

THE GENERAL BOARD
United States Forces, European Theater

SMOKE GENERATOR OPERATIONS
AND ORGANIZATION

MISSION: Prepare Report and Recommendations of Changes
Considered Necessary in the Doctrine, Organiza-
tion and Equipment of Chemical Smoke Generator
Units.

The General Board was established by General Orders 128,
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TABLE OF CONTENTS

PART ONE

INTRODUCTION

		<u>Page</u>
Chapter I	Process of Study	1
Section I	Committee Membership	1
Section II	Special Conferences.	2

PART TWO

REVIEW OF THE EMPLOYMENT OF SMOKE GENERATOR UNITS, EUROPEAN THEATER CAMPAIGN

Chapter I	Missions of Smoke and Smoke Generator Units	3
Section I	General Mission.	3
Section II	Antiaircraft Smoke Missions.	3
Section III	Tactical Smoke Missions.	4
Section IV	Secondary Missions of Smoke Generator Units	5
Chapter II	Tactics of Smoke and Smoke Generator Units	5
Section I	General.	5
Section II	Tactics of Smoke	6
Section III	Tactics of Smoke Generator Units	7
Section IV	Control of Smoke	8
Section V	Supply of Smoke Generator Units.	10

PART THREE

COMMITTEE REPORT

Chapter I	Necessity for Smoke Generator Units.	13
Section I	Discussion	13
Chapter II	Organization and Employment of Smoke Generator Units	13
Section I	Discussion	13
Chapter III	Improvement and Development of Smoke Generators.	18
Section I	Discussion	18
Chapter IV	Conclusions.	19
Chapter V	Recommendations.	20

THE GENERAL BOARD
UNITED STATES FORCES, EUROPEAN THEATER

SMOKE GENERATOR OPERATIONS AND ORGANIZATION

PART ONE

INTRODUCTION

CHAPTER I

PROCESS OF STUDY

SECTION I

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SECTION II

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1. Conferences were held with Brigadier General Hugh W. Rowan, Chief Chemical Officer, European Theater of Operations; Brigadier General C. H. Armstrong, Chief, Antiaircraft Artillery Section, The General Board, European Theater of Operations, and with specific individuals who were commanding officers of chemical smoke generator battalions and companies during the European Theater Campaign and who are listed in this report as Principal Consultants. (See Part One, Chapter I, Section Ib).

PART TWO

REVIEW OF THE EMPLOYMENT OF SMOKE

GENERATOR UNITS, EUROPEAN THEATER CAMPAIGN

CHAPTER I

MISSIONS OF SMOKE AND SMOKE GENERATOR UNITS

SECTION I

GENERAL MISSION

2. Generally stated, the mission of smoke, or artificial fog, is to conceal an object or activity from enemy observation and thus protect it from the effects of enemy weapons directed towards its destruction. The mission of chemical smoke generator units is to release smoke from positions within our lines so that it obscures the object to be protected.

SECTION II

ANTI-AIRCRAFT SMOKE MISSIONS

3. The mission of anti-aircraft smoke is to obscure an object or area on the earth's surface from enemy aerial observation thus preventing precision bombing and strafing. This is the type of mission for which our present smoke generator units were designed. A study of the activities of chemical smoke generator companies and battalions in the European Theater of Operations indicates that anti-aircraft smoke missions in rear areas were in the minority. (Reference: 1). The 25 Smoke Generator Battalion operated with the 50 AAA Brigade in the defense of PORTLAND and WEYMOUTH harbor, in Southern England, for several months. The smoke defense at this installation was highly effective according to Brigadier General C. H. Armstrong and Lieutenant Colonel Richard Newman. The 23 Smoke Generator Battalion arrived in France on 9 June 1944 to provide anti-aircraft smoke protection for the artificial port at OMAHA BEACH. This organization was never called upon to perform this mission. (Reference: 2). On arrival in France, the 25 Smoke Generator Battalion was assigned anti-aircraft smoke missions at VEXINS DAM and PORTAUBAULT where it was deployed but never called upon to smoke, according to Lieutenant Colonel Richard Newman. The 82 Smoke Generator Company and 87 Smoke Generator Company operated with four British smoke companies under British control at the port of ANTWERP, BELGIUM for several months. (Reference: 1 & 3).

4. Anti-aircraft smoke missions under tactical conditions and in close proximity to enemy positions, were performed by the 84 Smoke Generator Company and 161 Smoke Generator Company at MAYENNE and LAVAL in August, 1944. (Reference: 2 & 4). From September, 1944, to the end of the war in Europe the smoke mission executed by smoke generator units were all of a tactical nature, although in a few instances there was a secondary anti-aircraft mission.

SECTION III

TACTICAL SMOKE MISSIONS

5. The mission of smoke in tactical situations is to obscure an object, area or activity on the earth's surface from enemy terrestrial observation and prevent observed or direct fire of his ground weapons against the screened target. By virtue of the large number of missions of this type which were executed by smoke generator companies, the tactical smoke missions were of the greatest importance.

a. Employment of chemical smoke generator companies in tactical situations was initiated by Third United States Army in September 1944, when the 84 Chemical Smoke Generator Company was used to screen the construction of a bridge across the MOSELLE RIVER at ARNAVILLE, FRANCE, VU7547. (Reference: 4 & 5). Throughout the remainder of the war in Europe, this was the predominating mission for smoke companies. Its successful execution made the construction of heavy bridges possible at an earlier phase of river crossing operations and thus speeded the support of armor and heavy artillery and facilitated supply of the forces in the bridgeheads.

b. Another type of mission performed by the smoke generator companies was the screening of troop movements on the battlefield. A good example appears in the operation of a detachment of the 168 Smoke Generator Company, which supported troops of the 3 Infantry Division in reducing Maginot forts near MUTZIG in December of 1944. (Reference: 6).

c. In February 1945, the 162 Smoke Generator Company, operating in the vicinity of FREMERSDORF, Q29, and MECHERN, Q19, established a screen for the primary purpose of drawing fire and the attention of the enemy away from another locality where their principal operation took place. (Reference: 4). A variation of this application of smoke is its use wholly to draw artillery fire and thus cause the enemy to disclose the locations of his weapons.

d. The examples of tactical smoke missions cited above do not exhaust the possibilities for employment of smoke generator units in battlefield situations. The sole limitations in this respect are: The basic requirement that the smoke positions must be within our lines; the situation must permit adequate supply of smoke materials; and the commander of the supported troops must have an open mind and vision to accept a means of aiding his troops to accomplish their mission with minimum casualties and equipment losses.

e. In all of the operations of chemical smoke generator companies, Mechanical Smoke Generators, M1 or M2, have been the primary smoke producing means. On several occasions, however, smoke pots have been substituted for the mechanical generators. The reasons for this substitution were the need for silence and inability to reach smoke points with transportation so as to supply the required quantities of fog oil. The smoke pots have proven to be satisfactory in this employment, and the irritating quality of the HC smoke has been both advantageous and disadvantageous. In its operations in support of ROER RIVER crossings of the XIII Corps, a detachment of the 74 Smoke Generator Company used M4 smoke pots, and it is reported that a large part of the German garrison

abandoned their positions due to the irritation caused by the smoke. (Reference: 7). In other instances where HC smoke munitions were employed to screen bridge construction, the smoke caused some interference with the work of the engineer troops because of its irritating qualities. (Reference: 8).

