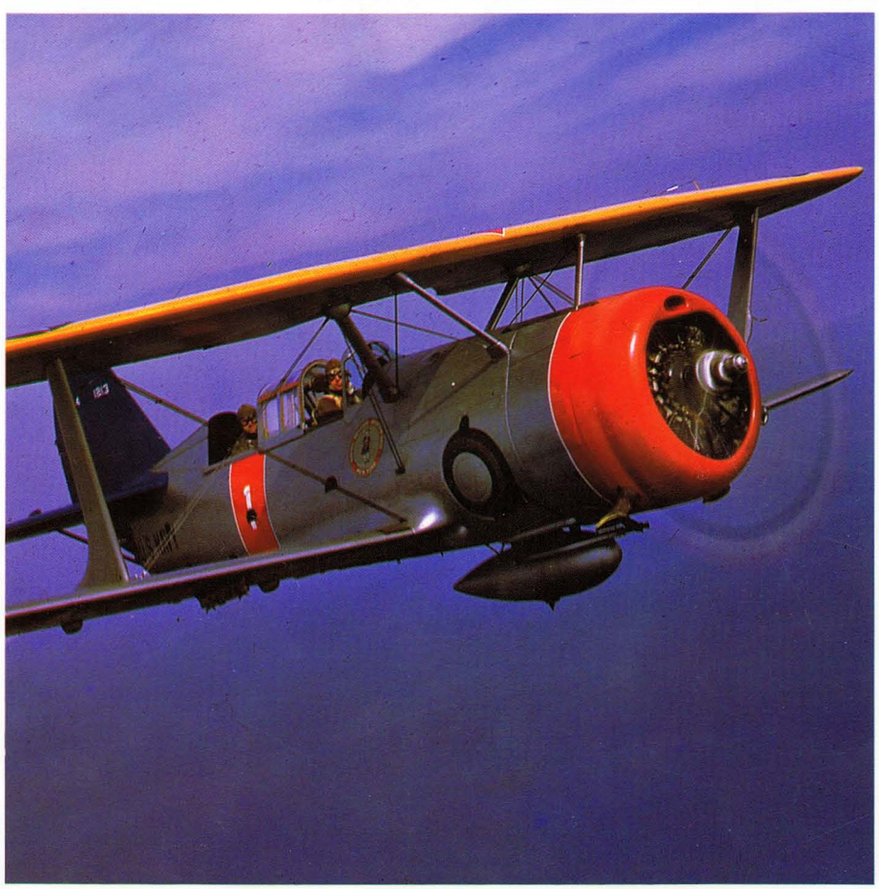
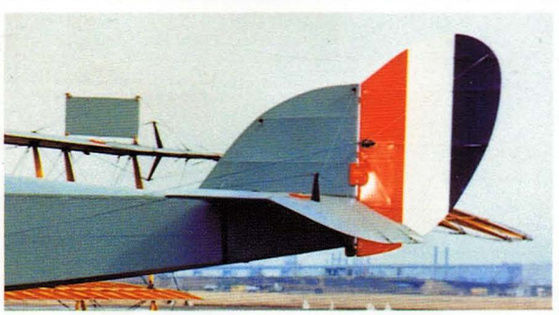
THE OFFICIAL MONOGRAM US NAVY & MARINE CORPS AIRCRAFT COLOR GUIDE

Vol 1 1911 — 1939





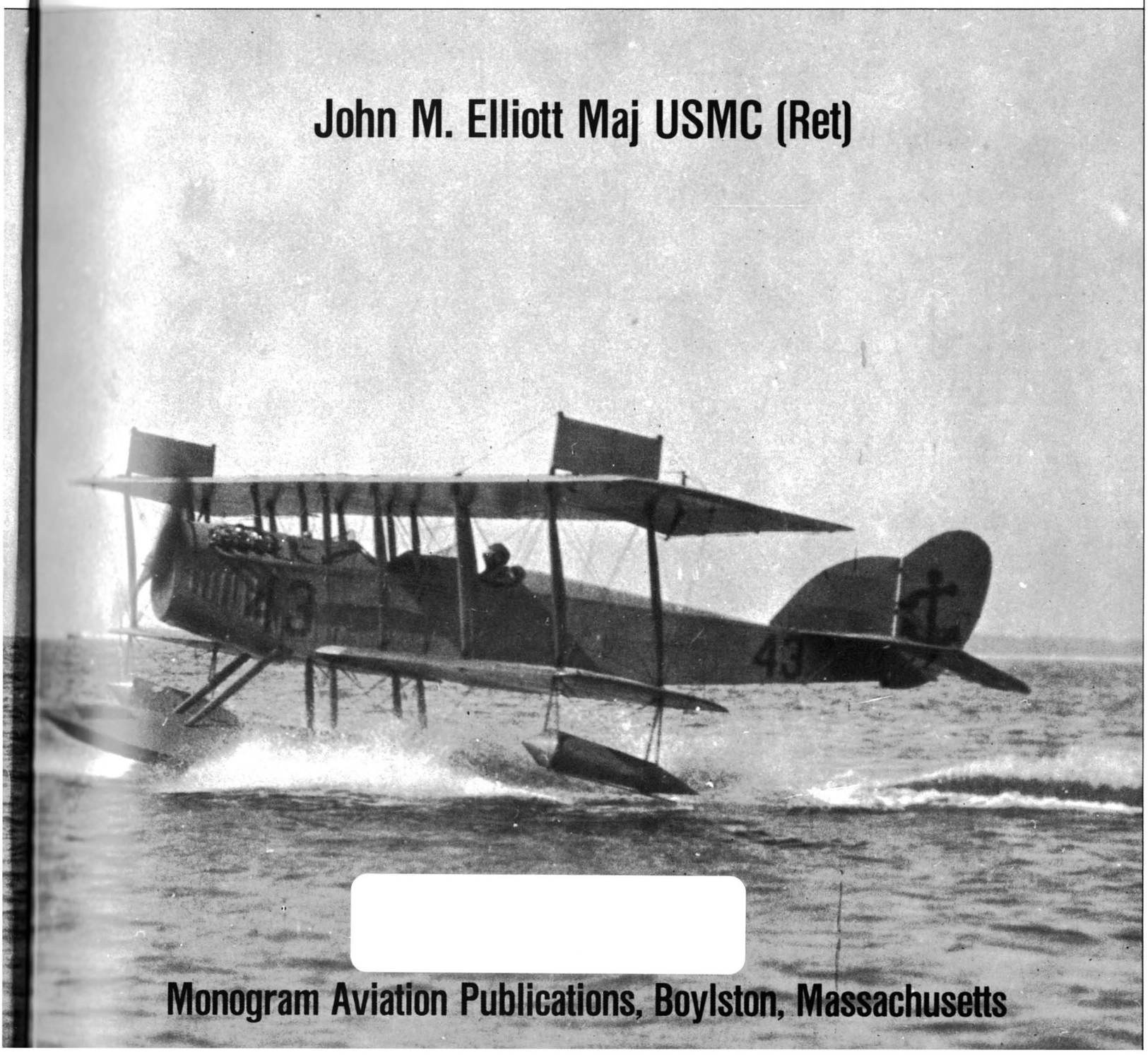
John M. Elliott Maj. USMC (Ret.)

The OFFICIAL MONOGRAM US NAVY & MARINE CORPS AIRCRAFT COLOR GUIDE Vol 1 1911–1939

A Curtiss N-9 trainer is shown at NAS Pensacola, Florida, sometime in 1917. It was an aircraft of this type which was the first seaplane ever looped successfully by Captain Francis T. Evans, USMC at Pensacola in 1917.

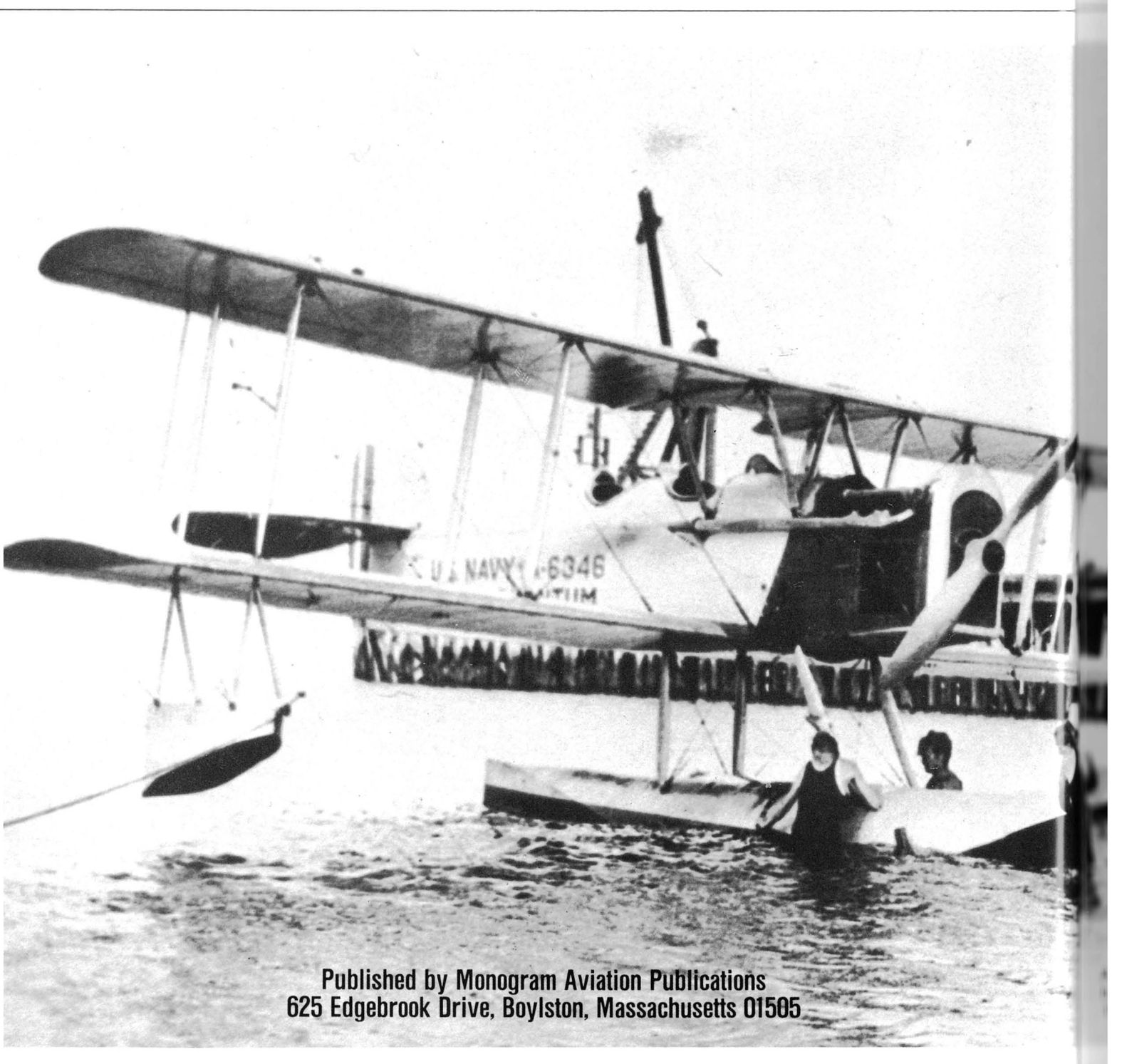
The OFFICIAL MONOGRAM US NAVY & MARINE CORPS AIRCRAFT COLOR GUIDE Vol 1 1911–1939

John M. Elliott Maj USMC (Ret)



Monogram Aviation Publications, Boylston, Massachusetts

Library of Congress Catalog Card Number 86-62376
ISBN 0-914144-31-6
Printed in Hong Kong



Published by Monogram Aviation Publications
625 Edgebrook Drive, Boylston, Massachusetts 01505

A Naval Aircraft Factory gunnery trainer, TG-1, built in 1922, is being beached at the Naval Reserve Air Station Squantum, Massachusetts, circa 1924.

CONTENTS


NAVAL RESERVE AIR STATION
U.S.NAVY
U.S. NAVY

Vought UO-1s are shown on the ramp at the Naval Reserve Air Station Squantum in the late 1920s. The USS Lexington utility airplane is properly marked. Those belonging to the reserve squadron show a local interpretation of the marking directives.

FORWARD

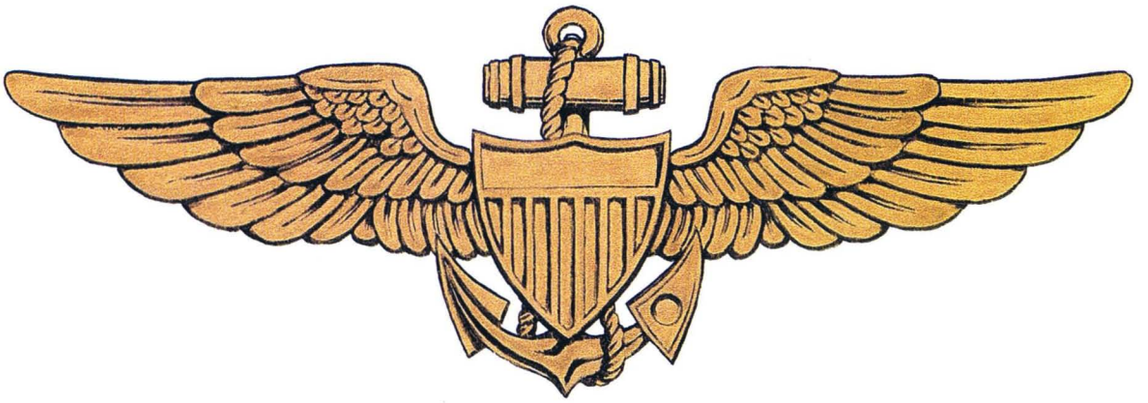
The constantly changing colors and markings of US Navy aircraft reflect attempts at better recognition and operation, as well as the political and geographical influences affecting military actions.

Each has been adopted for a specific purpose after thoughtful consideration by officers of the Fleet and the Bureau of Aeronautics in an attempt to standardize colors and markings throughout the naval service. The resultant regulations of the 1930's was an outstanding system for the time. After fifteen years of experimentation, the Navy developed by 1939 the most sophisticated system of military markings in the world. It worked well then because of the comparatively small size of naval aviation. However, the limited number of basic colors never would have been able to keep up with the explosive growth of the 1940's, so in a way it was a good thing that they could gracefully give way to the wartime light gray of 1941.

It has taken sixty years for some of this information to be published, and most of the specific details and dates have not been available until now. Major Elliott has done an outstanding job of assimilating a vast array of complicated and sometimes contradictory information, organizing it in a logical manner, and making it available for the first time. This is particularly gratifying to those of us who have lived through this period and yet often have been frustrated by an inability to explain what we have seen.

There is no doubt that this series of volumes will be the *Masterwork* on this subject and the basic reference work for all to benefit from.

William T. Larkins



INTRODUCTION

History generally is written with the "broad brush" treatment, but it is the minute details that catch our interest giving life to an otherwise dull historical subject. Such is the case in a study of aircraft insignia and markings.

Many discussions, even to the point of becoming arguments, as well as numerous articles have been written on the various types and specific periods of aircraft markings. This study attempts to cover the broad field of color schemes and protective coatings, markings, and insignia used on United States Navy/Marine Corps aircraft. It is realized that in a field as broad as this inevitably there will be some omissions or possible incorrect interpretation of the records. These points, it is hoped, will be researched, noted and reported by the readers so that we may all enjoy the completely factual presentation in a revised issue.

My research has been carried out along several general lines. Whenever possible, original Navy, Marine Corps, Army-Navy or Air Force-Navy directives, Military Specifications and official correspondence have been used as the authority. In the absence of those documents, photographs, secondary source material, the memory of those who participated in US Naval aviation as well as the serious historian/collector have been my guides. In the interest of accuracy, an attempt has been made to verify all points that are based on memory with several parties.

In numerous instances a photograph does not conform to the directives of the period. This study has been written in the vein of "do as I say, not as I do" in an attempt to present accurate information regarding how the aircraft should have been painted. It is realized that there have been many "odd ball" paint jobs. Some were a result of special occasions for which nonstandard markings were used, incorrect interpretation of the directives, and tardiness in making a change due to more important commitments. Others were based on economy or another seemingly valid reason to those involved as well as a personal desire for a particular marking which did not conform to the prescribed system.

The latter is particularly apparent in the Quantico-based Marine Corps squadrons during the period 1931 to 1938. An extensive search has failed to locate official directives specifying, authorizing or even condoning these colorful markings. In discussing these aircraft with those who flew and crewed them, it appears that there was a desire to have something just a little different from the regulation markings. Strangely, such flagrant violations of regulations by a command so close to the Bureau of Aeronautics and Chief of Naval Operations was tolerated for so many years. No other squadron in Naval aviation had such flexibility in its aircraft markings for such a long time.

In compiling the data for this study several formats were considered. The task of assembling all the varied directives in chronological order and presenting the multitude of detailed changes soon became overwhelming and confusing. At that point it was decided to present specific types of markings as a unit. Therefore, the subject matter has been subdivided and presented by sections and chapters to make it easier to follow the changes in a particular type of marking. The section breakdown is:

1. Aircraft Coloring and Protective Coatings;
2. National Aircraft Insignia;
3. Identification, Recognition Markings;
4. Maintenance, Safety Markings;
5. Meritorious Identification Markings.

Each section is broken down by chapters covering a spectific ten year period. For example, Section 2 Chapter 6 covers all the changes and instructions on the use and application of the national aircraft insignia from January 1, 1930, to December 31, 1939. Therefore, to check markings during this period, it is only necessary to check the appropriate chapter in each section plus a quick check of the previous chapters to determine what markings authorized earlier were still in effect. Photographs and drawings are included in each chapter to show exceptions to the rules, as well as to illustrate what is spelled out in the directives.

The drawings prepared for this study are stylized versions designed to depict the type and placement of insignia and markings rather than to portray a specific aircraft of a particular unit. It should be remembered that the original Navy instructions always have been of this general nature because of the numerous models and variations of each model. I have followed this practice.

The Burgess-Dunne was one of the first US Navy aircraft to be camouflaged in 1915/16. In an attempt to insure accuracy in painting this aircraft an extensive search of the

records was conducted. In addition to all known photographs that show the design developed by Mr. William Andrew McKay, a mural designer by profession, correspondence from Vice Admiral P.N.L. Bellinger and Clifford L. Webster, both of whom flew the aircraft and described the colors were invaluable. Personal papers of Captain Ken Whiting, who initiated the project, were made available by his daughter Mrs. Edna W. Nisewaner. All of this data was meticulously compiled into the painting by David Power which it is believed is as accurate as can be produced.

Whenever possible original aircraft drawings as well as photographs of the actual aircraft have been used as a guide in the production of the colored art work. In a few cases "artistic license" has been used as in the DH-4B painting. The author has in his collection photos that show all the markings depicted in this painting, on DH-4Bs in Santo Domingo. However, it cannot be positively stated that serial number A-5835 did carry squadron designation 1 ⓵ 2. However there were only five operational DH-4Bs in the squadron at that time, including A-5835, so the possibility of a correct match is quite good. The author assumes all responsibility for these few slight changes to history.

DEVELOPMENT OF US NAVAL AVIATION

The growth of Naval aviation with all the changes and commands involved could easily require a book of its own. The following explanation therefore can only provide a brief history. The primary purpose though is to provide an understanding of the organization of Naval aviation. Directives have been issued by commands at all levels and it is hoped that this will help the reader to understand where all these units stand in the chain of command as well as the squadron designations and the letters representing them.

The US Marine Corps is a component of the Navy Department, *not* of the US Navy. As such, directives issued at the Bureau level are applicable to both branches of the Naval Service.

When aviation first entered the US Navy, it was treated as another addition to the existing organization. Bureau of Construction and Repair had cognizance of the airframe while Bureau of Steam Engineering had cognizance of the power plant, just as though the aircraft were another class of vessel. The designation of aircraft was treated by class initially until the system became too cumbersome.

At first Naval aviation units were organized into squadrons during World War I. Their designation was by number or letter such as Squadron 1 and Squadron A, as well as long titles such as the 1st Marine Aeronautic Company (seaplane) or the F-5 Squadron of the Pacific Fleet Air Detachment. Most of these titles were limited to elements of the Northern Bombing Group in Europe or training squadrons in the United States. They appear to have been primarily of local significance with no overall organization. None carried over into the postwar period.

The beginning of a formal system appeared in February 1919 with the formation of the Air Detachment, Atlantic Fleet composed of the Shipplane, Seaplane and Kite Balloon divisions. A similar Pacific Fleet Air Detachment with the same organization was established in September 1919. Squadron numbers corresponded to the ship divisions to which each was attached. All Marine Corps squadrons at this time were identified by letters starting with Squadron A.

