being developed concurrently with the FM. POC MAJ Avery/CPT Drushal.
- NBC Toolbox. An NBC operational database on CD Rom and the World-Wide-Web. The address is: http://www.arl.mil/nbcweb. Contact the POC to obtain USERID and Password.
- Dragon's Lair BBS. Chemical School BBS available at: http://mcclellan-cmls-bbs.army.mil/ Copies of draft manuals out for staffing will be posted on the BBS. Must register to request USERID and Password.
- Digitized Doctrine. All Army field manuals, ARTEP/MTP, GTA, etc., including all Chemical Corps FM 3-Series can be viewed at: http://www.atsc-army.org/. Manuals may be viewed online or downloaded in Portable Document Format (.PDF) readable using the Adobe Acrobat reader program available for free at: http://www.adobe.com/acrobat/ FM 3-Series publications have restricted distribution statements, therefore, our pubs are locked with a password. Authorized users may register on-line to obtain ID and password.
- Joint Doctrine. Copies of all joint doctrine, including both approved and draft JP 3-11 are available on the Joint Doctrine Homepage at: http://www.dtic.mil/doctrine/ Joint Pubs may be viewed online or downloaded in Portable Document Format (.PDF) readable using the Adobe Acrobat reader program. POC MAJ Avery.

4015. Engineer Bridging Considerations

a. Ribbon/Assault Float Bridge

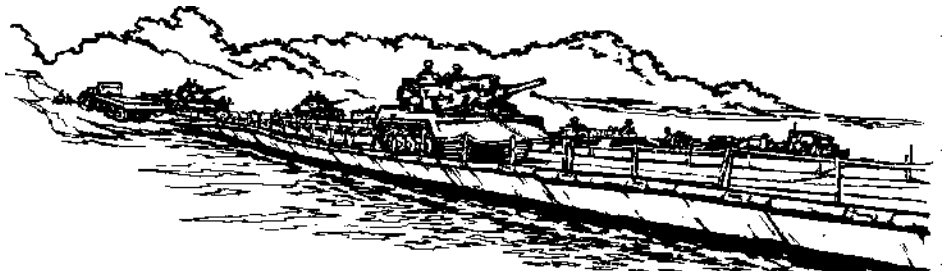


Figure 4-14. Ribbon/assault float bridging.

When making a determination to perform a tactical river or gap crossing you must consider the following:

- For gaps greater than 200 meters, rafting is generally more efficient due to currents and time to assemble.
- Assume all bridging must sustain Class 70 loads. Match the assets available to the need. If you can use a floating/ribbon bridge to meet your needs instead of a medium girder bridge (MGB), use it.

Length (ft/m)	Hours to Assemble	Class
252/77	1.0	70
125/38	0.5 (30 minutes)	70
75/23	0.3 (20 minutes)	70

Table 4-50. Ribbon/assault float bridge assembly.

One floating/ribbon bridge set has a maximum span of 252' or 77 meters, and can support up to class 70 loads. The assembly time is approximately 77m/hour. Army multi-role bridge companies rate 689' or 210 meters of ribbon bridge.

Bridge Type	Total	ESB/FSSG	MPF
Ribbon Bridge	4+6 rafts	6^{th} =0, 7^{th}=1, 8^{th}=3, 9^{th}=0	6 rafts/MPS 1, 2, 3
MGB	19	6^{th} = 4,7^{th}=2, 8^{th}=6, 9^{th}=4	3

Table 4-51. Number of bridge sets in major commands.

Notes:

- Feet/meter conversion: 1ft = .3048 meters, 1 meter = 3.2808 ft.
- Times are approximate. It generally takes more time and effort to move and offload bridging assets than it does to assemble.

These tables are for best case scenarios and must be adjusted for water current conditions.

River width (meters/feet)	100/328	150/492	300964	400/1,312
Minutes per round trip	8	10	16	20
Round trips per hour	7	6	3	3
Number of rafts per centerline	1	2	3	5

Table 4-52. River crossing capabilities.

River width (meters/feet)	500/1,640	600/1,968	800/2,824	1,000/3,280	1,200/3,936
Minutes per round trip	24	26	32	38	45
Round trips per hour	2	2	1	1	1
Number of rafts per centerline	5	6	6	6	6

Table 4-53. Raft crossing capabilities for longer span.

1 USMC Raft = 5 Interior Bays = 113 feet or 34 meters and two ramp bays, and can be assembled in 25 minutes. 1 Ribbon Bridge Bay is 22' 8"/about 7.1Meters.

Length (ft/m)	Hours to Assemble (2 story)	Class
151/47	18.0	70
102/31	12.5	70
75/23	9.5	70
50/15	6.25	70
25/8	3.0	70

Table 4-54. Medium girder bridge.

MGB, 1 set = 102’ or 31M at 70 class.
MGB Link Reinforced (2 bridges) Max 151'/47M @ Class 70

Type Unit	Vehicle	5-Bay Raft Trips		Type Unit	Vehicle	5-Bay Raft Trips
Armor Bn	161	101		Mortar Plt	8	2
Mech Bn	153	65		Scout Plt	6	2
FA Bn (155)	165	61		Engr Plt	5	2
Engr Bn (ERI)	139	59		Div Cav Troop	24	16
ACR	208	110		ACR Troop	24	16
Tank Co	15	14		ACR Tank Co	15	14
Mech Co	15	7		ACR HQ	6	3
TF HQs	6	4		FA Btry (155)	18	9
FA Btry (ACR)	13	10		TF Cbt Trains	30	13

Table 4-55. Unit raft requirements (Army).

Assembly Time	Vehicle Crossing Capability
77 meters/hr (day) 38 meters/hr (night)	150 veh/hr 50 meter spacing at 8 kph

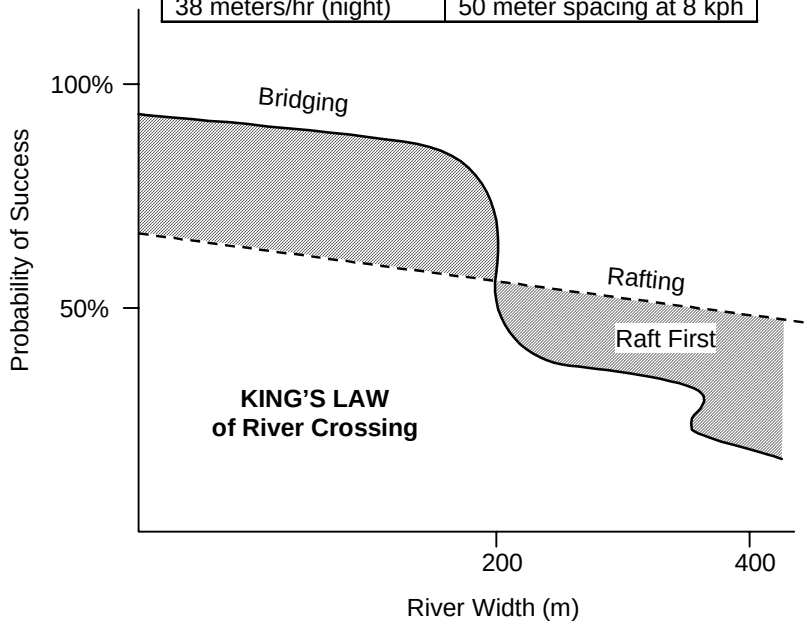


Figure 4-15. King’s Law of River Crossing.

b. Bailey M2 Bridge

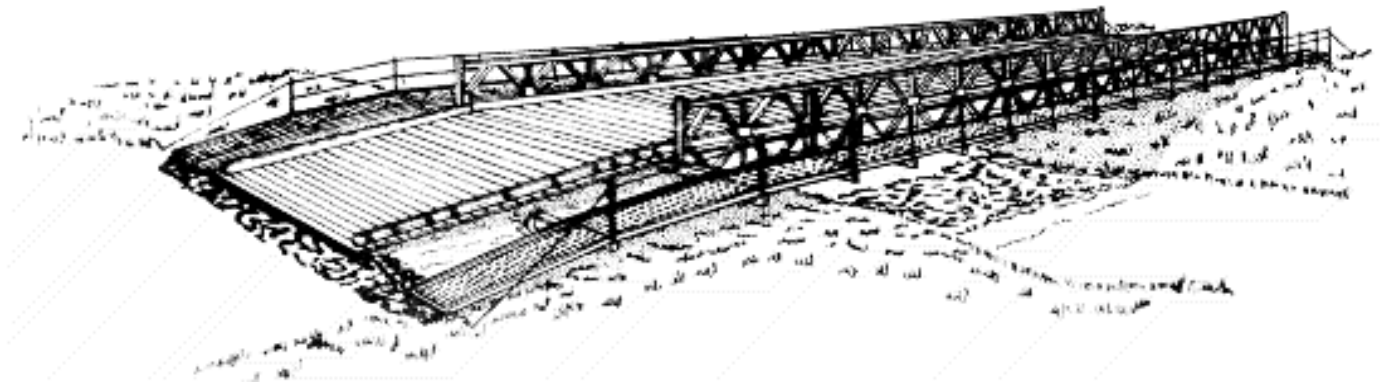


Figure 4-16. Bailey bridge.

The Bailey bridge is a through-type truss bridge, the roadway being carried between two main girders. The trusses in each girder are formed by 10-foot panels pinned end to end. In this respect, the Bailey bridge is often referred to as the "panel" or "truss" bridge. It is versatile. Standard parts can be used to assemble seven standard truss designs for efficient single spans up to 210 feet long and to build panel crib piers supporting longer bridges. There are no Bailey/M2 bridges in the USMC inventory. There are Bailey bridges in U.S. contingency stocks/ war reserve. Reference: FM 5-277

Truss/Story	Arrangement	Maximum Class 70 Length	
Single Single	SS	N/A	N/A
Double Single	DS	50ft	15m
Triple Single	TS	80ft	24m
Double Double	DD	110ft	34m
Triple Double	TD	120ft	37m
Double Triple	DT	140ft	43m
Triple Triple	TT	170ft	52m

Table 4-56. M2 Bailey bridge.

Type of Construction									
Span (ft/m)	SS	DS	TS	DD	TD	DT	TT	DT	TT
Construction by Manpower Only								Using One Crane	
40/12.1	1½								
60/18.3	1¾	2							
80/24.4	2	2¾	3						
100/30.5	2½	3	3½	4½					
120/36.6		3½	4	5	6½				
140/42.7		3¾	4½	5½	7½	11¾		10½	
160/48.8			5	6½	8½	13¾	19	11¾	16½
180/54.9				7	9½	14¾	21½	13½	18¼
200/61						16¾	24	14½	20½

Table 4-57. Estimated time for assembly (hours).

c. Armored Vehicle-Launched Bridge

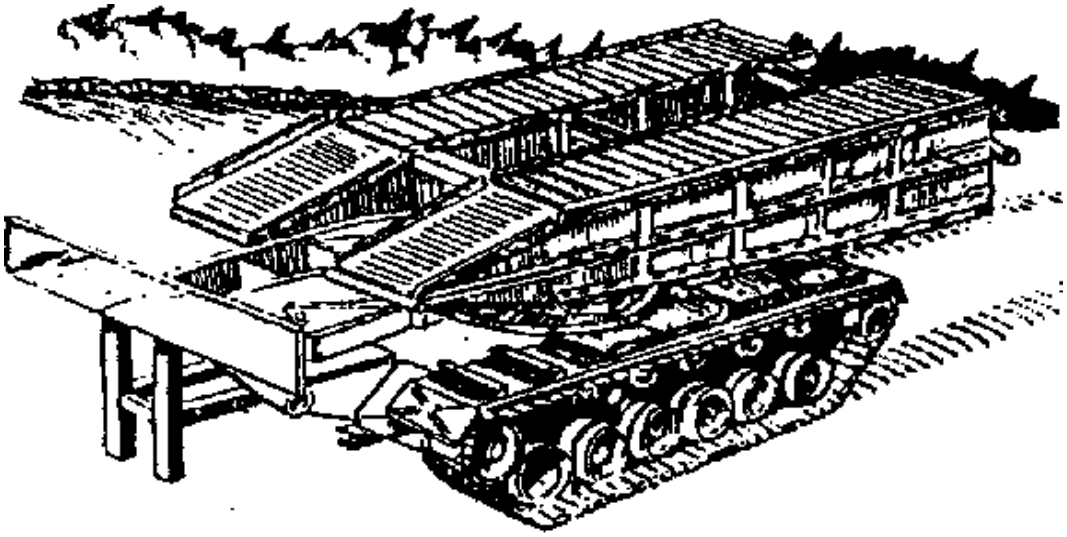


Figure 4-17. Armored vehicle-launched bridge.

The armored vehicle-launched bridge (ALVB) consists of three major sections: the launcher, the hull, and bridge. The launcher is mounted as an integral part of the chassis. The bridge, when emplaced, is capable of supporting tracked and wheeled vehicles with a military load. The bridge can be retrieved from either end. The roadway width of the AVLB is 12 feet. The bridge can be employed in two to five minutes, and retrieved in 10 minutes under armor protection.

MPS	I MEF	II MEF	Reserves	Stores	Total
6	6	6	3	34	55

Table 4-58. Armored vehicle-launched bridge/scissors bridge locations and quantities.

MPS	I MEF	II MEF	Reserves	Stores	Total
6	6	4	3	19	36

Table 4-59. M60 chassis locations and quantities.

The AVLB/scissors bridge can span a gap 57 feet with unprepared abutments and 60 feet with prepared abutments. The carrying capability is class 60. An upgrade program is underway to increase carrying capability to class 70.

The USMC maintains the AVLB within the tank battalions. This is because the AVLB is a modified M60 tank. No upgrade or change in chassis is planned. The Army maintains the AVLB within the engineer multi-purpose bridge company and uses engineers to operate it. The Army is developing a Heavy Assault Bridge to be mounted on an M1 tank.