SECTION IV

SECONDARY MISSIONS OF SMOKE GENERATOR UNITS

6. There were periods during the war in Europe when there was little or no demand for smoke. The personnel and equipment of smoke battalions and companies were not wasted at these times, but were diverted to secondary missions according to their capabilities. (Reference: 2 & 9).

7. In many cases the employment of smoke generator organizations on secondary missions had a profound effect on their availability and readiness to perform their primary mission. Usually it was necessary to turn in, or store, their smoke generators and other equipment not required to perform their assigned mission so that vehicles would be available and personnel not burdened with care and maintenance of impediments for which they had no immediate use. This caused serious delays in preparing for smoke operations. Some organizations which were committed to secondary missions in the communications zone were not released when there was a need for them in the armies to perform smoke missions. During the latter part of March 1945, it was proposed that other Chemical Warfare Service troops be converted to smoke generator units to meet the estimated future needs of the armies while six companies were being employed on secondary missions. (Reference: 2). The insufficiency of smoke generator companies in the armies was, in part, responsible for the practice of breaking companies up into small detachments, sometimes widely dispersed, for smoke operations. This placed a burden of supply and administration on the companies for which they were not designed and added much to their difficulties.

CHAPTER II

TACTICS OF SMOKE AND SMOKE GENERATOR UNITS

SECTION I

GENERAL

8. (This discussion is based on a study of available operation reports of smoke units and experiences of Lieutenant Colonel Fiske and the 23 Chemical Smoke Generator Battalion). The tactics of anti-aircraft smoke and the operating procedures of smoke companies are adequately set forth in Field Manual 3-50, "Large Area Smoke Screening". In the execution of anti-aircraft smoke missions in the European Theater of Operations, the procedures outlined in this manual have been followed quite closely. However, there is no published doctrine to guide smoke units in performing tactical smoke missions or to provide information to the commanders of supported units relative to the capabilities and limitations of smoke and smoke generator units. The procedures in the two types of smoke operations differ somewhat, and these differences are pointed out in this chapter.

SECTION II

TACTICS OF SMOKE

9. Placement of the screen. Since the purpose of smoke is to prevent observation, it is obvious that the screen should be placed between the object to be obscured and the enemy observation point. Screening is more effective when the smoke envelopes the enemy, but this placement is usually beyond the capabilities of smoke generator organizations. In antiaircraft smoke missions, the screen must cover the area or object like a blanket in order to come between the enemy observation points and the area or activity which we do not want the enemy to see. Thus, in reasonably level terrain, it is not necessary for our forces to be enveloped in smoke in order to prevent terrestrial observation. When this method is practicable, it has the advantage of permitting our activity to be carried out in an area free of smoke, thus hastening its conclusion and minimizing the interference to it caused by poor visibility. Screens of this type should not be too close to the screened object or fire directed at the screen will have effect on our activity. In some localities, of which the upper Rhine River Valley is typical, enemy observation points may be in positions comparable to that of an air observer. Since the smoke cannot always be depended upon to rise high enough so that the enemy observer cannot see over the top of the screen and into the area to be obscured, it may be necessary to envelop our activity in smoke.

10. In nearly every situation the commander has the choice of using one large screen or several small ones. This is true in both antiaircraft and tactical situations. Careful consideration of this possibility in antiaircraft situations has resulted in the doctrine being established that with a given number of smoke troops available, it is usually better to employ all on one large screen rather than establish decoy screens. In tactical situations, smoke usually draws the fire of enemy ground weapons. Small screens serve to mark, with a fair degree of precision, the scene of our activity, and so are likely to draw intense and rather accurate fire. The large screen, on the other hand, especially if well placed, covers such a large area of possible activity on our part that the enemy may consider it a waste of ammunition to fire into it at all, because of his doubt that he will hit anything profitable. As an example, a large smoke screen designed to protect tactical bridge construction should be several thousand yards in length, and several possible construction sites should be included within the area of the screen. If there is only one possible crossing site, it is likely that the effectiveness of the screen will be greatly reduced, because of the enemy knowing that this particular point is the scene of our activity, can place effective unobserved fire at the construction site. However, observed and direct fire would be denied to the enemy.

11. Time of development of the screen. When to start smoking is an equally important factor in the tactics of smoke. In antiaircraft smoke operations it is necessary that the screen be fully developed before the enemy air attack begins. In tactical smoke operations the enemy should be denied observation of the area before our activity in that area commences. If this is not done, the enemy has a chance to learn what is going on, know its precise location and make accurate adjustments of his weapons on points in the area. He can

then, even though he later is not able to see the area, place accurate fires which will seriously hamper our activity and possibly prevent its completion. Smoke coverage is not instantaneous, but requires from 15 minutes to half an hour, and sometimes more, to completely cover the area to be screened. This has at times been a source of trouble to smoke unit commanders. The commander of the supported unit will instruct the smoke unit commander to start smoking at a specified time, and later it is learned that the supported unit commander wanted the screen fully developed at that time.

SECTION III

TACTICS OF SMOKE GENERATOR UNITS

12. The tactics employed by smoke generator units are influenced by the nature of their mission. In any smoke operation involving smoke generator companies, it is essential that provision be made to accomplish the smoke mission with any wind direction. In antiaircraft smoke operations, this is done by having a smoke circuit, or series of smoke generator positions, surrounding the site to be screened. However, only those positions which are required for a given wind direction are occupied at any one time. Should the wind direction change, subdivisions of the smoke organization are moved to new positions. This procedure is possible in most antiaircraft missions if the roadnet is favorable and the activity is not in close proximity to enemy lines and thus exposed to fire of ground weapons. In tactical missions, the nearness of the enemy precludes movement of elements of the smoke generator organization to compensate for changes in wind direction. Therefore, the usual practice is to emplace generators and supplies at the individual positions in the smoke circuit. Coverage with any wind direction is then accomplished by starting up or shutting down appropriate generators. The antiaircraft smoke circuit is usually located one to one and a half miles upwind of the vital point to be screened. With generators (M1 type) spaced at 100 to 150 yards intervals, the smoke rises and becomes less dense by the time it reaches the area to be protected. This behavior of the smoke results in minimum interference to traffic movement and other important ground activity in the protected area. Tactical smoke circuits are usually not more than 500 yards upwind of the area or object to be obscured and so it is necessary to have less interval between generators to assure that a screen is formed from the generator smoke trails. Generator spacing in these situations has varied from 40 to 150 yards with M2 generators. Factors controlling the spacing of generators in both antiaircraft and tactical situations are terrain, wind speed and direction, and air turbulence. Usually it is desirable to limit the effective range of smoke screen so as to minimize the danger of interference with operations. This is frequently difficult to accomplish with generators in which the smoke output cannot be varied.

