

7

Division Tactics

The essence of leadership . . . was, and is, that every leader from flight commander to group commander should know and fly his airplanes.

Air Vice-Marshal I. E. "Iohnnie" Johnson, RAF

Background

During World War I it was recognized that the operation of two fighters together offered improved survivability and increased firepower. If two fighters are good, then why shouldn't three, four, or more be even better? Inevitably this philosophy was tested as the war ground on, and it met with some success. Greater numbers of aircraft, properly arranged, theoretically offered increased defensive lockout. More firepower could be brought to bear on the enemy in an initial attack, and the chances of being engaged by superior numbers of the enemy were diminished.

We were too busy fighting to worry about the business of clever tactics.

Harold Balfour, RAF

WW-I Fighter Pilot

(Later British Under-Secretary of State for Air)

Increasing the size of fighter formations also has disadvantages, however. The larger the formation, the easier it is to see, and the more difficult is the formation's task of achieving a surprise attack. Large formations are also less maneuverable. Turning can become an exercise in avoiding a midair collision, a situation that greatly decreases defensive lockout. The formation leader must carefully plan and execute each maneuver at considerably less than maximum-performance capability, allowing the other formation members to maintain position. Stragglers are very vulnerable, and their numbers must be minimized. Communications between and control of large numbers of aircraft can also be difficult. Hand signals may be given and relayed from fighter to fighter if aircraft spacing is close, such as in the "wild-geese Vs" of many fighters which were popular with both

sides late in World War I; but tight formations have been shown to reduce greatly a formation's defensive capability, especially against modern AAMs. Colored signal flares (fired from Very pistols) were sometimes used for signals during World War I, but they are generally impractical, particularly for modern fighters. The advent of radio in fighters in the 1930s greatly aided the communications and control task, but radios cannot always be relied on because of the possibility of malfunction, jamming, or interference. Movements of the leader's aircraft (e.g., wing rocking and porpoising) have generally proven to be the most effective means of non-verbal communication, but are by no means infallible.

Once they are engaged it is extremely difficult, if not impossible, to keep a large number of fighters together. A battle between large fighter forces most often degrades into a "fur ball," with each pilot fighting for his life independently and giving mutual support only by presence. Although such a condition may be positive from an offensive standpoint, defensively it leaves much to be desired. For instance, disengagement from such a fight is extremely hazardous for a lone fighter. For this reason many flight leaders in World War I attempted to reform their formations before disengaging. They would often have their aircraft painted in bright, distinctive colors or carry a banner streaming from some part of the aircraft for recognition purposes. In theory, any pilot who became separated in a melee could find and rejoin his leader. The enemy, however, seldom allowed such luxuries.

The German Air Service seems to have initiated the trend toward larger and larger fighter formations during World War I. The probable reason for this, besides the natural inclination toward tactical innovation by such great leaders as Boelcke and von Richthofen, is the fact that they were generally outnumbered by the Allied fighters on the western front. Flying in large formations often allowed the Germans to achieve local superiority in numbers at selected locations whenever they chose. Naturally, however, the Allies countered with larger formations of their own, leading to some really interesting engagements of as many as fifty fighters on each side.

One of the guiding principles of fighting with an air force is the assembling of weight, by numbers, of a numerical concentration at decisive spots.

Lt. General Adolph Galland, Luftwaffe

Between the world wars the advancements in aircraft technology, namely increased speed and reduced maneuverability, led most world powers to conclude that the day of the dogfight had passed. In future conflicts the role of the fighter was seen to be interception of strategic bomber forces. Bombers were much in favor at this time and were thought to be capable of defending themselves against fighter attack because of the effectiveness of the heavy, massed firepower of large bomber formations and the armor protection they could carry. Therefore, they would not require fighter escort protection, and there was little chance for fighter-to-fighter engagement. Consequently, the lessons of fighter tactics learned in World War I were largely forgotten, and training (what little there was) revolved around the interception and destruction of bombers. Fighter

design began to stress aircraft speed and heavy armament and armor and to neglect maneuverability and cockpit field of view.

With no war, we forgot about building airplanes we could see out of.

Colonel Erich "Bubi" Hartmann, GAF

The fighter formation almost universally accepted during this period was the three-plane vee, or "vic," with the aircraft positioned almost wingtip-to-wingtip for concentration of firepower. This formation (see Figure 7-1) allowed the leader to maneuver fairly well and to fly through clouds with little chance of losing his wingmen. He was able to hit quickly to limit exposure to bomber defensive fire, and all fighters could fire at once at the same target for maximum concentration of destructive power.

The vie had some drawbacks, however: only one bomber could be targeted at a time, and the close formation allowed defensive fire to be concentrated on all fighters simultaneously. The leader was also the only one likely to have a good shot, since the wingmen had to be more concerned with not running into somebody than with aiming their guns. Firing range for the wingmen was also increased, since they had to cease fire when the leader reached minimum range and broke off his attack.

Several of these vies could operate together and coordinate their attacks to bring additional targets under fire and to spread the defensive fire. These additional vies also offered each other some visual mutual support, since the defensive effectiveness of individual divisions was very limited because of formation requirements. One favorite arrangement of vies on patrol was for several vies to form a larger vie spaced at wider intervals than the individual elements. This was a fairly effective formation for visual cross-cover, but it was difficult to maneuver, so the elements often dropped into trail on each other when substantial maneuvering was required. This arrangement still offered good defensive coverage for all elements except "Tail-end Charlie."

This, then, was the thinking of most of the air powers of the world in the 1920s and 1930s. Some were able to test this doctrine during conflicts in the late 1930s, notably the Spanish Civil War and the Sino-Japanese War. These conflicts revealed that the relative superiority of bombers over fighters of the period was greatly exaggerated. Whenever bombers were met by determined fighter resistance, the bombers nearly always suffered



Figure 7-1. The Vic

unacceptably high loss rates. It was found that only air superiority supplied by fighter escort could provide the bombers with the protection necessary for the successful completion of their mission. Fighter-versus-fighter combat had returned!

This revelation, however, was not readily apparent to those nations which did not participate actively in these pre-World War II conflicts. Even the Russians, who took an active part in both wars, seemed to have missed the point. They, in addition to the British and the French, continued to retain the rigid vie doctrine into World War II. The Germans seem to have made best use of their experience, emerging from the Spanish Civil War employing the loose pair (*rotte*) and the division of four fighters composed of two pair (*schwärm*). The Japanese generally retained the division of three fighters, known as a *shotai*, and arranged them in vies, in echelons, or in a loose, staggered trail formation. This last formation (illustrated in Figure 7-2) provided better visual defense by allowing the wingmen to maintain looser positions on the leader; often they would weave back and forth to check the rear quarter. Once they were engaged, the aircraft in the *shotai* stayed together, falling into trail for hit-and-run attacks, or broke apart, with each aircraft fighting independently.