4016. Engineer Breaching Considerations

See FMFM 13-7, *MAGTF Breaching Operations*, and FMFM5-34, *Engineer Field Data*.

a. Breaching Tips

- Find a bypass, if possible (use caution to avoid kill zones).
- Breach fundamentals:
- Need 2-Lanes for Battalion.
- Need 4-Lanes for Regiment.
- Space lanes at least 500m apart.
- Go for more lanes than you need.
- Attack flanks (weak points) of obstacles or defense.

The acronym **SOSRR** stands for—

- **S**uppress
- **O**bscure
- **S**ecure
- **R**educe
- **R**esupply

b. Breaching Sequence

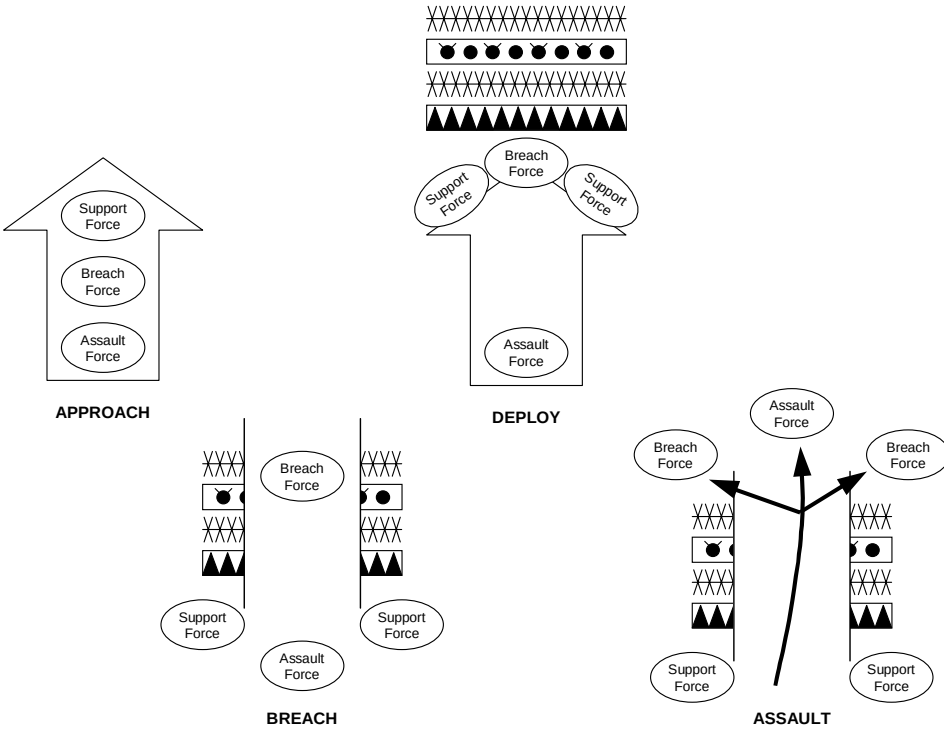


Figure 4-18. Breaching sequence.

c. Breach Complexity

This following table shows the complexity and time factors for expeditious planning of a breach when briefing at the division or higher level.

Action	Element	Time (Minutes)	Controlled By
Develop situation (verifying boundary of enemy obstacle system)	Force in contact	M to 2	S3/G3
Maneuver support force into overwatch position	Support	M + 2 to 15	Support CDR
Maneuver assault force into covered assault position	Assault	M + 2 to 15	Assault CDR
Call for artillery	DS artillery	M + 2 to 15	FSO
Build smoke	Mortars	M + 5 to 10	FSO
Suppress enemy with direct fires	Support	M +15 to 29	Support CDR
Suppress enemy with artillery fires	DS artillery	M + 10 to 29	FSO
Maintain smoke	DS artillery/mortars	M + 10 to 30	FSO
Maneuver breach force to breach location	**Breach**	**M + 20 to 23**	**Breach CDR**
Reduce obstacle prepare two lanes	**Breach**	**M + 23 to 30**	**Engineer Leader**
Place smoke pots	Breach	M + 23 to end of mission (EOM)	Breach CDR
Shift direct fires of f of the OBJ	Support	M + 29 to 30	Assault CDR
Shift indirect fires beyond OBJ	DS artillery	M + 29 to 30	Assault CDR
Assault to destroy enemy on far side of obstacle	Assault	M + 30 to 45	Assault CDR
Reorganize to continue mission	TF	M + 45 to EOM	S3
M= Contact with obstacle			

Table 4-60. Breaching complexity and time factors.

d. Breaching and Clearing Methods

From FM 5-34, Table 2-3 with modifications.

Nomenclature	Type	Mines Cleared	Weight (lbs)	Width Meters (ft)	Length Meters (ft)	Assembly Time	Employment Time in Minutes (Speed)
M193/M58A3 (Miclic)	Trailer Mounted	AT/AP	2900 ea	8 (26)	100 (328)	Crane and crew 35 min	4 (25 mph)
ML25 3 Shot (3 Miclics)	AAV Mounted	A7/AP	2519 ea	8 (26)	300 (984)	Crane and crew 60 min	1 (30 mph)

Table 4-61. Explosive breaching and clearing.

Nomenclature	Type	Mines Cleared	Weight (lbs)	Width Meters (ft)	Preparation Time	Employment Time in Minutes (Speed)
Roller	Tank mounted	AT/AP	20,000	2 @ 1.1 (3.6)	Crane and crew 45 minutes	4 (5 mph)
Plow	Tank mounted	AT/AP	12,000	2 @ 1.8 (6)	Crane and crew 45 minutes	4 (3 mph)

Table 4-62. Mechanical breaching and clearing.

e. Breaching and Clearing Equipment

TAMCM	Nomenclature	Qty	Location
BO475	AN/PSS-12 Mine detector	38	CEB
BO589	M9 ACE	16	CEB
B1298	Line Charge Launcher	38	CEB
B1315	MK154 Line Charge (3 shot)	9	AA BN
EO149	AVLB Bridge	6	Tank Bn
EO150	AVLB Chassis	4	Tank Bn
EO996	M1A1 Tank track width plow	16	Tank Bn

Table 4-63. Breaching and clearing equipment in a Marine division.

TAMCM	NOMEN	Qty	Location
N/A	D7 Armor kits	16	MCLB Albany
E0996	M1A1 Tank track width plow	72	MCLB Albany
F2069	M1A1 Tank rollers	7	MCLB Albany
F6031	Joint Service Flail System	3	MCLB Albany
U3031	Australian Mine Plows (for D8)	8	MCLB Albany
N/A	Mine clearing flail system	3	MCLB Albany
N/A	Towed assault bridging (TAB)	6	MCLB Barstow
N/A	Fascines	29	MCLB Albany
N/A	Fascines	42	MCLB Barstow

Table 4-64. Breaching and clearing equipment at Marine Corps Material Command.

4017. Engineer Obstacle Considerations

- Obstacles should support weapon systems.
- Obstacles should not impede our own mobility.
- Obstacles must hinder enemy movement.
- Obstacles are emplaced in depth, as resources will feasibly support considering time manpower and logistical complaints.

a. Hand Emplacement

	Disrupt	Turn	Fix	Block
Std Minefield Frontage (M)	250	500	250	500
Depth (M)	100	300	120	320
Time Required (Company)	30 min	1½ hrs	36 min	2 hrs

Table 4-65. Time to hand emplace minefield.

b. Minefield Design

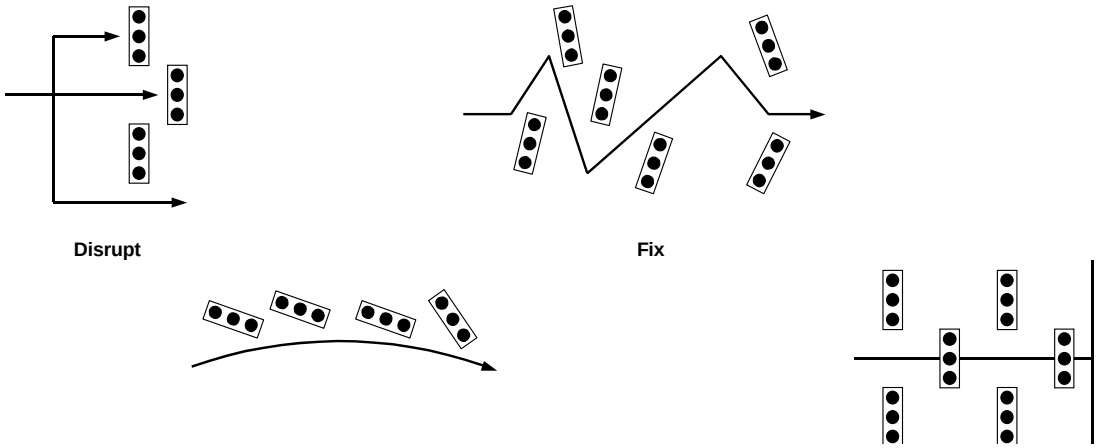


Figure 4-19. Minefield design.

Width of Avenue of Approach (m)	Disrupt	Turn	Fix	Block
500	0.5 hrs	1.4 hrs	1.0 hrs	4.0 hrs
1000	1.0 hrs	2.8 hrs	2.0 hrs	8.0 hrs
1500	1.5 hrs	4.2 hrs	3.0 hrs	12.0 hrs
2000	2.0 hrs	5.6 hrs	4.0 hrs	16.0 hrs
3000	3.0 hrs	8.4 hrs	6.0 hrs	24.0 hrs
4000	4.0 hrs	11.0 hrs	8.0 hrs	32.0 hrs
5000	5.0 hrs	14.0 hrs	10.0 hrs	40.0 hrs

Table 4-66. Company hours for hand emplacement.

The table below will be of value when developing counter mobility plans to ensure all obstacles are covered by fire.

Friendly	Max Eff
M203 Grenade launcher	160m
AT4 Anti-Tank missile	300m
SMAW Multi Purpose Assault	450m
M16A2 Rifle	580m
DRAGON	1,000m
M249 Machinegun	1,000m
M60 Machinegun	1,100m
M2 - .50 CAL Machinegun	1,200m
MK-19 Grenade launcher	1,600m
AAV - UGWS M2 .50 CAL	1,200m
AAV - UGWS MK-19	1,600m
M240G- 7.62 Machine gun	1,800m
LAV 25mm All Purpose Rounds	1,800m
LAV 25mm High Explosive	2,200m
JAVELIN	2,000m
M1A2 – 120mm	3,000m
60 mm MORTAR	3,500m (Illum) 3,200m (WP) 3,500m
81 mm MORTAR	5,800m (Illum) 5,100m (WP) 4,500m
AH-64 - HELLFIRE	8,000m
ARTILLERY 155mm	18km
ARTILLERY 155mm (RAP)	32km
MLRS – 227mm	32km
MLRS - ATACMS	142km

Enemy	Max Eff
BMP1 – 73mm	800m
BMP2 – 30MM	1,000m
T55 – 100mm	1,500m
T62 – 115mm	1,600m
BTR – 14.5mm	2,000m
BRDM – 14.5mm	2,000m
BMP3 – 30mm	2,000m
T64 – 125mm	2,100m
T72 – 125mm	2,100m
T80 – 125mm	2,400m
T90 – 125mm	2,400m
BMP1 – AT3	3,000m
T80 – AT8	4,000m
BMP3 - 100mm	4,000m
BMP2 – AT4/AT5	4,000m
T90 – AT11	4,000m
BMD – AT4/AT5	4,000m
BMP3 – AT10	5,000m
152 mm Howitzer	12,400m
SM-240mm Mortar	12,700m
BM-21 MLRS	20,500m
130mm Field Gun	27,150m
M-203 mm Howitzer	30km

Table 4-67. Weapons ranges to determine obstacle coverage by fire.

Notes:

- The advanced amphibious assault vehicle (AAAV) is scheduled to be in the operating forces by 2010.
- 30mm main gun firing two different types of rounds:
  - All purpose round—2500m.
  - High explosive incendiary round—3000m.

c. Demolitions

Target	Material				Time (hrs)
	TNT (lbs)	Cratering Charge (40 lb.)	Shaped Charge (40 lb.)	Thermite Grenades (each)	Hours to destroy w/10 men
Highways:					
• Major bridge (over 400')	1200				3
• Minor bridge (up to 400')	800				2
Tunnels	12,000				5
Road Craters:					
• 2-lane road (27')		7	2		2
• 4-lane road (70')		19	12		4
Railroads:					
• Major bridge (over 400'):					
• Single track	3,000				6
• Double track	4,500				6
• Minor bridge (under 400)					
• Single track	2,000				4
• Double track	3,000				4
• Tunnel	12,000				5
• Terminal facilities	1,000			50	4
• Rolling stock (locomotive and 30 cars)	50			125	4
Airfields:					
• Runway (per 1000')	5,500		25		8
• Fuel storage (per tank) :					
• Below ground	400			1	1
• Above ground			1	1	0.2
• Radar/radio apparatus	30			10	0.5
POL Facilities:					
• Storage and handling	50	15		10	1
• Refining facilities	100			15	1
• Distributing facilities	20			2	0.2
Electric Power Denial:					
• Generator	150			10	1
• Transformer station	100			25	1
Telecommunications Denial:					
• Microwave Tower	25				0.1
• Telephone exchange	25			2	0.2
• Repeater/radio station	50			2	0.2
• Satellite Dish	25				0.1
Waterways Denial:					
• Lock	200				1
• Levee wall		15	10		2
• Dam (navigational)	1,000				2.5

Table 4-68. Destruction of operational targets.