13. Reconnaissance and preparation of the plan. As in all military operations, it is essential that the smoke unit commander prepare a plan for the smoke operation. This plan is the result of his knowledge of the supported unit's mission, the mission assigned him by the commander of the supported unit and his reconnaissance of the area in which he is to operate. These activities require a certain amount of

time, and after he has prepared an acceptable plan, its details must be communicated to the smoke generator organization and some time allowed for reconnaissance by subordinate commanders. In antiaircraft operations, this procedure usually need not be a hasty one, but in tactical situations the time factor demands that this be done quickly. It has been characteristic of tactical smoke operations in the European Theater of Operations that insufficient time was allowed the smoke unit commander to make a reconnaissance and prepare an adequate plan for the operation. Smoke companies have usually been required to begin operations within a few hours of their arrival in the vicinity of the operational site. Experience of smoke unit commanders indicates that when their operations is preceded by a long motor march, it is necessary to thoroughly check all smoke generator and radio equipment to insure that it will be in working condition when its use is required. It is believed that the minimum time of one full day of daylight should be given a smoke unit to prepare for an operation. (An excellent example of thorough and painstaking preparations appears in the operation of a detachment of the 83 Chemical Smoke Generator Company at SCHOPHOVEN, GERMANY, 23 and 24 February 1945 in support of 30 Infantry Division assault crossing of the ROER RIVER. (Reference: 10).

14. Occupation of positions. In the usual antiaircraft smoke mission of a prolonged nature, positions are selected as a result of thorough reconnaissance, adequately marked or otherwise made known to all subordinates, and then are occupied daily at specified times. In tactical missions, the occupation of positions should be carried out under cover of darkness, and supplies for several hours operation moved to the position at the same time. Daylight occupation of positions frequently results in disclosure to the enemy of the precise locations of generators and their operating personnel, with consequent early destruction by artillery fire.

15. Security and protection of the unit in operation. In nearly all smoke generator operations, whether tactical or antiaircraft, the organization is so widely dispersed that individuals cannot mutually support each other in defense against any ground action. It must rely, therefore, on the action of other ground forces to defend the area in which it is operating, and forwarding of any serious enemy threat which would require their withdrawal or destruction of their equipment. Other security measures in antiaircraft smoke assignments include the use of such concealment as is available, staggering of individual generators and the siting of organic antiaircraft machine guns so as to discourage strafing attacks by enemy airplanes. In tactical smoke missions, defilade or cover of some sort is sought for individual generators and operating personnel to minimize the probability of injury to men and equipment. When time permits, the generators and operating supplies are dug in. Slit trenches should be provided for personnel.

SECTION IV

CONTROL OF SMOKE

16. Higher commander and coordination with the overall operation. In all operations, the smoke unit is attached to an organization of one of the arms, and the commander of the supported unit decides in a general way the manner in which smoke will be employed.

a. In the European Theater of Operations, antiaircraft smoke is under the control of the antiaircraft artillery commander. Other agencies, with whom smoke employment must be coordinated, are the air force, which may veto the smoke operation; and army and navy authorities responsible for the discharge of shipping at ports, who must agree daily to the employment of smoke. In practice, this procedure was satisfactory at established ports in the United Kingdom. It was found, however, that due to poor communications facilities in the OMAHA BEACH area, it was cumbersome and difficult to contact naval authorities. (Reference: 2). Control of all air defense means was exercised through a joint AA Operations-Fighter Control Room. The smoke battalion had a liaison officer available to be present at this place. The Naval Officer In Charge of OMAHA BEACH likewise had liaison officers there, but they never could be found. It is quite possible that had there been an urgent need for smoke in this area, that these coordinating difficulties would have been corrected quickly.

b. Tactical smoke operations. In tactical smoke operations, smoke generator companies have operated under control of engineer battalions and groups, infantry regiments, and sometimes infantry and armored divisions. In such situations, it is important that the commander, who has the primary interest in the overall operation, inform all elements of his command that smoke will be used, where it will be used, who is in direct command of the smoke operation and who should be contacted should the smoke cause excessive interference with any phase of the overall operation. There have been numerous cases of corps or division staff officers ordering individual generator operators or smoke sections to stop their generators.

17. In smoke operations, either antiaircraft or tactical, it is the function of the smoke unit commander to dispose his organization so that he can perform the mission assigned him efficiently. All orders to start smoking, stop smoking, and requests for more or less smoke, must pass through him.

18. The smoke unit commander judges the effectiveness of his screen by observing its density and coverage and by receiving reports from his subordinates and officers of the supported unit, who are usually dispersed over a fairly large area. Antiaircraft smoke screens cannot be accurately judged from positions on the ground. These screens should be observed from positions which approximate possible bomb release points. In practice, air observation of the screen is used whenever practicable in daylight trial operations to correct any deficiencies in placement of smoke generators. Since smoke is rarely used during daylight to support the antiaircraft defense, it is not practicable to exercise control over this type of smoke operation from the air.

19. Communications. Smoke generator companies have organic communications equipment designed for use in performing rear area antiaircraft smoke missions. The means provided are telephone and frequency modulated radios. With ample time to construct telephone lines along the whole smoke circuit, and with radio to supplement telephone communications, the communication system is quite complete and effective. The communications personnel, however, is not adequate to maintain the interior communication system and provide communication to the supported unit unless its command post is

quite close to that of the smoke generator organization. In tactical smoke operations, radio communication must be wholly relied on, as there is seldom time to construct the necessary telephone lines. In some cases it may be necessary to augment the organic radio equipment in order to insure rapid transmission of orders. In tactical smoke operations, the practice of establishing the smoke command post at or very near the command post of the supported unit has insured necessary close contact between smoke commander and tactical commander. In situations where two or more smoke companies have operated under control of a battalion headquarters, communications has been a serious problem due to the limited range of frequency modulated radio transmissions over irregular terrain.