Marine Corps aviation units at Quantico, Va. on December 1, 1920, were redesignated Flights C & D 2nd Air Squadron, Flights E & F 3rd Air Squadron. The units deployed to Santo Domingo and Haiti were redesignated on January 1, 1921, as Flights A & B 1st Air Squadron and Flights G & H 4th Air Squadron.

Navy units were redesignated, merged, inactivated, disestablished, appeared and disappeared from the records, not always with an explanation. General Order No. 30, effective July 12, 1920, provided for the organization of Naval forces afloat into the Atlantic, Pacific and Asiatic Fleets. Within these units the type forces were designated Battleship, Cruiser, Destroyer, Submarine, Mine, Air and Train. The Air Detachments within each fleet became Air Forces.

With the creation of the Bureau of Aeronautics on August 10, 1921, all aviation activities were consolidated in the one Bureau. The Chief of Naval Operations had operational control, while the Bureau of Aeronautics had technical control of the aircraft and their use.

Chief of Naval Operations letter, Serial No. 26983 dated June 17, 1922, introduced the use of letter symbols to indicate squadron mission, established new titles and assigned numbers in sequence according to the order in which each unit of a given type was authorized. These designations

became effective July 1, 1922, and established the following designations.

Old	New
Combat Squadron 3	VF Squadron 2
Combat Squadron 4	VS Squadron 1
Scouting Squadron 2	VS Squadron 1
Seaplane Patrol Squadron 1	VT Squadron 2
Spotting Squadron 3	VO Squadron 2
Spotting Squadron 4	VO Squadron 1
Spotting Squadron 11	VO Squadron 3
Torpedo Plane Squadron 1	VT Squadron 1

This was the first use of the letters VF, VS, VO and VT to designate a type of squadron although it had been used since July 17, 1920, to designate an aircraft type. At this time the proper designation was Fighting Squadron and Scouting Squadron. The title Bombing Squadron was added later. It was not until 1948 that the current Fighter Squadron designation was adopted. VS and VB squadrons were being phased out by that time.

At the same time, in anticipation of a reorganization that would merge the Atlantic Fleet and the Pacific Fleet into the United States Fleet, the aviation commands were retitled Aircraft Squadrons, Scouting Fleet and Aircraft Squadrons, Battle Fleet. These two Fleets were to replace the former Atlantic and Pacific Fleets. In addition to these, the new US Fleet contained a Control Force and a Fleet Base Force. The Control Force was composed largely of submarines and contained no aircraft. Because of a lack of aircraft and a suitable vessel to serve as a tender, the aircraft squadrons command in the Base Force was not established at this time. The Asiatic Fleet may, for the most part, be disregarded as there were never many aircraft assigned. The three Marine Corps squadrons in China during 1927 and 1928, which never had over thirty aircraft, represented the largest aviation assignment.

On August 24, 1922, all Marine Corps squadrons were redesignated using the VF and VO designations. However, once again the terms used were opposite to what we now use. Where the old system had used the Flight as the unit senior to the squadron, the new system used the Division. Under this new system there was, for example, the 1st Division VO Squadron 3, 2nd Division VO Squadron 3 and 3rd Division VO Squadron 3. Other units were identified in the same manner. On July 1, 1925, this was changed so that there was only one division (active) to each squadron. This provided two inactive divisions for future expansion and listed more individual squadrons.

There was no aircraft carrier in 1922 so that the two Navy VF squadrons generally operated from battleships when they went to sea. Carrier landing practice commenced on January 22, 1925, with VF-2.

Patrol squadrons became a part of Naval aviation with the formation of VP-6 in 1924. Chief of Naval Operations letter SC 111-78:1 dated May 29, 1924, specified that the letter "M" be placed after the squadron number in correspondence to differentiate between a Navy squadron and a Marine Corps squadron with the same number. On Marine Corps aircraft this distinction was made by circling the mission letter. This was the first mention of Marine Corps aviation in the Naval Aeronautical Organization. The term division was dropped by the Marine Corps so that Navy and Marine Corps squadrons were identified in the same manner.

All these bits and pieces finally were formalized with the issuance of General Order No. 161 having an effective date of July 1, 1927. Squadron designations now consisted of three elements

1. Class designation,
2. Squadron identification number,
3. Assignment letter.

Due to numerous changes in class designations since 1922, they were redefined as follows.

	Heavier-than-air	Rigid Airship	Nonrigid Airship	Kite Balloon Free Balloon
Observation	VO		ZNO	ZKO
Fighting	VF			
Torpedo and Bombing	VT			
Scouting	VS	ZRS	ZNS	
Patrol	VP	ZRP	ZNP	
Utility	VJ			
Training	VN	ZRN	ZNN	ZKN
Experimental	VX			
Bombing	VB			

The manner of assigning the squadron designation number remained unchanged. As a matter of fact, General Order No. 161 was the first of numerous directives to state that the "class designation and identification number never changes, and is similar to the fixed identification numbering of all naval vessels of all types." Unfortunately, this concept was not followed, which has resulted in confusion of unit lineage almost to the point of utter disaster.

A suffix letter was attached to the squadron designation to identify the Fleet unit with which the squadron was serving. These letters were as follows.

Battle Fleet	B
Scouting Fleet	S
Asiatic Fleet	A
Fleet Base Force	F
Control Force	C
Naval District	D (followed by District number)
US Marine Corps	M
US Naval Reserve	R
Experimental	X
US Fleet (further assignment to fleet unit not yet made)	U

By combining the elements of the above lists it can be seen that Observation Squadron One attached to the Battle Fleet was designated VO-1B; Observation Squadron Three attached to the Scouting Fleet was designated VO-3S; Torpedo and Bombing Squadron Five attached to the 14th Naval District was designated VT-5D14; while Fighting Squadron Nine—Marines—was designated VF-9M.

On December 10, 1930, General Order No. 211 with an effective date of April 1, 1931, substituted the term "force" for "fleet" in the case of subordinate commands. It was expected that the Scouting Force would normally be in the Atlantic with the Battle Force in the Pacific. Both units were to be combined as a fleet concentration during the winter maneuvers. The title "Commander Aircraft" replaced "Commander Aircraft Squadrons" in the Battle Force and Scouting Force.

Aircraft finally became a part of the Base Force on December 2, 1930, when a seaplane tender, one Utility Squadron and two Patrol Squadrons were assigned from the Battle Fleet. After the fleet concentration of 1932, the Scouting Force, less a small training squadron, remained in the Pacific. This made possible the operation of the entire fleet as a unit. An important consideration for aviation was the increased number of Patrol Plane Squadrons which could be operated either from tenders or coastal bases.

Assignments of vessels in the *Organization of the Seagoing Forces of the U.S. Navy for Fiscal Year 1933,* assigned all carriers to the Battle Force while patrol aircraft were assigned to the Base Force to provide a better organization to the aviation components of the fleet. This left the Scouting Force with only cruiser-based aircraft, which had operated under Commander Cruisers, rather than Commander Aircraft, Scouting Force. Therefore, the title Commander Aircraft, Scouting Force, was abolished on April 1, 1933. At the same time an Aircraft Base Force command was created in its place with cognizances over tender-based aircraft as well as Fleet Air Bases at Pearl Harbor and Coco Solo with their attached squadrons.

General Order No. 241 dated December 8, 1933, created the Fleet Marine Force (FMF), a Marine Corps unit constituted as an integral part of the United States Fleet. This step took the Marines out of the "expeditionary force" category and committed them to an overriding wartime mission of the seizure of bases for naval operations. Marine Corps General Order No. 67 dated December 20, 1933, changed the titles Aircraft Squadron, East Coast Expeditionary Force (AS,ECEF) and Aircraft Squadrons, West Coast Expeditionary Force (AS,WCEF) to Aircraft One, Fleet Marine Force and Aircraft Two, Fleet Marine Force respectively.

Again the system was changed on July 1, 1937. Assignment letters were dropped except in the case of cruiser aircraft squadrons, squadrons attached to Naval Districts, Marine Corps squadrons and Navy and Marine Corps reserve units. The letter "C" was assigned to cruiser-based squadrons while "M" was retained for Marines. In these four cases the assignment became the first word of the squadron designation. The letter designation "C" or "M" was placed between the V for heavier-than-air and the mission letter such as Cruiser Scouting Squadron Two (VCS-2) and Marine Fighting Squadron One (VMF-1). The letter designator for Naval Districts and Reserve units followed the squadron number as before. In the case of cruiser aircraft squadrons, carrier-based squadrons and battleship aircraft squadrons, the squadron identification numbers were made to conform to the number of the fleet unit to which the squadron was

attached. VCS-2 in the above example was attached to Cruiser Division Two. Fighting Squadron Three (VF-3) belonged to the USS SARATOGA (CV-3), while Scouting Squadron Forty One (VS-41) and Scouting Squadron Forty Two (VS-42) were attached to the USS RANGER (CV-4). Additional digits were added to the carrier designation when more than one squadron of a given type was assigned to a carrier as with VS-41 and VS-42 embarked in the Ranger.

Patrol squadrons, Utility squadrons, Reserve squadrons and those assigned to Naval Districts continued to be numbered serially as formed.

The number of each Marine Corps squadron became the same as the number of its Aircraft Group of the Fleet Marine Force. Under this system VF-9M became Marine Fighting Squadron One (VMF-1) of Aircraft One, Fleet Marine Force and VO-8M became Marine Scouting Squadron Two (VMS-2) of Aircraft Two, Fleet Marine Force. Squadrons not a part of the Fleet Marine Force, such as a Service Squadron, retained their designation of Service Squadron 1M or 2M, while VO-9M became Marine Scouting Squadron Three (VMS-3), even though there never was an Aircraft Three.

Proposed Assignment of Aircraft and Naval Aeronautical Organization, Fiscal Year 1939—Change In, dated October 23, 1937, reestablished the Commander Aircraft, Scouting Force, and assigned all Patrol Squadrons to the Scouting Force. This left just the Utility Wing in the Base Force under Commander Utility Wing, Base Force.

On May 1, 1938, Aircraft One, FMF and Aircraft Two, FMF were redesignated 1st Marine Aircraft Group, FMF and 2nd Marine Aircraft Group, FMF respectively.

The term Air Group, with the addition of the carrier to which assigned, started during the early years of carrier aviation to designate the squadrons aboard that particular carrier. This became a formal title on July 1, 1938, when the authorization for Air Group Commander billets became effective.

On July 23, 1938, Commander Aircraft, Scouting Force recommended a reorganization of the designation for Patrol Wings and their assigned squadrons. Under this system the Wings would be designated by a single digit while the squadrons would use two digits, the first of which was the wing number. This would allow up to nine squadrons in a wing and basically followed the numbering system employed for carrier-based squadrons where the squadron number was based on the ship number.

Thus, Patrol Wing One would consist of VP-11, VP-12, VP-13, etc.; Patrol Wing Two would consist of VP-21, VP-22, VP-23, etc. The numbers 1 through 9 were not used to eliminate any possible confusion between a garbled address for Patrol Wing One (PatWing ONE), and Patrol Squadron One (PatRon ONE). In any event, they did not fit into a two digit system. Nor were the numbers 10, 20, 30, etc. used.

This system was approved by the Chief of Naval Operations on September 21, 1938, to become effective July 1, 1939.

While this must surely be the briefest history of US Naval Aviation prior to World War II, it is hoped that it will help the reader with little or no knowledge of this period to better understand what is presented in this book.

ACKNOWLEDGMENTS

The gathering of photographs and data used in the preparation of this publication was possible only through the help and cooperation of numerous persons spanning many years prior to retiring from Marine Corps aviation and during the years since. I would like to thank the following who have been of particular help.

Mr. Harry Schwartz, Archivist, Modern Military, National Archives, spent many hours searching the files for specific documents and guided my search through his intimate knowledge of the Archives. His enthusiasm and cheery greeting was always a morale booster through the long weeks of page by page record searching.

Colors, their use and identification are truly the heart of this book. Throughout the years of research I have relied on Mr. Kenneth L. Kelly, Colorimetry and Spectrophotometry Section, National Bureau of Standards. Mr. Kelly was the first to provide factual color documentation to make the tracing of a color through all the records possible. We all owe him a debt of gratitude for the cross referencing of Federal Standard 595 colors with the Munsell system which at long last gives a standard for colors used on Naval aircrafts.

The official records, complete as they are, are cold and sterile and can never provide all the data. This lack has been filled through personal knowledge and insight of those also interested in the subject. For assistance in making the

documents come alive I wish to thank the following persons, and in particular Mr. W.T. Larkins, for their assistance both through documentary and personal knowledge as well as their enthusiastic support for the need and value of this book:

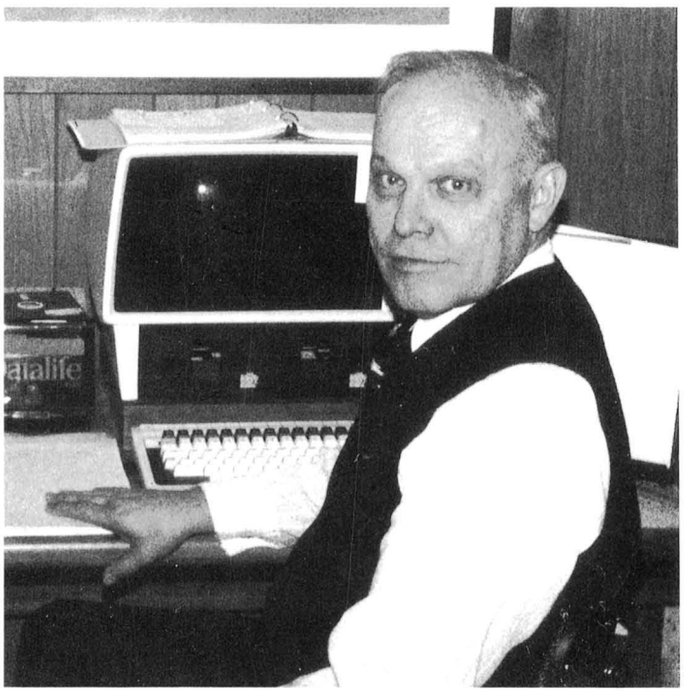
Mr. Boyd W. Campbell; Mr. David Power; Mr. Ev Payette; Mrs. K. Lloyd, Naval History Center, Office of the Chief of Naval Operations; Mrs. Jennette A. Koontz, Naval History Center, Office of the Chief of Naval Operations; Mr. Robert B. Wood, Research Specialist, National Air and Space Museum; Mr. Phil Edwards, Technical Information Specialist, National Air and Space Museum; Mr. Van Wyen, Aviation History, Office of the Chief of Naval Operations; Mr. Van Vleet, Aviation History, Office of the Chief of Naval Operations; Mr. Lee Pearson, Naval Air Systems Command; Dr. William Armstrong, Naval Air Systems Command; Mr. Ralph W. Donnelly, Historical Branch, Headquarters Marine Corps.

To all my friends and associates in Navy and Marine Corps aviation, both on active duty and retired, who have assisted in so many ways through the many years on this endeavor, Thank You. I hope that all who read this book will find it informative and interesting.

I especially want to thank my family for their assistance in this project. My brother Lt. Col. R.D. Elliott USAF (Ret) who read the early drafts and suggested numerous changes to make the text easier to understand based on his many years of aviation experience. None of this would have been possible without the active support and encouragement of my wife Helen, in assisting with the volumes of records we transported around the country from duty station to duty station, in searching the records with me and for the many hours of proofreading. I have been most fortunate.

JOHN M. ELLIOTT
MAJOR USMC (RET)

Major Elliott spent his early years in Santa Barbara, California, where his interest in naval aviation was initiated by the frequent stops of Navy and Marine Corps aircraft on cross-country flights as well as visits by the USS Lexington, USS Saratoga, and other capitol ships with their float pieces. Realizing a long time desire, he enlisted in the US Marine Corps in 1942 for four years. Upon completion of boot camp he was assigned to the aviation ordnance field where he was



to serve for twenty-four years. During this time he served in dive bomber and fighter squadrons, O & R facilities and taught in aviation technical schools rising to Master Sergeant. As an officer he served in fighter and attack squadrons and as the Group, Wing and Air Station Ordnance Officer in the US and overseas. During this time he saw naval aviation grow from single cal. .30s in the rear seat of SBDs to a nuclear delivery capability.

Upon retirement he went to the Smithsonian Institution as Chief, Collections Branch, National Armed Forces Museum Advisory Board. With the demise of the concept for a national military museum he became the Contract Administrator for the Smithsonian. During these years he became well known to those restoring naval aircraft, model builders and other museums for his knowledge on the painting and marking of US naval aircraft.

After eighteen years at the Institution he has returned to the field of naval aviation as assistant historian under CNO (Air Warfare).

SECTION 1

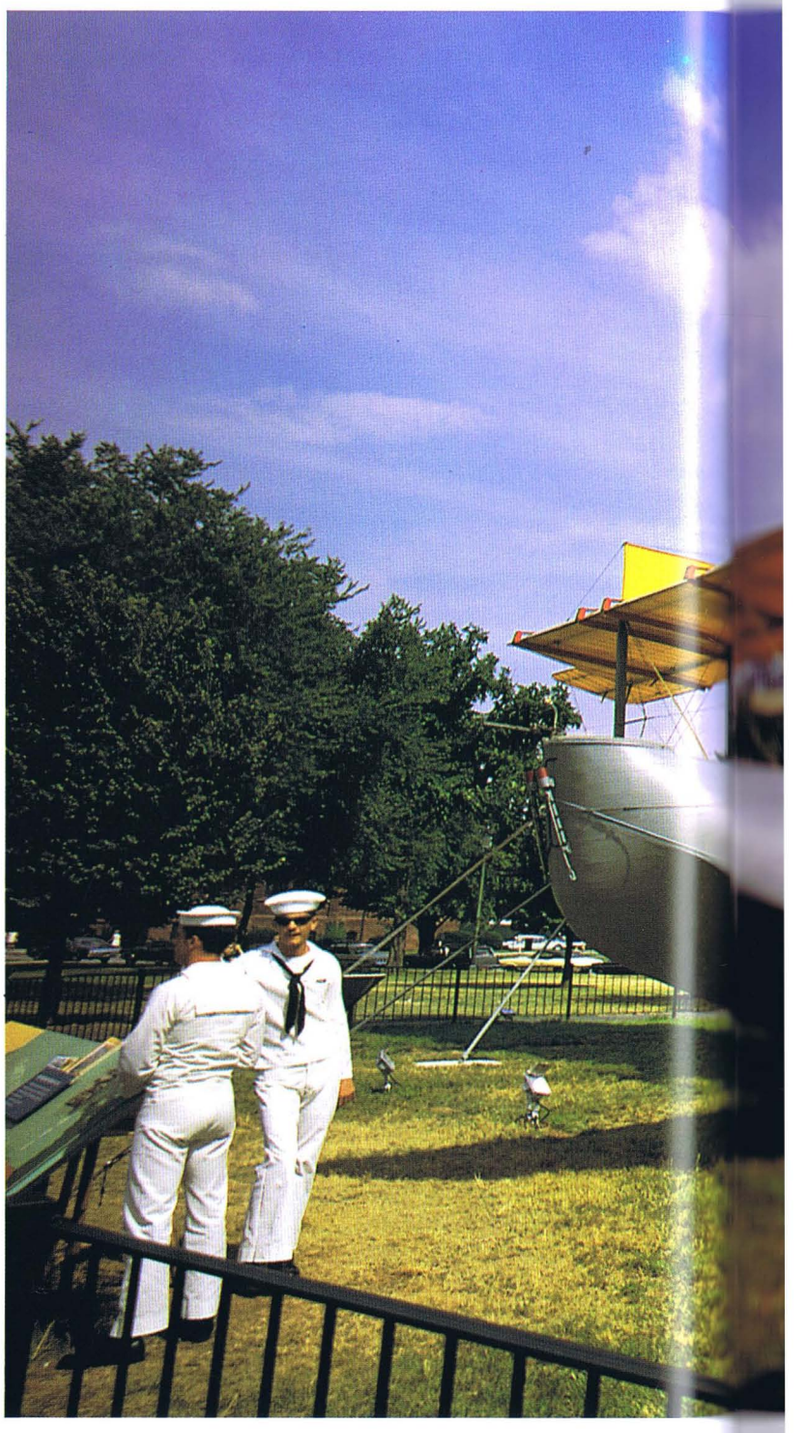
AIRCRAFT COLORING AND PROTECTIVE COATING

CHAPTER 1 1911–1919

Accurate descriptions of the painting and protective coatings applied to early Navy/Marine Corps aircraft is not possible. Several factors have contributed to this unfortunate situation. In the early days of US Naval aviation, and all aviation for that matter, directives pertaining to painting and the colors used were practically nonexistent. The practice of the individual aircraft manufacturer was accepted by the military as the manner in which those specific aircraft were to be painted. An examination of photographs of early Naval aircraft shows, in most cases, what appears to be the original color of the fabric and varnished woodwork.