Notes:

- For classification data, see FM101-10-3, paragraph 4-8.
- This table is intended as a guide for planning purposes only

4018. Engineer Survivability Considerations

	Number of D7G Dozers			
	2	**4**	**6**	**8**
LAR Plt (7 LAV 25)	16 hrs	8 hrs	6 hrs	4 hrs
LAR Co (25 LAV 25)	56 hrs	28 hrs	21 hrs	14 hrs
TANK Plt (4 M1A2)	9 hrs	5 hrs	4 hrs	2.5 hrs
TANK Co (14 M1A2)	32 hrs	16 hrs	12 hrs	8 hrs
FA Btry (6 155mm)	14 hrs	7 hrs	5 hrs	3.5 hrs
FA Bn (18 155mm)	40 hrs	20 hrs	15 hrs	10 hrs
AAV Plt (6 P7A1)	14 hrs	7 hrs	5 hrs	3.5 hrs
AAV Co (48 P7A1)	108 hrs	54 hrs	41 hrs	27 hrs

Table 4-69. Time required for the M9 Armored Combat Earthmover to complete a fighting position.

	Number of D7G Dozers			
	2	**4**	**6**	**8**
LAR Plt (7 LAV-25)	8 hrs	4 hrs	3 hrs	2 hrs
LAR Co (25 LAV-25)	26 hrs	13 hrs	10 hrs	6.5 hrs
TANK Plt (4 M1A2)	8 hrs	4 hrs	3 hrs	2 hrs
TANK Co (14 M1A2)	26 hrs	13 hrs	10 hrs	6.5 hrs
FA Btry (6 155mm)	10 hrs	5 hrs	4 hrs	2.5 hrs
FA Bn (18 155mm)	28 hrs	14 hrs	11 hrs	7 hrs
AAV Plt (6 P7A1)	6 hrs	3 hrs	5 hrs	1.5 hrs
AAV Co (48 P7A1)	48 hrs	24 hrs	18 hrs	12 hrs

Table 4-70. Time required for the M7G Dozer to complete a fighting position.

Whenever possible M9 ACES and D7G Dozers should be employed in pairs or teams. This will increase productivity to about 2.5 for 2 blades.

If you are working an ACE or D7 Dozer for 4½ hours, here is how the time is apportioned for planning—

- 3½ hrs digging.
- ½ hr maintenance.
- ½ hour for moving/marking.

4019. Engineer Bulk Fuel Considerations

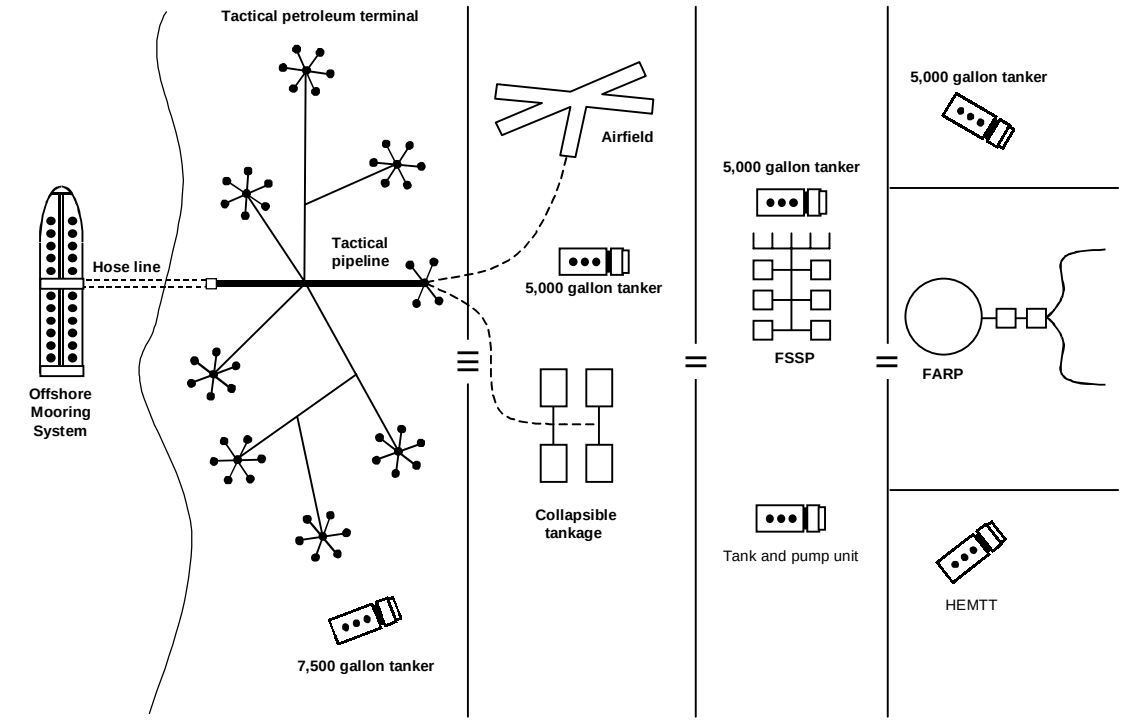


Figure 4-20. Typical bulk petroleum distribution in an undeveloped theater.

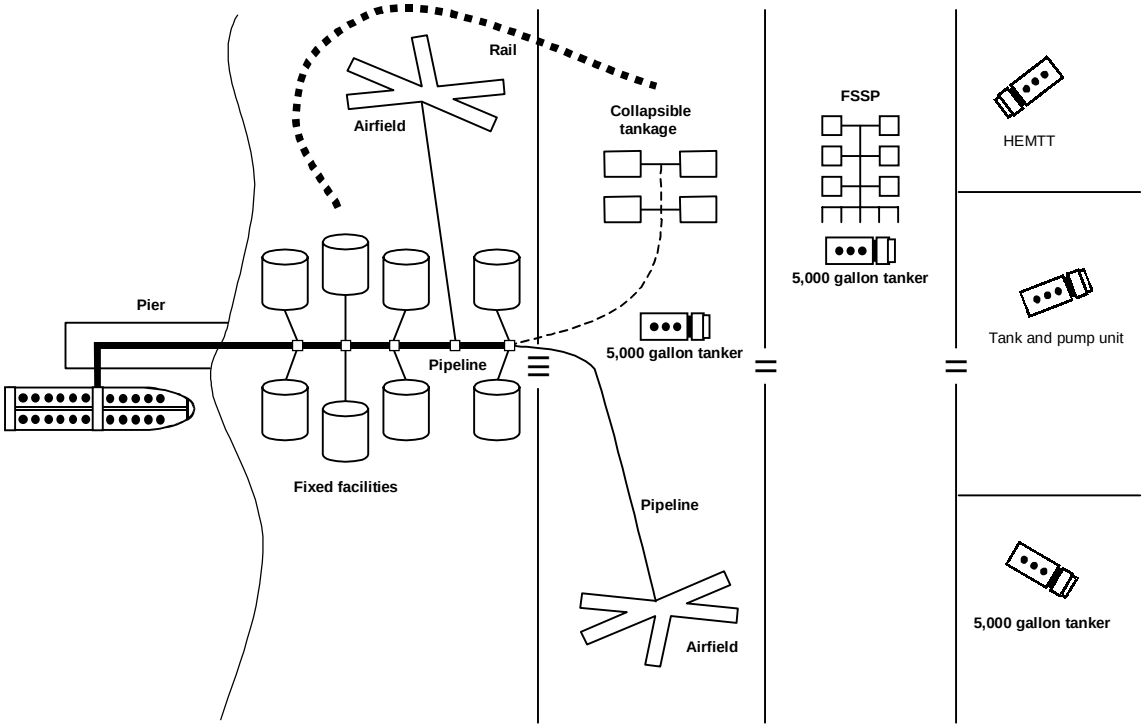


Figure 4-21 Typical bulk petroleum distribution in a developed theater.

a. Amphibious Assault Fuel System

It requires 16 amphibious assault fuel systems (AAFSs) to support a MEF. Each USMC bulk fuel Company rates 8 AAFSs. Two bulk fuel companies are required to support a MEF. The AAFS does not have aircraft refueling capabilities. (Note: The AAFS will be undergoing a reconfiguration starting in FY00. The reconfigured AAFS will consist of a mix of 50k and 20k gallon fuel capacity fuel tanks and modification of its fuel receiving, transfer and issuing capabilities for increased efficiencies. It will require 4 reconfigured AAFS to support a MEF with 4 reconfigured AAFS per bulk fuel company. Only one bulk fuel company will be required to support a MEF.)

Capability		Current AAFS	Reconfigured AAFS
Storage		600,000 gal	1,100,000 gal
Receipt	Ship-to-shore	720,000 gal per day	720,000 gal per day
	From rail tanker	600,000 gal per day	1,100,000 gal per day
	From tanker trucks	600,000 gal per day	1,110,000 gal per day
	Bulk issues	360,000 gal per day	550,000 gal per day
	Retail issues	360,000 gal per day	550,000 gal per day
	Assault hose line bulk distribution	3.5 miles at 720,000 gal per day	See Hose Reel System
Note: All receipt, issue and transfer capabilities are based on a 20 hr operational day.			

Table 4-71. Amphibious assault fuel system.

b. Tactical Airfield Fuel Dispensing System

The tactical airfield fuel dispensing system (TAFDS) provides tactical aircraft refueling services (hot and cold) at MAGTF tactical aircraft bed-down sites, expeditionary airfields (EAF), and forward operating bases (FOB). A fixed-wing MWSS rates 6 TAFDS while a rotary-wing MWSS rates 4 TAFDS. It requires 2 fixed-wing and 2 rotary-wing MWSSs to support a MEF. The TAFDS will also be reconfigured in FY00 to include a mix of 50k and 20k gallon capacity fabric fuel tanks. For the future reconfigured TAFDS, the fixed-wing MWSS will rate 3 TAFDS and the rotary-wing MWSS will rate 2.

Capability		Current TAFDS	Reconfigured TAFDS
Storage		120,000 gal	320,000 gal
Receipt	From AAFS assault hose line	720,000 gal per day	720,000 gal per day
	From tanker truck	120,000 gal per day	720,000 gal per day
	Issue	6 refueling points at 250,000 gal per day	12 refueling points at 500,000 gal per day
Note: All receipt, issue and transfer capabilities are based on a 20 hr operational day.			

Table 4-72. Tactical airfield fuel dispensing system.

c. Hose Reel System

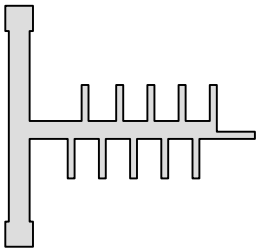
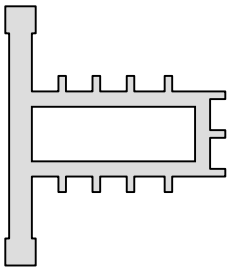
A hose reel system (HRS) consists of 6 inch diameter “lightweight” hose loaded on a reel that is mobile loaded on a 900 series tactical vehicle for deployment and recovery. Each HRS will consist of 11 hose reels with 2400 ft of hose per reel with an overall assault hose line distance of 5 miles per HRS. The lay rates for the HRS will be 2.0 to 2.5 miles per hour and a retrieval rate of 0.5 to 0.75 miles per hour. Each MEF rates 8 HRS for a total of 40 miles. The HRS has a 600 gal per min flow rate with up to 720,000 gal per day, as based on a 20 hr operational day.

Type	Storage Cap	Time to construct (earthwork)
Helicopter Expedient Refueling System (HERS)	10k gal	No earthwork required
Fabric Tank Linear Tank Farm	20k gal	2 D7 Dozer hours
Horse Shoe Tank Farm Layout	120k gal	3 D7 Dozer hours
Amphibious Assault Fuel System with Side-by-Side Linear Tank Farm Berms	600k gal	12 D7 Dozer hours
Fabric Fuel Tank Berm	50k gal	1 D7 Dozer hour
Horse Shoe Fuel Tank	50k gal	3 D7 Dozer hours

Table 4-73. Time to construct various tank farm configurations.

4020. Engineer Expeditionary Airfield Considerations

The storage of these assets on MPF ships have reduced the US deployment time to any theater of operations in the world from 9-10 weeks to 2-3 weeks. Edge clamps, cruciform stakes, and earth anchors are used to secure AM-2 matting to the ground. Portable aircraft arresting gear and marking systems are installed to form a complete airfield that enables air activity at night, in inclement weather conditions, and otherwise unprepared environments.

Configuration	Configuration Graphic	Equipment Needed	Time to Construct
96' x 96' VTOL pad		(1 each) F70 – Field Tool Kit 12' AM2 mat 6' AM2 mat Anchors and accessories H-Connectors	Crew of 16 can construct in 8 hrs
72' x 960' runway with 2 Integral 96' x 96' VTOL pads. Parking hides for 11 MV-22 (designed for 25' x 102'), no ordnance. Subgrade prepared to a minimum CBR of 25. Stakes are installed as vertical and horizontal load devices		(1 each) F70 – Field Tool Kit (224 pieces) F71 - 12' AM2 mat (209 pieces) F72 – 6' AM2 mat (6 sets) F74 – Anchors and accessories (4 sets) F77 – H-Connectors	**Site preparation:** A crew of 15 working 10 hrs per day can complete in 5 days with: • 2 graders. • 2 dump trucks. • 2 compactors. • 1 D7 dozer. • 2 TRAMs w/ buckets. • 3 6-10K forklifts. **Installation:** A Crew of 36 working 10 hrs per day can complete in 3 days.
72' x 960' runway with 2 Integral 96' x 96' VTOL pads. Parking hides for 11 AV-8B (designed for 32' x 56'). Net explosive weight of 3,000 lbs considered for each aircraft. Subgrade prepared to a minimum CBR of 25. Note: If any other type aircraft operate on this airfield, the configuration must be redesigned to accommodate new ordnance separation distance and aircraft clearance zones		(1 each) F70 – Field Tool Kit (267 pieces) F71 - 12' AM2 mat (267 pieces) F72 – 6' AM2 mat (6 sets) F74 – Anchors and accessories (6 sets) F77 – H-Connectors	**Site preparation:** A crew of 15 working 10 hrs per day can complete in 5 days with: • 2 graders • 2 dump trucks • 2 compactors • 1 D7 dozer • 2 TRAMs w/ buckets • 3 6-10K forklifts **Installation:** A Crew of 36 working 10 hrs per day can complete in 3 days.