20. Weather information. The behavior of smoke is dependent upon certain weather elements; the wind direction, its speed, and the turbulence of the atmosphere. Overall visibility will influence the density of smoke needed to accomplish the smoke mission. It is desirable that accurate forecasts of these weather elements be available to the smoke commander when he is preparing his plan. Experience has shown that while forecasts provided to smoke commanders have had reasonable accuracy for the general area of operations, they have been unreliable for the specific time and place at which the smoke operation was performed. Smoke companies are provided with excellent weather equipment and with weather observers to obtain data. The wind measuring equipment available to these companies is of two types: an elaborate wind vane and anemometer (ML-80) with an indicator (ML-117) which operates by remote control, and a small portable wind vane (ML-73) and anemometer (ML-62). The elaborate equipment has been used seldom because of the time required to install it and difficulty of concealing it. In practice, smoke commanders have used artillery metro messages augmented by their own observations to provide current weather information. When used, forecasts of general weather and forecasts of wind direction and speed probabilities (wind roses) have been used primarily to establish priorities in the development of the smoke circuit when time was an important factor in getting into operation.

SECTION V

SUPPLY OF SMOKE GENERATOR UNITS

21. Supply has been the greatest problem of chemical smoke generator companies. The basic reason for their difficulties is the lack of cargo transportation in the company. However, supply difficulties varied in companies due to difference in their transportation. In the European Theater of Operations, three different types of smoke company organizations existed. Two types conformed to the present Tables of Organization and Equipment 3-267, these being organizations equipped with the Mechanical Smoke Generator, M2. The third type of company resulted from incomplete re-equipment under the latest Tables of Organization and Equipment 3-267. These companies were re-equipped with Mechanical Smoke Generators, M2, but because of non-availability of $\frac{1}{2}$ -ton trucks and trailers retained their $2\frac{1}{2}$ -ton trucks and, in some cases, a substantial number of trailers. The type organization equipped with the Mechanical Smoke Generator, M1, is omitted from consideration in this study because of its generator being

obsolete. In considering the supply of smoke generator units, the tonnage requirements should be borne in mind. The Mechanical Smoke Generator, M2, uses about 560 pounds of fog oil, gasoline and water per hour. Assuming that all of the company's 48 generators are operated, its requirements are approximately 13½ tons per hour. A company equipped strictly in accordance with Tables of Organization and Equipment has 12½ tons of cargo capacity in its 2½-ton trucks, provided the kitchen truck is used for operational supplies. Water and gasoline are usually available from sources within ten miles of the site of the smoke company's operation. Fog oil supply points, however, have been very much farther than this, varying from 50 miles to several hundred miles. Three specific instances are cited here for example: When the 84 Chemical Smoke Generator Company operated at MAYENNE, FRANCE, its fog oil had to come from OMAHA BEACH, a distance of about 120 miles; (Reference: 2). When the 84 Chemical Smoke Generator Company was relieved of its smoke mission at ARNAVILLE, FRANCE (U74), it sent 20 trucks and trailers back to OMAHA BEACH to replenish its fog oil supply, an estimated distance of approximately 400 miles; (Reference: 4). The 23 Chemical Smoke Generator Battalion, operating on the RHINE RIVER at points between BONN and REMAGEN, drew its fog oil supplies from ROLS-DORF on the west side of the ROER RIVER near DUREN, about 60 miles away. (Reference: 9).

a. Fog oil supply. The conventionally organized smoke generator company is not capable of supplying its operational requirements of fog oil with its organic transportation when the turn around time from the fog oil dump to the generator positions exceeds one hour. This type of company has invariably been supplied in its operations by transportation provided by the supported unit. In some cases, detachments from quartermaster truck companies have been attached to the smoke unit to transport its fog oil. On the other hand, the type of company with mechanical Smoke Generators, M2, and 2½-ton trucks, can handle a large portion of its supply requirements. As an example, the 23 Battalion, operating on the RHINE, transported approximately 50% of its fog oil requirements with company transportation. (Reference: 9). The conventionally equipped company cannot carry any basic load of operational supplies and move its T/E equipment. Companies equipped with 2½-ton trucks were able to carry a basic load of 4½ hours of smoke supplies.

b. Other supplies. Supply of requirements other than smoke materials was not as difficult, but did present some problems. These problems arose primarily from the brevity of their attachments to other organizations, rather than lack of transportation.

c. Maintenance. Aside from the supply of operational materials, maintenance of the Mechanical Smoke Generator, M2, presented a problem of great importance. This machine, perhaps due to an effort to reduce its weight to a minimum, has shown a tendency to be unreliable in operation. Normally, the defects which occurred have not been serious and usually require some minor adjustment or the replacement of a part. However, spare parts for this machine were never available for issue of the prescribed organizational set of spare parts to companies. So far as is known, even the chemical maintenance companies were unable to get standard spare parts. As a result of this situation, generators which required simple first and second echelon maintenance had to

be returned to chemical maintenance companies for repair. In some cases maintenance companies fabricated parts which were frequently needed and maintained small detachment in the vicinity of smoke generator companies so as to repair quickly machines which were non-operational. During one week of smoke operations, the 23 Chemical Smoke Generator Battalion (consisting of two companies) sent 34 generators to a maintenance company for repair. (Reference: 9). Many more were adjusted or had repairs made on them by company generator mechanics. Motor vehicle maintenance was also a problem in smoke generator companies. This was due to an insufficient number of motor mechanics in the organization. Again the frequent changes in attachment made it difficult for companies to maintain contact with ordnance units which had their vehicles for third and fourth echelon maintenance work.

PART THREE

COMMITTEE REPORT

CHAPTER I

NECESSITY FOR SMOKE GENERATOR UNITS

SECTION I

DISCUSSION

22. Several factors must be considered in determining whether there is a need for chemical smoke generator units. Smoke has proven to be of great value in defense against air attack and on the battlefield. Its future utility as a means of antiaircraft defense is dependent upon the tactics and techniques which air forces may use in the future. Allied air forces have used radar devices extensively in bombing enemy targets. This application of radar has nullified the effect of smoke. It is reasonable to assume that the enemy air force in the next war will be as well equipped with radar devices as our own air force was in this war. Again, it has been predicted that in the future bombing fleets may be composed of pilotless aircraft, which may be guided to their target by remote radio control, or perhaps directed to their target in a manner similar to the firing of a cannon, that is, it being started in a given direction with a timing device to control the place at which the missile explodes. Obviously, smoke can not be an effective defense against such an attack. On the battlefield, it is quite possible that the development of radar and infra-red observing equipment may likewise nullify the effect of smoke. This would be especially true if such devices had wide enough distribution in the enemy forces to assure effective control of fire and reliable observation. The German army had a number of infra-red observing devices, but it is not known how extensively they were used. Infra-red rays are capable of penetrating haze and artificial fog, but not natural fog. (Reference: 13). Thus, the need for smoke in the future must be determined by study of scientific developments designed to overcome the concealing power of smoke, and the efforts to produce a smoke that will be opaque to infra-red and radar rays. If it is determined that there is a need for smoke, then the need for chemical smoke generator troops is established.