The German *schwärme* normally deployed in a "finger-four" formation,

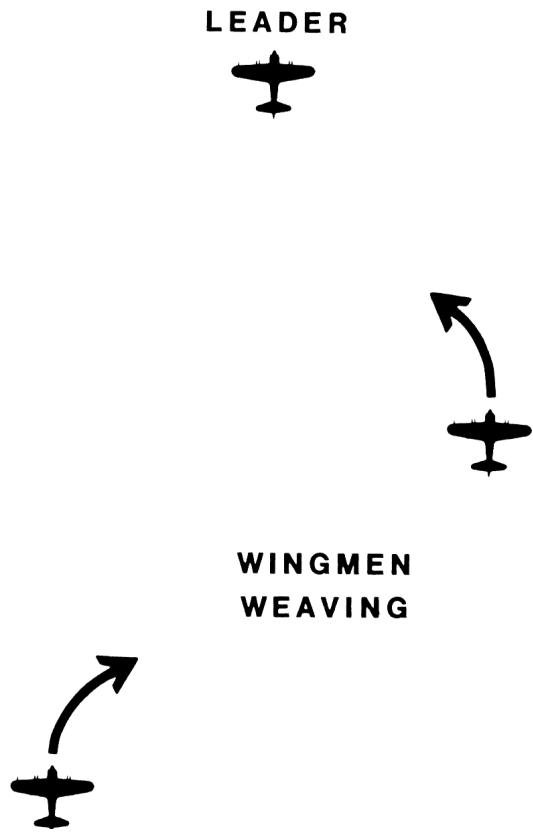


Figure 7-2. Japanese *Shotai*

so called because of its similarity to the positions of the finger tips on the hand (see Figure 7-3). Spacing between aircraft in this formation was on the order of 600 ft, roughly the equivalent of the fighters' turn radius, which provided ample maneuver room and good visual cross-cover. The *schwärm* typically separated into two *rotten* for coordinated attacks and engagements. Several *schwärme* were often combined and coordinated for massed air strength.

The finger-four arrangement proved to be vastly superior to the tighter formations of the Allies, and it gave the Luftwaffe a considerable advantage early in the war. It was soon copied, however, by nearly all the combatants. The Germans then decided that a line-abreast arrangement might provide even better defensive coverage and, typically, jumped another step ahead of their adversaries. Late in the war the line-abreast, or "wall," formation (shown in Figure 7-4) was generally favored by the Luftwaffe, with the Allies retaining the finger four.

Interestingly, however, near the end of the war the Germans often employed their new Me 262 jet fighters, the only jets to see significant combat, in the old tight vie (which they called *ketten*). Jet fighters were used primarily as bomber interceptors rather than as dogfighters, and the *ketten* provided more concentrated firepower as well as a greater number of divisions with limited aircraft assets than would have resulted from four-plane flights. Since each of the divisions (*ketten*) normally attacked only one bomber on each pass, more divisions allowed a greater number of bombers to be attacked in a shorter time. Defensive protection against fighter attack in this tight formation was supplemented by a tremendous speed advantage over Allied aircraft (about 100 kts), which made rear-quarter intercept very unlikely at combat speeds.

Pre-Engaged Division Maneuvering

With fighters widely spaced and nearly line abreast as in the finger-four and wall formations, maintaining position in turns requires some ingenuity. Probably the most effective method is based on the cross-over turn, or tac turn, as discussed for two aircraft in the last chapter. Figure 7-5 illustrates

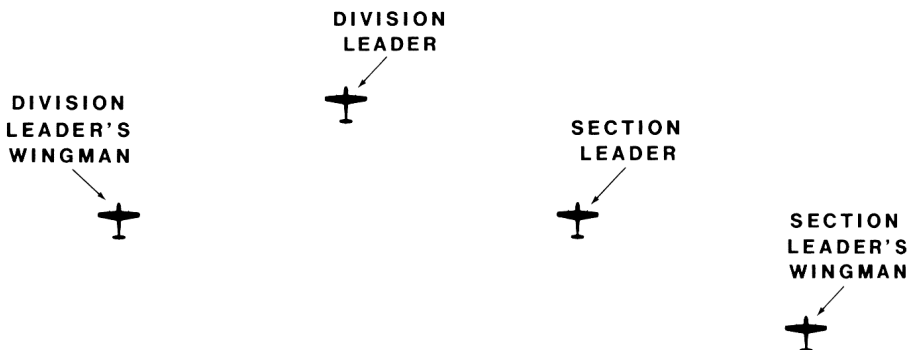


Figure 7-3. German *Schwarm* in Finger Four

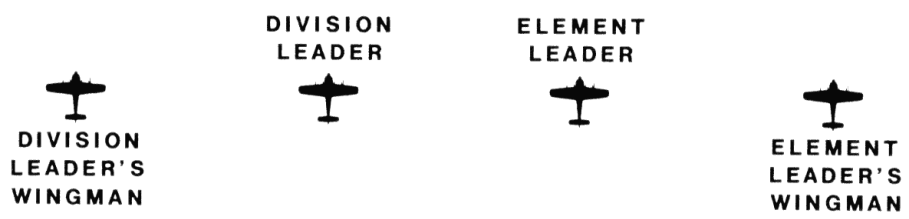


Figure 7-4. Line-Abreast or Wall Formation

how this concept is applied to a division of four fighters in finger four. A line-abreast division would turn almost identically.

In this case the division leader (sometimes called the flight leader) wants to turn the flight 90° to the right, toward the second section (element) of two fighters. He does this by simply turning right at time "1." The division leader's wingman, on the left in this case, immediately turns hard right to pass behind the leader. The wingman's turn needs to be a little tighter than that of the leader, and the wingman may have to dive slightly in his turn, crossing below and behind the leader, in order to maintain speed and regain the proper position quickly at time "1." Meanwhile the element leader generally pulls up to cross over the flight leader, and he will be almost directly overhead at time "2," having turned considerably less. After passing over the flight leader, the element leader tightens his turn and drops back down to regain his speed and position at time "3." The element leader's wingman pulls up with his leader between times "1" and "2," crosses above the flight leader, then begins a very gradual turn, generally crossing over his element leader between times "2" and "3" to assume his proper position on the opposite side of the formation at time

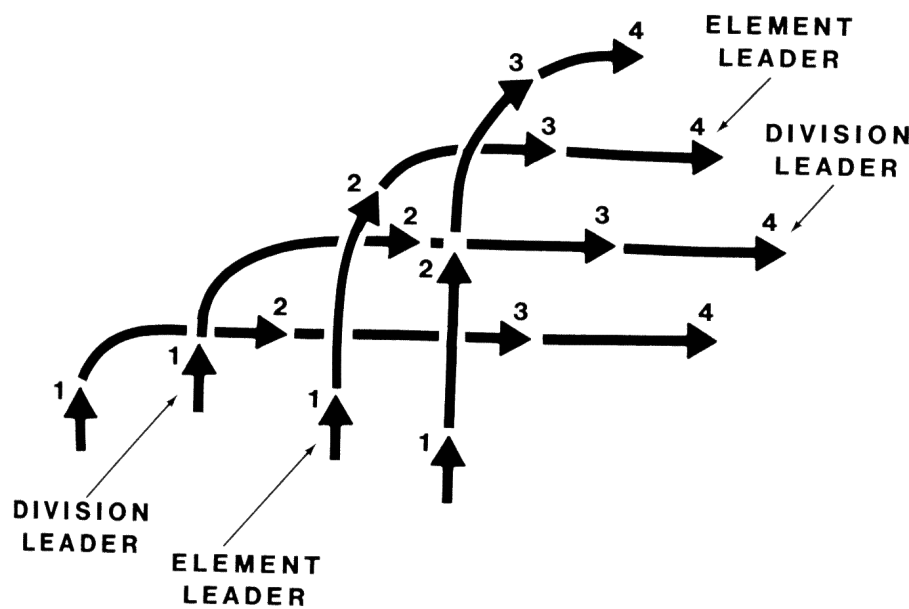


Figure 7-5. Division Tac Turn

"4." At time "4" the division is again in finger four, but it is reversed; that is, the element is now on the flight leader's left rather than on his right.

Although this drill may look very complex on paper it is really quite simple with a little practice. The element leader simply does a tac turn on the division leader, and the wingmen do what is necessary to maintain position on their respective leaders. Essentially, each element does a tac turn, with a delay between. The individual aircraft, however, must travel different distances from start to finish of the turn. The fighters originally on the outside of the turn will fly farthest. Since all the fighters are likely to be at or near maximum power, speed is adjusted as necessary by climbing or diving relative to the other aircraft to maintain the desired positions.