When paints and other coatings of various colors were used, they were specified by their manufacturers' trade names. No scientifically determined number, code or any other system existed that can be definitely related to specific colors today. A check through *"The ISCC-NBS Method of Designating Colors and a Dictionary of Color Names"* by the National Bureau of Standards, quickly shows the impossibility of trying to relate to colors by name alone. For example, under the broad category of Moderate Yellow we find Lemon (Yellow) is one of 119 color names. Included in this category are such far ranging colors as Chinese Yellow, Cuban Sand, Dutch Pink, English Pink, French Pink, Italian Pink, Naples Yellow, Neapolitan Yellow, Venetian Yellow and Verona Yellow.

In a limited number of cases colors were defined in such a way as to be accurately determined today. For example, the red, white and blue used in the national aircraft insignia was specified in the earliest directive to be the colors as used in the American flag. The specification for these colors have been retained in the textile industry and can be identified accurately today.



Right: The NC-4 is shown on display during May 1969 at the Smithsonian Institution, Washington, DC, for the 50th anniversary of its flight when it became the first aircraft to cross the Atlantic.

Left: The third Curtiss airplane purchased by the US Navy, being beached at the Aviation Camp Annapolis, Maryland, well illustrates the natural finish on wing fabric and varnished wood surfaces which were standard for the period. The color on the vertical tail is undetermined.

The memory of those who flew or maintained Naval aircraft, with the exception of a very few individuals highly skilled in the art of color matching, is useless in determining exactly what shades were used. As a test, using a color catalog, try to determine the exact shade of the automobile you were driving in 1943. Include your OD jeep! Incidentally, how did you do on matching the car sitting in your driveway?

The first method of matching paints for Naval aircraft was through the use of wet samples, none of which exist today. This system was replaced with printed color cards many of which still exist. However, it is not possible to determine the precise amount of color shift through the years caused by light, soil or chemical breakdown of the sample. In many cases two Master Sample Color Cards for the same color, when viewed side by side show considerable difference in shade. Which is correct?

Colored porcelain (vitreous enamel) on steel plates was used as master samples during the 30's. It is believed these are still the original shades. However, with the rapid expansion for World War II it was necessary to revert to printed masters with all their inherent shortcomings. Even though these were standardized as Army-Navy colors, there is no way today to state accurately that a specific color name meant a certain shade.

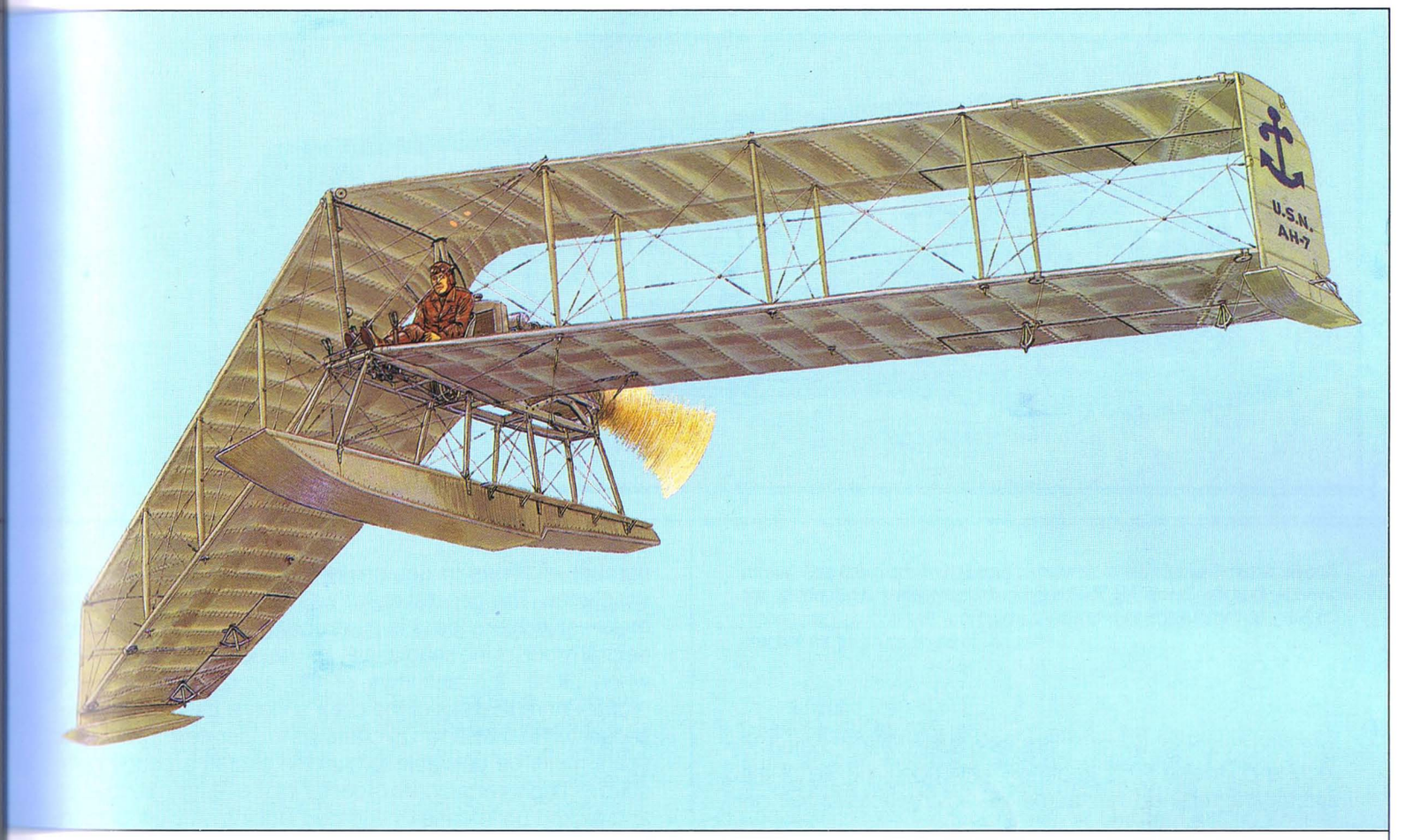
Finally, it appears that future historians can say with reasonable accuracy what a particular color was supposed to be. Names are no longer used to identify colors in Federal Standard 595a. With the introduction of the *Federal Standard 595a: Colors*, each color is identified by spectrophotometric analysis. These analytical values can be converted into a Munsell Number, a universally accepted system of color identification. Many US government and industrial color specifications are written using the Munsell notation. In addition to this the British Standards Institute uses the notation to designate standard paint colors. The German Standard Color System provides a Munsell notation for each of its 585 samples, while the Japanese Industrial Standard for Color is based on the Munsell notations. Now we no longer must rely on a color name but can identify it by an alphabetical/numeric code which is understood world wide. For those who do not have access to the Federal Standard, there is a five digit identification number for quick reference. Now, for example, we are able to identify the glossy red in the national aircraft insignia, formerly known as Insignia Red, by its Federal Standard 595a number of 11136 or its Munsell Number of 5.6R 3.9/10.1.

There is one additional problem area that must be mentioned in relation to colors. Although specifications do exist and paint, dope and lacquers are manufactured to these specifications, the problem of color matching is not eliminated. There are so many variables introduced by the various ingredients from numerous suppliers that paint, dope and lacquers are a batch by batch product. Anyone who has run short of material in the middle of a painting job has run into the problem of color match, unless the second purchase was of the same batch number as the first.

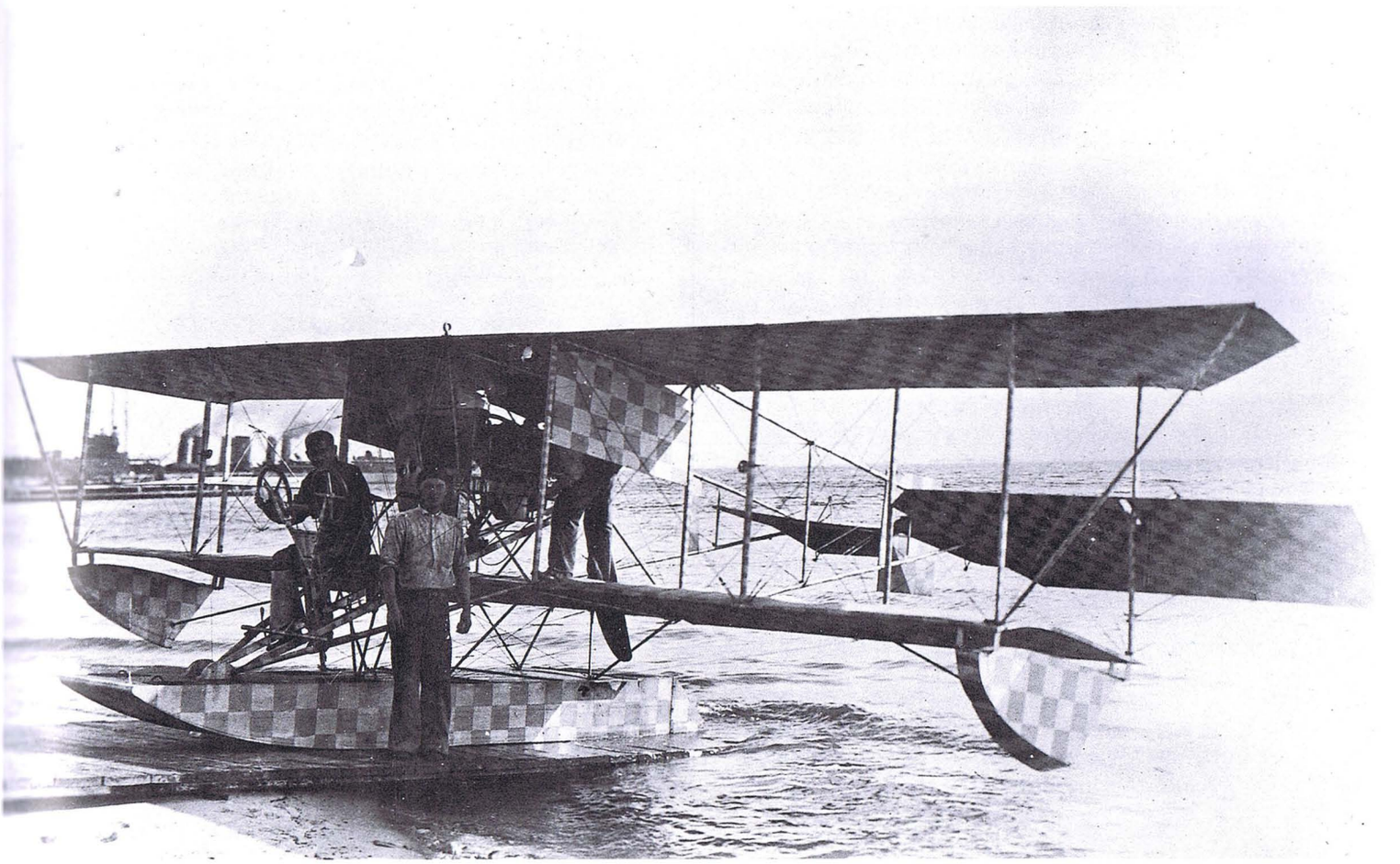
Colors are a fragile item. Many factors affect them such as sunlight, petroleum products and salt water among others. All of these are at work on Naval aircraft. Look down the flight line sometime and see the variation from one aircraft to another. From all this it should be obvious that it is just not possible to state that a specific aircraft flown by any one person was painted the exact shade of any given color. So, what we will be referring to in this book is the color as it came from the can. We will leave it up to the reader to determine in his own mind how much that color changed for any specific aircraft at any given time.

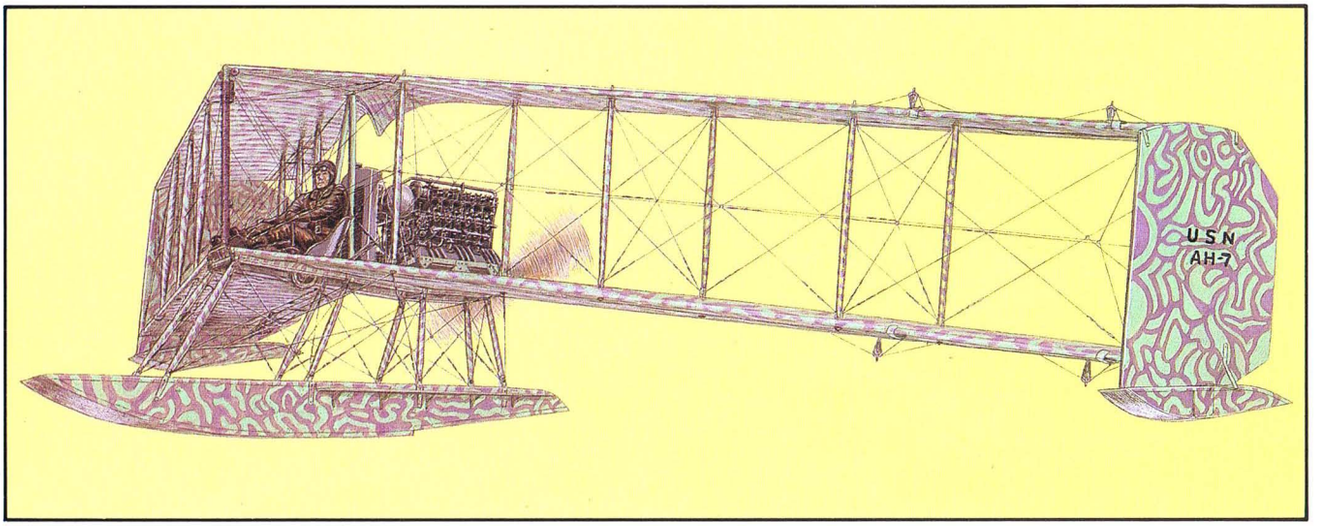
This then outlines the problem of determining and describing the colors that have been used in the painting of Naval aircraft.

The first aircraft acquired by the Navy were civilian models being sold to the public with the manufacturers' standard finish. Examination of photographs of these aircraft suggest that they were finished with only a varnish coat over the doped fabric surfaces and woodwork. There is a possibility of a light gray enamel over the exposed woodwork. Finishes on these early aircraft were dictated more from a practical necessity than any need for camouflage or identification. Aerodynamic requirements made it essential that the fabric conform to the airfoil shape without any variation. This was achieved through the application of four or five coats of cellulose acetate or cellulose nitrate dope. To prevent the fabric from becoming damp and sagging, a top coat of varnish or enamel was applied. This tended to give the fabric a yellow cast. The wooden frame members similarly were varnished or painted to prevent them from absorbing mois-



Above: Burgess acquired the manufacturing rights to the English Dunne tailless aircraft and produced two versions for the US Navy. The AH-7 achieved longitudinal stability through the 30° sweepback. This produced an aircraft that could be flown "hands off" for extended periods and was used in many early aerial gunnery experiments. It is shown here in its normal gray scheme. An early camouflage design was also experimented with on this aircraft. **Below:** The Curtiss AH-18 is shown in a checkerboard design. It is believed that this was an early attempt to break up the large surfaces of one color for camouflage purposes.





Above: Artist David Power's detailed impression of the green and lavender Burgess-Dunne AH-7. This is one of the earliest attempts by the US Navy to camouflage an aircraft.

ture and warping. Metal fittings and wires were coated to reduce corrosion. This treatment prolonged the life of the aircraft and retained their aerodynamic characteristics.

It can only be assumed that the coatings of floats and hulls conformed to the normal practices of the day in boat building. Early photographs seem to indicate some form of finish being applied to flying boat hulls with a slate (gray) color being referred to in correspondence.

The Burgess-Dunne AH-7 which had been built in 1914 was given a "dazzle" finish of irregular shapes similar to the scheme used on some surface vessels during World War I. Just when this scheme was applied is not known but a postcard from Pensacola dated July 2, 1916, shows this scheme and identifies it "as an attempt at camouflage," the colors being green and lavender. While similar colors were used on some German aircraft in Europe, it seems strange that they would be applied to an aircraft which by its design would fly over water the majority of the time. Vermillion was mentioned in a NAS Pensacola Board letter on Painting Seaplanes in February 1917. It is possible that this was the color used on the Burgess-Dunne or on a Curtiss hydroplane which was painted in a checkerboard pattern.

As late as February 13, 1917, the Bureau of Construction and Repair in letters to the Inspector of Engineering Material, Brooklyn, New York, stated: "As experience in service with seaplanes has not yet been sufficient to determine the most satisfactory color scheme to be used, the Bureau is not prepared at this time to issue instructions in the premises." However, it did specify that "two coats of Valspar or equivalent to be applied to the tops of planes and one coat to the bottom of planes." Contract Number 116 for N-9s specified a yellow varnish be used on these seaplanes.

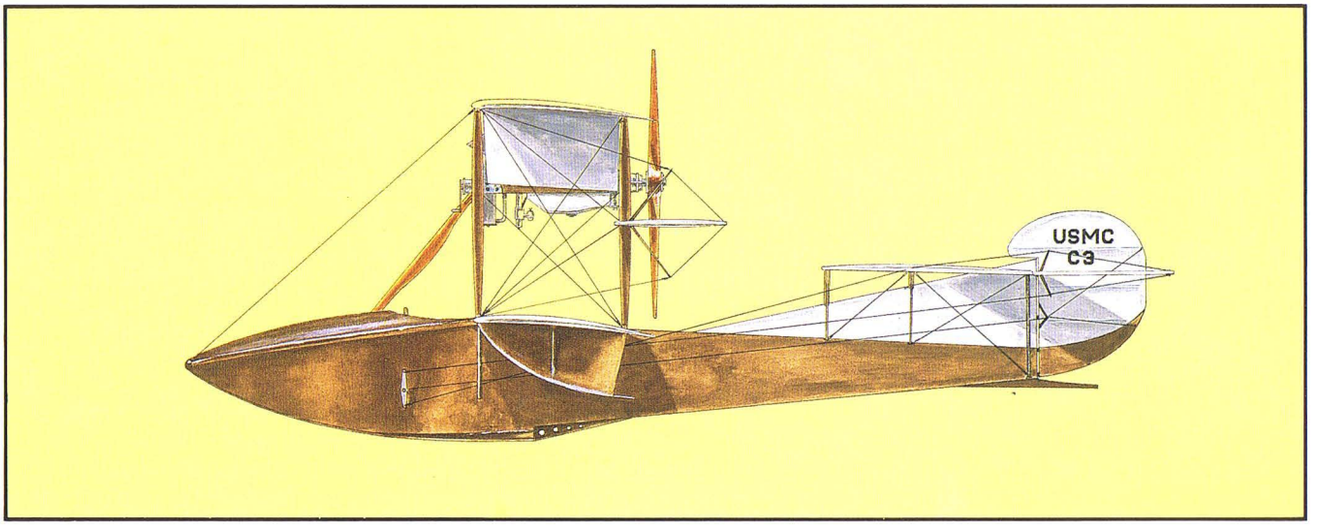
On March 5, 1917, in response to a request from the Bureau of Construction and Repair concerning the color for seaplanes, the Commandant, NAS Pensacola, Florida suggested the possibility of reducing the visibility of aircraft overhead by painting the undersurfaces white. The Station had made a number of efforts to determine the best color for painting seaplanes. The general result was that it appeared to be a matter of indifference. It is practically impossible to hide the central group of the seaplane at any reasonable distance and when close, the shadows of the aircraft itself make it prominent regardless of the color scheme used. It was also suggested that when an aircraft was to operate from a ship at sea it might be desirable to give the aircraft a gaudy color, such as bright vermillion in order for it to be readily discovered and picked up in case of a forced landing. In view of more important tests desired involving seaworthy qualities and more effective propulsion the Bureau did not desire to experiment with color visibility at this time.

On March 13, 1917, the Bureau of Construction and Repair directed that all interior woodwork, pontoons and wing struts of wood be given two coats of clear Spar Varnish. This "bright finish" was for the purpose of readily detecting cracks and checks in service. Fabric was to be doped with 5 coats of nitrocellulose or other approved preparation and then given a protective coating of Spar Varnish or enamel to which sufficient pigment had been added to give an opaque yellow covering. Decks of pontoons were to be painted or enameled to match the wings. No specific shade of yellow was specified; however, it was to be opaque. These instructions were for all outstanding contracts; however, where seaplanes had already been finished, no change was required.