CHAPTER II

ORGANIZATION AND EMPLOYMENT OF SMOKE GENERATOR UNITS

SECTION I

DISCUSSION

23. Smoke generator troops were initially separate companies. Being designed primarily for antiaircraft smoke protection of large and important installations, it was found that in nearly every situation several companies were required. In order to provide a coordinating and command

agency for such installations, the battalion headquarters and headquarters detachment was created, and companies were attached to and detached from battalions in accordance with the requirements for troops at a given installation. When there was no longer a need for antiaircraft smoke at ports and other installations in the European Theater of Operations, many of the smoke companies and battalions were made available to the armies for such battlefield use as they were suitable for. In most situations, a single company was adequate to perform the mission assigned. Because of this, and the inadequacy of the present battalion headquarters and headquarters detachment to accomplish the proper functions of a headquarters, many smoke unit commanders and chemical staff officers feel that there is no need for a battalion organization. On the other hand, army chemical officers and unit commanders generally agree that there is a need for a battalion headquarters and headquarters company which is capable of properly supporting smoke companies with supply, administration and representation at the headquarters of the unit to which they are attached. (Reference: 12). Even though most smoke missions are performed by detached companies, occasions do arise in tactical situations where two or more companies are required on a single smoke mission. Again, there are situations where only one company is required for a smoke mission, but several companies may be operating in close proximity to each other. In the first situation, a headquarters is required to coordinate the activities of the two companies and exercise command over the smoke operation. In the second case a battalion headquarters, or a portion of it, can profitably move to the vicinity of the operation, exercise general supervision over the operation, and through closer contact with the several companies take over their supply and liaison problems. A separate company, not permanently assigned or attached to a given command, is handicapped by the lack of a battalion headquarters to look after its supply and personnel administration, and generally supervise its activities.

24. There has been some thought that two types of smoke generator units should be organized in order to effect economies in manpower and equipment. It has been proposed that one type be created for employment in the relatively static type of mission, which would exist in the protection of ports or other rear area installations where supply of operational materials would not require much organic transportation. The other type of company would be designed for use in the combat zone where supply points are usually some distance away from the site of operations. To evaluate these proposals, it is desirable to consider some of the historical aspects of this war. At the beginning of our participation in this war, the enemy air forces were relatively strong. They had the capability of delivering effective air attacks anywhere in the Theater of Operations, and there was fear of attacks against Zone of the Interior installations. To reduce the effectiveness of such attacks, the smoke generator units were created with the concept of employing them in situations where good roads existed and ample supplies were available nearby. By the time the allies were ready to execute their major offensive against Germany in Europe, attrition had so weakened the German Air Force that it was no longer capable of effective air attack against our important rear area installations. Since there was no longer a need for chemical smoke generator units in the

missions for which they were designed, an effort was made to find some use for them. At about the same time, the Mechanical Smoke Generator, M2, became available and made possible the employment of these organizations in tactical situations. So, some companies were made available to the armies, and others were diverted to secondary missions. We see then that an organization which was designed for employment under one set of conditions was committed to operating under quite different conditions which put it under a rather severe handicap. Too much time is required to effect the conversion of an organization from one type to another to permit the salvaging of men and equipment in a unit for which there is no longer any need. Similarly, the time required to correct T/O & E deficiencies resulting from war experience is excessive. Major wars are of such great magnitude that a high degree of coordination must be exercised over all national activity, and extreme care must be employed in the utilization of manpower. With regard to smoke generator organizations, it is believed that this can best be accomplished by designing a single type of smoke generator unit which can work efficiently in the rear area mission and on the battlefield.

25. In this study of chemical smoke generator units it is not intended to present a new organization which is complete in all details, but rather to indicate the changes required in structure and major items of equipment.

a. The chemical smoke generator battalion should be composed of a headquarters and headquarters company, a medical detachment, and four organically assigned chemical smoke generator companies, (See Chart #1, Appendix). It is believed desirable to have the companies organically a part of the battalion so that the complete organization trains as a whole and, through constant association of personnel in the organization, it becomes a team. Also, by fixing the number of companies in the battalion, there is a definite proportion of transportation available for supply of operational materials. A medical detachment has been considered desirable by all smoke unit commanders interviewed. In studying tables of organization and equipment of separate battalions in the arms and services, it is noted that none lack a medical detachment. It is also believed that there should be a chaplain and appropriate assistants attached to the battalion.

b. Battalion headquarters and headquarters company.

- (1) The battalion headquarters and headquarters company should be organized substantially in accordance with the T/O & E proposed by Major J. Fuller, formerly commanding the 22 Chemical Smoke Generator Battalion, with slight modifications to conform to comments of various headquarters which reviewed this proposal. (Reference: 12). The functions of the battalion headquarters are command, administration and operational control of smoke operations when two or more companies of the battalion are engaged in a single mission. Personnel of the battalion headquarters assist detached companies by providing technical advice to the supported unit, assist in the preparation of smoke plans and in

coordinating the smoke plan with other agencies concerned. Battalion headquarters also may perform the important function of assisting in the rehabilitation of companies which have been engaged in operations and have sustained equipment and personnel losses. The battalion headquarters should handle all supply matters pertaining to Class II, IV and V (fog oil) for the companies of the battalion. A diagram of a suggested headquarters organization appears in Chart 2, Appendix.