As with the two-aircraft tac turn, two of these maneuvers can be performed in the same direction to effect a complete reversal. The advantages and disadvantages of tac turns were discussed in the previous chapter and remain the same here. A reversal of this type takes a lot of time and space, but it provides good visual cross-cover throughout.

Along with the tac turn, many of the other turn techniques described in the last chapter for use by fighter pairs, such as the cross turn and the in-place turn, can be adapted to most division formations, although some can become rather complex with large numbers of aircraft. In some cases, however, the increased number of fighters in the division and the required staggering of the turns of individual aircraft can provide improved visual coverage for the division over that of a two-plane section performing the same maneuver.

The commanding officer is responsible [for seeing] that neither he nor any of his pilots are surprised by the enemy. If he cannot see to that, he is no good as a leader.

Baron Manfred von Richthofen

Other Division Formations

To this point little has been said about trail formations, largely because of their inherent defensive weakness. Trail, or sucked-echelon formations, can, however, be very effective offensively, since they are well suited to sequential attacks by the trailing elements. When more than two fighters are involved, trail formations can also be devised to offer a reasonable defensive posture. One example is the "battle box," an arrangement of sections in trail as shown in Figure 7-6.

In this formation the defensive function is provided by visual cross-cover within each section, which may be arranged in spread, as shown, or in acute echelon. The trailing section also covers the leading section and provides improved offensive potential. This and similar arrangements have been used by nearly all air forces at one time or another from World War I to the present day. Additional sections can be added to the string ad infinitum, each stepped up or down as desired to enhance visibility or to reduce detection. The maneuverability of trail formations is greatly simplified, since each element has only to "follow the leader," and cross-overs involve only two aircraft at a time. The defensive capability of trail formations, although greatly improved by two-plane elements, is still inferior to



Figure 7-6.
Sections in Trail

the more line-abreast arrangements, since with trail formations leading elements are poorly placed for rapid support of trailing elements.

When the division is composed of only three aircraft, a modification of the old vie can be useful. This formation, depicted in Figure 7-7, places a section in loose trail on the lead fighter. This arrangement is particularly well suited to the use of decoy tactics. The lead fighter can "stooge" around looking helpless until it is attacked by the enemy, at which time the trailing section, often stacked high, can swoop in and pull off a rather rude surprise party. Separation between lead and trail elements of this formation normally should be such that a bogey cannot slip into its weapons parameters behind the lead fighter without entering the trailing element's firing envelope.

The [German] is a master at using stooge decoys who would probably be as helpless as they look, if half the Luftwaffe were not keeping a jealous eye on them from the sun.

Group Captain Reade Tilley, RAF

The reverse of the vie is the "section-and-stinger" formation depicted in Figure 7-8. In this case the single fighter (the "stinger") trails the lead

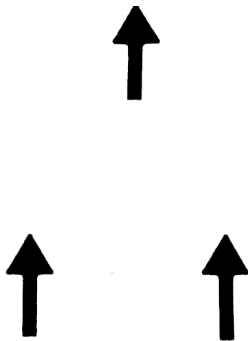


Figure 7-7. Modified Vic

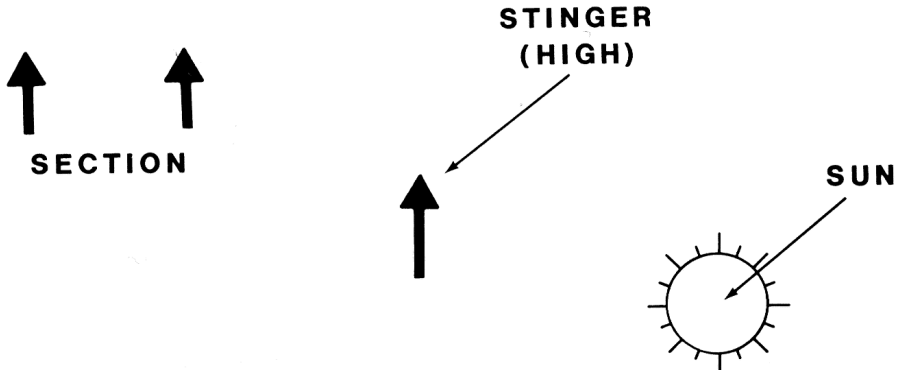


Figure 7-8. Section and Stinger

section to offer the element of surprise. This was one of the favorite tactics of the Flying Tigers during World War II. The Japanese, since they normally flew in three-plane divisions, could more easily be enticed into battle against a section of two. The stinger could then have his pick. Although beautiful when it works, this tactic has obvious defensive weaknesses, as the stinger is quite vulnerable. It is probably best suited as an occasional variation to standard two-plane section doctrine rather than as a steady diet. The best position for the stinger is usually high above the section on the sun side, and only slightly in trail. If he is attacked, the stinger should normally attempt to dive and drag his attackers down toward the support of the section. In a radar environment, a stinger positioned very low "in the weeds" may be able to avoid enemy detection.

Tactics are much like plays in any team sport. Each tactic has weak and strong points and can be anticipated and defeated by the opponents if the fighters "go to the well" too often with the same routine. Probably the most effective system is to employ a basic fighting unit, the two-plane section, for example, so aircrews can become highly proficient in its use. Then, depending on the number of aircraft available, the mission, and the expected opposition, these units can be combined with others in trail or stacked high or low according to environmental conditions. This technique varies the look presented to the enemy and always leaves him guessing as to whether he has everyone in sight before he attacks. Enemy pilots tend to get rather paranoid after they have attacked a leading or low element a few times.

Engaged Division Maneuvering

"DICTA BOELCKE"

1. Try to secure advantages before attacking. If possible, keep the sun behind you.
2. Always carry through an attack when you have started it.
3. Fire only at close range and only when your opponent is properly in your sights.
4. Always keep your eye on your opponent, and never let yourself be deceived by ruses.

5. In any form of attack it is essential to assail your opponent from behind.
6. If your opponent dives on you, do not try to evade his onslaught, but fly to meet it.
7. When over the enemy's lines never forget your own line of retreat.
8. Attack on principle in groups of four or six. When the fight breaks up into a series of single combats, take care that several do not go for one opponent.¹

(Note: Captain Oswald Boelcke, who drew up this list, was killed in a midair collision with his wingman while both were attacking the same aircraft.)

Captain Oswald Boelcke
German Air Service, 1916
40 Victories

As discussed earlier, engaged maneuvering with many fighters in a rigid formation (i.e., the equivalent of division fighting wing doctrine) has serious limitations and generally has proved effective only against unescorted, poorly maneuvering aircraft such as bombers and transports. Something more flexible is required when fighter-versus-fighter engagement is anticipated.

Fluid Four

The most effective doctrines generally build the division by combining two or more elements of two fighters. Pilots in the division attempt to stay together during the pre-engagement phase and, when it is practical, to exit together from hostile airspace. During an offensive attack the elements of the division may remain together or they may split for coordinated attacks, but the pilots in each section attempt to stay together. Once the division has been split up, each element of it may operate according to any of the section doctrines detailed in the previous two chapters. Mutual support can also be provided between the elements using double attack or loose deuce tactics, and there is no requirement that the doctrine employed between the elements be the same as that used within each section.

As a case in point, consider the example of a four-plane division composed of two sections. Each section might fly welded wing, but the two elements can cooperate as in double attack. For instance, one section could attack an enemy formation while the other section provided defensive "top cover." This combination of fighting wing and double attack doctrines is commonly known today as "fluid four," and it has been widely used by many air services from the time it was first introduced by Werner Moelders during the Spanish Civil War, right up to the present.