Note: Expeditionary airfields (EAF) allow for the design of an infinite number of configurations. The three configurations used in this table do not represent any standard airfield configuration. There is no standard EAF configuration. Per the AM-2 Tech Manual, a 16 man crew can install 3,300 ft^2 per hour.

Table 4-74. Time to construct various expeditionary airfield configurations.

Type Aircraft	Minimum Parking Hide Requirements for Drive-In/Drive-Out (for 1 airframe)		Area Required for 8 Airframes	Time to Construct
F-18	Wing Span w/missiles Length Forward Clearance Aft Clearance Side Clearance Overall Area Required	41’ 56’ 63’6” 63’6” 7’6” 10,250 ft^2	81,984 ft^2	Crew of 16 working 10 hr days can complete in 2.5 days
CH-46	Width (Rotors Turning) Length (Rotors Turning) Forward Clearance Aft Clearance Side Clearance Overall Area Required	52’ 85’ 25’ 25’ 13’ 14,136 ft^2	82,384 ft^2	Crew of 16 working 10 hr days can complete in 2.5 days
CH-53	Width (Rotors Turning) Length (Rotors Turning) Forward Clearance Aft Clearance Side Clearance Overall Area Required	79’ 99’ 65’ 65’ 13’ 23,712 ft^2	189,696 ft^2	Crew of 16 working 10 hr days can complete in 6 days
UH-1	Width (Rotors Turning) Length (Rotors Turning) Forward Clearance Aft Clearance Side Clearance Overall Area Required	48’ 58’ 49’ 49’ 13’ 11,388 ft^2	91,104 ft^2	Crew of 16 working 10 hr days can complete in 3 days
AH-1	Width (Rotors Turning) Length (Rotors Turning) Forward Clearance Aft Clearance Side Clearance Overall Area Required	48’ 58’ 49’ 49’ 13’ 11,388 ft^2	91,104 ft^2	Crew of 16 working 10 hr days can complete in 3 days
AV-8B	Wing Span w/missiles Length Forward Clearance Aft Clearance Side Clearance Overall Area Required	32’ 47’ 50’ 50’ 8’ 6,808 ft^2	55,200 ft^2	Crew of 16 working 10 hr days can complete in 2 days

Table 4-75. Time to construct expeditionary airfield parking hides for various aircraft.

4021. Engineer Water Storage/Production Considerations

a. Reverse Osmosis Water Purification Unit

The reverse osmosis water purification unit (ROWPU) is a proven system that is capable of treating water from any available source. The purification process removes NBC contaminants from water, produce potable water from brackish shallow and deep well sources, and satisfactorily treat water from fresh, brackish, or seawater sources.

The Engineer Support Battalion lists 35 ROWPUs on its table of equipment. The ROWPU is transported in an 8 ft by 8 ft by 10 ft rigid frame.

Production Rate	Sea water source: 600 gallons per hour Fresh water source: 1,800 gallons per hour
Weight	7,300 pounds
Length	120 inches
Width	96 inches
Height	96 inches
Power Source	30 KW generator

Table 4-76. Reverse osmosis water purification unit capability.

This system is used by all of the U.S. military services and has performed well for the Marine Corps. During Operations Desert Shield/Storm the ROWPUs were used extensively and proved themselves to be reliable and capable. The ROWPU provides a truly expeditionary capability, allowing Marine units to acquire water from a multitude of sources.

b. Water Supply Support System

The water supply support system consists of modular components to provide flexible and responsive water support. The ability to alter the system configuration and the interchangeability of components allows for the creation of limitless combinations of tailored systems to meet any mission requirement. The table below lists major water supply support system allowances for the MEFs and MPSRONs.

	MPSRON 1	MPSRON 2	MPSRON 3	I MEF	II MEF	III MEF
Sixcon water pump module	55	55	55	89	89	60
Sixcon water tank module	215	215	215	300	264	204
3,000 gal collapsible tank	104	104	104	695	582	386
600 GPH ROWPU	41	41	41	121	101	56
Medium fresh water purify unit	0	0	0	35	32	20
500 gallon water drum	42	42	42	66	48	66
Forward area water point supply support system	7	7	7	11	8	11
350 GPM water pump	6	6	6	5	2	3
600 GPM water pump	6	6	6	2	2	2
Dual tank connection kit	16	16	16	7	5	5
Pump station	6	6	6	1	1	1
Storage assembly	2	2	2	0	0	0
Distribution point	2	2	2	0	0	0
10 mile segment kit	1	1	1	0	0	0
Hose assembly	128	128	128	20	20	20
50,000 gal water tank	18	18	18	4	4	4
20,000 gal water tank	13	13	13	6	6	3

Table 4-77. Water supply support system allowances.

4022. Movement Control Concept

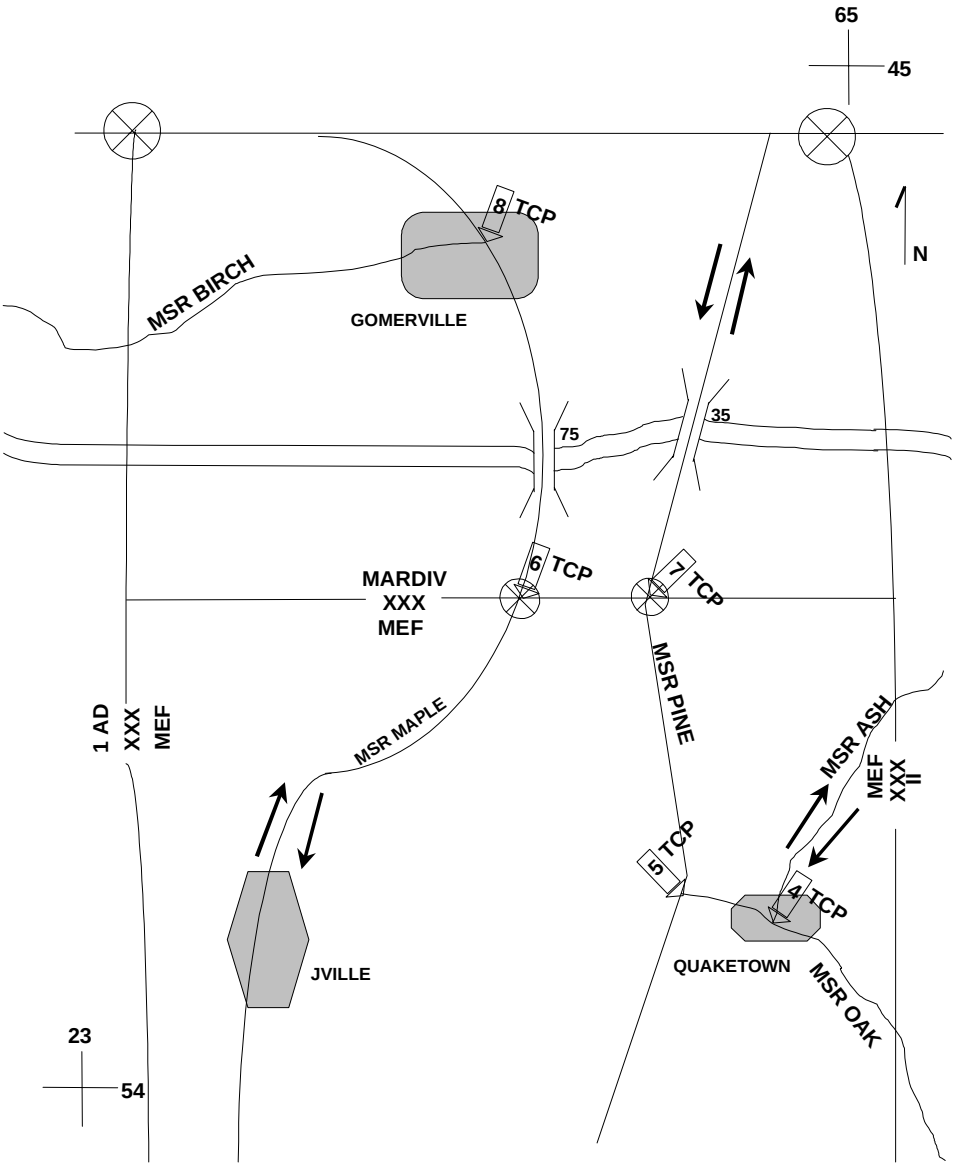


Figure 4-22. Movement control diagram.

4023. Movement Control Planning Factors

Movements are measured by calculating how long it takes to move a given distance. The three methods of measurement are speed, pace, and rate of march. They are defined as follows:

- Speed is the actual rate at which a vehicle is the actual rate at which a vehicle is moving at a given time as shown on the speedometer. It is expressed as KPH or MPH.
- Pace is the regulated speed of a convoy or an element as set by a lead vehicle, the pacesetter. It is constantly adjusted to suit road, terrain, and weather conditions. Pace is also expressed as KPH or MPH.

- Rate of march is the average number of kilometers traveled in a specific time period. It includes short periodic halts and short delays, but does not include long halts, such as those for eating meals or for overnight stops. It is expressed in KMH or MPH. Rate of march is used in movement calculations.

a. Time-Distance Factors

Time and distance factors are used to perform a wide range of calculations for planning highway movements. They can be used to develop movement tables and to conduct expedient planning and calculating to deconflict movement requests.

b. Distance Factors

Distance factors are expressed in kilometers or meters. The following terms are used to describe distance factors:

- *Length of any column or element of a column*- length of a roadway which the column occupies. It is measured from the front bumper of the lead vehicle to the rear bumper of the trail vehicle and includes all gaps inside the column.
- *Road space* - length of a column, plus any space (safety factor), added to the length to prevent conflict with preceding or succeeding traffic.
- *Gap* - space between vehicles, march units, serials, and columns. Gap is measured from the trail vehicle of one element to the lead vehicle of the following element. The gap between vehicles is normally expressed in meters. The gap between march elements is normally expressed in kilometers.
- *Lead* - linear spacing between the heads of elements in a convoy or between heads of successive vehicles, march units, serials, or columns.
- *Road distance* - distance from point to point on a route, normally, expressed in kilometers.
- *Road clearance distance* - distance that the head of a column must travel for the entire column to clear the RP or any point along the route. Road clearance distance equals the column's length or road space plus road distance.

c. Time Factors

Time is expressed in hours or minutes. The following terms are used to describe time factors:

- *Pass time (or time length)* - time required for a column or its elements to pass a given point on a route.
- *Time space* - time required for a column or its elements to pass any given point on a route plus any additional time (safety factor) added to the pass time.
- *Time gap*- time measured between vehicles, march units, serials, or columns as they pass a given point. It is measured from the trail vehicle of one element to the lead vehicle of the following element.
- *Time lead* - time measured between individual vehicles or elements of a column, measured from head to head, as they pass a given point.
- *Time distance* - time required to move from one point to another at a given rate of march. It is the time required for the head of a column or any single vehicle of a column to move from one point to another at a given rate of march.
- *Road clearance time* - total time required for a column or one of its elements to travel the road distance and clear a point along the route or the RP. Road clearance time equals the column's pass time or time space plus time distance.

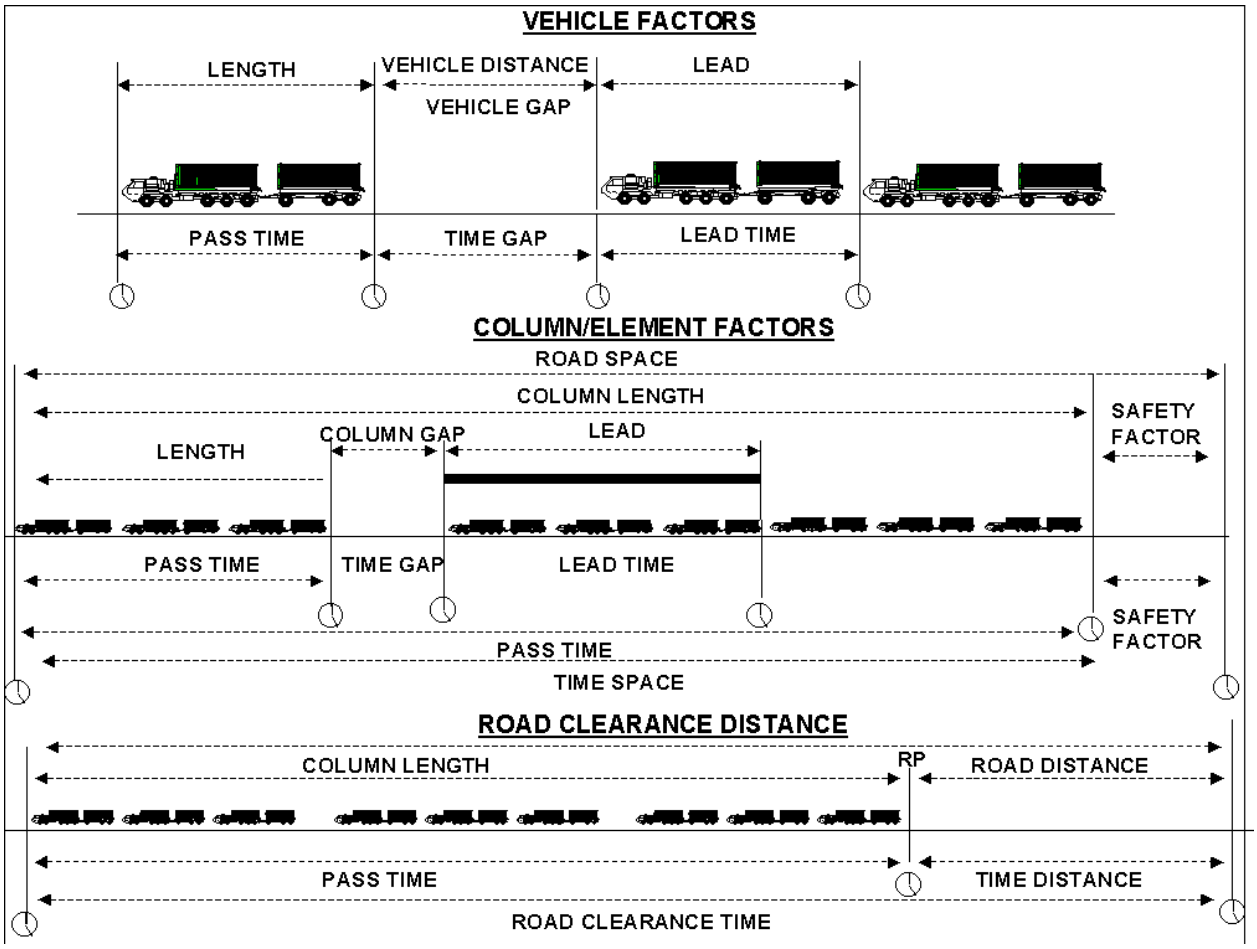


Figure 4-23. Time and distance factors.