- (2) The headquarters company serves the headquarters in carrying out its functions of administration and supply of the battalion. Chart 3, Appendix, shows a diagram of a suggested organization. The principle service rendered by the headquarters company to the smoke generator companies is supply of fog oil. In addition to this, personnel of the supply platoon dilute fog oil with kerosene to thin it for cold weather operations. It is believed that first and second echelon maintenance should be accomplished only in the smoke generator companies. Maintenance support by the headquarters company should consist of spare parts stocks, a reserve of three generators per company (in addition to the two carried by each company) and acting as intermediary between the companies and chemical maintenance companies for third and fourth echelon work. Organization of the supply section into four squads, each having four 2½-ton trucks and four 1-ton cargo trailers, permits attachment of one such squad to a detached company when the situation indicated that the company's supply problem could be accomplished better in this manner. Each supply squad, augmented by maintenance men from the companies, could handle the equipment of one company and have it available quickly and in good condition when it is needed for smoke operations. The battalion communications means should include telephone and radio. The telephone communication is necessary within the battalion headquarters and to all the companies when they are reasonably close together and to the headquarters. In most cases, telephone communication to the headquarters to which the battalion is assigned is also necessary. Because the companies are frequently an appreciable distance away from the headquarters, radio communication is necessary to maintain contact. Radios provided should have a reliable range of 100 miles. Sufficient radio operation personnel should be provided to permit continuous operation of the battalion radio station.

c. Experience in the European Theater of Operations has shown that the chemical smoke generator company has some deficiencies. The most serious of these has been its inability to handle fog oil supply and to carry a basic load of smoke material. The organization diagrammed in Chart 4 has been designed to correct the known organizational defects of the company. It consists of a company headquarters and two operations platoons. This does not represent an increase in the number of smoke generators which the company operates, but is designed to provide greater flexibility and better control in the organization. It has been found that continuous operation of the company places an excessive strain on the personnel. By having two operations platoons, both could be employed in missions requiring only daylight operation; and in situations where both daylight and night operations are required, one platoon can relieve the other. This organization likewise provides permanently organized small detachments which can conveniently be assigned independent missions at points in the vicinity of the company's location, but not too far distant. Each platoon is composed of two sections, and each section has three squads. The major deviation from the present organization appears in the squad organization and equipment. The present squad is composed of one corporal and two privates, and operates two Mechanical Smoke Generators, M2, which are transported in a $\frac{1}{4}$ -ton trailer, squad personnel riding in the $\frac{1}{4}$ -ton truck which tows the trailer. There are two serious deficiencies in this squad organization. First, the squad cannot carry with it any fog oil. Second, the corporal is the truck driver. When it is necessary to move the vehicle away from the smoke operations line, the squad leader goes with it. It may be argued that one of the privates could drive the vehicle away, but regardless of who drives it, one-third of the squad is lost. In the proposed organization, the squad is composed of one corporal, two technicians fifth grade (truck drivers), and four privates or privates first class. This squad operates four Mechanical Smoke Generators, M2, which are mounted on two $2\frac{1}{2}$ -ton trucks. Each truck will carry a four and a half hour supply of fog oil, gasoline and water for the two smoke generators. This squad may be used efficiently in either anti-aircraft smoke operations or in tactical smoke operations. In the anti-aircraft smoke operations, the generators would be operated from their mounts on the trucks. This provides for the necessary mobility of elements of the company. Due to the relatively short operating periods in anti-aircraft smoke operations, resupply of fog oil can be accomplished by battalion headquarters company. When the present company is required to operate in anti-aircraft smoke missions, it is necessary that a stock of fog oil be established at each smoke point. This is time consuming in preparing for the operation, results in having on hand an excessively large quantity of fog oil, and due to its great dispersion is impossible to guard so as to prevent pilferage. Obviously, this difficulty is eliminated when the fog oil supply is carried with the generators. In tactical smoke missions, the squad trucks are driven to the selected positions, generators, operating supplies and generator operators unloaded. The trucks are then available to augment the battalion headquarters company in supplying fog oil to the companies. Some other modifications of the company organization have been indicated by experience. It is considered necessary to have one additional officer in the company. In many tactical smoke situations, sections of operations platoons have been assigned separate smoke missions. In every case it has been considered desirable to have an officer in charge of each

section. This has resulted in putting the whole responsibility for mess operation and feeding of the personnel in action, the supply of operating materials, and motor and smoke generator maintenance on a non-commissioned officer, usually the first sergeant. Two additional smoke generator mechanics should be provided so that there is one per section of the operations platoons. Auto mechanics should be increased to provide better second echelon motor maintenance. The number of radio operators should be increased so that the company radio station can be operated 24 hours a day for a prolonged period. The present basis of radio operators, one per radio, is inadequate when the company is on a prolonged mission. It was found in the operations of the 23 Smoke Generator Battalion on the RHINE that the command radio set operator and the company commander became exhausted rather early in the operation because there was no relief for them. (Reference: 18).

CHAPTER III

IMPROVEMENT AND DEVELOPMENT OF SMOKE GENERATORS

SECTION I

DISCUSSION

26. Twelfth Army Group comments and recommendations with regard to subject matter contained in the Report of Army Ground Force Equipment Review Board, and report and recommendations of European Theater of Operations to the Chief of Staff, United States Army, based on studies of the aforementioned documents, regarding "continuation of research to improve the mechanical smoke generators" are concurred in. Specific comments on desirable improvements in the Mechanical Smoke Generator, M2, follow:

a. Increased ruggedness and dependability is the most important improvement required in the smoke generator.

b. Reduction of size and weight of the generator is desirable but should not be attained at the expense of increased ruggedness and dependability.

c. An effort should be made to reduce the amount of noise made by the generator when in operation. Excessive noise has precluded its use in front line operations where secrecy was of paramount importance. (Reference: 11). On other occasions the noise of the generator prevented operating personnel from hearing incoming enemy artillery shells, causing casualties which could have been avoided if the men had heard the shells and taken cover. (Reference: 4).

d. A modification of the Mechanical Smoke Generator, M2, to permit variation of its smoke output is desirable. In tactical situations it is usually desirable that the distance downwind to which the smoke is effective be limited so as to decrease interference with other battle activities. Another advantage of this capability would be adjustment of smoke screen density to that desired by the supported unit. It may be argued that this can be accomplished by spacing generators at wider intervals or by decreasing the number of gen-

erators in operation. In some situations this is a satisfactory solution but in many cases it is likely to result in a series of separate smoke trails which never form a homogeneous screen.

e. Another desirable modification of the generator is one permitting instantaneous shutdown by stopping the engine of the generator. Although this has been done many times in practice, due to ignorance on the part of the operator or by command of senior officers, it results in clogging water line components with fog oil and consequent failure to operate when started again. Normal shutdown procedure now requires about three minutes.

f. To preserve the value of smoke it may be necessary to alter its nature, if possible, so that it counters the effectiveness of radar and infra-red observing and fire control devices. Active research to accomplish this end should be carried out. Field tests and tactical studies should be engaged in to determine the utility and desirability of such altered smoke. It is believed that the requirement for smoke generator units in the future hinges on this point.