In fluid four doctrine each two-plane section essentially replaces one fighter of the double attack pair. Instead of an engaged fighter and a free fighter, fluid four uses an engaged section and a free section, each flying fighting wing. With this substitution, virtually everything said about double attack to this point applies to fluid four, including the offensive attacks, defensive counters, and engaged maneuvering. Fluid four offers the obvious advantage over double attack of increased numbers. The greater firepower available is especially valuable during an initial attack.

The effectiveness of this fluid four doctrine is probably best demonstrated by a four-plane division of U.S. Navy F6F Hellcat fighters led by

Lieutenant Eugene Valencia (23 victories) during World War II. His division, nicknamed "Valencia's Mowing Machine," accounted for the destruction of fifty Japanese aircraft without a loss (or even a hit). This team developed fluid four tactics, which were by no means universally accepted by the Navy at that time, to a fine art. The name "Mowing Machine" was derived from the alternating attacks by the two elements of the division, which traded roles as engaged element and free element (top cover), producing action resembling that of the blades of a lawn mower.

By combining fighting wing with double attack, fluid four gains more offensive potential than either two-ship doctrine makes available. Defensively there are pluses, also. More eyeballs positioned properly afford better lockout in the pre-engagement phase, and the wingmen in each element can provide additional insurance for their leaders which is not available in double attack. The wingmen can be very effective defensive factors once the division is engaged, particularly when the enemy is equipped only with guns. The longer firing ranges of AAMs and the close spacing of the wingmen in fighting wing greatly reduce the defensive value of the wingmen against missile-equipped bogeys, but a wingman can still at least provide valuable moral support. Most of the defensive potential when engaging missile-equipped bogeys is derived from the free element.

With this last fact in mind, modifications have been made to fluid four doctrine to improve it both offensively and defensively. These involve more extensive use of double attack and even loose deuce techniques within the fluid four framework. During a fight, for instance, the engaged section can vastly increase its offensive effectiveness by employing loose deuce methods, while defense, the major shortcoming of loose deuce, is supplemented by the free section. If the scenario requires less offensive power and greater defensive capability, the engaged section may use double attack instead of loose deuce. This substitution provides two layers of defense: the free section protects the engaged section, and the free fighter of the engaged element protects the engaged fighter. In most cases, however, this redundancy amounts to overkill and unnecessarily sacrifices offensive potential.

Particularly in an AAM environment, additional defensive effectiveness can be attained by relaxing the fighting wing restraints on the free element. During engagements the free section generally is more vulnerable to surprise attack, since a large portion of the pilots' attention must be devoted to guarding the engaged section. Allowing the wingman in the free element to maintain a flexible position, as nearly line abreast as possible, provides better defensive mutual support within the free section. The leader of the free element should continue to hawk the fight in the double attack manner, but the looser position of his wingman allows each pilot in the section to divide his attention about equally between defending his own formation and guarding the engaged element.

When modified as described, fluid four is an extremely powerful offensive doctrine and a very tough nut to crack. It suffers, however, from the same problems associated with double attack, namely, the tendency for the division to break down in the face of superior numbers, and difficulties

when the division opposes an all-aspect missile threat. Division integrity is most likely to be broken by a determined attack on the free element during an engagement. The free section is then forced to defend itself and can no longer provide direct support to the other element of the division. This situation is considerably less critical than when it occurs in double attack, however, because mutual support can still be maintained within each section of the division. Each element should employ double attack or loose deuce techniques to maintain section integrity and defeat or drive off the opponents quickly. As soon as the opportunity arises, each section should attempt to rejoin and support the other.

When facing overwhelming numbers, even section integrity is very difficult to maintain during an engagement. It is generally futile under these conditions to attempt close support on a division level after the division has made an initial coordinated attack. Section integrity might still be maintained, however, and the strike-rejoin-strike technique described in the last chapter offers perhaps the most workable plan. Every effort should be made under these circumstances to avoid extended section maneuvering, either offensive or defensive, since the chances are very high that the aircraft of the section will become separated, leaving each fighter vulnerable to attack by multiple bogeys. An offensive attack should be broken off if success is not achieved immediately. Likewise in defensive situations, every opportunity to disengage should be seized and the section reformed for best mutual support.

An interesting divisional defensive tactic that was devised by Raoul Lufbery during World War I has survived into the modern era. Known as the "Lufbery circle" or the "wheel," this tactic calls for all fighters to fall into trail and follow each other around in a circle. When there was a large number of evenly spaced fighters, each fighter could effectively cover the tail of the one ahead and discourage any attacks. The wheel was continued until the enemy gave up and went home, or until the division leader could slowly work his fighters back to friendly airspace.

The advent of all-aspect missiles pretty much destroyed the effectiveness of this tactic, since it was no longer necessary for attackers to enter the wheel to shoot. Even RQ missiles can usually be fired from well outside the confines of the circle on the target's belly-side. The Lufbery circle can be quite effective in a guns-only environment, however. Techniques used to counter it successfully include simply waiting out the defenders' combat endurance until they are forced to abandon the circle and break for home. High-speed hit-and-run attacks using steep diving and climbing reattacks and high-deflection gun passes can also effectively counter the wheel. Use of the vertical plane and high-angle approaches minimizes the attackers' exposure to the defensive fire of other aircraft in the circle.

Engaging multiple bogeys armed with all-aspect missiles is tough. The free element in a fluid four engagement is quite vulnerable to attack in this case. Once the division is engaged by such bogeys the free element is almost obligated to maintain close contact in order to deny the enemy min-range parameters for his weapons. Ordinarily when bogeys extend

away, the free element should break off its pursuit so that defensive support can be maintained for the engaged element. When all-aspect AAMs are involved, however, allowing the enemy a free extension invites him to turn around and shoot. This complication greatly reduces the free element's value in division defense. Section strike-rejoin-strike techniques result in a similar dilemma. Releasing a bogey from attack to rejoin in a defensive formation almost guarantees that the section will be greeted by missiles in the face if re-engagement is attempted. Section hit-and-run tactics may prove to be the prudent course in this scenario.

Gaggle Doctrine

Occasions invariably arise when the fighters do not have the luxury of using hit-and-run tactics, regardless of how necessary they might be. The mission objectives might require extended engagement of the enemy to avoid losses to friendly bombers, transports, reconnaissance aircraft, high-value ground targets, etc.; or the division may be attacked and forced to defend itself until escape is possible. When a division is faced with roughly equal numbers of the enemy whose fighters, pilots, and weapons are not clearly superior, using modified fluid four is normally very effective. In general, however, a fighter force cannot be expected to prevail over a well-flown opposing force composed of a greater number of independent elements. For instance, three fighters operating independently (i.e., three separate elements) often will wreak havoc with four fighters operating in two fighting wing sections (i.e., two independent elements). A greater number of independent elements allows the superior force to achieve a two-on-one situation against some hostile elements, while one-on-one holding actions are maintained elsewhere. This is the primary reason for the increased offensive power of loose deuce over fighting wing. The other advantage enjoyed by numerically superior forces is that all elements are not likely to be engaged simultaneously, which gives free elements more opportunities to attack from unseen positions while maintaining more energy and, therefore, better maneuvering potential. This is the primary offensive advantage of double attack over fighting wing.

When one fighter force is faced with engaging a numerically superior enemy force, or a force of roughly equal numbers but better aircraft or weapons, its offensive potential can be greatly expanded if the friendly force breaks up into smaller elements. In many cases this means allowing each aircraft to operate independently. As with loose deuce, defense in this scenario is not normally organized, but generally is provided through presence only. The more friendly fighters involved, generally speaking, the more effective will be mutual support by presence, and this type of support can be effective long after any organized support has broken down. Unfortunately, organized mutual support most often disintegrates when each supporting element becomes defensive, in which case the elements can be of little assistance to each other and mutual support by presence is largely ineffective. This situation too often degrades into several one-versus-one fights with no support among elements. For best results, mutual support by presence should be preplanned, and independent action should be initiated while the division is still offensive or neutral.