The earliest reference located which specifically mentions a color being applied to Naval aircraft is a Valentine & Company letter dated July 24, 1917. It states that the Curtiss Aeroplane Company was using a colored varnish called Valspar-Curtiss English Khaki Gray Enamel. Khaki and gray as we know them today are two very different colors. A letter from the Sperry Gyroscope Co. for information on this paint described it as a greenish buff. Records of the original manufacturer of this varnish have been used by them to compound a sample from the original formula. This sample is in the light tan tones and the color can now be identified by the Munsell Number 3.4Y 5.77/4.5.

While no dates can be determined for the use of Cream and Yellow, early correspondence refers to the use of these colors. Yellow is specifically mentioned in regards to early Aeromarine aircraft.

By mid-February 1918, the practice of finishing the tops of hulls and pontoons with varnish had been superseded by



painting. The resistance of the straight varnish finish to salt water had been found to be not as great as might be required in the life of the members. It also required considerable skill and a long time to apply.

In the course of establishing a paint scheme for Naval aircraft, two new paints were developed: Naval Gray Pontoon Enamel and Low Visibility Gray. The Pontoon Enamel contained a higher percentage of varnish to give additional protection from salt water than provided by varnish or paint alone. Manufacturers were directed on March 15, 1918, that Low Visibility Gray Enamel was to be used in finishing aircraft. The change in color was not considered too important as manufacturers were not required to repaint parts already produced in the Khaki Gray. A letter to the Superintending Constructor of Aircraft, Garden City, Long Island, from the Bureau of Construction and Repair dated, March.21, 1918, states that the Khaki Enamel had been superseded by the Low Visibility Gray Enamel. It further states that the Khaki Wing Enamel and the Low Visibility Naval Gray Pontoon Enamel are identical in color. The letter implies that Naval Gray Pontoon Enamel is the color name intended. The Low Visibility term was never applied to this color.

All manufacturers were directed on April 6, 1918, that in order to reduce the number of finishing materials and simplify painting operations they must use one type of paint on hulls, pontoons and wings of naval aircraft. This paint was Low Visibility Gray Enamel. It was to be applied on doped or varnished airplane fabric, primed wood and metal. Considerable difficulty had been encountered at some Stations due to lack of gas tightness of balloonets and envelopes. To eliminate this problem the Chief of Naval Operations (Air) on April 26, 1918, recommended to the Commandant, NAS Pensacola, Florida, that the rubberized fabric on one airship be doped in the same manner as done by the British. This system consisted of five coats of clear dope and two coats of aluminum dope. No other reference has been located to give the results of this procedure. However, it is known that one hundred gallons of clear dope and a sufficient quantity of aluminum powder were shipped to Pensacola for this project. This would have been the first application of aluminum dope to the exterior of any US Naval aircraft.

Above: The first aircraft assigned to the US Marine Corps in 1914 was the Curtiss C-3. It was redesigned later that year as the AB-3. The mahogany plywood hull was finished with clear varnish as was the practice for pleasure boats of the period.

While Naval Gray was specified as the standard color as early as April 6, 1918, it was not until April 24 and 28 that actual tests were conducted to determine the validity of this decision. Seven N-9s at Naval Air Station, Norfolk, Virginia were used in the tests. Each aircraft was painted in a different scheme as shown below.

Aircraft Number	Paint Color
A-409	White (slight blue tint)
A-229	Light Blue
A-411	Dark Pearl Gray
A-427	Light Pearl Gray
A-412	Warm French Gray
A-357	Battleship Gray (Naval Gray)
A-216	Upper wing surfaces, top of fuselage, pontoons and floats, Battleship Gray (Naval Gray). Lower wing surfaces, sides and lower parts of fuselage and pontoons, Light Blue.

In the first test aircraft A-229 departed at 3 P.M. flying at approximately 500 feet. The color of the aircraft was almost exactly that of the sky. In approximately two minutes it disappeared from sight and hardly could be seen with glasses. On the return trip, however, the aircraft became visible due to the shadows cast by the wings.

All aircraft were launched on April 28 to be viewed at the same time under the same conditions. When viewed from the ground there was no apparent difference in the color of the aircraft at an altitude of approximately 3,000 feet (914.40 m), regardless of angle. When observations were made from above, at various heights, the Warm French Gray and Battleship Gray (Naval Gray) were least visible. Of these two the Naval Gray was less visible. Thus, the tests "proved" the Naval Gray scheme specified was the best of those considered.

Left: Lieutenant T.G. Ellyson, Naval Aviator No. 1, was photographed in the "cockpit" of the Curtiss A-2 during 1911.

Aircraft Technical Note No. 36 *"Instructions For Finishing Naval Aircraft,"* dated May 20, 1918, required, among other things, metal fittings to be copper or zinc plated prior to painting. The overall aircraft including hull bottom was to be painted with Naval Gray Enamel. Somewhere along the line the Low Visibility part of the name had been dropped.

On June 29, 1918, Standard Aircraft Corporation was instructed to coat all external structural wires with Spar Varnish to which approximately 5 percent Chinese Blue had been added. A slight color was to be given to the wires without obscuring the metal. This too became standard practice. Internal structural wires were to be painted with Naval Gray Enamel. By July 1918 struts and exterior spars were to be painted Naval Gray after having been given one coat of Spar Varnish. Although these paints were known as enamel they did not have the high gloss we associate with enamel today but were rather a matte to semigloss finish.

Lacking more specific information it must be assumed that seaplanes operated by the First Marine Aeronautic Company in the Azores as well as Naval seaplanes in the US were painted in this manner.

The Commanding Officer Naval Air Station, Bay Shore, Long Island, on July 17, 1918, wrote the Bureau of Construction and Repair in connection with the camouflage effect of Naval Gray aircraft. This scheme caused the aircraft to blend with the sky and water and reduced their visibility. While this was an excellent scheme for combat it was completely contrary to his requirements in a training facility. The aircraft used for training were required to remain within sight of the watch tower and a distinctive color would be highly advantageous. It was recommended that all aircraft used for training purposes be painted a bright yellow, or some other suitable color. This appears to be the first request for special painting of training aircraft and the forerunner of the familiar "Yellow Peril."

Aircraft for Marine Corps aviation were procured from the Army as well as the Navy. The first DH-4s delivered to the Marine Corps were obtained from Army contracts. These aircraft arrived in Miami, Florida during June 1918, with the Army overall Olive Drab paint scheme. No information has been located to describe the painting of the "Jennies" obtained from the Curtiss Flying School in Miami, when the field was taken over by the Marines.

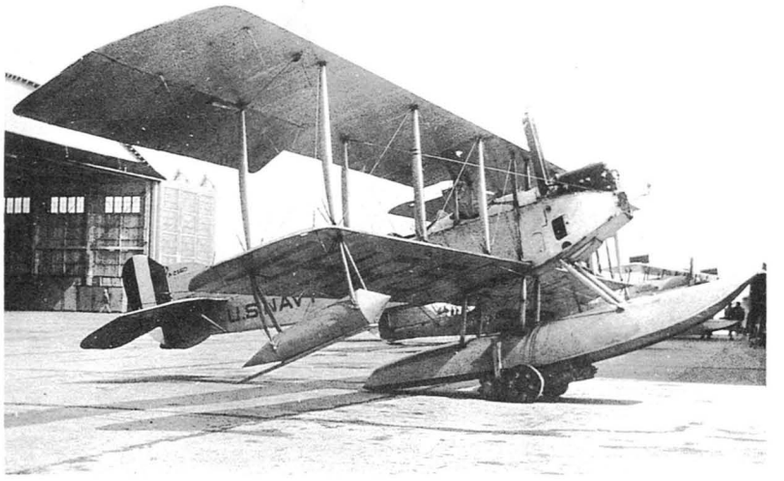
The DH-4s operated in France by the Day Wing, Northern Bombing Group were painted, as near as can be determined, in a two-tone color scheme. In this scheme all surfaces viewed from above were painted Olive Drab (which by some is remembered as a Gray Green) while the sides of the fuselage and all surfaces viewed from below were painted gray.

They also operated some DH-9As. These were obtained from the Royal Flying Corps in a "horse trading" deal of three Liberty engines for one DH-9A. The Marine Corps emblem was applied as well as the three concentric circle national aircraft insignia, but the overall paint scheme remained as originally painted by the Royal Flying Corps.

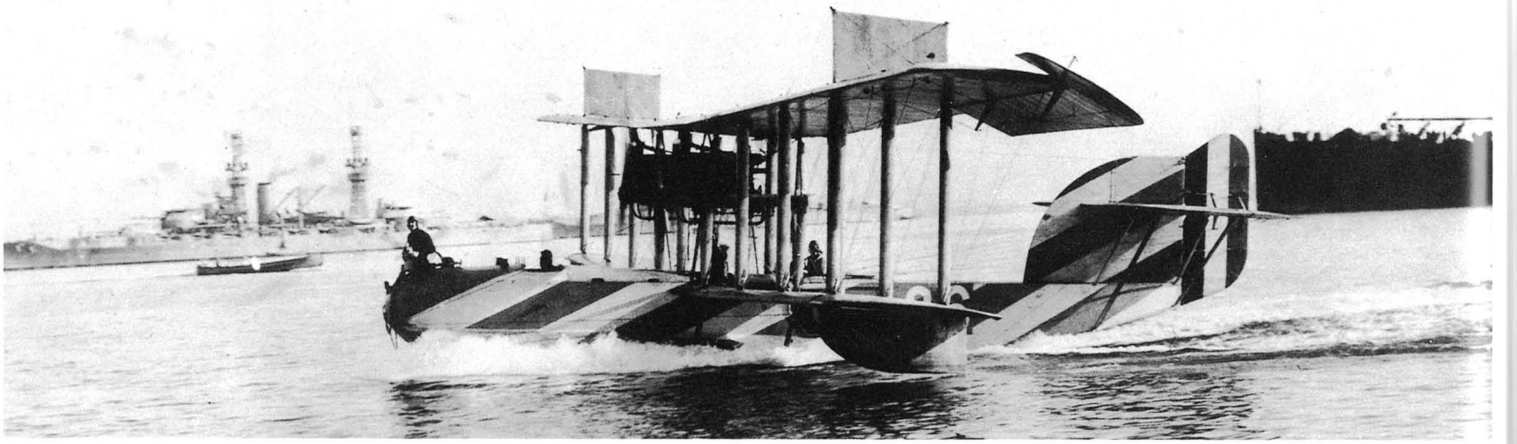
Aircraft production had a higher priority than did color schemes and the materials used. This resulted in both Khaki Gray and Naval Gray color schemes being used until the end of the war.

By mid 1919 the necessity for camouflage no longer was an overriding consideration, thus the necessity of prolonging the life of aircraft fabric took precedence. Aluminum Enamel was specified for all new fabric applied to wings, fuselage and control surfaces but was not to be applied over either Khaki or Gray Enamel. Other parts continued to be painted Naval Gray Enamel. The change to Aluminum Enamel was made because the reflective value maintained the fabric at a considerably lower temperature which lengthened the life of the fabric. It was recognized that the aluminum finish did not possess the low visibility of the Naval Gray but this was considered of lesser importance under peace conditions. The use of pigmented dopes was not authorized at this time. They were considered, by the Navy, to be difficult to brush out and did not give the protection afforded by pigmented Spar Varnish—the so-called Wing Enamel. The Pacific Fleet Air Detachment was authorized to paint the top surface of its aircraft Yellow as an experiment to determine the value of increased visibility in the event an aircraft was forced down.

Right: The Curtiss AB-5 on the seaplane ramp at Pensacola, Florida, appears to have a mottled camouflage scheme. The Curtiss F boats were one of the main training plane types as America entered World War I. The national aircraft insignia was not yet established but the anchor designated it as a US Navy airplane.



Right: This Curtiss N-9 was photographed at Hampton Roads. The type served as a standard primary and advanced seaplane trainer during World War I. Over five hundred were delivered to the Navy and the type remained in service up to 1926.

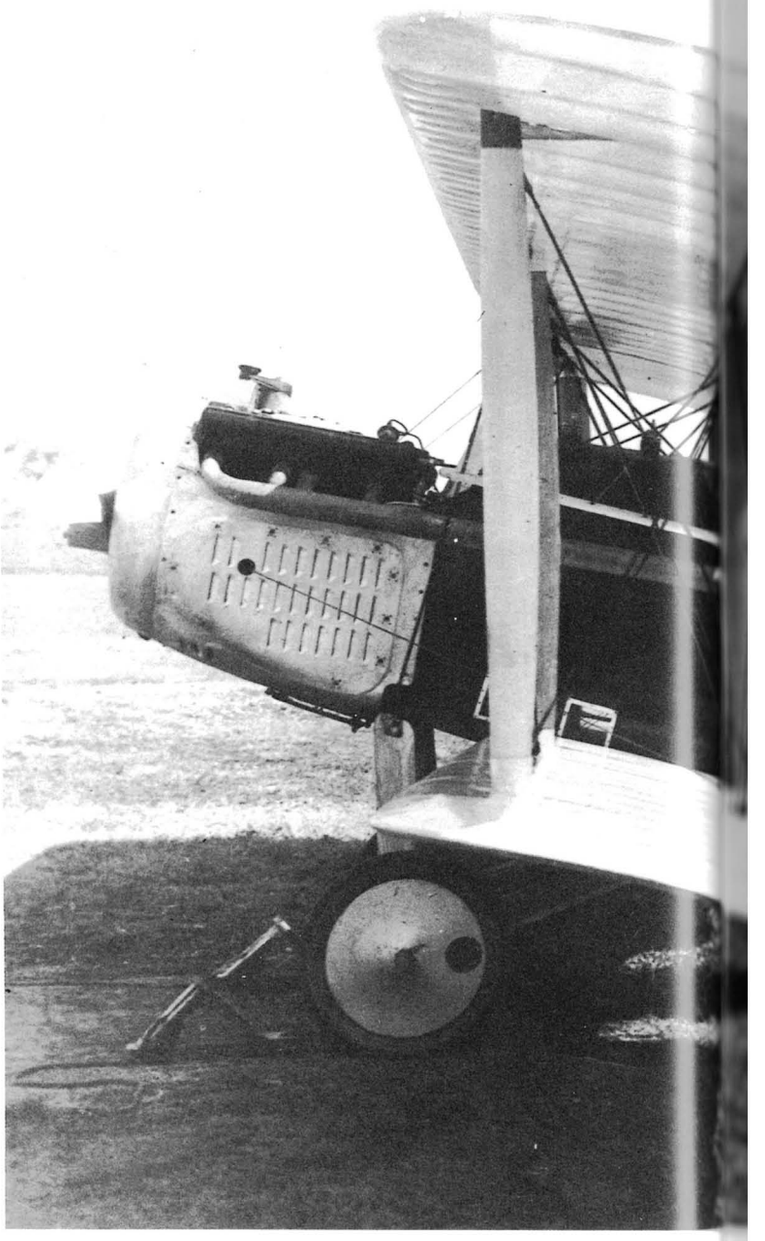


CHAPTER 2 1920–1929

Numerous locally devised painting schemes came into use after World War I. These included checks, stripes, dazzle painting as used on some vessels during the war, and various local identification markings. In an effort to eliminate these, the Bureau of Construction and Repair, in May 1920, requested all commands to report any deviations from the prescribed markings, reasons for such deviations, and suggested changes. The submitted reports show variations by nearly every installation. Most of these changes concerned marking systems to identify individual aircraft and their organization more easily. The only change reported in the overall painting was the yellow top side of the upper wing and skid fins used by the Pacific Fleet Air Detachment. The majority of the aircraft being operated by the Navy were water-based aircraft and were painted in the regulation Aluminum or Naval Gray schemes.

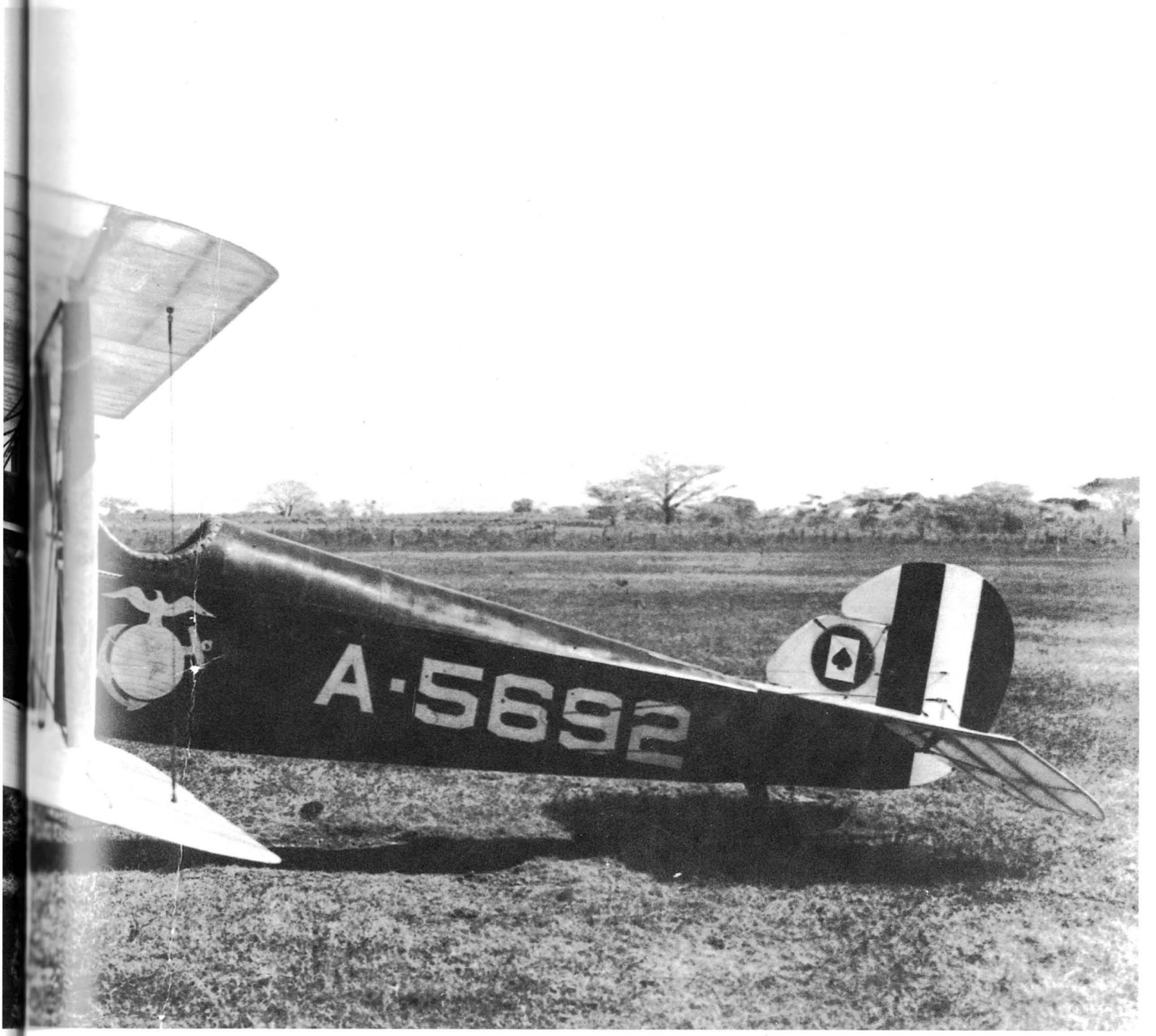
The report from Marine Flying Field, Marine Barracks, Quantico, Virginia, dated May 25, 1920, appears to be typical for land-based aircraft. It stated that two JN-4 fuselages had been doped and then covered with clear varnish. Two additional JN-4s had been painted with Aluminum Wing Enamel to match wings furnished by the Naval Aircraft Factory. In photographs the fabric surfaces of the Quantico aircraft appear to be gray; however, the metal cowling around the engines was painted an undetermined dark color.

The aircraft being operated at Marine Flying Field, Parris Island, South Carolina were reported to be painted Forest Green as originally finished by the factory. All repainting was being done with Naval Gray Enamel. As these aircraft are known to have been procured from the Army Air Service, it is most likely that the Forest Green referred to was really a



Right: This extensively modified Vought VE-7F had a varnished mahogany fuselage covering. An early version of the Marine Corps emblem as applied to aircraft was applied by VO-1M in Santo Domingo, Dominican Republic. The Ace of Spades squadron insignia was designed at this time becoming the first officially recognized Marine Corps squadron insignia. This insignia is still in use.

Opposite: Scouting Squadron One of the Atlantic Fleet developed a system of stripes and squares of various colors to identify its aircraft as shown on this Curtiss F-5L.