CHAPTER IV

CONCLUSIONS

SECTION I

27. It is concluded that:

a. A requirement exists for chemical smoke generator companies but this requirement is subject to evaluation of the need for smoke in view of present known devices which reduce its effectiveness.

b. A requirement exists for a battalion organization for smoke generator companies, subject to the same considerations as in a, above.

c. It is desirable to change the organization of Headquarters and Headquarters Detachment, Chemical Smoke Generator Battalion as set forth in T/O & E 3-266S, dated 28 September 1944.

d. A change in the organization of the Chemical Smoke Generator Company as set forth in T/O & E 3-267, dated 4 May 1944, is desirable.

e. Published doctrines for employment of chemical smoke generator units do not provide information and instructional material on the employment of these units in battlefield situation.

f. Improvements in the Mechanical Smoke Generator, M2, are desirable.

CHAPTER V

RECOMMENDATIONS

SECTION I

28. It is recommended that:

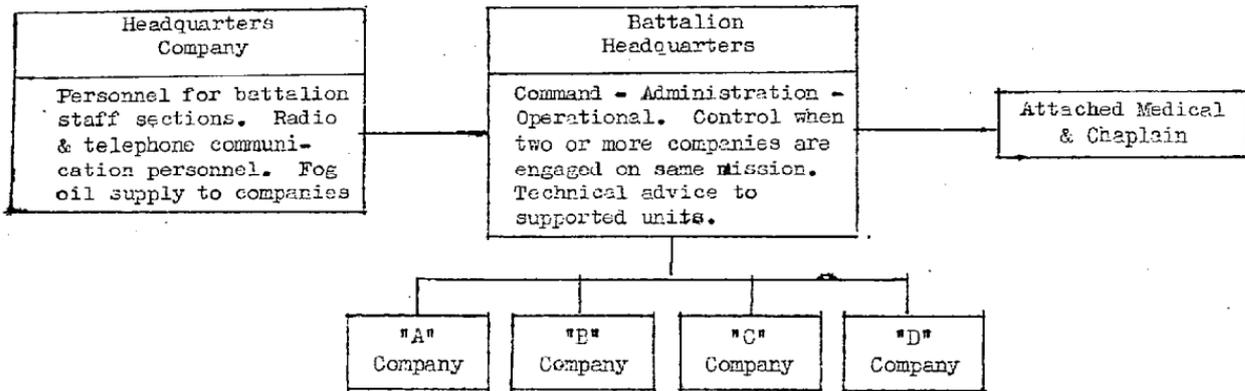
a. Tables of Organization and Equipment for a chemical smoke generator battalion, with organic composition as indicated in Part Three, Chapter II, Paragraph 23, of this report, be prepared and published.

b. Appropriate revisions and changes to FM 3-5, "Tactics of Chemical Warfare"; FM 3-50, "Large Area Smoke Screening"; and FM 100-5, "Operations" to adequately set forth the doctrines of employment and the capabilities and limitations of smoke generator units in tactical smoke operations be prepared and published.

c. Active research and development be continued to improve mechanical smoke generators as indicated in Part Three, Chapter III, Paragraph 26, of this report.

(PROPOSED)

Chemical Smoke Generator Battalion

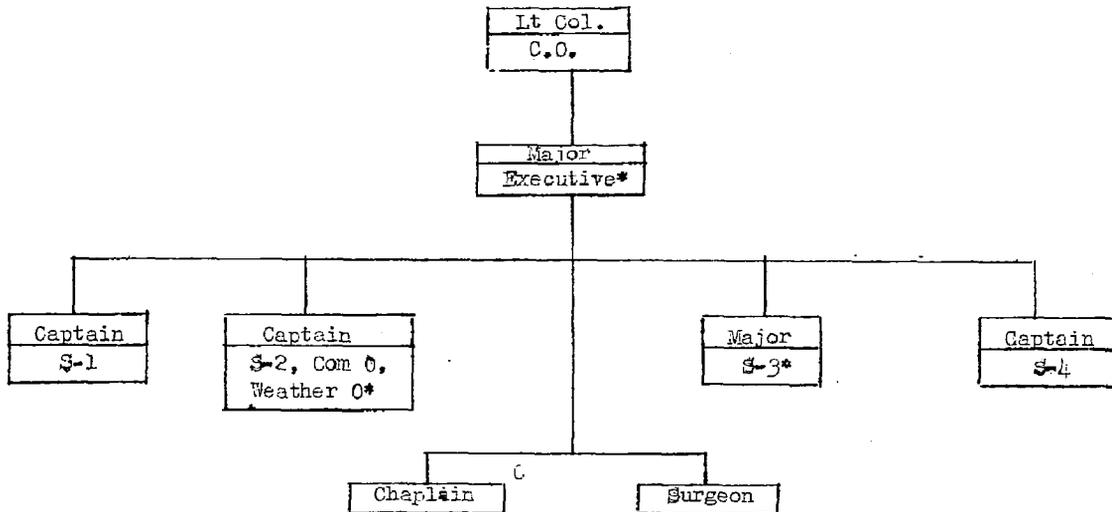


25 Sept 45

EXHIBIT 1, CHART 1

(PROPOSED)

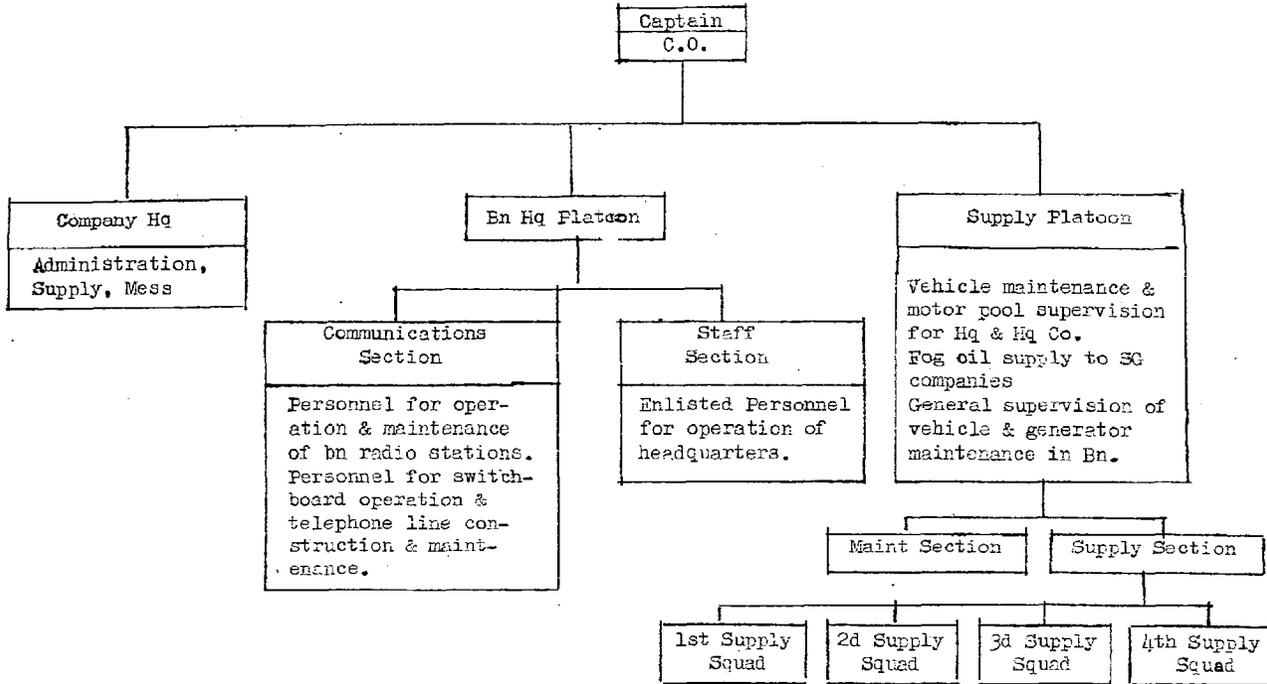
Headquarters
Chemical Smoke Generator Battalion