"Gaggle" doctrine applies loose deuce techniques to groups of three or more fighters. According to this doctrine, patrol and attack normally are coordinated on the division level, or with several divisions, as described for fluid four. Once the battle is joined, however, individual pilots are permitted to operate independently. The techniques involved in such engagements are essentially identical to those discussed in conjunction with the loose deuce engagement described by Figures 6-9 through 6-11, but on a greater scale. Basically, each pilot attempts to define the threat sector, neutralize any attack in such a way that a final turn can be made comfortably toward the threat sector, and be alert for "shots of opportunity" on unwary bogeys. As in loose deuce, classic one-versus-one engagement is discouraged by this doctrine. Pilots should turn only as necessary to neutralize an attack, or to position for a slashing attack of their own. In general, a turn should not be continued past 90° in any one direction without a reversal, or at least a roll reversal and a visual check of the belly-side. This means that if a bogey is sighted which cannot be shot within about 90° of turn, the pilot had better look for another target. Some of the basics of gaggle tactics can be illustrated by the sample engagement begun in Figure 7-9.

At time "1" in this example the intrepid fighter pilot approaches the "bogey cloud" from the east. This bogey cloud represents a volume of airspace which appears to contain the greatest number of enemy fighters. At this time the pilot picks out one bogey in a vulnerable position on the edge of the cloud and decides to attack it. Unfortunately, his attack is discovered and the target turns hard left in defense. By time "2" it has become quite obvious that a quick kill is not going to be available, so the attacker breaks off his attack before he is committed to a critical overshoot and continues to watch the bogey until he is certain it will be no immediate threat (time "3"). Recognizing that the threat sector (i.e., the bogey

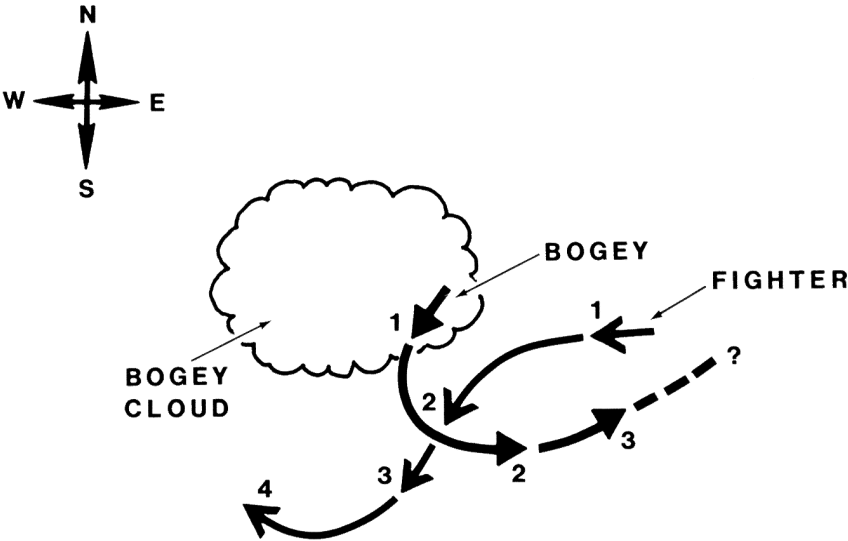


Figure 7-9. Gaggle Engagement

cloud) is now on his right side, the pilot of the fighter reverses hard right to negate any attack which might be coming from that direction.

At time "4" in Figure 7-10 the fighter has completed a turn of about 90° to the right. Since the pilot is not certain all the bogeys are localized inside the bogey cloud, he decides a belly-check is for at this point, and he rolls left to clear his south side. Seeing nothing, he rolls quickly back to the right just in time to discover an attack from the north (time "5"). This attack requires a break turn into the bogey, which overshoots at time "6." The defensive maneuver now leaves the fighter pilot in a difficult position. Having already turned about 90° he would like to reverse, or at least roll left for a belly-check. A reversal, however, would likely place him in jeopardy with the overshooting bogey, probably resulting in a slow-speed scissors (not a healthy place to be in a bogey-rich environment), or, at best, forcing the pilot to turn his aircraft's tail to the bogey cloud. If the pilot even pauses for a belly-check at this point he could present the bogey with a RQ missile shot, and he would also most likely penetrate the bogey cloud. Once inside the bogey cloud, the pilot would be in great danger because he would no longer have a well-defined threat sector and he could easily be attacked from several directions at once.

In Figure 7-11 the fighter pilot makes the decision that at the moment seems to be the least hazardous, to continue his defensive turn toward the southeast until the threat sector is placed on the left side. At time "7" he then reverses into a gentle left turn, overbanked to get a good visual check deep in his left rear quarter, and accelerates to regain some of the energy he lost in the recent defensive break. At time "8" he notices a friendly fighter just to the left of the nose, its pilot apparently unaware of a bogey attacking from his right.

The pilot immediately gives his threatened wingman a radio call: "Break right." Then, as shown in Figure 7-12, the free-fighter pilot quickly

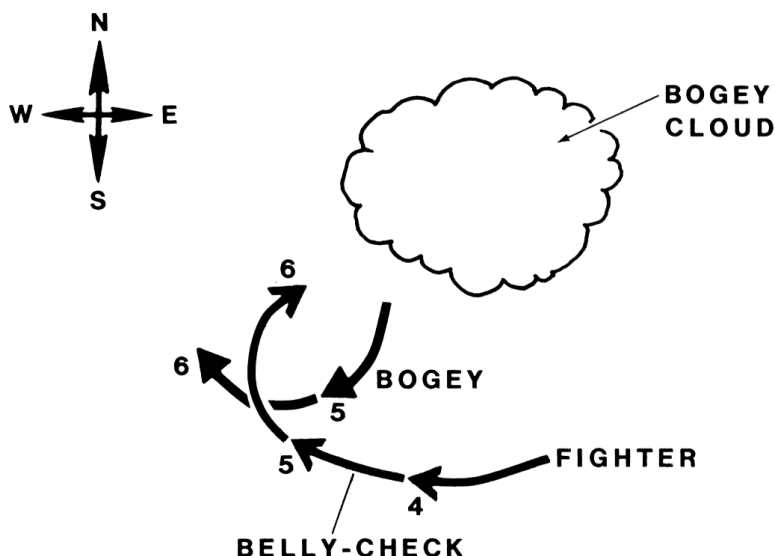


Figure 7-10. Gaggles Engagement (Continued)

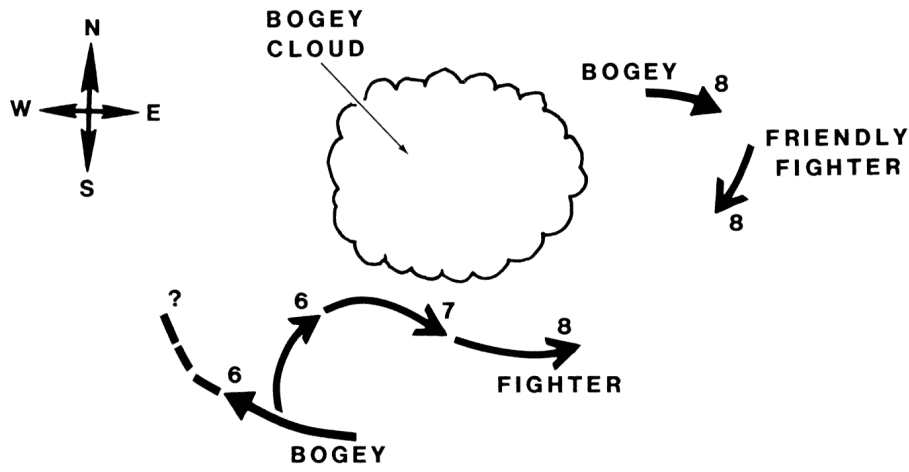


Figure 7-11. Gaggles Engagement (Continued)

rolls right to check his south side and, finding himself clear, reverses back left to bracket the attacking bogey.