Left: This UO-1 (A-6986) was assigned to the Chief of the Bureau of Aeronautics, Admiral W.A. Moffett. The highly polished cowling and Dark Blue cockpit area is believed to be the first of the special staff aircraft paint schemes with Bureau approval. **Opposite lower:** The fuselage of this De Havilland DH-4B (A-6371) was painted blue in the manner of an Admiral's barge. This particular machine was assigned to LCdr. Millington B. McComb, Commanding Officer of Naval Air Station Pearl Harbor.

green form of Olive Drab that was then being used. This line of reasoning is based on additional correspondence concerning "Standard Green color paint used on the DH-4-B surfaces." It is not logical to assume that any paint would be made a standard color for the few aircraft operated by the Marine Corps at that time.

The Navy standard schedule for doping wings during this period was to saturate the fabric with a 15 percent solution of diammonium phosphate, either before or after it was applied to the wing structure. This was a fire-retardant measure. Fabric-covered surfaces then were given two coats of Cellulose Acetate Dope, followed by not less than two nor more than four coats of Cellulose Nitrate Dope. Finally, two coats of Aluminum Wing Enamel were applied, except on the underside of horizontal surfaces. Here one coat of Aluminum Wing Enamel was used. While not specified, it can be assumed that this schedule applied to fabric-covered fuselages as well.

On July 12, 1921, the Bureau of Aeronautics authorized two coats of Yellow Enamel to be applied to the top wing surface after the nitrate dope to such seaplanes at NAS Pensacola as the Commandant deemed desirable. This was the first official directive for more colorful painting of Naval aircraft.

The Commandant, NAS Pensacola, Florida, on December 9, 1922, requested permission to modify the standard paint scheme on selected JN and VE-7 aircraft so that they would be easily recognized as "friendly" or "enemy" aircraft when used in combat training. This was to be accomplished by painting the fuselage from a point six inches (15.24 cm) aft of the designating number to its after end. One type was to be red, the other yellow. This request was approved by the Bureau on January 9, 1923.

On September 27, 1923, VO-1M based in Santo Domingo asked Headquarters Marine Corps if its DH-4s were to remain Olive Drab or be repainted aluminum. The query originated because the last DH received was painted aluminum as were all its spares. They were instructed that the aircraft were to remain OD until further orders. Thus, not only were they operating aircraft of mixed color schemes, but this further substantiates the contention that the Forest Green and Olive Drab were synonymous.

Technical Order Number 54, dated February 4, 1924, required that the practice of striping or camouflaging aircraft be discontinued. Standard painting and markings were to be applied during the next overhaul and all aircraft were to be in compliance not later than July 1, 1924. However, the upper surface of the upper wing could be painted Chrome Yellow or other color instead of gray, to increase the visibility in case of a forced landing. If adopted, the application had to be uniform throughout all squadrons at a Station, Force or Fleet. A final coat of clear Spar Varnish also was required on all fabric-covered surfaces.

The Army Air Service used pigmented dope to color the fabric of their aircraft. It was their opinion that this method made a repair easier and that a periodic top coating would keep the fabric taut. The Navy on the other hand specified pigmented enamel. This, they believed, gave better protection than pigmented dope and was easily removed with thinner so that a fabric repair could readily be made. In order to evaluate the two systems in the field, the Bureau of Aeronautics on April 8, 1924, authorized Curtiss Aeroplane and Motor Co. to finish the F4C aircraft, then under contract, with Aluminum Pigmented Dope in lieu of the Aluminum Wing Enamel specified. Markings and insignia continued to be applied with enamel of the appropriate color.

The exception to this policy was the use of pigmented acetate dope on the covering of the rigid airship ZR-1 USS SHENANDOA. This system was used to save weight. Additionally, there was no necessity for the outer covering to be as taut or to conform consistently to an airfoil shape as in the case of an airplane wing. The overall color was aluminum powder in the dope while the black lettering was produced with carbon black in the dope.

Technical Order No. 67 dated June 18, 1924, required all aluminum and Duralumin parts be given two coats of Aluminum Wing Enamel for protection against corrosion.

Technical Order No. 68 dated June 24, 1924, appears to be the first directive, other than those issued to manufacturers, that in its own right specifically detailed the painting of Naval aircraft. Interior wood surfaces were to be given two coats of Spar Varnish except areas liable to be splashed with oil or gasoline. In this case they were to be protected by three coats of Spar Varnish or an approved gasoline-proof paint. Wood surfaces to be in contact with doped fabric were to be coated with clear dope. All exterior wood surfaces were to be given three coats of Spar Varnish except hulls and floats. The wood surface of hulls and floats above the water line were to

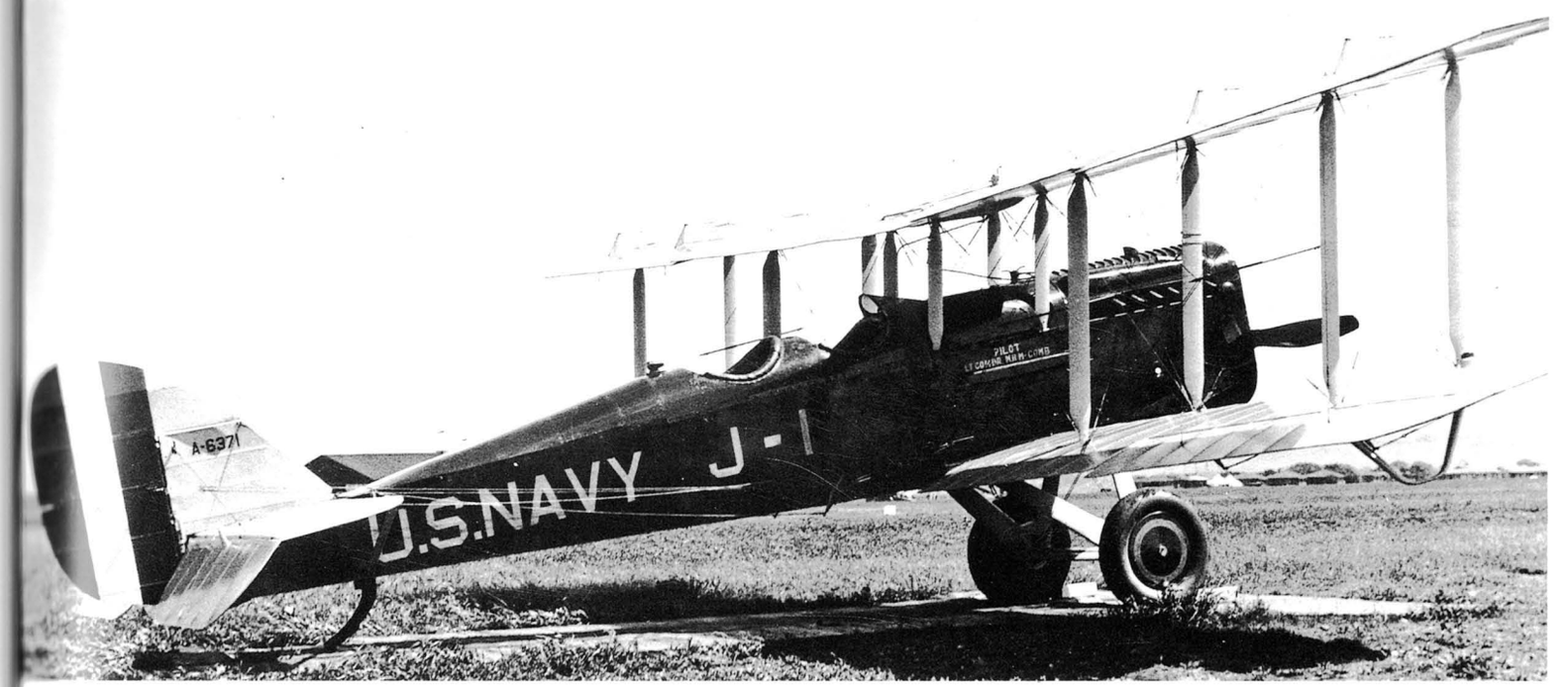
be given three coats of Aluminum Wing Enamel. Below the water line they were to be protected by two coats of anti-fouling paint. This was generally a copper base paint similar to that used on small craft.

Fabric covering set in dope or casein glue, such as hullls and floats, were given two coats of Aluminum Wing Enamel when exposed, otherwise two coats of Spar Varnish. Fabric-covered surfaces such as wings, fuselage and tail surfaces were to be given not less than two nor more than four coats of dope, covered with two coats of Aluminum Wing Enamel and sealed with one coat of Spar Varnish. The undersurface of horizontal surfaces was to be given only one coat of Aluminum Wing Enamel. The upper surface of the upper wing of training planes had to be given two coats of Naval Yellow Enamel in place of the Aluminum Wing Enamel. Where desired by operating units, the top of the upper wing also could be given two coats of Naval Yellow Enamel in place of the Aluminum Wing Enamel. As stated in Technical Order No. 54, if adopted, this painting had to be uniform throughout all squadrons at a Station, Force or Fleet.

It proved to be impractical to comply with the requirement of finishing interplane and landing gear struts with Spar Varnish on the aircraft then in service where these parts had previously been painted Naval Gray or Aluminum Wing Enamel. In these cases Technical Order No. 76 dated September 17, 1924, directed that when refinishing these parts they were to be sanded down to the wood, given two coats of Aluminum Wing Enamel and a final coat of clear Spar Varnish.

During 1925 Chance Vought Corp. was authorized to finish 20 UO-1 aircraft and Glen L. Martin Co. to finish 40 SC-2 aircraft with Aluminum Pigmented Dope in place of Gray Enamel. Several stations also were authorized to finish one aircraft in this manner as the Bureau continued to evaluate the two finishing methods.

After receiving numerous complaints about the wearing qualities of Aluminum Wing Enamel on hulls and floats, the Bureau of Aeronautics on January 22, 1925, requested an official evaluation from both the Battle Fleet and the Scouting Fleet.



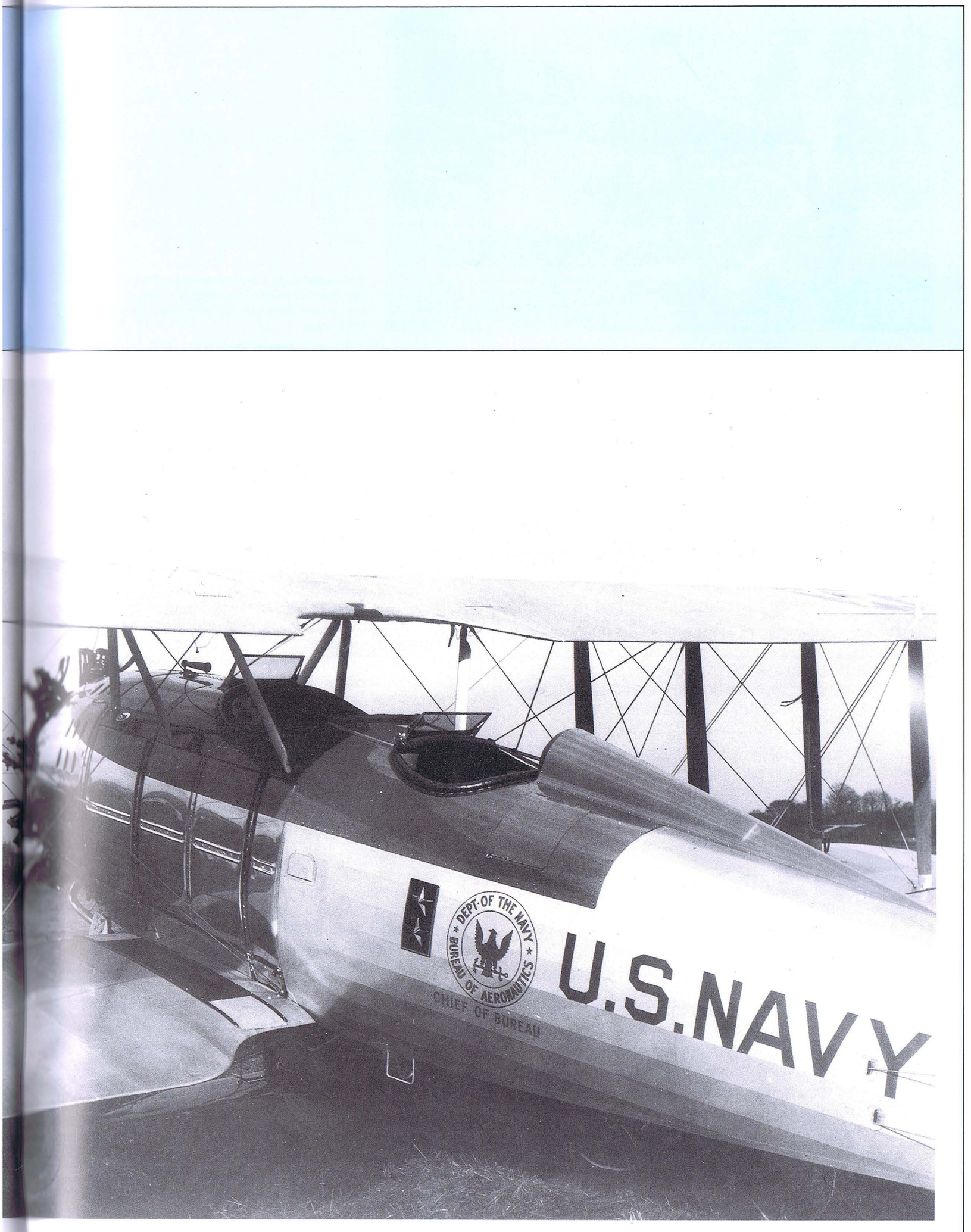
The general opinion was that the Aluminum Wing Enamel was unsatisfactory for use on hulls and floats. Even with several coats of Spar Varnish over the Aluminum Wing Enamel it tended to deteriorate rapidly when in contact with salt water and was difficult to maintain. A return to Gray Enamel for hulls and floats was recommended. Opinions varied as to the use of Aluminum Wing Enamel on fabric surfaces.

After several years of optional use in the Fleet, yellow on the upper surfaces became mandatory with the issue of Bureau of Aeronautics Technical Order No. 101, dated May 19, 1925. This order specified that the upper surfaces of the upper wing, horizontal stabilizer and elevators were to be given two coats of Naval Yellow Enamel in place of Aluminum Enamel.

Technical Order Number 102, dated June 2, 1925, directed that the newly developed Coal Tar-Rosin Anticorrosive and Antifouling paints were to be used on the bottoms of all hulls and floats, both wood and metal, in lieu of the copper paint previously required.

Just when the practice of painting special staff aircraft started has not been determined. However, in 1926 Admiral W. A. Moffett, the first Chief of the Bureau of Aeronautics, had a Vought UO-1 specially painted. This, it is believed, was the first such special paint scheme. The metal skin on the forward portion of the fuselage was highly polished and a dark blue area was painted on top of the fuselage to include both cockpits. In addition, the Bureau of Aeronautics emblem and two stars denoting his rank of Rear Admiral were displayed on each side of the fuselage.

Top: The Bureau of Aeronautics emblem was applied to the aircraft of the Chief, Bureau of Aeronautics, and racing planes entered by the Navy. **Right:** A simplified version of the above badge is painted below the cockpit of Admiral W.A. Moffett's UO-1 in April 1926. The two stars forward of the badge denote the Admiral's rank.


DEPT·OF THE NAVY
BUREAU OF AERONAUTICS
CHIEF OF BUREAU
U.S.NAVY

Left: A Berliner Joyce OJ-2 reserve aircraft shows the squadron insignia and designation on the side of the fuselage. Note the color shift from metal to fabric areas.

CHAPTER 3 1930–1939

Technical Order No. 80 dated January 4, 1930, stopped the practice of painting the bottom of floats and hulls with antifouling paint. It had been determined that this finish gave poor protection against corrosion and that marine growth was not serious enough to require this finish.

In 1930 the Assistant Secretary of the Navy for Air was flying his own distinctively painted aircraft. This consisted of an overall dark blue fuselage with the flag of four stars around a foul anchor denoting his office on each side of the fuselage. No painting instructions have been located for this scheme.

The Bureau of Aeronautics in a letter to The Manager, Naval Aircraft Factory, dated April 21, 1931, listed the following colors to be used on Naval aircraft.

1. Insignia Red
2. Royal Red
3. White
4. Insignia Blue
5. True Blue
6. Black
7. Willow Green
8. Lemon Yellow
9. Orange Yellow

At this time it was noted that colors 1 and 2 were believed to be close enough in shade to permit their interchangeability. It appears that Orange Yellow is just a new name for Naval Yellow Enamel previously specified for use on the upper surfaces of top wing, horizontal stabilizers and elevators.

A Bureau of Aeronautics letter dated August 1, 1930, sent color samples to various units of the Fleet. These colors were identified for the first time as Army-Navy Standard Colors (AN Standard). Subsequent correspondence from the Bureau of Aeronautics identified the yellow to be used on the upper surface of wings and tail surfaces as Orange Yellow. Some confusion had been created when this color had been referred to as Taxi Orange by Commander Aircraft, Battle Force on June 2, 1931.

SR-15a *Aeronautics Specification, Finishing Naval Aircraft,* dated August 1, 1931, specified the various techniques to be employed in the use of protective finishes applied to all areas and types of material. It also clarified the requirement for the upper surfaces of the upper wings and ailerons to be painted Orange Yellow. It should be noted that this meant only the upper surface of the ailerons, as in the case of the wing, not the entire aileron. Horizontal tail surfaces were no longer directed to be Orange Yellow. All other fabric surfaces were to be Aluminum Pigmented Dope. External metal and wood surfaces were to be painted with Naval Aircraft Gray Enamel. Training aircraft were to be Orange Yellow overall, except the landing gear which was to be Naval Aircraft Gray Enamel. Steps, handgrips and walkways were to be given two coats of Insignia Blue or Black Enamel over the regular finishes specified. This was the first time pigmented dope had been specified in lieu of enamel and Spar Varnish for the color finish.

Surfaces in contact with doped fabric now were required to be covered with aluminum foil 0.0005 inch (.0127 mm) thick. The foil to be attached by approved glue, shellac or foil adhesive and applied over the regular finishes.

Bureau of Aeronautics letter Aer-D-158-EC dated March 8, 1932, authorized the painting of exhaust deflectors, the inner surface of ring cowls and shutters with Black Enamel in place of gray as previously specified.

After extensive testing and discussion, SR-70 *Application of Dopes and Lacquers to Fabric Surfaces of Aircraft,* dated May 15, 1933, specified the use of pigmented dopes for the final coat on fabric surfaces. Under no circumstance were fabric-covered surfaces to be finished with clear dope only. Pigmented lacquers were to be used for insignia and markings.

During the '30s the upper surface of the horizontal stabilizer of some Naval aircraft were painted Orange Yellow the same as the upper surface of the wing. No instruction has been located directing this except Technical Order No. 101. All other known specifications for this period direct that the empennage be painted the same as the fuselage. Carrier-based aircraft were an exception in that their empennage would be painted a distinguishing color for each squadron or vessel. However, a letter from Captain A. C. Read, by direction of the Chief, Bureau of Aeronautics, to the Comet Model

Airplane and Supply Company dated January 6, 1934, does state that the top of the horizontal stabilizer was painted Chrome Yellow the same as the upper surface of the upper wing indicating that Technical Order No. 101 was still in effect.

On May 5, 1934, the Chief of the Bureau of Aeronautics sent a letter, Aer-D-158-RC, to the Commander in Chief US Fleet and all other commands which operated special staff aircraft detailing the blue and aluminum color scheme for painting these aircraft in the field. It appears that this was the formal blessing on what had already become a standard practice.

The Naval Aircraft Factory issued Specification PF-6, *Tentative Process Specification for Painting Special Aircraft,* dated August 1934. As so often happens, every new bit of information generates new questions. In this case it is the color of paint used. Throughout the specification Admiral Blue is designated. A check with the Paint and Camouflage Office as well as queries to those who painted the aircraft at the Naval Aircraft Factory has failed to turn up any reference to Admiral Blue in any other paint document, including those Bureau of Ships directives used to paint the Admiral's Barge and Captain's Gig. Most of those asked remember it as a dark blue slightly darker than Insignia Blue.

PF-6 provided detailed instructions on the methods and materials to be used at the Naval Aircraft Factory for painting and doping the exterior of aircraft assigned to senior officers. These aircraft were to be painted in two schemes. Class I was for aircraft assigned to Flag officers (Admirals) and Class II was for aircraft assigned to the Assistant Chief of the Bureau of Aeronautics, and Commanding Officers of aircraft carriers, tenders, fleet air bases, and major air stations with the rank of Captain or Commander. Parts finished with Admiral Blue were to be painted with enamel. Parts finished in aluminum were to be painted with Aluminum Enamel or dope depending on the surface to which it was applied.

The color scheme for Class I aircraft was as follows.