d. Distance, Rate, and Time Calculations

Distance, Rate, and time factors are used to make scheduling calculations for columns of any size. When two of the three factors are known, the third can be found by using one of the equations shown in the following figure. These factors are determined using the following formulas—

Distance equals rate multiplied by time. If the rate of march is 40 KMPH and time is 4 hours, the distance is 160 kilometers.

$$40 \times 4 = 160$$

Rate equals distance divided by time. If a convoy travels for 5 hours to complete a 190 kilometer trip, its rate of march is 38 KMPH.

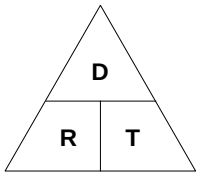
$$190 \div 5 = 38$$

Time equals distance divided by rate. If the distance is 210 kilometers and the rate of march is 42 KMPH, the time is 5 hours.

$$210 \div 42 = 5$$

e. Finding an Unknown Factor of Distance, Rate, or Time.

Divide a triangle as shown. To find an unknown factor, cover it. The uncovered portion of the triangle gives you the formula for finding the unknown.



For example, if the distance (D) is unknown, cover it and RT (rate x time) remains. If rate (R) is unknown, covering R leaves $\frac{D}{T}$. Do the same for time (T), and you find $\frac{D}{R}$.

f. Arrive and Clear Time Calculations

Arrive and clear times are not the same as time factors. The time factors measure a quantity of time or distance. Arrive and clear times represent actual time as displayed on a clock. The arrive time is the time the first vehicle in the column will arrive at an SP, CP, or RP. It is derived from the time distance. The clear time is the time the last vehicle in the column will clear that SP, CP, or RP.

- **Calculating Arrive Times**. The arrive time at the SP is the same as the SP time. To calculate the arrive time at the first CP, take the distance from the SP to the first CP, divide by the planned rate of march, and multiply by 60 (minutes). Add this time to the arrive time at the SP to determine the arrive time at the first CP.

  Example: Distance from SP to first CP: 10 km
  March rate: 50 KMIH

  Solution: 10 ÷ 50 = .20 hrs x 60 = 12 min

  If the arrive time at the SP was 0800, then the arrive time at the first CP would be 0812.

  To calculate the arrive time at the second CP, take the distance from the first CP to the second CP, divide by the rate of march, and multiply by 60. Add the amount of time to the arrive time at the first CP to determine the arrive time at the second CP.

  Example Distance from first to second CP: 15 km
  March rate: 50 KMIH

  Solution: 15 ÷ 50 = .30 hrs x 60 = 18 min

  If the arrive time at the first CP was 0812, then the arrive time at the second CP would be 0830. Continue this method to calculate the arrive time at succeeding CPs through the RP.

- **Calculating Clear Times**. To calculate the clear times at each CP, planner must determine the pass time. Calculating pass time requires four calculations: density, time gaps, road space, and pass time. These four calculations are determined using the following formulas:

  Density = 1,000/Vehicle gap + average length of vehicle

  Note: Vehicle gap is expressed in meters, representing the gap between vehicles. Average length of vehicle is expressed in meters, representing the average length of the most common vehicle in the column.

  Example: If the vehicle gap is 100 meters and the average vehicle length is 18 meters, then—

  $$\text{Density} = \frac{1{,}000}{100+18} = \frac{1{,}000}{118} = 8.5 \text{ vehicles per kilometer}$$

Time gaps = [(number of march units – 1) x (march unit time gap)] + [(number of serials - 1) x (serial time gap – march unit time gap)].

Example: If a column has two serials with two march units each and the gap between march units is 5 minutes and the gap between serials is 10 minutes, then—

Time gaps [(4 - 1) x 5) + [(2 - 1) x 5] = [3 x 5] + [1 x 5] = 15 + 5 = 20 minutes

$$\text{Road space} = \frac{\text{number of vehicles}}{\text{density}} + \frac{\text{time gaps} \times \text{rate}}{60\ (\text{minutes})}$$

Example: number of vehicles = 87
Density = 8.5 per km
Rate = 50 KMH
Time gaps = 20

$$\text{Road space} = \frac{87}{8.5} + \frac{20 \times 50}{60} = 10.2 + 16.8 = 26.9 \text{ km}$$

$$\text{Pass time} = \frac{\text{roadspace} \times 60}{\text{rate}}$$

Example: Continuation from above.

$$\text{Pass time} = \frac{26.9 \times 60}{50} = \frac{1{,}614}{50} = 32.2 \text{ or } 33 \text{ minutes}$$

In this example, the clear time at the SP is 33 minutes after the first vehicle crossed the SP. If the arrival time at the SP is 0800 the clear time at the SP will be 0833. If the arrival time at the first CP is 0812, the clear time at the first CP will be 0845. Use this same method to calculate the arrive and clear times at succeeding CPs to the RP. This movement can be depicted as:

CP	Arrive Time	Clear Time
1	0800	0833
2	0812	0845
3	0830	0930

Table 4-78. Example clear and arrive times 1.

The pass time will stay the same throughout the route as long as the march rate and density do not change. If the march rate or density changes, then recalculate the pass time to determine the new clear time.

- **Rest Halts**. The march rate compensates for short halts, but does not include scheduled rest halts. Plan scheduled rest halts during the movement planning process. When planning rest halts, allow time to get vehicles off the road and staged, time to rest, and time to get vehicles back on the road. If you need 10 minutes for a rest halt, then schedule 15 minutes for the halt to ensure time to get vehicles on and off the road.

  If a rest halt is scheduled at a CP, the arrive time at the CP does not change. What changes is the clear time at that CP and the arrive and clear times at succeeding CPs. Adjust the clear time by the scheduled halt time. If a rest halt is scheduled between CPs, adjust both the arrive and clear times at the next CP by the scheduled halt

time. Continuing, with the previous example, if you plan a 15-minute rest halt between CP 2 and CP 3, you must adjust the times as follows:

CP	Arrive Time	Clear Time
1	0800	0833
2	0812	0845
3	0845	0918

Table 4-79. Example clear and arrive times 2.

Note the 15-minute delay in arriving and clearing CP 3. If you planned the rest halt at CP2, your adjustments would be as follows:

CP	Arrive Time	Clear Time
1	0800	0833
2	0812	0900
3	0845	0918

Table 4-80. Example clear and arrive times 3.

Note the 15-minute delay in clearing CP 2, arriving at CP 3, and clearing CP3.

The pass time will stay the same throughout the route as long as the march rate and density do not change. If the march rate or density changes, you must recalculate the pass time to determine the new clear time. Follow these guidelines to simplify calculations:

- Prepare and use conversion tables for changing US common distances to metric distances, number of vehicles to time length, and distance to time.
- Standardize variables to reduce calculation time. When possible, use standard march rates and density.

4024. Movement Planning Data

a. Unopposed Foot March

	Visibility	Rate of March (km/hr)	Normal March (8 hrs-km)	Forced March (12 hrs - km)
Roads	Day	4	32	48
	Night	3	24	36
Cross-Country	Day	2	16	24
	Night	1	8	12
Note: Computed on a 50-minute hour, allowing for 10 minute halt each hour.				

Table 4-81. Movement planning for unopposed foot march.

b. Unopposed Vehicle Movement Speed

	Visibility	M1/AAV/BFV	Wheeled Vehicle
Maximum Unopposed Road Speed:	Day	40 km/hr	35 km/hr
	Night	30 km/hr	25 km/hr
Maximum Unopposed Offroad Speed	Day	20 km/hr	10-15 km/hr
	Night	10 km/hr	5-10 km/hr

Table 4-82. Movement planning for unopposed vehicle movement.

c. Opposed Vehicle Movement Speed (Delaying)

	Visibility	M1/AAV/BFV	Wheeled Vehicle
Maximum Opposed Road Speed vs. Enemy Delaying	Day	6-10 km/hr	6-10 km/hr
	Night	2-4 km/hr	2-3 km/hr
Maximum Opposed Offroad Speed vs. Enemy Delaying	Day	4-6 km/hr	2-4 km/hr
	Night	2-3 km/hr	1-2 km/hr

Table 4-83. Movement planning for enemy delaying vehicle movement.

d. Opposed Vehicle Movement Speed (Defending)

	Visibility	M1/AAV/BFV	Wheeled Vehicle
Maximum Opposed Road Speed vs. Enemy Defending	Day	1-2 km/hr	1-1.5 km/hr
	Night	1 km/hr	0.5-1 km/hr
Maximum Opposed Offroad Speed vs. Enemy Defending	Day	1-1.5 km/hr	.05-1 km/hr
	Night	.05-1 km/hr	.05 km/hr

Table 4-84. Movement planning for enemy defending vehicle movement.

e. Typical Pass Times for a Tactical Road March (U.S. Army)

	Heavy Division on One Route			Brigade on One Route		
Rate (km/hr)	40	30	25	40	30	25
Column Length (km)	301	245	180	70	55	40
Pass Time	7 hrs, 30 min	8 hrs, 15 min	7 hrs, 15 min	1 hr, 45 min	2 hrs	1 hr, 40 min

Table 4-85. Typical pass times for a tactical road march.

f. Movement Planning

Speed Miles/Km per Hour	Rates of March Miles/Km per Hour *	Minutes to Travel 1 Km*	Meters per Minute	Minutes to Travel 1 Mile*
10 mi/hr 16 km/hr	8 mi/hr 12 km/hr	5	200	7.5
10 mi/hr 15 km/hr	9 mi/hr 15 km/hr	4	250	7.5
15 mi/hr 24 km/hr	12 mi/hr 20 km/hr	3	333	5
20 mi/hr 32 km/hr	16 mi/hr 25 km/hr	2.4	417	3.75
25 mi/hr 40 km/hr	19 mi/hr 30 km/hr	2	500	3
30 mi/hr 48 km/hr	25 mi/hr 40 km/hr	1.5	667	2.4
35 mi/hr 56 km/hr	30 mi/hr 46 km/hr	1.3	767	2
40 mi/hr 64 km/hr	35 mi/hr 53 km/hr	1.13	883	1.5

This table provides the time required to travel 1 km or 1 mile while using specified march speeds.

* The travel times are calculated based upon rates of march (miles/km in 1 hour) and include time for scheduled short halts and time lost due to road and traffic conditions. The time for long halts must be added to the total time traveled (miles or km) by the travel time factor for 1 mile or 1 km for the designated speed.

Pass Time Computation:

Vehicles No. of Passage Points (PP)	= Vehicle per Passage Point
Rate of Movement (MKPH) Column Interval (X Km)	= Vehicle per Hour at PP
Vehicles per PP Vehicle per Hour at PP	= Pass Time

Table 4-86. Movement planning.