The bogey pilot, who has not seen the second fighter, continues to press his attack to time "10" in Figure 7-13, when the unseen fighter reaches a near "dead-six" position and squeezes off a missile. As the weapon leaves the rail, the shooter rolls right to check his belly-side (to the east in this case), then rolls back to assess the results of his shot.

At time "11" in Figure 7-14, the bogey explodes. At about the same time, the much-relieved defensive pilot announces he is low on fuel and is "bugging out." That sounds good to the other pilot at this point also, so he comes hard right to join in combat spread, and the section departs together to the southeast (time "12").

In summary, gaggle doctrine is loose deuce tactics applied to more than two fighters, with each pilot operating autonomously once the engagement begins. Each pilot attempts to define a bogey cloud that encompasses

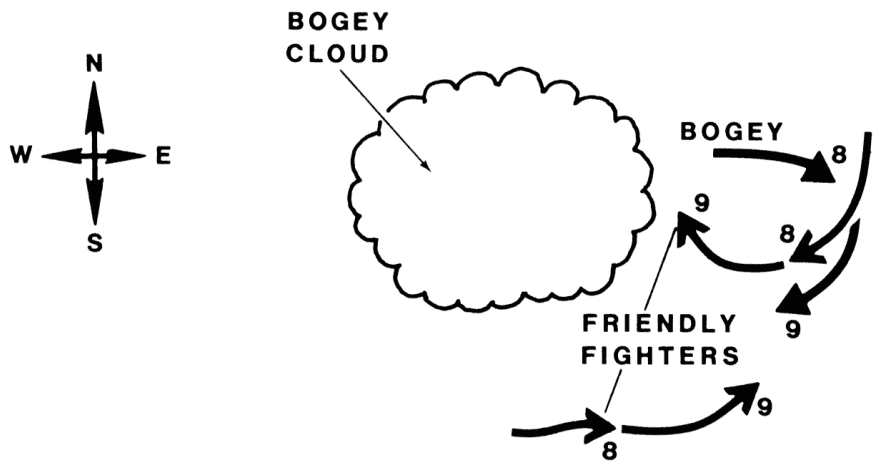


Figure 7-12. Gaggles Engagement (Continued)

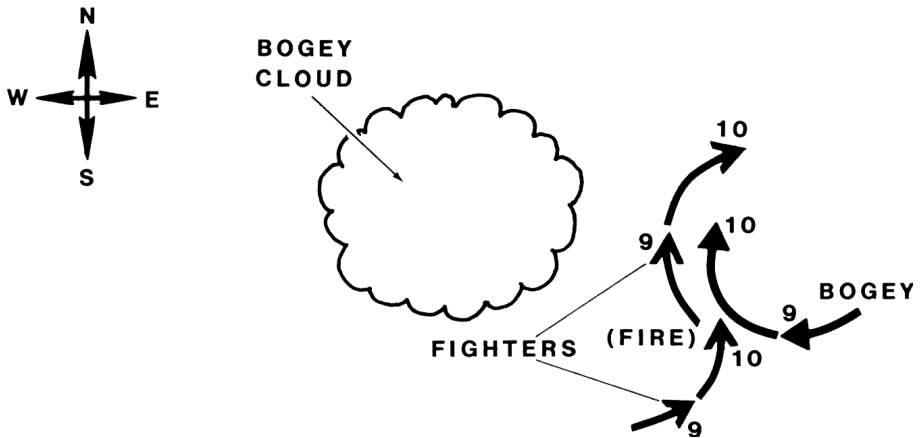


Figure 7-13. Gaggles Engagement (Continued)

the majority of the enemy aircraft, and cruises the perimeter of this hostile region in an attempt to pick off unsuspecting victims around its edges. Attacks are generally made only on those bogeys which offer an easy shot requiring a minimum of maneuvering. If the attack is discovered, it should normally be broken off and the hunt resumed. A useful rule of thumb is to turn no more than 90° in one direction at any time without a reversal or a belly-check. When attacked, counter as necessary with the goal of escaping as quickly as possible, and avoid prolonged one-versus-one maneuvering. Normally, enemy fighter pilots are just as cautious as the friendlies in this scenario, and they are reluctant to press an attack against a fighter that is maneuvering defensively.

As a rule, level or nose-low turns should be made to maintain adequate speed for effective defensive maneuvering. Steeply nose-high moves should be avoided, unless the friendlies are opposing guns-only bogeys of much inferior energy performance and there is a well-defined bogey cloud. Likewise, hard turns should be avoided in order to maintain energy. If at all possible, only sustained-C levels should be used, and speed for optimum sustained maneuvering should be maintained.

Penetration of the bogey cloud should be avoided if at all possible. If he enters the cloud inadvertently, the fighter pilot should extricate himself as quickly as possible, using repeated belly-checks in both directions.

By this time, there were fifteen Camels and twenty or more Fokkers in the "Scrap," and it had become a question of luck more than good judgement, as Camels and Fokkers alike twisted, half-rolled, turned and dove, the tracer bullets flying in every direction. The [Germans] knew that they were good fliers and, being brave men, they tried to bring down their opponents singly. This more than any one thing proved their undoing, as the pilots of the "148th" watched their chances and wherever a pilot was in trouble, two or more would help him out by shooting the Fokker down. One after another the Fokkers went down, seven in all.²

Mutual support in gaggles doctrine is by presence only. Each pilot is primarily responsible for guarding himself, but he must remain constantly

on the lockout for threats to friendly fighters. Whenever a wingman is sighted, the airspace all around his aircraft should be scanned visually to determine if he is under attack or is pursuing a bogey that might make an easy target. Egress from the hostile area should be made with other friendlylies if at all practical. When a pilot is leaving the area, he should make a "bugout" call on the fighter frequency so that the remaining friendly pilots can assess the changing numerical odds.

If you have a lot of pilots flying around you, many to fly with, then you are not very keen to look around. A lot of people arc not looking at all.
Colonel Erich "Bubi" Hartmann, GAF

The problems associated with gaggle tactics are the same as for loose deuce, with the added difficulties arising from increased numbers of fighters and bogeys. With more bogeys comes greater difficulty in defining the threat sector, since some of the enemy are almost always unaccounted for at any one time. Some degree of task overloading is generally present throughout the engagement. As the battle continues the bogey cloud tends to expand and it becomes more difficult to define. When he is unsure of the threat sector the pilot might be well advised to extend a considerable distance from the fight, though preferably he should remain within visual range of some participant, and then return in an attempt to redefine the "fur ball" from a distance. Extending away in the direction of the sun or climbing or diving to highlight the fight against low or high cloud are effective techniques. Due care must be exercised during these maneuvers, however, since enemy pilots may be using the same methods. The pilot cannot afford to padlock some aircraft in the distant fight and neglect his