Wing Group	
Outer panels; Upper surface of upper wing	Chrome Yellow
Under surface of upper wing and both surfaces of lower wings	Aluminum
Wing struts and cuff; Inter-aileron strut; Aileron control; Exposed wing root faring; Wire anti-vibration birds	Admiral Blue

Body Group	
Nose shutter; Fixed Nose shutter; Anti-drag ring; Engine compartment cowl; Cockpit cowl; Headrests; Windshield frames; Exposed surfaces of fuel tanks; Landing gear; Chassis; Wheels; Tail wheel; Arresting hook (if any); Fuselage Fabric	Admiral Blue
Moveable nose shutter	Burnish and Lacquer (clear)
Fuel tank straps; Chassis "X" wire bracing; Miscellaneous trim and hardware (Latches, Fasteners, Wires, Locks)	Chromium

Tail Group	
Fabric covering; Fairing	Aluminum
Brace wires	Chromium

A streamline shape was to be applied to the outside surface of each wheel fairing. The shape was to be painted on the Admiral Blue Enamel with gold leaf size. This then was to be sprinkled with aluminum powder before it dried.

Letters and/or numerals on the fabric were to be Black on Aluminum or Aluminum on Admiral Blue. To avoid the feather edge at the junction of the aluminum characters and the blue, a narrow red stripe was to be traced at the junction line.

The requirements for Class II aircraft were the same except that the forward section of the fuselage covering was painted Admiral Blue to just aft of the trailing edge of the wing root fillet at the lower longeron and the blue area was then "faired in."

These aircraft had a minimum of four coats of clear dope, two heavy spray coats of aluminum dope followed by two medium coats and one light coat of enamel. A good grade of automobile polish was applied to the exposed surfaces to give a high gloss.

Parts that were specified to be chromium were to be chrome plated except that tie rods could be of corrosion-resisting steel in lieu of chromium plated rods provided they were highly polished.

No reference is made in PF-6 concerning the painting of the aircraft for use by the Assistant Secretary of the Navy for Air.

No changes were made to this specification through the years even though it was written specifically for SU type aircraft. The entire specification was cancelled early in 1943 as no longer being required. All requirements pertaining to the exterior color, insignia, and marking of Naval aircraft by that time were contained in Specification SR-2, *Exterior Color, Insignia and Marking of Naval Aircraft.*

A formal study on the camouflage of Naval aircraft was not conducted until 1934. Patrol Squadron 2F (VP-2F) based at NAS Coco Solo, Canal Zone, conducted tests and submitted a report dated May 25, 1934, on the three types of camouflage required for Naval aircraft. These were:

1. for components viewed from below against the sky which may be clear, cloudy or overcast and referred to as "sky" camouflage,
2. for components viewed from above against a background of land, water or combination of both and referred to as "sea" or "ground" camouflage,
3. when viewed from the side the background can be either sky or ground depending on the viewer's position in relation to the horizon. Any such camouflage must be a compromise. However, the best results are obtained by graduating the colors from the darkest at the top to the lightest at the bottom.

Unlike the Navy, the US Army Air Corps had experimented with camouflage practically from the beginning and VP-2F recommended the sky camouflage described in War Department Technical Order .No. 07-1-1 dated January 23, 1933, as the best scheme until proven otherwise. In this scheme the bottom surface of the wings, empennage and fuselage were to be light blue, mottled with irregular patches of purple along the edges. The purple patches were to be from one to two feet (60.96 cm) wide along the edge, with an equal amount of light blue between, and to extend from one to three feet (30.48 cm) to three feet (90.44 cm) into the surface area. These dimensions are to be adjusted in size and spacing so as to be proportional to the size of the surface being mottled.

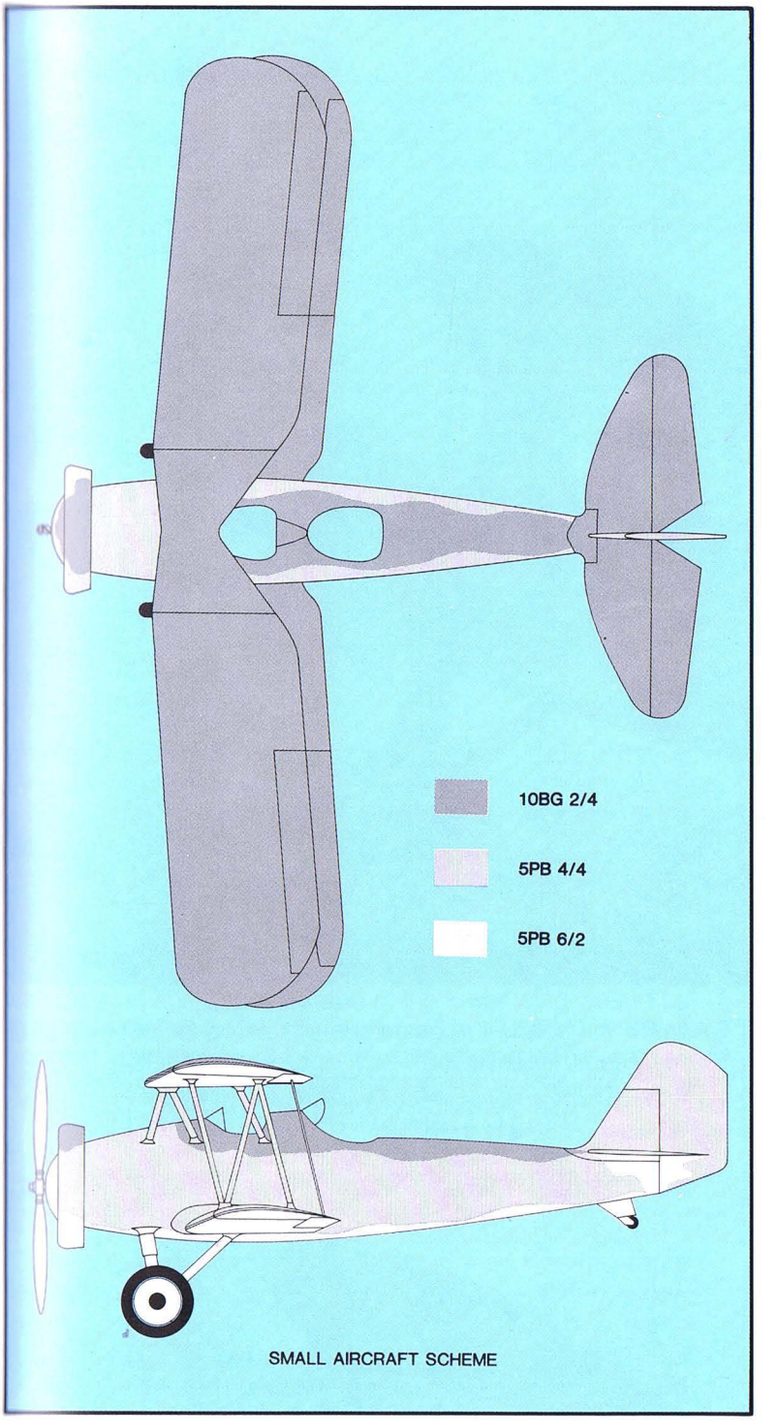
The Air Corps night sky camouflage scheme requiring all surfaces viewed from below, including the vertical fin and rudder, to be painted black and this was considered to be the most suitable basis to adopt until further evaluation proved otherwise.

However, none of the Air Corps schemes for ground camouflage was satisfactory for Naval use. A standard color scheme for a ground (sea) camouflage is not possible because the sea background varies so greatly with its state of agitation, the cloudiness of the sky, geographical location, attitude of the sun in relation to the point of observation, and the wind direction. Numerous observations of the sea were made under the above conditions. Three color samples were made up although none of these are known to exist. It was proposed that these colors be used to paint the upper surface of some aircraft using basically the same pattern as shown in the Air Corps directive.

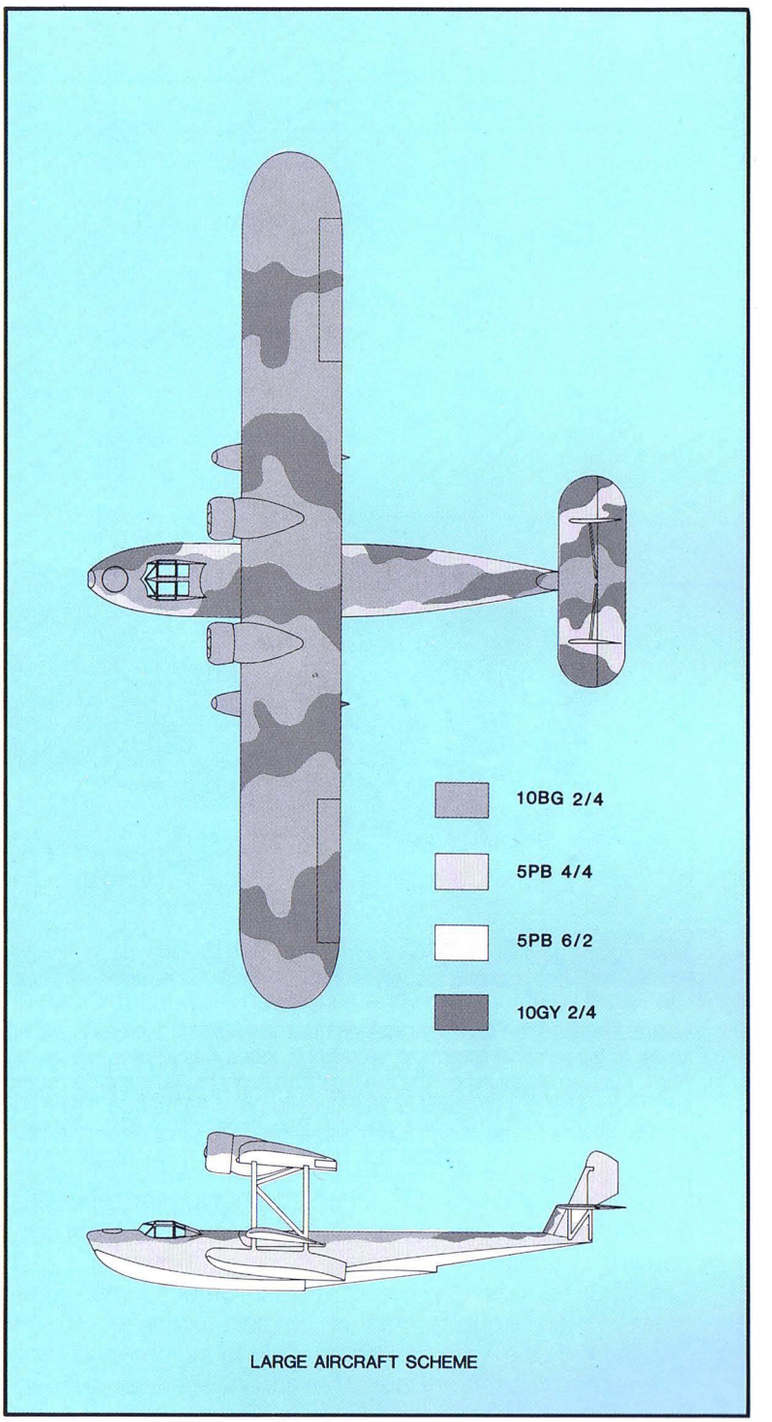
As a result of these experiments in the Fleet, the Bureau of Aeronautics on August 1, 1934, requested the Naval Research Laboratory to investigate the question of camouflage for Naval aircraft. Numerous tests and theoretical studies were conducted and on November 22, 1934, a *"Preliminary Report on Sky Camouflage of Naval Airplanes"* was submitted. Basically this report said that the color used was not as important as the correct brightness or reflectivity. The paint scheme arrived at using the rules developed in the study was to paint the upper surfaces a dark gray blue, the under and vertical surfaces a light gray blue. All paint was to be matte or nonspecular. Night camouflage was to be matte black overall. It was noted that while an aircraft might be painted so as to be invisible in the direct beam of a searchlight it would be detected by the shadow cast on any cloud cover.

On March 15, 1935, the Naval Research Laboratory issued *"Handbook of Instructions for Naval Airplane Camouflage."* These instructions were compiled based on the available literature, results of experiments conducted by Aircraft Squadrons, Fleet Air Base, Coco Solo, Canal Zone and the Naval Research Laboratory. Consequently, while they were

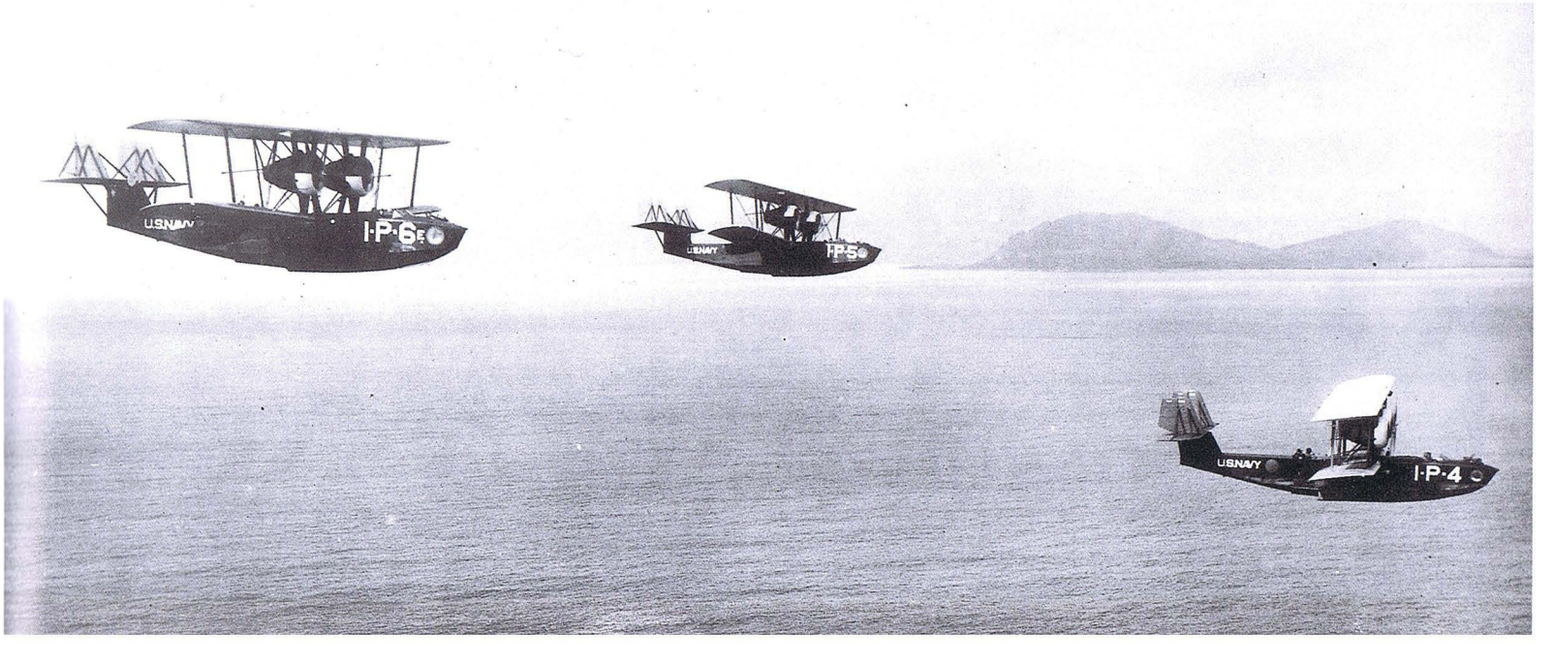
Right: There were numerous locally applied camouflage schemes tried during the later part of the 1920s and the 1930s. These PK-1 flying boats comprising the second section of VP-1B have dark blue hulls during a camouflage experiment in the Hawaiian Islands area circa 1932.



SMALL AIRCRAFT SCHEME



LARGE AIRCRAFT SCHEME



Above: This Boeing F4B-1 was assigned to the Assistant Secretary of the Navy for Air as his personal command aircraft. Mr. Ingles was a naval aviator in World War I. The flag displayed on the fuselage is that of the Assistant Secretary for Air and consists of a Blue anchor and four stars on a White field. There is no hoist or fly side to this design and it was applied the same on both sides.

Below: The Vought 02U-4 was convertible and could be operated either on wheels or floats. This number nine aircraft of VS-6S assigned to the heavy cruiser USS Salt Lake City was photographed ashore on January 29, 1930. The demarcation between aluminum-doped fabric and Naval Aircraft Gray enamel on the metal surfaces is clearly evident.

correct for the area in which the experiments were conducted, it was recognized that they might have to be modified for use in other areas.

Struts, wires and other gear too small to be seen at a distance were not required to be painted. However, any surface that could cause a glint of light or sparkle in sunlight was to be painted with a matte (lusterless) paint. *Note: the following Munsell numbers in parentheses are the current equivalent of the numbers specified in the directive.* Sea and sky camouflage for small aircraft was to be Munsell BGB 2/4 (10BG 2/4) for the upper surface of the upper wing, stabilizer and top of fuselage. The upper surface of the lower wing was to be BGB 2/4 (10BG 2/4) at the leading edge blending to PB 4/4 (5PB 4/4) at the trailing edge. The vertical tail surfaces were to be PB 4/4 (5PB 4/4), while the sides of the fuselage were to blend top to bottom from PB 4/4 (5PB 4/4) to PB 6/2 (5PB 6/2). If a sky-only camouflage was desired, the dark blue green BGB 2/4 (10BG 2/4) was to be omitted leaving these areas their normal colors.

Sea and sky camouflage for large biplanes was the same except that the sea camouflage used patches of dark yellow green Munsell GYG 2/4 (10GY 2/4) and dark blue green BGB 2/4 (10BG 2/4) instead of the solid BGB 2/4 (10BG 2/4). However, the upper surface of the lower wing remained BGB 2/4 (10BG 2/4). An irregular area of the vertical fin below the stabilizer on multi-tail airplanes was to be painted PB 6/4 (5PB 6/4).

Flying boats with the bottom and lower portion of the sides painted Navy Gray were determined to be correct enough for sky camouflage without any additional painting. Sea camouflage was to use the colors and patterns decribed above.

On May 6, 1935, the Bureau of Aeronautics directed that certain units (or components thereof) be camouflaged in accordance with the *"Handbook of Instructions for Naval Airplane Camouflage."* During the Fleet Exercise in the Pacific November 12-15 the effectiveness of the scheme was to be evaluated.

During these exercises one section of aircraft in each of eleven squadrons (VF,VS,VB,VT and VP classes) so camouflaged were flown in their respective squadrons during these operations and in the vicinity of San Diego prior to the exercise. The BGB 2/4 (10BG 2/4) sea camouflage was very effective against the sea and wooded land areas. However, in maneuvers where the top surfaces were viewed against the sky the camouflage increased the visibility of the aircraft. The sky camouflage PB 6/2 (5PB 6/2) and side color PB 4/4 (5PB 4/4) were considerably too dark for the San Diego area. The findings of the 1934 preliminary report were shown to be correct in that reflecting value, not color, was the most important consideration.

Additional tests were to be made utilizing BFC-2 aircraft at NAS San Diego where conditions could be standardized. VP type aircraft were not included due to the amount of work required to camouflage them and also because the results of the earlier tests were not significantly different from those of the smaller aircraft to warrant the effort. Gray and purple blue with a reflecting value of eight, instead of four and six, were used on the side and bottom. Mottling and dazzling were tried in an attempt to break up the outline. The dark blue-green sea camouflage was left off the top surfaces.

Tests were conducted on a bright clear day at altitudes from 1,000 feet (304.80 m) to 10,000 feet (3048.00 m). On June 4, 1936, Commander Aircraft, Battle Force reported, "It was clearly demonstrated that the reflecting power of the surfaces was the principle element in camouflage. The different camouflage colors of blue, green and gray, also the yellow tops of upper wings and the red tails of the standard airplanes, did not show up as such at altitudes above 3,000-4,000 feet [914.40-1219.20 m]. The red tails showed up to dark however, due to their reflecting power, about number 5.

"The principal element of betrayal of the airplanes appeared to be the different reflecting power of different parts of the airplane at different angles and in different positions, even though painted the same color, such as in the shadows on the side of the fuselage under the upper wing. It appears impossible to camouflage for all of the probable angles and positions involved.

"The effect of dazzling the dark green upper surfaces of plane number 2 was negligible."

It was decided to conduct yet another test, still utilizing the BFC-2 airplanes of VF-2B. In this test the bottom and side gray and purple blue was made slightly darker to a reflecting value of seven. A light border (approximately GYG 6/6 [10GY 6/6] was painted around the upper wing surface which retained the standard BGB 2/4 (10BG 2/4). An attempt was made to compensate for the shadow of the

upper wing on the fuselage using triangular gray areas on the fuselage. Four airplanes were flown at the same time as a control. These were two standard aluminum varnished BFC-2s and two standard gray enamel F4B-4s with white tails. The value of the aluminum varnish, gray enamel and the yellow top wing finishes on these airplanes was seven, the same as the general camouflage value in the test.