4025. Logistics Concept

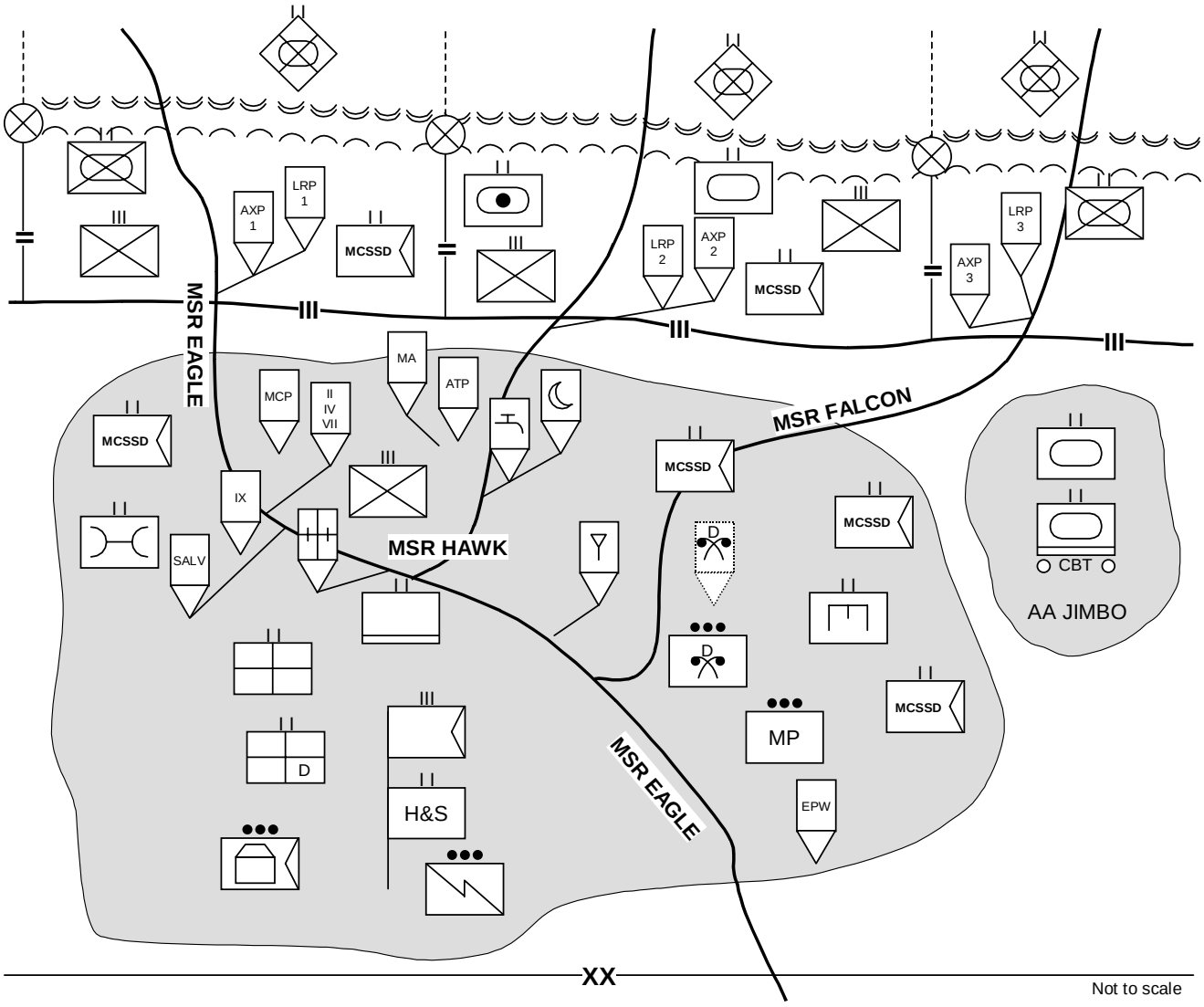


Figure 4-24. Logistics concept diagram.

4026. Logistics Planning Factors

a. Marine Expeditionary Force Daily Supply Requirements

	Daily	30 DOS	60 DOS
Class I	196	5,894	11,788
Class II	83	2,500	5,000
Class III (P)	40	1,200	2,400
Class II (B)	950,010	28,500,300	75,000,600
Class IV	139	4,183	8,366
Class V	1,600	74,000	96,000
Class VI	26	780	1,560
Class VIII	3	100	200
Class IX	41	1,240	2,480
Water	260,300	7,809,000	15,618,000
Mail	34	1,020	2,040

Table 4-87. Marine expeditionary force daily supply requirements.

b. Class I (Food)

A-Ration	2.549 lbs/meal
B-Ration	1.278 lbs/meal
MRE	1.860 lbs/meal
Volume per case MRE	0.83 ft^3
Ration Cold Weather	2.750 PMD
Health Comfort Pack	0.146 PMD

125 cases per 500 personnel
17.64 lbs per case
52 cases per new pallet
48 cases per old pallet
32 pallets per LCAC (single stack – to be used in 4-8 ft seas)
64 pallets per LCAC (double stack – to be used in 0-4 ft seas)
17.64 lbs x 52 cases = 917 lbs per 52 case pallet
17.64 lbs x 48 cases = 847 lbs per 48 case pallet
917 lbs per new pallet x 32 pallets = 29,344 lbs per LCAC (in 4-8 ft seas) = 14.67 STONS
917 lbs per new pallet x 64 pallets = 58,688 lbs per LCAC (in 0-4 ft seas) = 29.34 STONS
847 lbs per old pallet x 32 pallets = 27,104 lbs per LCAC (in 4-8 ft seas) = 13.55 STONS
847 lbs per old pallet x 64 pallets = 54,208 lbs per LCAC (in 0-4 ft seas) = 27.1 STONS

Table 4-88. Class I (food) planning factors for LCAC cargo movement.

c. Class I (Water)

Function	Daily GPM Requirements	
	Sustaining	Minimum
Drinking	1.5	1.5
Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Medical treatment	0.4	.4
Subtotal	6.4	3.7
+10% Waste	0.6	0.4
Total	**7.0**	**4.1**

Table 4-89. Class I (Water) requirements for temperate zones.

Function	Daily GPM Requirements	
	Sustaining	Minimum
Drinking	3.0	3.0
Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Heat Casualty Treatment	0.2	0.2
Medical Treatment	0.4	0.4
Subtotal	8.1	5.4
+10% Waste	0.8	0.5
Total	**8.9**	**5.9**

Table 4-90. Class I (Water) requirements for tropical zones.

Function	Daily GPM Requirements	
	Sustaining	Minimum
Drinking	2.0	2.0
Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Medical Treatment	0.4	0.4
Subtotal	6.9	4.2
+10% Waste	0.7	0.4
Total	7.6	4.6

Table 4-91. Class I (Water) requirements for arctic zones.

Function	Daily GPM Requirements	
	Sustaining	Minimum
Drinking	3.0	3.0
Personal Hygiene	1.7	1.0
Field Feeding	2.8	0.8
Heat Casualty Treatment	0.2	0.2
Medical Treatment	0.4	0.4
Centralized Hygiene	1.8	0.0
Construction	0.5	0.0
Vehicle Maintenance	0.2	0.2
Aircraft Maintenance	0.2	0.2
Laundry	2.1	0.0
Subtotal	12.9	5.8
+10% Waste	1.2	0.6
Total	14.1	6.4

Table 4-92. Class I (Water) requirements for arid zones.

d. Class II (PMD)*

Southwest Asia (SWA)	2.091
Northeast Asia (NEA)	3.367

* Per Institute of Defense Analysis study on chemical defense equipment (CDE), 1986-1988, add the following CDE modifiers for:

- NATO +2.205 PMD
- NEA +3.270 PMD
- SWA +4.038 PMD

e. Class III (P): 0.51 PMD

	Assault	Sustained
MEF	1,204,856	950,010
MPS	563,868	443,738
MEU	63,842	48,145

Table 4-93. Class III requirements (gal).

MEF Command Element		
Unit	**Daily Fuel Requirement (gal) Assault (12 hrs)**	**Daily Fuel Requirement (gal) Sustained (8 hrs)**
MHG/Intell Bn/MLE	8,766	6,084
Radio Bn	4,406	3,707
Comm Bn	7,128	5,641
Services Co	1,563	1,592
Gen Spt Comm Co	4,459	3,435
MEF CE Total	**26,322**	**20,459**

Marine Corps Division		
Division HQ Bn		
H&S Co	3,163	1,725
Truck Co	10,403	5,399
Det, Truck Co	2,601	1,350
Comm Co	2,885	1,938
Det Comm Co	721	484
MP Co	337	315
Inf Reg	5,402	3,340
Inf Bn	966	564
Artillery Reg	22,607	13,970
Artillery Bn	3,341	1,954
Tank Bn	30,285	15,608
Tank Co	5,222	2,627
LAV Bn	8,828	4,715
LAV Co	1,195	602
AAV Bn	20,442	5,376
AAV Co	3,701	602
CEB	8,269	7,600
CEC	255	128
CESC	6,544	6,634
Division Total	**112,621**	**59,986**

Force Service Support Group		
H&S Bn	5,739	5,151
HQ Co	3,644	3,134
Services Co	276	276
Comm Co	1,175	1,174
MP Co	644	567
Engr Spt Bn	24,244	31,382
H&S Co	808	805
Engr Spt Co	14,685	21,672
Engr Co	1,584	2,132
Bridge Co	1,577	1,379
Supply Bn	740	632
Ammo Co	577	523
Supply Co	102	68
Med Log Co	61	41
Maint Bn	13,298	12,400
H&S Co	4,922	5,012
Elect Maint Co	3,552	3,518
Engr Maint Co	907	884
Ordnance Maint Co	1,421	1,181
MT Maint Co	1,593	1,505
Gen Spt Maint Co	903	300
Landing Spt Bn	8,646	9,104
H&S Co	443	429
Landing Spt Co	61	41
Lndg Spt Equip Co	8,020	8,634
Motor Transport Bn	48,998	57,386
H&S Co	3,638	3,140

G/S MT Co	26,466	31,152
D/S MT Co	9,447	11,547
Medical Bn	1,290	1,828
H&S Co	1,137	1,066
Surgical Spt Co	51	254
Dental Bn	123	81
H&S Co	0	0
Dental Co	41	27
Subtract CSSD	-11,032	-12,469
FSSG Total	**92,046**	**105,495**

Table 4-94. Class III (POL) planning factors.

f. Class IV (PMD)

	NEA	SWA
Construction	3.67	3.80
Barrier	6.25	4.29
Total	9.92	8.09

Table 4-95. Class IV requirements.

g. Class V(W)

Refer to Marine Corps Order 8010.1E: Class V(W) Planning Factors for Fleet Marine Force Combat Operations.

h. Class VI (PMD) (After D+60)

Temperate	Trop/Arid
2.06	3.40

Table 4-96. Class VI requirements (after D+60).

i. Class VIII (PMD)

SWA	NEA
1.47	1.10

Table 4-97. Class VIII requirements.

4027. Maritime Prepositioning Force Employment Considerations

The following items are considered for MPF employment—

- A permissive environment.
- Adequate strategic airlift.
- Adequate aerial tanker support for Flight Ferry aircraft.
- Adequate offload forces (OPP, LFSP, AAOG, NSE) at the POD
- Suitable road network between the port and/or beach and the associated airfield.
- Recover and Launch B-747, C-141, C-17, and C-5 aircraft.
- Recover 30 AMC transport aircraft per 24 hour period.

- Provide for offloading of aircraft safely using available apron space.
- Provide an overflow area for passengers and cargo.
- Provide a helicopter buildup area.
- Provide minimal air traffic control activities.
- Operate tactical aircraft.
- A rotary-wing site that is both VFR and IFR capable.

If a usable port is available, the following should be considered—

- Accommodate the ship's stern ramp and vehicle weight to the pier.
- Allow ships with drafts up to 36.6 feet (Waterman Class) and 34.5 feet (AMSEA Class) pier side.
- Accommodate a surge offload of vehicles for staging or performing initial corrective maintenance at the MCC, as well as an area for staging containers at the Container Operations Terminal Lot (preferably hard stand).
- Accommodate the offloading of fuel, water, ammunition, and possible storage of same.

If no usable ports are available, the following should be considered—

- Instream offload of MPE/S with access to improved road networks.
- Provide sufficient staging/maintenance areas suitable for the offload of MPE/S.
- Increased offloading time and force standup.

Command relationships—

- MPS are operationally assigned to the FLTCINC or NCC of the appropriate unified combatant command.
- ADCON resides with COMSC
- Administrative direction and support of Navy and Marine Corps forces and the control of the MPE/S resides with the type commander.
- The initiating directive will specify the command relationships in the various MPF operational phases and ID the CNSF and the OPCON of forces assigned to the MPF mission.

Sustainability—

- A combination of prepositioned material and airlifted elements associated with a MEF(Fwd) for up to 30 days.
- A MEU sized MAGTF may be sustained for a greater amount of time depending on the size of the force and the number of MPS in support of the operation.

4028. Maritime Prepositioning Force (Enhanced) Capabilities

a. Table of Equipment Restoration

T/E restoration is a term used for USMC assets removed from the squadrons to make room for additional M1A1 tanks. The addition of an MPF(E) ship to each squadron enables the return of these items to the MPF program. T/E restoration assets vary by squadron based on each MEFs priorities but the bulk of the TAMCNs are for five ton trucks. (95 for MPS-1 and 3, 40 for MPS-2). Other gear includes bridging units and heavy engineer assets.

b. Expeditionary Airfield

The EAF is consists of two hundred and eighty containers of equipment and provides the capability to build a notional EAF 2000. This capability is designated to include: 96 foot wide by 3,850 foot long runway, 75 parking spaces for

tactical aircraft, 3 parking spaces for transport aircraft, fueling area and revetments, arresting gear, airfield lighting and visual landing aids, and arresting gear. The EAF is normally spread to three ships in the squadron in three modules, which support the following:

- **SHIP 1**: 471,683 sqft parking, R/W fuel pit, runway to support 18-CH53s, 18-MV22s/CH46s, 24-A/UH-1s.
- **SHIP 2**: 445,000 sqft parking, R/W fuel pit, runway to support 12-CH53s, 12-MV22s/CH46s, 12 A/UH-1s.
- **SHIP 3**: 445,000 sqft parking, F/W fuel pit, runway to support 20-AV8Bs, 14-F18.

Any reduction in the equipment identified will result in an equivalent reduction in capability (e.g., shorter/narrower runway, less parking, or no arresting gear). Three ships together can be configured to support C-5 aircraft.

c. Naval Mobile Construction Battalion

The naval mobile construction battalion (NMCB) pack-up consists of tools and equipment to support a 750 man Naval Mobile Construction Battalion aboard each squadron. Each battalion is divided into 5 capability sets: three core sets, one basic set, and one heavy set. A core is designed to support 250 Seabees with their tools and an assortment of construction equipment including dump trucks, dozers, graders, loaders, 5 tons, and an assortment of other construction gear. A basic module is designed to augment a core with additional camp support and vertical construction assets. The heavy module augments a core with additional horizontal or earth moving equipment. The NMCBs maintain their flexibility and can further deploy several detachments from a downloaded MPF packup.