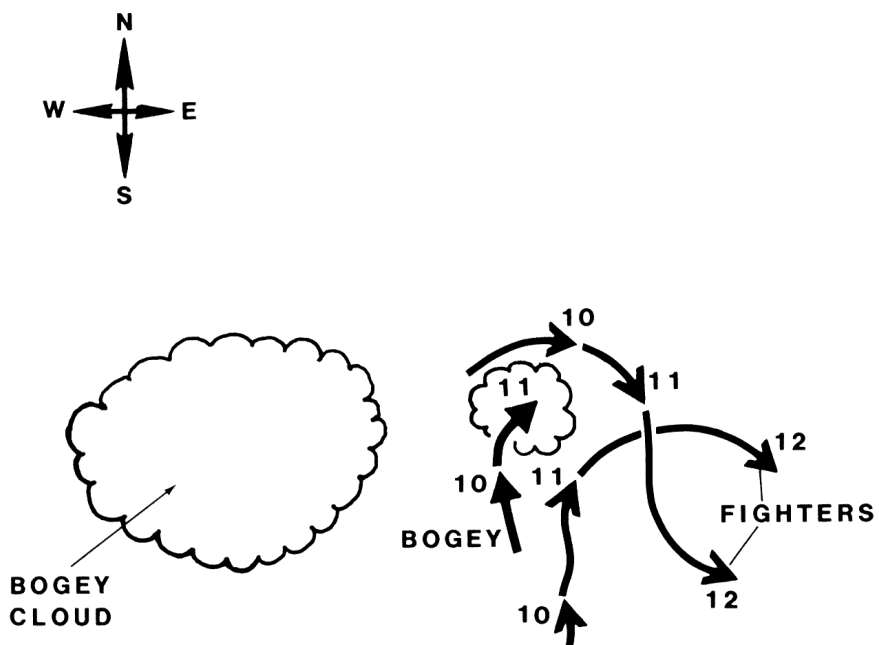


Figure 7-14. Gaggle Engagement (Conclusion)

defensive lockout. Defensive mutual support by presence is sacrificed when a fighter leaves the immediate engagement area.

If the decision is made to return to the fight after extending away, there are two points to keep in mind. First of all the fighter should approach the fur ball from well above or below the general engagement altitude to highlight the fight against favorable background, to minimize the chances of being detected, and to provide greater flight-path separation for attacking an unsuspecting target. This technique can also provide look-up to enhance missile shots, and it tends to limit the vertical threat sector, improving lockout efficiency. The second point is to avoid pointing the aircraft directly at the bogey cloud during the return, especially in the final stages of approach. Positioning the fight in the left or right forward quarter again allows concentration of lockout in one quadrant by defining the threat sector. This procedure also enhances offensive effectiveness by allowing the pilot to pick his time to point and shoot into the fur ball as he cruises the boundary, rather than making him dependent on the shot geometry provided at the moment he arrives within firing range. In addition, keeping the fight off to one side reduces the chances of accidental penetration of an ill-defined bogey cloud.

Comparison of Fluid Four and Gaggle Doctrines

The choice between the two divisional tactical doctrines presented here is often not clear-cut, as each doctrine has both strong and weak points. Both, however, recognize the advantages that may accrue from numbers, mutual support, and coordination in the pre-engagement, attack, and disengagement phases. Fluid four, particularly when it is modified to allow the engaged element to employ loose deuce techniques, offers credible offensive power while providing effective defensive potential. When engaging an inferior or roughly equivalent number of independent fighting elements, or an enemy of inferior or roughly equal capabilities, this admirable balance between offense and defense often tips the balance in favor of fluid four.

Regardless of the name, fluid four techniques are not necessarily limited to groups of four fighters. When only three fighters are available a single can serve as the free element, although with degraded capability. If more than four fighters comprise the force, it should generally be divided into groups of four or two for maneuverability, lockout, and control reasons; but once it is time to fight, the group leader usually decides which divisions or elements will engage and which will provide cover. The general rule for this decision is to ensure that the engaged fighters enjoy at least parity in numbers (of individual elements, but not necessarily of individual aircraft) with the enemy force, but at least one element is held in reserve to guard against additional bogeys or to join in the fight should the engaged element or elements get into trouble.

When attacking an inferior force we use only the strength necessary and always maintain a flight or an element as top cover.

Lt. Colonel Gerald R. Johnson, USAAF

It is when a force is opposed by a larger enemy force, or by one equipped with superior aircraft or weapons, that gaggle tactics are most useful. A hypothetical scenario has a force committing to engage with two-plane elements against a superior enemy force, waiting for the almost inevitable breakdown in section integrity, and then trying to salvage the situation by righting as individual fighters; but gaggle doctrine permits each fighter to operate as a single from the outset. This tactic multiplies the offensive potential of the force by greatly increasing the number of independent elements, and it relies on defensive mutual support by presence when it is most effective, namely, while the friendly force is offensive or neutral. As with loose deuce, the object is to shoot targets of opportunity whose pilots are unaware of their immediate danger. If a bogey is not positioned to provide a quick kill, or if it shows some effective defensive reaction, it should not be pursued, but neutralized. The hunt then continues for an easier victim. Extended one-versus-one combat is to be avoided in this doctrine. If an aircraft is engaged defensively, its pilot's goal is to terminate the engagement as quickly as possible. Usually this means escape from the attacker, but sometimes it may be necessary to fight until the offensive can be regained and the bogey destroyed. When neither is possible, the defender calls for help and does his best to survive until some nearby team member can lend support.

Because of the multiplication of independent elements, increased ability to maintain the offensive, and the effectiveness of mutual support by presence under such conditions, gaggle tactics are normally more productive than fluid four when a force is opposing an enemy of equal or greater numbers. For example, assume that two four-plane divisions engage with similar aircraft, weapons, and pilot capabilities. One division employs modified fluid four, allowing its engaged section to split (two independent elements) for loose deuce maneuvering, while retaining a free element in fighting wing (one element) for cover. This arrangement effectively yields a total of three separate elements. Meanwhile, the opposing division uses gaggle tactics, splitting into single fighters (four independent elements). By using this method the gaggle division effectively outnumbers the fluid four division and can be expected to have the better day. This is the same principle which gives a double attack or loose deuce section dominance over opponents in fighting wing.

In situations where the friendly force outnumbers the enemy, the added offensive power of gaggle doctrine may not justify the reduced defensive capability. Inefficiency results when an overwhelming number of fighters are involved on any one side. These pilots are likely to spend much time staying out of each other's way and reacting offensively or defensively, at the expense of combat effectiveness, to unidentified aircraft that are later found to be friendly. Under such circumstances, holding free elements out of the engagement in the fluid four manner can pay dividends. The number of engaged elements maintained should equal or slightly exceed the number of the enemy. When modified fluid four is used with more than four fighters, the result is a combination of the two doctrines, with the engaged fighters employing gaggle tactics and the free fighters fluid four.

In a dog-fight such as this, when the odds are heavily on your side, there is a great temptation to lower your guard, to get in close, and hammer your enemy until he falls. Too many pilots concentrate on one target and forget to keep a sharp lookout for friend or foe; too many airplanes converge, in a dangerous funnel-like movement, on the single quarry, and the risk of mid-air collision is high.

Air Vice-Marshal J. E. "Johnnie" Johnson, RAF

Dissimilar-Aircraft Divisions

Quite often employment of different fighter types within the same division becomes necessary or desirable. This situation can result from shortages of any one aircraft type or from complementary capabilities. For instance, one aircraft type may have better navigation, communications, radar, or weapons capability, and another may have superior performance as a clear-weather, daylight dogfighter. Combining these two types might provide greater flexibility and increased mission capability.

Obviously there are almost unlimited possible combinations for such dissimilar divisions, and all of them cannot be covered here. In general, however, the most likely scenarios involve small numbers of larger, more expensive, heavily armed, or high-capability aircraft in combination with larger numbers of smaller, cheaper, highly maneuverable day fighters. For instance, a single sophisticated fighter might provide navigational or radar capability to position the division favorably for an attack, and maybe supply first-shot, long-range weapons capability, while a section of simpler day fighters provides improved close-in offensive and defensive power.

Likely formations for such a combination include line abreast, with the sophisticated fighter in the center flanked by the day-fighter section, or the loose modified vie as depicted in Figure 7-7, with the day fighters in trail. In either case the day fighters, as the defensive members of the team prior to engagement, are normally stepped-up to provide quicker defensive response to attacks on the single and to furnish them with greater energy when an engagement begins.