* Available to provide technical advice to supported unit, assist in smoke plan preparation and coordination and make advance arrangements for smoke company when companies are detached. These personnel constitute the forward echelon of battalion headquarters when two or more companies are engaged in the same mission.

25 Sept 45

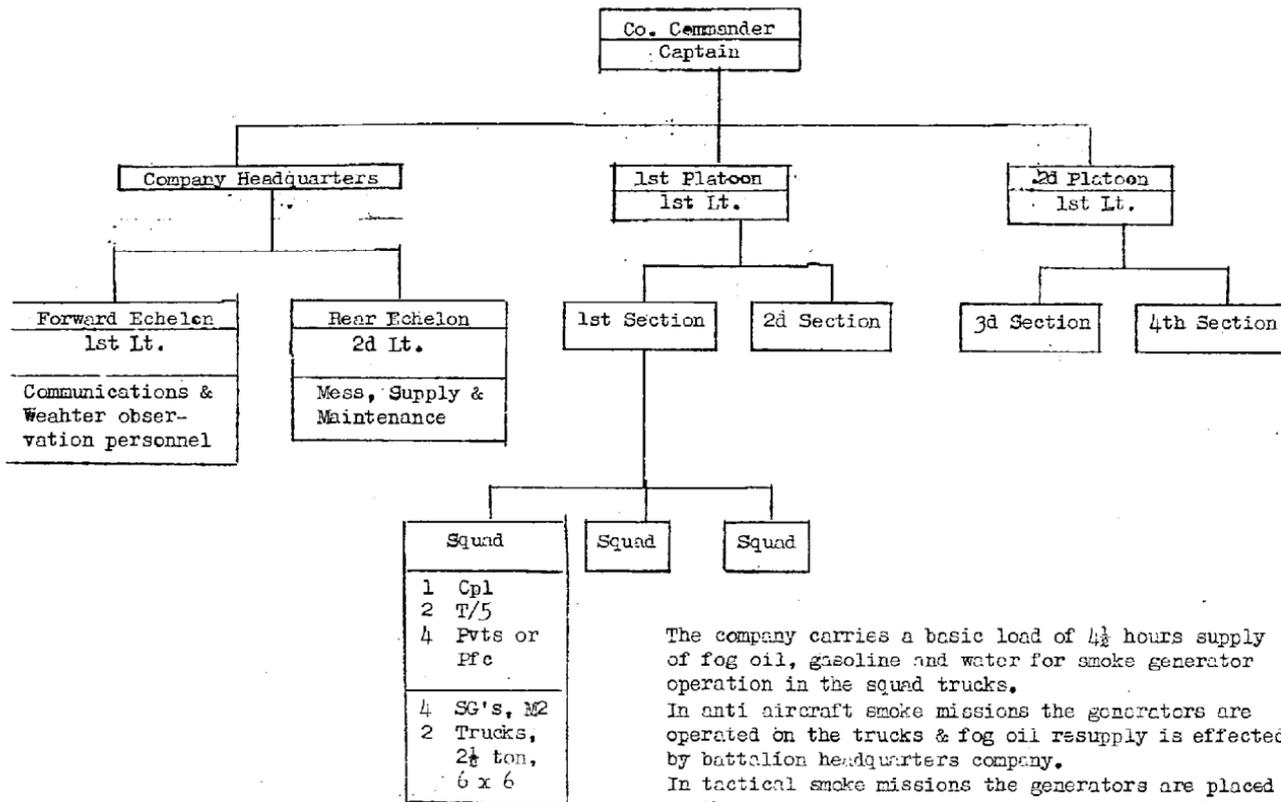
Headquarters Company
Chemical Smoke Generator Battalion



Supply Section-carries two hours supply of fog oil. Supply squads may be attached to companies when they are widely separated. Supply Section also carries a reserve of three generators per company

25 Sept 45

Company, Chemical Smoke Generator Battalion



The company carries a basic load of 4½ hours supply of fog oil, gasoline and water for smoke generator operation in the squad trucks.

In anti aircraft smoke missions the generators are operated on the trucks & fog oil resupply is effected by battalion headquarters company.

In tactical smoke missions the generators are placed on the ground for operation and the squad trucks are available to augment the battalion headquarters company in maintaining oil supply.

25 Sept 45

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5. Final Operations Report, Arnaville, France, 84 Chemical Smoke Generator Company.
6. Report on Use of Smoke, Headquarters European Theater of Operations, Chemical Warfare Service, - undated.
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9. Report of Smoke Generator Operation in Support of Rhine River Bridge Construction, Headquarters 23 Chemical Smoke Generator Battalion, 4 May 1945 (with 4 annexes and 2 inclosures).
10. Report on Roer River Smoke Screen, Schophoven, Germany, 23-24 February 1945, Headquarters 30 Infantry Division, Office of the Chemical Officer.
11. Report of Smoke Generator Operations, 74 Chemical Smoke Generator Company, 9 March 1945.
12. Letter, Headquarters 22 Chemical Smoke Generator Battalion, APO 758, dated 25 February 1945, Subject: "Changes in T/O and E 3-266S, dated 28 September 1944 for Headquarters and Headquarters Detachment, Chemical Smoke Generator Battalion", with 7 indorsements.
13. Number 1121 German Development and Military Use of Infra-Red Equipment.
14. Letter, Headquarters Seventh Army, APO 758, dated 6 February 1945, Subject: "Problems of Smoke Generator Operations". File: 470.6 - CW. With 1 inclosure and 7 indorsements.

ANNEX

Exhibit 1

Charts 1, 2, 3 and 4. Proposed Organization
of Smoke Generator Battalion.