The Seabee gear is usually loaded on three ships in a core, core-basic, and core-heavy configuration. Class IV (construction material) is not pre-positioned. Seabees have a wide array of construction capabilities that include: pre-engineered buildings, bunkers, towers, water purification, power generation, runways, piers, surveying and planning and well drilling. With FOE assets NMCBs can operate and construct batch plants, quarries, rock crushers, pile driving, and other specialized construction.

d. Fleet Hospital

Each MPF (E) squadron will contain a 500 bed fleet hospital (FH). The FH is broken up into two capability sets. The NEMSS (Naval Expeditionary Medical Support System) consists of material and equipment to construct a 150 bed hospital. This facility is capable of an average of 30 daily admissions and 14 daily operative procedures. It consists of 206 medical personnel and 68 support personnel. The NEMSS requires about 2 acres to setup.

The bulk of the 500 bed hospital is usually loaded on a different ship from the NEMSS. It will have the capability of an average of 80 daily admissions and 54 daily operative procedures plus 78 average daily specialty clinical care. It consists of 737 medical personnel and 241 support personnel. It requires 28 acres to setup.

4029. Maritime Prepositioning Force Engineer Equipment (Extract)

TACMN	Nomenclature	CE	GCE	ACE	CSSE	Total	MPSRON[1]	FIE
B0114	Bridge Erection Boat	0	0	0	4	4	4	0
B0152	Medium Girder Bridge	0	0	0	1	1	1	0
B0215	2½ Cubic Yard Bucket, GP	0	9	11	16	36	24	12
B0355	Compactor Ditcher	2	0	1	1	4	0	4
B0391	50k lb Rough Handling Container	0	0	4	10	14	14	0
B0395	250 cfm Air Compressor	0	5	4	9	18	10	8
B0443	30-ton Crane	0	0	2	7	9	8	1
B0446	7½-ton Crane	0	1	11	14	26	16	10
B0465	Decontamination Apparatus	2	0	12	0	14	0	14
B0570	500 gal Fabric Fuel Drum	0	0	0	56	56	56	0
B0589	M9 Armored Combat Excavator	0	6	0	0	6	6	0
B0685	Amphibious Assault Fuel System, 600k gal	0	0	0	8	8	6	2

B0891	10 kw/60 Hz Generator	5	36	38	40	119	106	13
B0953	30 kw/60 Hz Generator	18	18	52	26	114	75	39
B1021	60 kw/60 Hz Generator	5	20	8	8	41	16	25
B1045	100 kw/60 Hz Generator	4	4	18	8	34	16	18
B1082	Road Grader	0	0	4	3	7	6	1
B1135	Helicoper Refueling System (HERS)	0	0	8	0	8	8	0
B1220	MoMat	0	0	12	66	78	78	0
B1292	Lt.Weight Decontamination Apparatus	2	42	14	18	76	49	27
B1298	Line Charge Launch Trailer	0	18	0	4	22	18	4
B1320	Minefield Marking Set	0	4	0	3	7	4	3
B1625	Ribbon Bridge Raft	0	0	0	2	2	2	0
B1720	MGB Link Reinforcement Set	0	0	0	1	1	1	0
B1785	420-C Roller	0	0	1	2	3	2	2
B1830	Chain Saw	2	12	15	16	45	31	14
B2085	Fuel Six-Con	4	49	41	76	170	48	122
B2086	Water Six-Con	4	4	12	209	229	215	14
B2130	3k Fabric Water Storage Tank	3	23	71	48	145	104	41
B2460	T-5 Dozer	0	4	4	4	12	12	0
B2462	D7 Dozer	0	4	11	13	28	17	11
B2464	Dozer with Multi-Bucket	0	0	4	3	7	4	3
B2482	SEE Tractor	0	8	3	2	13	6	7
B2561	Extended Boom Fork Lift	2	7	24	25	58	46	12
B2566	4,000 lb Fork Lift	0	7	10	14	31	24	7
B2567	10,000 lb Fork Lift	0	15	15	27	57	37	20
B2604	ROWPU	0	6	16	19	41	41	0
B2631	50,000 gal Water Tank	0	0	0	18	18	18	0
B2632	20,000 gal Water Tank	0	0	0	16	16	16	0
B2685	Welding Maching	0	6	5	7	18	15	3
D0235	40-ton Low Boy Trailer	0	4	7	13	24	15	9
D0881	Mk 18 Ribbon Bridge Trailer	0	0	0	20	20	20	0
D1072	5-ton Dump	0	10	10	29	49	49	0
E0149	AVLB – Bridge	0	6	0	0	6	6	0
E0150	AVLB – Chassis	0	4	0	0	4	4	0
FZ710	AM-2 Mat, 2 x 12' panels (432 sqft)	0	0	2268	0	2268	2268 [2]	0
FZ720	AM-2 Mat, 2 x 6' panels (216 sqft)	0	0	2268	0	2268	2268 [2]	0
ZXXX [3]	Arresting Gear Set	0	0	2	0	2	2	0

Note:
1. "Z" TACMNs in MPSRON column represent Enhanced MPS quantities.
2. Present AM-2 quantity is 245 (FZ710) and 244 (FZ720) for MPSRONs 2 and 3 only.
3. Arresting Gear Set is made up of six TACMNs.

Reference: NAVMC 2907 of January 1998 (except Z TACMN).

Table 4-98. Maritime prepositioning force engineer equipment (extract)

4030. Maritime Prepositioning Force Offload Planning Data

a. Time Requirements

Navy Day (Offload Day – 1)

	Hours
Offload Side Loadable Warping Tug (SLWT) and LCM-8s	1.5
Moor-Anchors	6.0
Offload Other Lighterage	5.0
Position Ships Ramp	0.5
Assemble Causeway Section Powered (CSP) and Non-Powered (CSNP)	3.5
Install Fenders	1.5
Discharge AAVs	2.0
Install POL/Water Systems	9.0
Assemble Roll-On/Roll-Off Discharge Facility (RRDF)	36-40
Discharge RTCHs	3.0
Remove Hatch Cover	1.0

Table 4-99. Maritime prepositioning force offload time requirements.

b. Lighterage Characteristics

	CSP	CSNP	SLWT	LCM-8
Length (ft)	90	82	82	74
Beam (ft)	21	22	21	21
Loaded draft (ft)	4	4	5.2 (aft)	
Capacity (tons)	70	100	N/A	65
Speed (knots):				
Empty	10	N/A	N/A	12
Loaded	7	N/A	N/A	9

Table 4-100. Lighterage characteristics.

c. Causeway Ferry Capacities

	Vehicles	Containers
CSP + 3	18	23
CSP + 2	13	16
CSP + 1	8	9
LCM-8	2	0

Table 4-101. Causeway ferry capacities.

d. Bulk Fluid Offload Times

5,000 feet from shore	700 gpm
10,000 feet from shore	300 gpm

Table 4-102. Bulk fluid offload times.

4031. Typical Principle End Items on MPSRON to Support a MEU/MEB

Ordnance	
LAV AT	2
LAV 25	5
LAV LOG	1
LAV RECOV	1
AAVC7	1
AAVR7	1
AAVP7	12
M1A1	4
Armed HMMWV TOW	8
M198 Howitzer	8

MT/Comm Equipment	
Armed HMMWV	11
LVS Power Unit	15
LVS Wrecker	1
LVS Trailer	12
5 Ton	52
P-19	2
HMMWV	87
MRC-110	15
MRC-138	10
MRC-142	4
M970 Refueler	6

Engineer Equipment	
ROWPU	8
RTCH	4
D7	4
EBFL	3
TRAM	4
M9 ACE	2
MC1150 Tractor	1
Line Charge	1
Watercons	17

Table 4-103. Typical major principle end items aboard a MPSRON to support a MEU.

Ordnance	
LAV AT	4
LAV 25	14
LAV LOG	3
LAV RECOV	3
AAVC7	9
AAVR7	4
AAVP7	96
M1A1	58
HMMWV (TOW)	72
M198 Howitzer	30

MT/Comm Equipment	
Armed HMMWV	57
LVS Power Unit	109
LVS Wrecker	4
LVS Trailer	53
5 Ton	282
P-19	8
HMMWV	473
MRC-110	65
MRC-138	60
MRC-142	21
M970 Refueler	26

Engineer Equipment	
ROWPU	41
RTCH	14
D7	17
EBFL	46
TRAM	37
M9 ACE	6
MC1150 Tractor	7
Line Charge	18
Watercons	111

Table 4-104. Typical major principle end items aboard a MPSRON to support a MEB.

4032. Command, Control, Communications, and Computers Planning Considerations

Command, control, communications, and computers (C4) planning is inextricably linked with operations planning. The goal of C4 planning is to support mission accomplishment. The process C4 planner's use is generally the same regardless of the mission or geographical area. The checklist can be applied to other C4 staffs—single-Service, subordinate component, and multinational. Numerous sources of information may be used to answer the checklist questions. The following list is representative:

- Existing operation plans and operation orders.
- The MAGTF and joint force commander's CBAE.
- Area studies.
- Unit files.
- MCWP 6-2, MAGTF Command and Control.
- MCWP 6-22, Communications and Information Systems.
- MCWP 6-23, Information Management.
- CJCSM 6230.01, C4 Planners Handbook.
- CJCSM 6231, Manual for Employing Joint Tactical Communications.
- CJCSM 6230.04, Manual for Employing Revised Battlefield Electronic CEOI Systems.
- CJCSM 6230.05, Joint Have Quick Planners Manual.
- DISA Contingency Plan.
- Joint Communications Support Element Planning Guide.
- Lessons-learned from previous operations and exercises to include JULLS.
- CJCSI 6111.01, C4 Systems Description.
- TPFDD schedule.
- Joint Pub 5-00.2, Joint Task Force Planning Guidance and Procedures.

a. Common Questions

These questions apply to any mission. They elicit background information, and each serves as a data point to answer other questions. This list of questions is not all-inclusive. These questions should be asked repeatedly throughout the planning process as C4 planners adapt to an evolving operational and tactical situation. They provide a framework for supporting C4 planning for each phase of an operation, focusing C4 planners on the mission and how the JFC intends to accomplish it.

Parameters

- What is the JTF mission?
- What is the signal and/or communications unit mission?
- What is the geographic operational area?
- What is the JFC's estimate of the mission and vision (intent and concept of operations) to accomplish it?
- What are the JFC's C4 requirements?
- Who are the subordinate component and supporting forces? What are the command relationships?
- How will the forces deploy (means of transport), and what is the deployment timeline?
- Are there any transport and/or lift restrictions (availability of assets, departure and arrival locations)?
- Are there any satellite landing rights?
- When are the operations planning meetings scheduled? How will C4 planning meetings fit into this schedule? Has DISA been involved regarding coordination of technical requirements?
- Are there any planning constraints?
- Are there any special C4 requirements? Who has them?
- What national space-based assets are required and/or available to support the operation? Has a USSPACECOM Joint Space Support Team been contacted?
- What C4 capabilities are available to the joint force: SHF and/or UHF commercial satellite, DSCS, fleet satellite communications, MILSTAR satellite terminals, JWICS, MILSTAR, HF and VHF radio, tropospheric and LOS microwave systems, LANs and WANs, AUTODIN, DISN, land mobile radio, personal communications systems?
- What frequencies are available for the joint operations area?
- What are the general communications security (COMSEC) requirements? Will the Intertheater Communications Security Package (ICP) be used? Who will draft the callout message?
- Who is the potential adversary? What are their capabilities to conduct offensive information warfare? Does a joint force plan exist to counter the threat?
- What are the releasability requirements for multinational operations?

Subordinate Component Forces

- Where will their C4 nodes be located?
- What are their C4 requirements?
- What are their C4 capabilities?
- What type of C4 systems do they have (power, frequency bands, interoperable and compatible with other subordinate components' equipment, mobility)?
- Who is the component C4 staff point of contact for planning and technical management and direction?
- Are there any special C4 requirements resulting from the mission and the JFC's estimate, intent, and concept of operations?
- Are subordinate and supporting C4 plans consistent with the supported JFC's C4 plan?

Supporting Forces and Activities

- What is the mission of the supporting forces and/or activities (this includes allies and coalitions)?
- What are their C4 capabilities?
- What information does the supported JFC need from the supporting forces and/or activities (intelligence, weather, imagery, mapping, deployment) and how will it be accessed?
- What C4 support will the supporting forces or activities require from the supported JFC?

Non-organic C4

- DISA.
- Does the operational area have a DISA Regional Control Center or field office?
- Who is the DISA point of contact?
- What is the DISN infrastructure in the operational area?
- Are sufficient gateways available? What are the interface requirements to access the gateways? Is the equipment available?
- Is Telecommunications Service Provisioning and/or National Security Emergency Preparedness involving authority provided and current?
- What are the anticipated DSCS and commercial satellite requirements?
- Has modeling of space networks been initiated by DISA?

Commercial Networks

- Are commercial networks available for use? Who can approve access to them? Are funds available? Has DISA been contacted to ensure required lead times for normal allocations? (1) Satellite (2) Data (3) Voice?
- What special interfaces are required to access the commercial network and where are the access points?
- What are the locations and types of switches in the commercial network? What are their technical parameters?
- Where are the locations and types of systems providing the backbone transmission network?
- What type of power is used—voltage, current, commercial grid, or generator?
- Does the operational area have a cellular network? What are the transmission media, frequency band, and interface requirements?
- What are the system standards? Is the system available for use?
- CJCS Controlled C4 Assets.
- What CJCS controlled assets are available?
- What capabilities are available?
- Will JCSE support be required in the operational area, or will other defense and commercial assets be sufficient?
- Will JCSE support be needed for en route communications?
- Has a CJCSI 6110.01, "CJCS-Controlled Tactical Communications Assets," support request for CJCS controlled C4 assets been submitted?
- What are the JCSE's logistic support and electrical power requirements?
- What are the JCSE airlift considerations, allocations, and/or priority?