Commander Aircraft, Battle Force in the same letter reported this test and stated. "All the airplanes had about the same camouflage efficiency especially above 5,000 feet [1524 m], except for the reflection of the sun from the aluminum sides of the standard BFC-2s and the F4B-4 white tails at certain angles.

"Plane number 3, with the lighter yellow green border, was superior to the original BGB 2/4 [10BG 2/4] surfaces in sea camouflage especially at altitudes above 4,000 feet [1219.20 m]. It is noted, however, that observations were not made over deep water."

The final conclusions from these three Fleet experiments, as reported by Commander Aircraft, Battle Force were: "The present gray or aluminum finishes are as good as any other for camouflage purposes with the following exceptions:

1. The top surface must have a dark blue green finish, possibly with a lighter border, if sea camouflage is necessary. If sea camouflage is not necessary it should be omitted as it interferes with good sky camouflage.
2. Aluminum has high reflecting power at certain angles. If a nonreflecting aluminum varnish, enamel or lacquer can be developed this color of finish should be retained, but since this does not appear feasible, it may be necessary to revert to a gray finish for maximum camouflage preparedness for war.
3. Any particular light or dark tail or squadron markings such as white and black must be eliminated; and preferably all such coloring should be reduced to a minimum."

The results of these tests were evaluated at the Bureau of Aeronautics and on August 14, 1936, the Chief of Bureau of Aeronautics by Third Endorsement to Commander Aircraft, Battle Force letter reported to Chief of Naval Operations that: "The results of the tests set forth in this report show that special daytime camouflage of Naval aircraft is of questionable value, in view of the widely varying conditions of visibility. However, some future research into an aluminum or gray paint or dope of lower reflective value, as suggested in paragraph 10(b) of the basic letter, may prove valuable for use in wartime operations.

"No further action with respect to airplane color camouflage is deemed necessary or advisable at this time."

These recommendations were approved by Chief of Naval Operations on August 19, 1936.

Bureau of Aeronautics Specification SR-15b dated August 15, 1936, specified that all interior surfaces, unless otherwise directed, were to be finished in aluminum color. Wheel-type landing gear or floats on training aircraft, which had been gray now were to be finished aluminum.

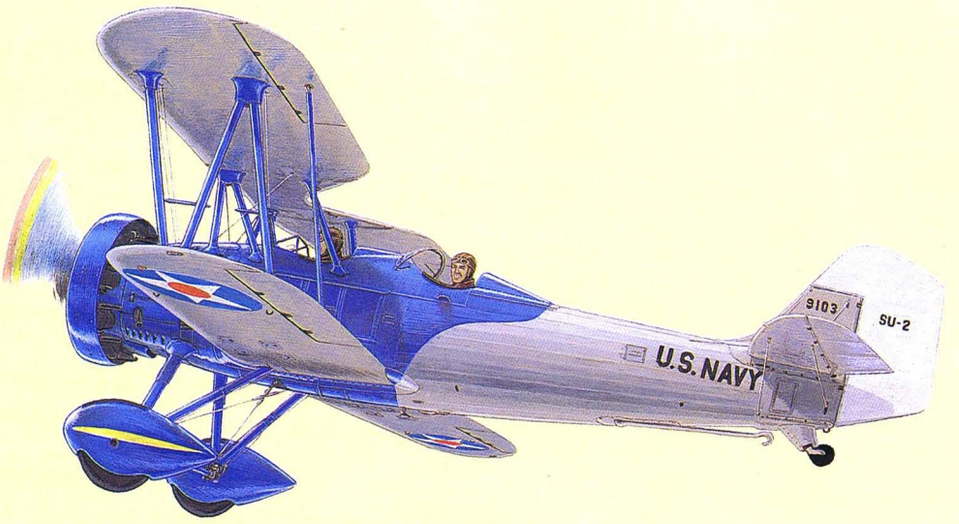
Unless otherwise specified, the bottoms of amphibians, flying boats and floats were to be finished with Black asphalt-base bituminous paint up to and approximately 6 inches (15.24 cm) above the normal load waterline.

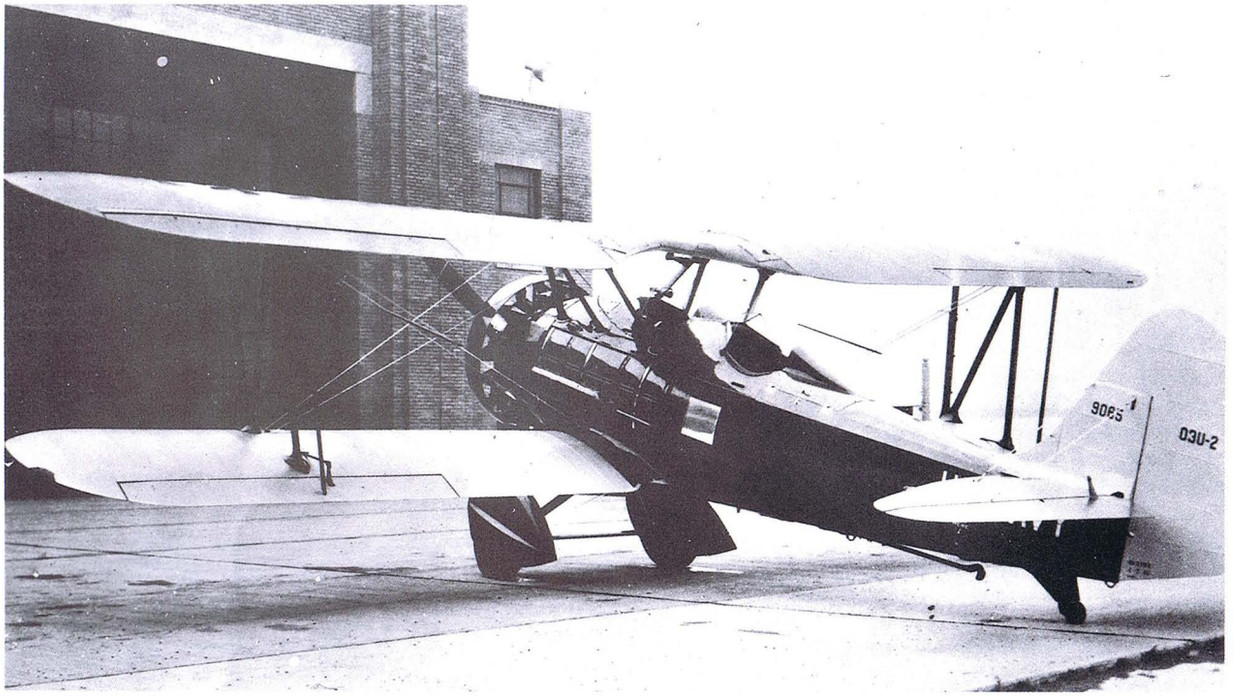
All struts, other than open end struts, on seaplanes were to be dipped after final painting in hot rust preventative compound to a depth of at least 1 inch (2.54 cm) above the top bolt. In cases where the fitting is integral with the strut, this dip was to be 3 inches (7.62 cm). Upon assembly of struts to their attachment fittings, the connection was to be coated with rust preventative. When fairings covered a strut fitting, the entire portion of the strut under the fairing was to be coated with rust preventative. This treatment shows in photographs as though the strut ends were painted black.

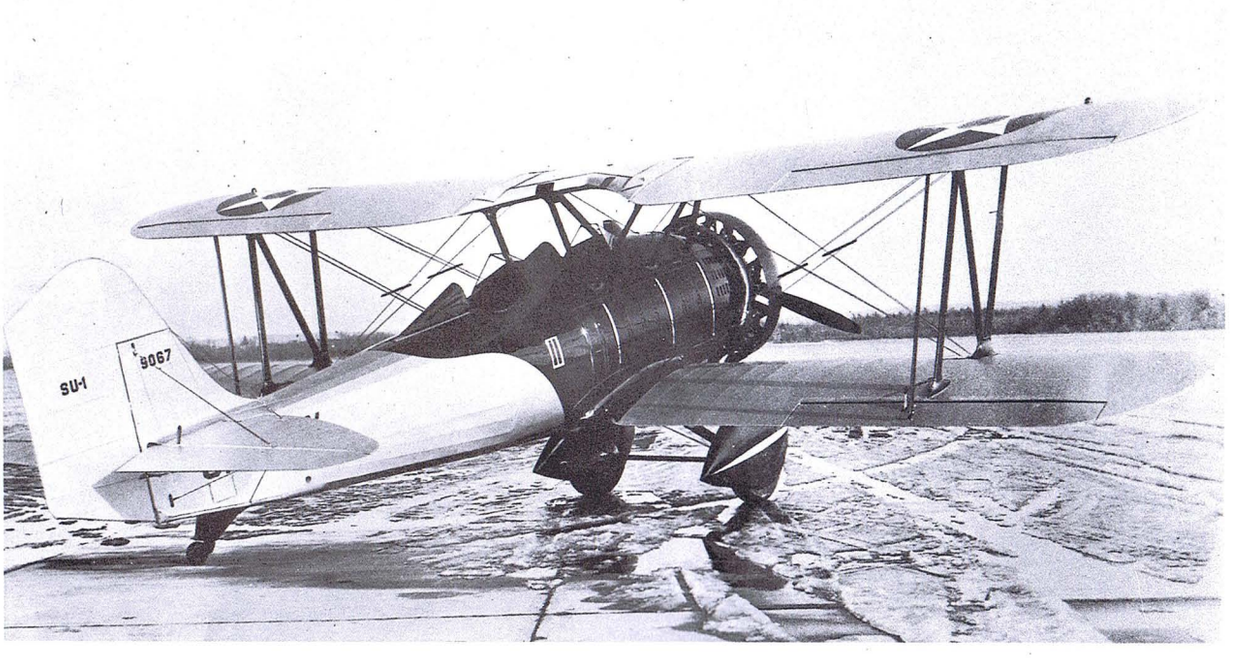
Late in 1935 a project was initiated by the Naval Research Laboratory to determine the feasibility of camouflaging an airplane by use of artificial illumination. It was reasoned that if the illumination could be adjusted so that all areas would have the same brilliance as the sky background, the airplane would vanish from sight. While the theory was good, the practical application had too many variables to be practical with the technology available. Tests were conducted at Naval Air Station Anacostia with the XFF-1. Twelve 400 watt tungsten lamps spaced about 2 feet (60.96 cm) apart were mounted on the under surface of the fuselage aimed at the observer rather than the airplane. It was reasoned that this

Continued on p. 39

Above: A Boeing F4B-2 is shown assigned to the Commanding Officer of Fighting Squadron Six (VF-6B). The full cowl and section leader fuselage band are Insignia Red. Note the variation between the gray metal and aluminum fabric. **Below:** This shows another Boeing F4B-2 of VF-6B assigned to the number two position in the squadron formation during the same time period as the above photo. This vividly portrays the deceptive color rendition of some early photographs.


U.S. NAVY
9103
SU-2


9065
03U-2


SU-1
9067

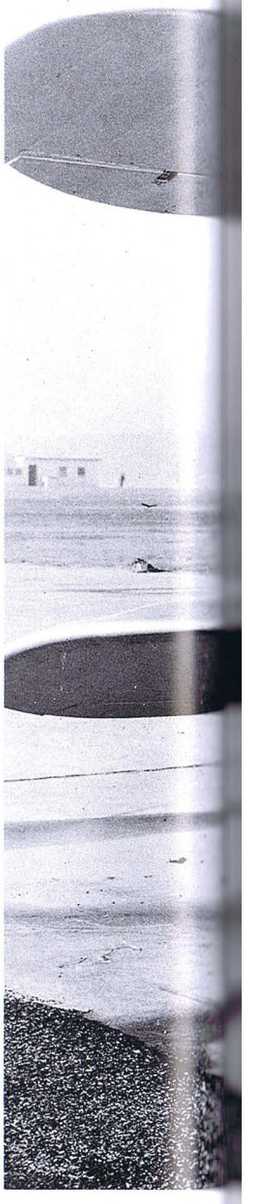
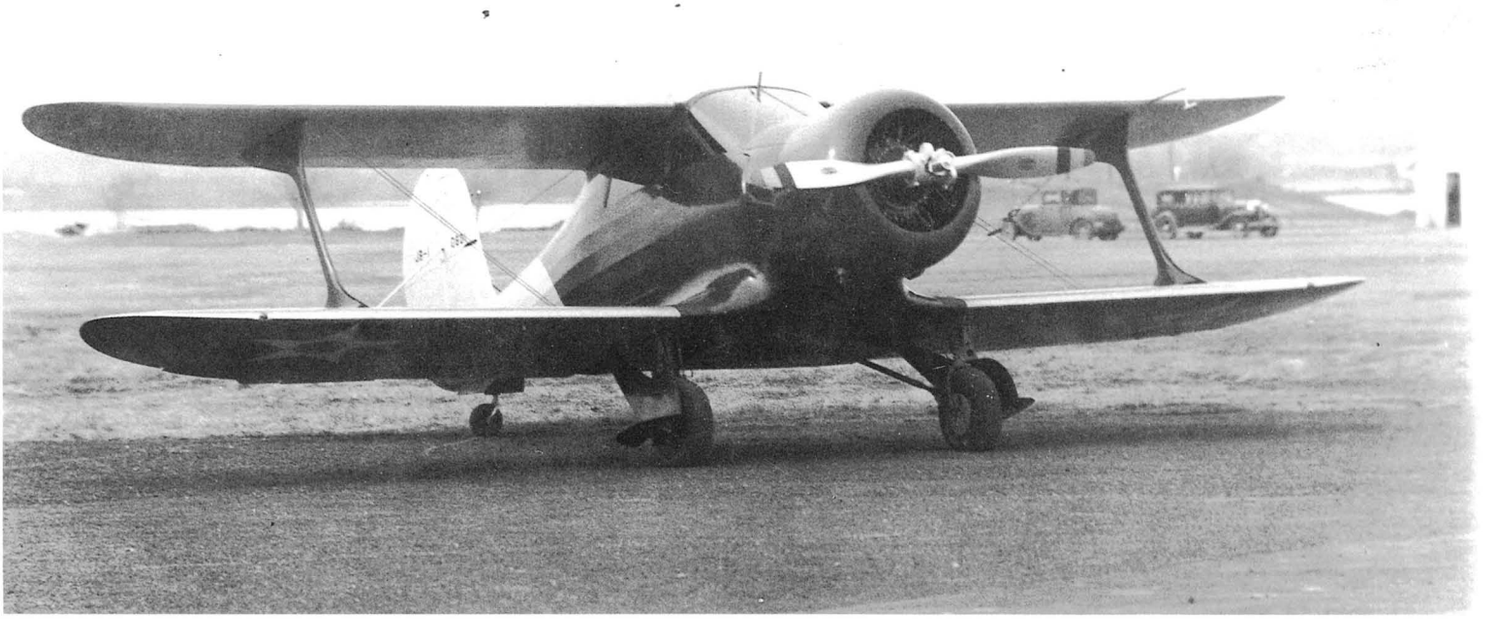


Illustration opposite left: A Vought SU-2 in the special paint scheme for an aircraft assigned to the Assistant Chief of the Bureau of Aeronautics or the Commanding Officer of an aircraft carrier, tender or fleet air base with the rank of Captain or Commander. **Photo opposite middle:** The solid Admiral Blue fuselage denotes an Admiral's aircraft. The panel under the cockpit would hold a placard denoting his rank when the Admiral is aboard. **Opposite lower:** The half aluminum and half Admiral Blue fuselage denotes a senior staff officer's aircraft. **Below:** The same aircraft is seen from the front. Note the Aluminum stripe applied to the wheel pants and the high gloss finish of these staff aircraft. **Right:** The blue staff aircraft of Rear Admiral John Halligan, Commander Aircraft, Battle Force over NAS San Diego, California. The fact that the Admiral is in the rear seat is shown by his two star flag under the cockpit.


A-8845
F8C-7
CURTISS



would require much less illumination than if the aircraft had to be illuminated to the same brilliance. On October 1, 1936, three flights were made during the middle of the day at approximately 5,000 feet (1524 m). The airplane was flown about 6 miles (9.6558 km) from the Air Station in a direction roughly away from the sun alternately turning the lights on and off for thirty second intervals. When viewed with the unaided eye at distances up to 2 miles (3.2186 km), the lights seemed to illuminate about one quarter of the visible fuselage under surface to somewhere near the brightness of the sky background. At distances of 3 to 6 miles (4.8279 to 9.6558 km) neither the light nor any effect of their illumination was apparent. The airplane always appeared as a dark speck against the sky background.

A meeting was held on April 5, 1937, at which time it was "recommended that no further research be conducted at this time in connection with the reduction of daytime visibility of aircraft in flight by the method proposed by Mr. Bittinger" (artificial illumination). The Naval Research Laboratory continued to investigate the problems without success and on September 14, 1937, was advised by the Bureau of Aeronautics that it had no intention of conducting the project any further.

The normal procedure in applying the Orange Yellow to the upper surface of the wing and ailerons had been for the line of demarcation to extend along the leading edge of the wing. Wind tunnel tests showed that any roughness on the leading edge could cause large increases in drag and loss in lift. Technical Order No. 50-38, dated August 23, 1938, directed that the yellow was to extend around the leading edge and aft to a point on the undersurface of the wing approximately 5 percent of the chord from the leading edge. Even at that point the juncture of the two finishes was to be as smooth as possible. An exception was made in the case of the PBY as a structural joint extended along the leading edge and they were to be equipped with deicer boots in the near future.

Cockpit enclosures were to be finished with a semigloss Bronze-Green or similar approved color. Other personnel spaces were, in general, to be finished in semigloss light or pastel greens. Cargo spaces could be finished with Aluminized Zinc Chromate, or similar to other interior spaces. Structural spaces could also be finished with Aluminized Zinc Chromate.

After years of evaluating numerous paint schemes the Bureau of Aeronautics on December 14, 1939, finally issued camouflage instructions under the heading *"Tentative Requirements for Application of Camouflage to Fleet Aircraft."*

At its best, camouflage is a compromise. Its finer development is subject to change to suit a large variety of conditions, the most frequent of which are the differences in lighting between morning and afternoon or between clear and cloudy skies. Thus, it is a practical impossibility to always provide camouflage in its ultimate refinement.

Reports and correspondence dealing with camouflage and gunnery exercises invariably refer to reflections as being the primary source of aircraft betrayal. Turns or other maneuvers while approaching a target bring out certain stray reflections which would not have been observed had straight courses been maintained.

All external surfaces of the airplane were to be covered with paint or other material producing the lowest possible specular reflection. Particular attention was to be given to propellers and such minor items as antenna wires, antenna insulators, handgrips, lighting fixtures, etc.

For day sky camouflage all bottom and vertical surfaces were to be finished with nonspecular Aluminum. For day sea or ground camouflage all top surfaces were to be finished in nonspecular Dark Green. Other matte dark colors of blue, gray or black could be employed if green were not available immediately. The fuselage dividing line between sky and sea camouflage was to be parallel to the longerons and extending aft from the trailing edge of the lower wing. If sky camouflage were of prime importance this line could be raised to coincide with the leading edge of the stabilizer. In the event more light finish was required on the sides of the fuselage the line could be raised further but should not exceed that point which would permit less than the top quarter of the fuselage being dark in color.

Opposite top: The Boeing F4B-2 was replaced with this Curtiss XF8C-7 as the personal aircraft of the Assistant Secretary for Air. The Curtiss Navy Helldiver logo was nonregulation as were the fuselage stripes. The aircraft is shown at NAS Anacostia, Washington, DC on November 5, 1930. **Left:** One of the last aircraft types to be painted in the special staff and command markings was this Beechcraft JB-1 used by senior staff officers below flag rank between 1937 and 1939. **Top this page:** The last aircraft painted for the Assistant Secretary of the Navy for Air was this Lockheed XRO-1 "Altair" which replaced the Curtiss XO2C-2 (XF8C-7).