The modified vie generally offers greater protection against attack, particularly by long-range RQ missiles, and may also allow small day fighters to fly closer together to facilitate keeping each other in sight. Another possible advantage of this formation arises when the day fighters are equipped with all-aspect missiles, but visual identification (VID) must be made on any target before firing. This VID might be accomplished by the pilot of the lead fighter, who could then clear the trailing day fighters to fire before the target penetrates their min-range boundary. The modified vie is also conducive to "baiting" tactics. Enemy fighters might be overeager to pounce on a single, poorly maneuvering lead fighter, and be bounced in turn by trailing day fighters.

The more nearly line-abreast arrangement of fighters is useful when all of them are equipped with all-aspect missiles and are likely to be cleared to fire well outside min-range parameters. In this case all fighters can fire in unison for maximum firepower, much like a battleship broadside. This formation also contributes to the effective use of the bracket or pincer

attack by the day fighters. As illustrated in Figure 7-15, in the final stages of approach the day fighters can use their altitude advantage to dive and accelerate ahead of the leader to bracket the target at the merge.

Once they are engaged in a close-in visual fight, the day fighters are in their element and generally should carry the load. This may be an ideal scenario for modified fluid four tactics; the sophisticated single provides cover by sanitizing the area visually and/or electronically, while the day fighters engage using loose deuce methods. Large, poorly maneuvering fighters should, in general, be kept out of such hassles, since this is not their arena and they are likely to do poorly in it. Aircraft that are large relative to others in a fight attract bogeys like a flame draws moths. If such a fighter becomes engaged, the day fighters will be forced to spend most of their effort in support. When one fighter goes defensive, the effectiveness of the entire division suffers.

Generally speaking, it is important in mixed-bag divisions for formations to be designed, and missions assigned, so that each fighter type can concentrate on what it does best. Some fighters are better in a dogfight, some are more heavily armed, and some operate better than others at high altitude. Whenever possible, advantage should be taken of these qualities.

A couple of historical examples may serve to illustrate this point. The Luftwaffe in World War II often used twin-engined Me 110s, Ju 88s, and Me 410s, heavily armed with cannon and unguided rockets, to attack Allied bombers, while the more maneuverable Me 109s and Fw 190s kept the escort fighters occupied. Early in the same war in the South Pacific the

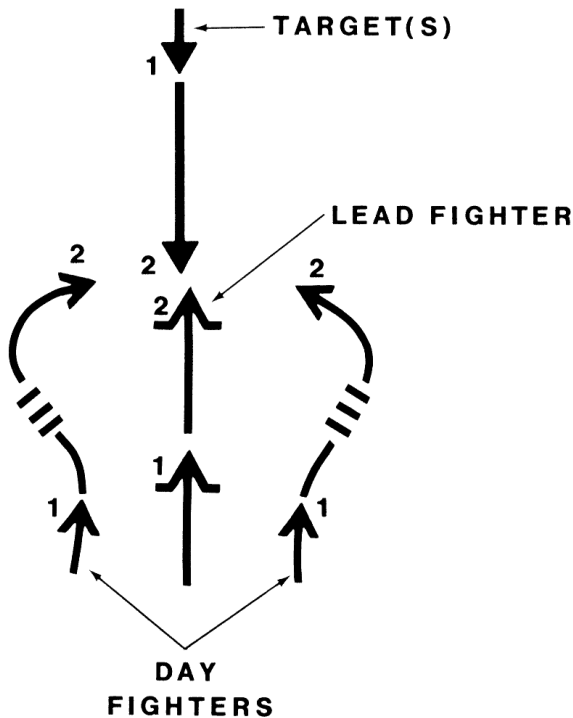


Figure 7-15. Three-Plane Pincer Attack

Americans employed turbocharged P-38 fighters as top cover in combination with P-39s and P-40s (equipped with simple, medium-altitude superchargers) on fighter sweeps against the Japanese. P-39s and P-40s stayed at low levels where they could retain decent performance, while the P-38s tackled any high-altitude threat.

Operating mixed-bag sections or divisions is not without its problems. Quite often the optimum cruise speed of one type is significantly below that of the other, requiring some fighters to operate at less than ideal speeds in order to keep a formation together. This condition may result in reduced range, endurance, or defensive effectiveness for one or both types of fighters. The faster fighters in such situations often weave from side to side so that average forward progress can be slowed while they maintain high airspeed for maneuverability considerations. This technique allows the mixed formation to remain together, but it usually still reduces the range and endurance of the faster aircraft, as well as making them more vulnerable to attack from the rear. Weaving formations are also more easily spotted visually.

The attack phase can be complicated by aircraft performance variations. For instance, when supersonic and subsonic fighters operate together, attack timing can be difficult. The requirement that each fighter type enter a fight at a given time at near its respective best engagement speed can affect formations and usable tactics. The timing for a pincer attack (Figure 7-15), for example, would be difficult with subsonic day fighters accompanying a supersonic single. For all aircraft to arrive at the target at nearly the same time, either the day fighters would have to begin their attack from well in front of the single (section-and-stinger formation), or the single would have to enter the fight subsonic. If neither of these situations is satisfactory, the day-fighter pilots may just have to accept the fact that they will engage at some time after the initial pass between the enemy and the supersonic fighter or fighters. In any case, this situation calls for careful consideration.

The engaged phase of mixed-bag operations is more complex also. The relative performance capabilities of different fighter types can change depending on altitude. For instance, subsonic jets (and non-turbocharged prop fighters) generally have poor combat performance at high altitudes, but they may be superior at low levels. There are two schools of thought on vertical deployment of high-performance and low-performance fighters. One school recommends deploying the low-performance fighters level with or above the high-performance wingmen. The altitude margin adds to the low-performance fighters' energy level at the start of an engagement and allows them to provide better support to the other fighters at lower altitudes. If the aircraft in the higher element are engaged, they can drag the fight downhill, while the high-performance fighters should be able to climb up to support rather quickly. One problem with this philosophy, however, is that both aircraft types may be forced to fight, at least for some time, at less than ideal altitudes for their performance; that is, poor high-altitude fighters may be engaged at high altitudes, and vice versa. This makes the entire division more vulnerable to hit-and-run attacks. Placing

low-performance fighters at higher altitudes also leaves the division more vulnerable to high-to-low attacks, which can be very dangerous because of the high closure typically involved in this kind of attack.

The second philosophy calls for stacking the high-performance fighters above the lower-performing aircraft. A division deployed in this manner is stronger against attacks from above, and each fighter type will be closer to its ideal regime if attacked. The high element in this arrangement can still support the low fighters, but the low-performance fighters may not be able to climb up to a high-altitude fight. This situation is not usually a great disadvantage, however, since such fighters likely would not fare well in a high-altitude fight anyway, and the high-performance fighters can drag the fight down to low altitude to gain support if necessary. During high-altitude engagements, the low-performance fighters should generally remain below the fight, providing defensive lockout and waiting to pounce like hungry alligators on any bogey that falls out the bottom of the fight.

Disengagement from mixed-bag fights also deserves some close attention. Typically, high-performance fighters will be forced to withdraw first for fuel considerations. If it is considered prudent for all friendly fighters to exit the combat arena together, this may effectively limit the combat endurance of the low-performance fighters. In addition, high-speed fighters may not have the luxury of a simple "red-line" bugout if they are forced to remain with their slower wingmen. Disengagement may have to begin even earlier if these fighters are to have enough fuel reserves to fight their way back home. Complications such as these quite often offset any advantage gained through mixed-bag fighter operations.

Notes

1. Johannes Werner, *Knight of Germany*, pp. 183-84.
2. W. P. Taylor and F. L. Irvine, *History of the 148th Aero Squadron*, p. 39.