Other C4 Support

- Is C4 support needed from specialized communications units?
- Who are the points of contact and what are the request procedures?
- What are the units' C4 capabilities and limitations?

b. Planning Activities

This section assumes that the basic questions have been answered and covers high-level and detailed C4 planning. Although these functions are listed separately, they are concurrent rather than sequential actions. The planners interact to refine the planning products, C4 estimates, Annex K, and JCEOI.

High Level Planning

- What nodes will be necessary to provide a global C4 network and where will they be located?

- Which nodes will have to be connected?
- What transmission media will be used to interconnect the nodes?
- What types of C4 equipment will be located at each node (equipment strings, interoperability of the equipment)?
- What are the frequency requirements for each node? How will the frequencies be allotted (joint, multinational, and subordinate components)? Are there potential frequency conflicts?
- What are the call signs and/or words for each node?
- What units will provide, install, operate, and maintain the equipment for each node? What is their operational readiness status?
- What lift assets are available to deploy these units? When will the units deploy and activate the nodes or network?
- Is the deployment schedule of C4 assets consistent with the phases of the plan? Will it permit the provision of C4 support when and where needed?
- What is the phased buildup of C4I in the operational area?
- Has C4 scheduling information been added to the time-phased force and deployment data and/or time-phased force and deployment list?
- Have the JFC and J-3 been informed of potential C4 shortfalls and recommended solutions?
- How will keying material be managed(ordering, generation, storing, distribution, transferal, and destruction)?What are the procedures for handling compromises? Is a COMSEC logistics management activity needed in the joint operations area? What access will allies have to U.S. COMSEC?
- Are network and node diagrams available?
- Have special C4 requirements been addressed (search and rescue, SOF, enroute C4, embarkation and debarkation connectivity)?
- How will the joint, JSOTF, subordinate component, and supporting forces networks interface with non-organic networks (DISN, commercial, JCSE)?
- When and where will the Joint Communications Control Center be established?
- Are the subordinate component, JSOTF, and supporting C4 plans consistent with the joint C4 plan?

Detailed Planning

Circuit Switches

- Does a circuit switch network diagram exist that shows information about the switch and circuit switch network connectivity (switch type, area code, trunk groups, capacity)?
- How does the switch route calls: flood, deterministic, or circuit switch routing task execution plan?
- Where do circuit switches need to be located? How will they be connected?
- What special features or restrictions will be imposed on subscribers? Who will authorize and enforce these restrictions?
- Where are the Defense Switched Network (DSN) interfaces? Are precedences authorized? By whom?
- How will subscriber assistance be handled?
- Where is the greatest anticipated traffic load? Does sufficient capacity exist to handle it?
- What types of status reports are required, and when will they be submitted?
- How will traffic metering and network loading be measured, modeled, and managed?
- Who will publish telephone directories and how will they be distributed?
- How will MWR calls be accommodated?

Data Networking

- What is the anticipated JTF component data requirements?

- Has automation been planned and/or engineered into the network (x.25, IEEE802.3, TCP/IP)?
- What and/or where are the network identifications and gateways?
- Will data of various classifications "ride" a secure tactical backbone? How will traffic of various classifications be controlled and managed? Are multi-level information systems security initiative devices needed and are resources available?
- What is the joint architecture topology?
- Who is the joint data networks manager?
- What are the NIPRNET, SIPRNET, and JWICS connectivity requirements?
- What Integrated Tactical Strategic Data Networking points of presence will be used? Has a gateway access request been submitted in accordance with DISA contingency and/or exercise plans?
- What is the addressing scheme?

Message Switches

- Where are the message switches required?
- What is the trunking plan?
- What is the network connectivity of all message switches?
- Have routing indicators been developed and routing tables established?
- Is this an R and/or Y network?
- Has a plain language address directory been created?
- How will special category traffic be handled? Who will be authorized to have access?
- What are the intra nodal and inter nodal terminals?
- What types of status reports are required and when will they be submitted?
- What AUTODIN Switching Centers are connected to the message switch?
- Who is the Automated Message Process System Security Officer?
- Who will act as the AUTODIN controller?

Transmission Systems

- Are the circuit requirements, routing, channelization, and other parameters identified in high-level planning valid? Have satellite access requests been submitted? Have frequency requests been approved and published?
- What are the characteristics and connectivity of multi-plexers in the network? Are they compatible?
- What are the timing requirements for the network components? How will timing be accomplished?
- What types of status reports are required and when will they be submitted?

Video Teleconferencing

- What data rate is to be used?
- Who are the participants?
- What is the schedule?
- Who is providing the bridging and MCU?

c. Technical Management and Direction

Joint Communications Control Center

- What are the operational procedures for the JCCC?
- How will the JCCC be manned?

- What reports will be required, how often will they be required, and when will they be submitted?
- How will network reconfiguration be accomplished?
- Who are the points of contact at the subordinate control centers?
- Who will submit the Telecommunications Service Request and Telecommunications Service Order?
- Who will coordinate changes to connectivity with the DISN? With the commercial networks?
- What kind of statistics will be kept? Who will analyze them? What will be done with them?
- How will changes caused by the evolving tactical situation be handled?
- Can the JCCC direct changes within subordinate component networks to optimize C4 within the joint operations area?
- Where is the boundary between technical direction and operational direction?
- How will frequency deconfliction be managed? How can potential conflicts be anticipated?
- Who will control frequency spares and authorize their use?
- Who manages the allocated satellite bandwidth used by the geographic joint forces?

Joint Communications Support Element

- Who is the JCSE POC?
- How will JCSE participate in the technical management process?
- Are there any special reporting requirements for systems provided by the JCSE?

d. Other Planning Functions

Spectrum Management

- What are the provisions and procedures for frequency planning and use for opposed and/or unopposed entry operations into an operational area?
- What frequency allotments and assignments are available for the operational area?
- Can the allotted and assigned frequencies support the equipment deployed to the operational area (communications, computer LANs and/or WANs, sensors, surveillance radars, GPS, airspace control radars)?
- Will the frequencies work (propagation and topographic analyses)?
- Does the allocation and assignment of frequencies to subordinate component commands contribute to mission accomplishment?
- What are the enemy capabilities to interfere with allotted and assigned frequencies? Does a joint plan exist to counter the threat?
- How will meaconing, interference, jamming, and intrusion (MIJI) be reported?
- Who will submit MIJI reports to the Joint Spectrum Center (JSC)?
- Will the JCCC resolve electromagnetic interference issues? Will JSC support be required to resolve interference issues?
- Are sufficient spare frequencies available?
- What emission control measures will be applied?
- Will the JFC implement an electronic deception plan? Are sufficient frequencies available to support this plan?

Security

- Will the cryptographic equipment interoperate?
- What are the keying material requirements?
- Does a key management plan exist?
- How will cryptographic compromises be detected and corrected?
- What computer security measures will be employed on the LANs and WANs in the operational area?

- How will access to the various networks be controlled (electronic and physical)?
- Have COMSEC emergency destruction procedures been established?
- What is the logistics plan for the cryptographic equipment?
- Are equipment and keymat sufficient to support planned and unplanned operations?
- Have key change times been established and promulgated?
- Have provisions been made for over-the-air-rekeying where applicable?
- Is an ICP available? Is it needed?
- What will we transition to and when?
- What is the foreign information warfare threat facing the C4I system?
- Are virus detection software applications installed and operational? Are passwords issued and in use? Has a contingency plan been developed to guide recovery actions should data be modified or destroyed by unauthorized intrusions?
- Do remotely accessed computer systems possess features to identify users and substantiate their identification before allowing information to be processed?

e. Exercise Timeline

The below list is a suggested timeline for execution of tasks to be accomplished during exercises. While not as inclusive of the items above, the timeline provides the planner with the relative relationship of key planning events.

Task	Date
Assign C4 planner	D-365
Concept development conference	D-355
Activate MAGTF plain language address	D-350
Initial planning conference	D-250
Identify initial host nation support	D-250
Annex K (Draft) distributed at initial planning conference	D-250
GMF architecture diagram (rough)	D-250
Switching architecture diagram (rough)	D-250
Data architecture diagram (rough)	D-250
JECG architecture support	D-250
Identify minimum C4 systems	D-250
Activate exercise addressee indicator group (after initial planning conference)	D-250
Identify reserve/Air National Guard requirements	D-210
Draft combined/joint communications control center organization	D-200
Main planning conference	D-190
Decision on COMMEX	D-180
Advanced concept technology demonstrations planned	D-180
New system implementation plans (GBS, DMS, MSS, Medical (tele-medicine))	D-180
Designated approval authority assigned	D-180
Identify personnel shortfalls	D-180
Publish JCCC manning table of organization	D-170
Publish software and protocols (e.g., JTAC, GTN, NTS/RPS, COP, TACCIMS)	D-170
Final planning conference	D-150
Finalize host nation support requirements	D-150
TPFDD synchronization	D-120
SIPRNET tunneling (joint staff waivers) to JFC (foreign connections to the SIPRNET including MLS	D-120
Promulgate CMS intent-to-use message	D-120
Annex K (Final draft) (changes from final planning conference)	D-120
Components provide frequency requirements	D-120
Request for service	D-100
Submit SIPRNET accreditation package	D-100
Components submit initial UHF/EHF/SHF satellite access requests to JFC	D-90

COMEX	D-90
Consolidated frequency request from JFC to appropriate JFMO	D-90
Submit Intertheater Communications Security Package request	D-90
JFC submit equipment shortfall request to combatant commander in CJCSI 6110.01 format	D-90
Tactical area codes	D-60
Technical control conference	D-60
Master net list requirements	D-60
Call sign/call words	D-60
GMF architecture diagram (final)	D-60
Switching architecture diagram (final)	D-60
Data architecture diagram (final)	D-60
Submit request for JCSE equipment	D-45
Consolidated SHF/GMF satellite access request	D-30
Consolidated UHF satellite access request	D-30
Consolidated EHF satellite access request	D-30
Request GENSER four-letter R/I	D-30
Publish Annex K (Final)	D-30
Publish formal phone directory	D-20
SAA/ODMs published	D-20
ADVCOMs	D-4/5
Final COMEX, on station	D-2/3
Execute	D-Day
Redeployment plan	D+5

Table 4-105. Exercise timeline.

4033. Information Operations Considerations

a. Basic Considerations

- Coordination with higher headquarters: CINC is the ultimate IO coordinator: What IO activities must be approved by theater (or higher) authorities? Does the MEF have knowledge of the Joint Force IO Plan? Does the MEF IO Plan conflict with the Joint Force IO Plan? Has the MEF IO Cell coordinated IO Plans with the Joint Force IO Cell? Have all available assets been considered for employment? Has the use of joint air assets: been coordinated in a timely manner (Required to be in ALOREQ? Request 24-30 hours prior to ATO to be executed? e. g., JPOTF, JSOTF, JFACC assets [EC-130H Commando Solo, Leaflet drops, other (EW, Deception)]). Does the IO cell have fulltime intelligence support?
- MEF IO Planning. Are all IO activities integrated into a single coherent IO plan that supports the MEF commander's intent (e.g., concept of decisive action)? Has the MEF requested expertise from relevant supporting commands (e.g., Joint Information Operations Center (JIOC), JWAC, FIWC, LIWA) to assist in IO planning? Are nodal analysis tools available/employed for offensive IO planning?
- MEF IO Execution. Has the MEF established IO representation in Current Operations with procedures for ensuring their receipt of critical information? Has the MEF IO cell established measures of effectiveness and a means for branch/sequel planning and tasking of relevant IO assets (e.g., physical destruction and EA)? Is there dedicated intelligence support to the IO cell?
- As of 1 October 1999, USSPACECOM was tasked with providing IO support (especially computer network attack/defense) to regional CINCs.

b. Deception

Tools for deception planning: Objective, Target, Story, Means, Feedback. Limited Distribution (close-hold)? Has the MEF conducted basic risk vs. gain analysis? Is the deception story feasible, and does the target have the ability to detect, assess, and react to the deception story?

c. Psychological Operations

Greatest weapon is TRUTH: resist use of PSYOP to deceive (compromises PSYOP credibility.) CINC retains approval authority for all themes; JPOTF and other components retains majority of assets. Maximize reachback capability for cultural intelligence.

d. Electronic Warfare

Has the IO cell provided input to/coordination with the Joint Restricted Frequency List (JFRL), MEF Targeting Board? Has intelligence gain/loss analysis been conducted with respect to targets selected for electronic attack?

e. Physical Destruction

Are IO targets integrated with the overall IO plan and presented at the Targeting Boards to be integrated with the plan for fires? Has intelligence gain/loss analysis been conducted?

f. Information Assurance

Joint INFOCON determination; MEF vulnerability assessment; active & passive information security measures.

g. Operations Security

COG/CV analysis contributes to identification of EEFIs; analysis of threat collection capabilities, indicators of EEFIs linked directly to active & passive OPSEC measures in relevant MEF plans?

h. Special Information Operations

Does the MEF have a means to coordinate with and employ national capabilities to ensure its success? Are these activities coordinated with the IO concept of support and the MEF plan?

i. Civil Affairs

Is the MEF Civil Affairs Officer or representative engaged in IO planning? Are Civil Affairs actions coordinated with the IO concept of support?

j. Public Affairs

Is the MEF Public Affairs Officer or representative engaged in IO planning? Are Public Affairs actions coordinated with IO activities? Are Public Affairs and related considerations factored into the overall IO plan?

k. Legal Considerations

Is there appropriate legal expertise available at the MEF to resolve any of the various legal consequences of the IO concept of support.