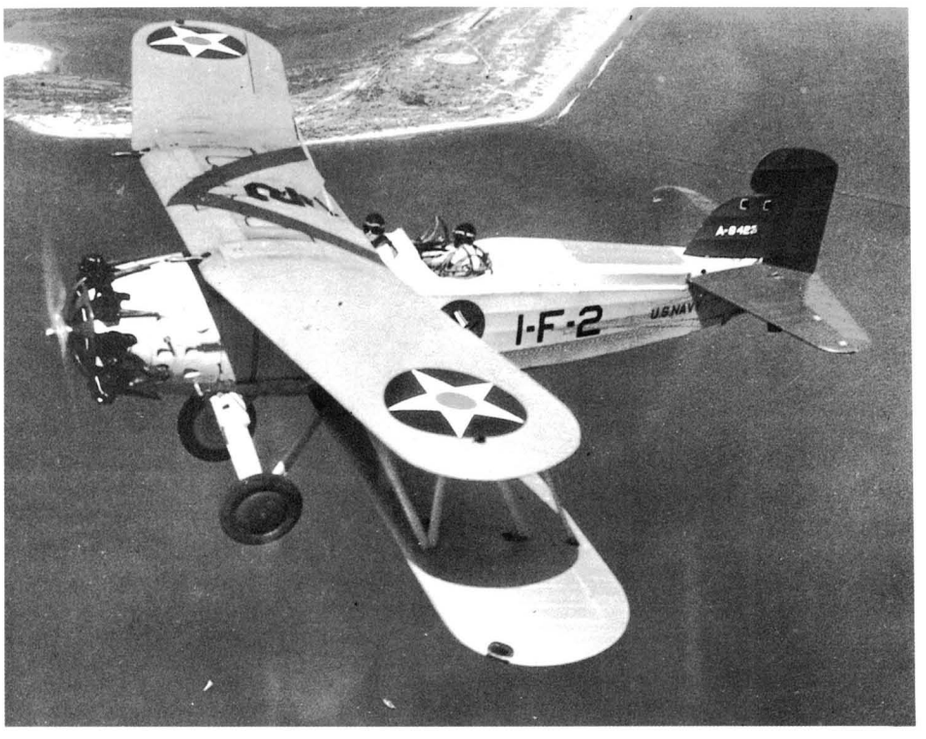
The current insignia and marking identification as required for rendezvous and close range identification purposes were to be retained but nonspecular paint was to be used.

These instructions could be modified to reduce the visibility under certain local conditions of sky and sea by individual commands through modification of the sky and sea colors as were determined more effective to serve their purpose.

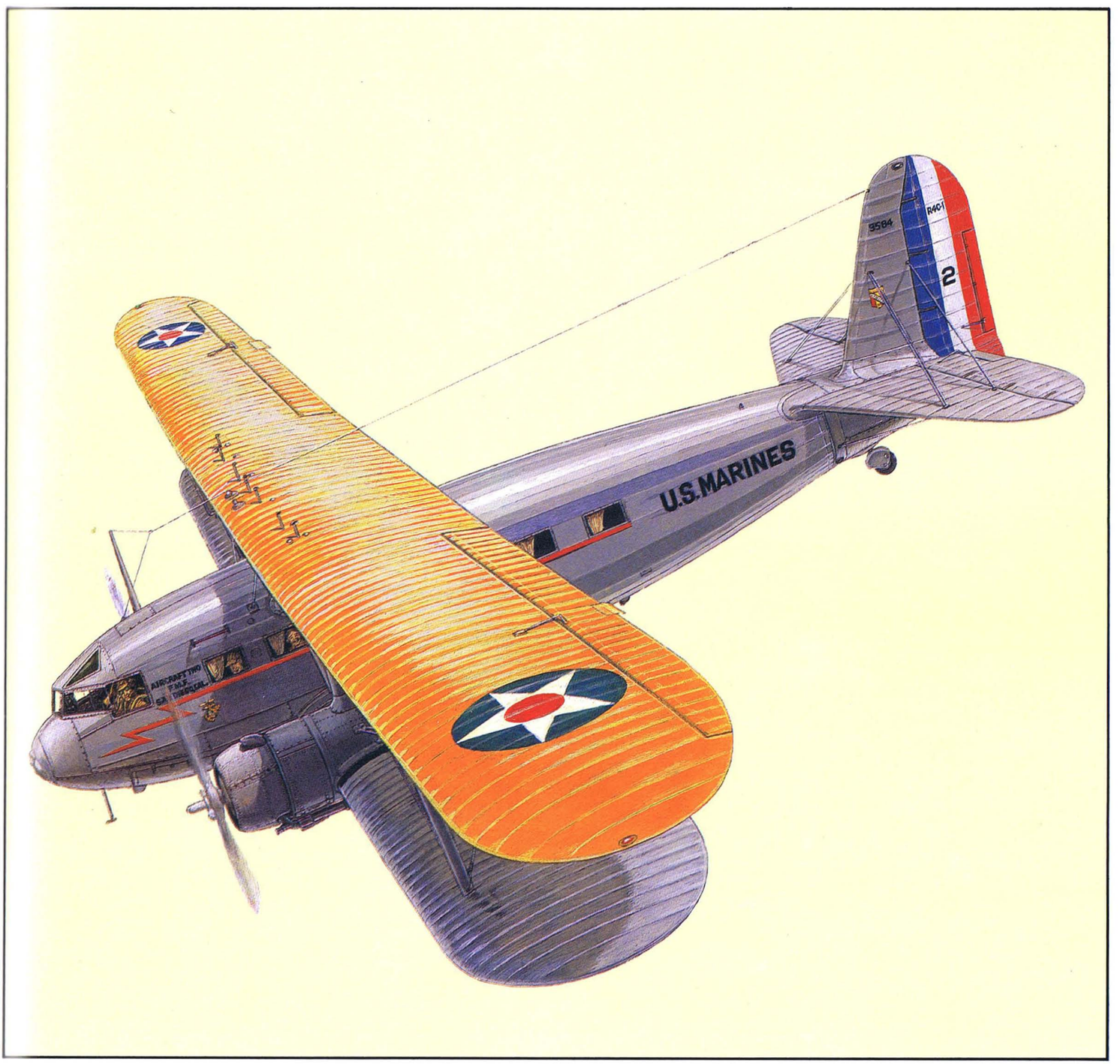
For missions requiring night operations, it directed that the underpart of the aircraft was to be finished in a solid nonspecular black finish.

The current trends indicated a preference for solid colors over the more generally regarded camouflage patterns of leopard spots, jig saw patterns, odd lines and odd angles for purposes of added confusion. Some advantage may be served by spotting top surfaces when viewed against similarly spotted terrain, but the particular condition under which suitable matching of the two may be effected is rare, especially in a sea camouflage environment. Confusing or zigzag lines have no deception to a mechanical tracking device and have been known to have facilitated observation by means of coincidence range finders when used against ships. Such markings may have some value in creating an ocular deception under certain conditions. Dividing lines between colors should be diffused and any degree of sharpness be avoided. Stocks of semipermanent materials to meet these requirements, having an anticipated durability of approximately one year, were to be made available at principal overhaul bases. Less durable materials were also to be provided. It was anticipated that these materials would be of the cold water type.

It was stressed that in the application of these matte materials a relatively smooth surface was essential where high performance aircraft were concerned. Care was to be used to carry a smooth finish over the leading edges. It was preferred that the top color be continued over the leading edge as was the current Orange Yellow color, unless such continuation created undesirable effects.



Left: This two-seat Curtiss F8C-4 "Hell Diver" is an example of how colorful US naval aircraft were with their aluminum-doped fabric, Light Gray metal surfaces and Chrome Yellow upper surface of the top wing. Chevron, on top wing, engine face plate and wheel disc are Insignia Red indicating the first section. The Insignia Red tail surfaces show the squadron is attached to the USS Saratoga. **Right Illustration:** Curtiss R4C-1 "Condor" assigned to Marine Utility Squadron Two (VJ-2M) at Naval Air Station San Diego, California.


U.S.MARINES
3584
R4C1
2


SOC-1
9877
U.S.NAVY
CRUISERS
SCOUTING FORCE

In a letter to the Commander in Chief, US Fleet dated December 19, 1939, the Chief of the Bureau of Aeronautics stated that the Bureau was not satisfied that Dark Green or other dark color was the most effective under average conditions. Additional tests were to be conducted to investigate other shades such as Light Sky Blue, Sea Blue, Sea Gray, Steel Gray and others to determine if some of these colors were in general more suitable. It was recognized that the camouflage of aircraft was not an exact science but rather a compromise of many variables.

The Chief of the Bureau of Aeronautics on the same day also wrote to the Manager, Naval Aircraft Factory requesting that such tests be conducted with three aircraft flying along the New Jersey coast. Each airplane was to be painted in a different scheme so that two aircraft could always be evaluated against each other by the third. The primary area of investigation was to be day sea camouflage against a water background to evaluate the concealment of landplanes and seaplanes on the water close to shore. Concealment from attack from above and concealment against the sky when making an offensive approach were also to be investigated.

One aircraft was to be painted in accordance with *"Tentative Requirements for Camouflage of Naval Aircraft"* for control purposes. Additional sea camouflage colors to be tested were Sky Blue, a Sea Gray somewhat lighter in shade than Navy Gray, a Sea Gray somewhat darker than Aircraft Gray, at least two shades of Steel Gray made by varying the mixture of aluminum and lamp black and a Medium Blue for which True Blue could be used. Some comparisons from above were to be made with the subject aircraft having each side of the top surfaces finished in a different color. Both sharp and subdued-color dividing lines were also to be studied. Due to the war in Europe this project was given the highest priority and was to be completed by April 1, 1940.

Left: This Curtiss SOC-1, Serial No. 9877, was the staff aircraft for Commander Cruisers, Scouting Force. A nonaviation billet that was assigned a personal aircraft. Fuselage, landing gear and wing struts were in Admiral Blue. Upper surface of top wing was in Chrome Yellow while the remaining surfaces were aluminum.

SECTION 2

NATIONAL AIRCRAFT INSIGNIA

CHAPTER 4 1911–1919

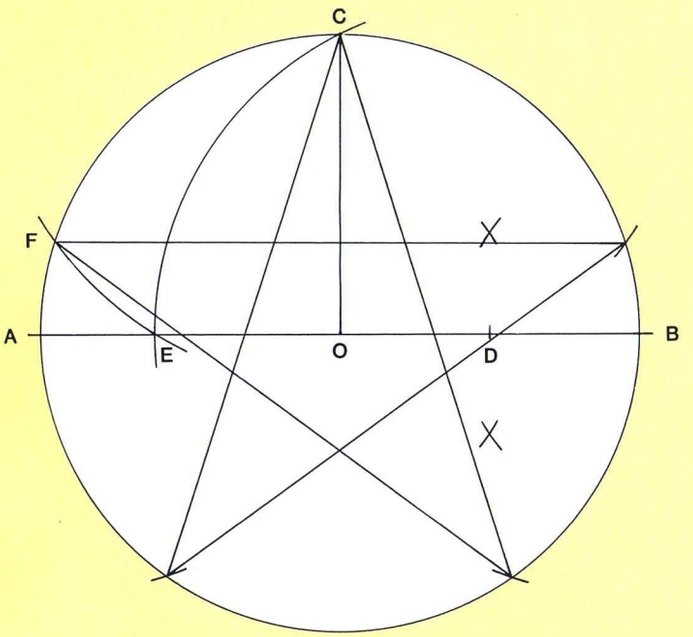
Perhaps the most familiar and noticeable of all markings on US Navy and Marine Corps aircraft is the national aircraft insignia. Because this insignia is so prominently displayed, any deviation from the standard size and location is quickly apparent.

A five point star can be plotted geometrically with just a compass in the following manner. Draw the circle in which the star is to be inscribed. Within this circle draw a diameter AB and a radius OC perpendicular to it. Bisect OB to locate point D. With point D as center and radius DC, draw arc CE. With C as center and radius CE, draw arc EF. Step off the distance CF around the circle. A perfect five point star is constructed by connecting every other point.

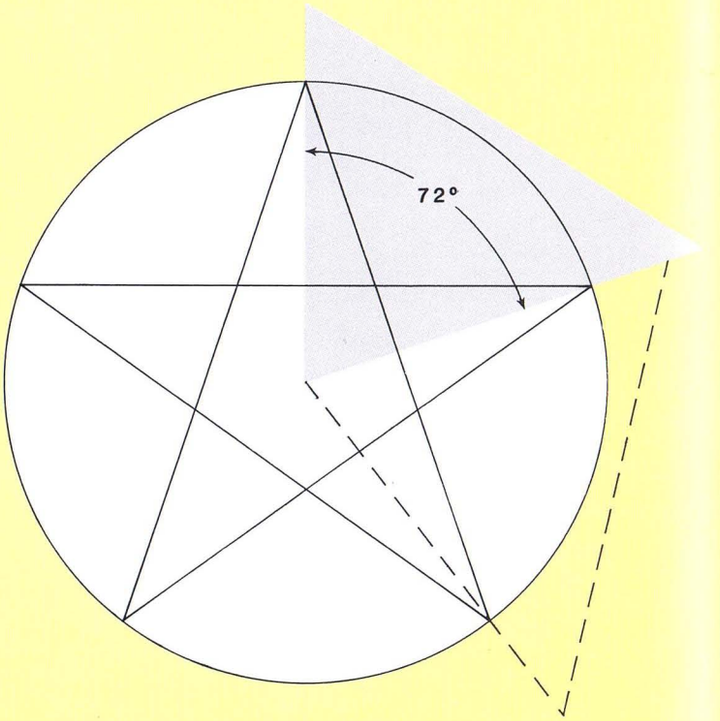
During World War II the Service Squadron at MCAS, Mojave, California, devised a method by which the star in the national aircraft insignia could be plotted in any size quickly and accurately. This applies to just the star so it can be used regardless of the rest of the insignia design. Cut out an equilateral triangular template with an apex angle of 72 degrees. Place the apex of this triangle at the center of the circle in which the star is to be drawn with one of the equilateral sides of the template intersecting the circle where the top point of the star is to be located. The point of intersection between the other side of the template and the circle is the next point of the star. By rotating the template and using the point just plotted the third point is located on the circle. After all five points are located in this manner the star is drawn in the conventional manner.

Right: The restored Curtiss N-9 of the NASM on loan to the Navy Aviation Museum, Pensacola, Florida. The photograph shows the aircraft at the Naval Aircraft Factory, Philadelphia just after the restoration was completed.

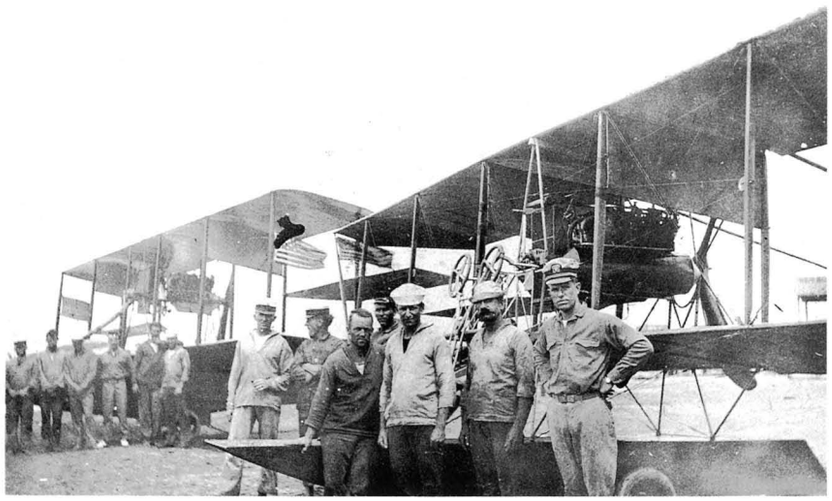
PLOTTING THE STAR



COMPASS METHOD



TEMPLATE METHOD



Right: All of the Aviation Section was sent to Mexico in 1914. This shows the half that operated at Vera Cruz flying reconnaissance missions for the fleet and US Army. This is the first use of a national insignia on a Navy aircraft in a combat situation.

The first known directive regarding a national insignia for use on Naval aircraft was Navy Department General Order No. 299, dated May 19, 1917. The directive stated in part "... This insignia is a five-pointed white star inside a blue circumscribed field, with the center of the star red. The diameter of the circumscribed circle will be equal to the chord of the wing on which the insignia is placed. The diameter of the inner circle will not extend to the inner points of the star by an amount equal to one twenty-fourth of the diameter of the circumscribed circle. The inner circle will be painted red, that portion of the star not covered by the inner circle will be painted white, and that portion of the circumscribed circle not covered by either inner circle or star will be painted blue. The shades of red, white, and blue will be the same as those used in the American flag.

"One of each of these insignia will be placed on the upper surface of each upper wing in such a position that the circumference of the circumscribed circle just misses contact with the wing flap [aileron]. One of each of these insignia will be placed in a corresponding position on the lower surface of each lower wing.

"Both sides of that portion of the rudder which is in rear of the rudder post will be painted with three equally wide bands parallel to the vertical axis of the airplane and colored red, white, and blue of the same shades as mentioned hereinbefore, the blue band being nearest the rudder post, the white band in the center and the red band at the tail of the rudder." This design also was adopted by the US Air Service.

Colonel William "Billy" S. Mitchell who had been named by General Pershing to command the AEF's Air Service, Zone of the Advance in France objected to this design. During combat the rapid and accurate identification of an aircraft as friend or foe is vital. It should be remembered that it was strictly a visual identification problem in World War I. Colonel Mitchell recommended that the US aircraft be identified by the use of three concentric circles, similar to the national insignia in use on British and French aircraft, but with a different sequence of colors. This would standardize the basic design on all allied aircraft as a three color cockade.

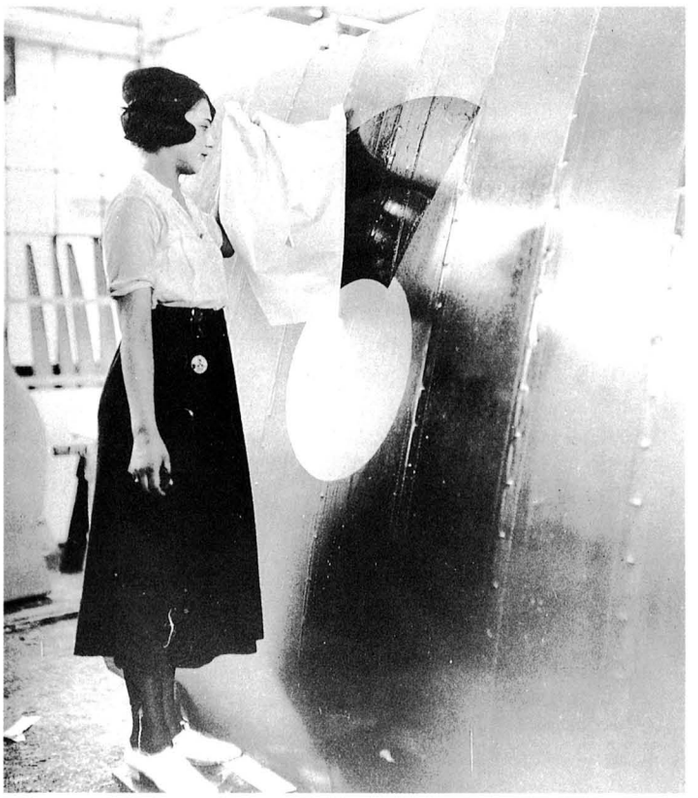
The star insignia was replaced on all Naval aircraft by red, white, and blue cockades with the issuance of Navy Department General Order No. 364, dated February 8, 1918. This insignia was to be a red circle, circumscribed about an inner blue circle and center white circle. The diameter of the red circle was to be 5 feet (152.40 cm) for all airplanes having a chord length of 5 feet (152.40 cm) or greater. In cases of chord length less than 5 feet (152.40 cm) the red circle was to be equal to the chord length. The diameter of the blue circle was to be two thirds of the diameter of the red circle while the white circle was to be one third the diameter of the red circle. These colors were to be the same as those used in the American flag. The positioning of these cockades remained the same as that previously used for the superceded insignia.

Both sides of that portion of the rudder which is to the rear of the rudder post was painted with three equally wide bands parallel to the vertical axis of the airplane and colored red, white, and blue of the same shades as mentioned above. However, the colors were now reversed with the *red* band being nearest the rudder post, the white band in the center and the blue band at the tail of the rudder. No Naval aircraft were to operate in Europe with the star insignia, but the requirement was not as strict in the United States to make this change and some aircraft were never converted.

It is not known just when decalcomania insignia were first used on Naval aircraft. However, their use was prevalent enough by various manufacturers to prompt the Bureau of Construction and Repair on July 26, 1918, to request an all stations report on their serviceability. This method was lighter and quicker to apply than the painted versions.

Aeronautical Specification No. 49, *Aircraft Insignia and Marking* dated November 30, 1918, for the first time spelled out the application of the national aircraft insignia being applied to lighter-than-air craft. Dirigibles were to have two 5 foot (152.40 cm) diameter insignia placed on the outer covering, one on top and one on the bottom with the center of the insignia on the fore and aft center line of the dirigible. The top insignia was to be at the point of greatest diameter while the lower insignia was to be just forward of the suspension band. The rudders were to be marked the same as on aircraft except the stripes were not to be longer than 5 feet (152.40 cm) in length or 18 inches (45.72 cm) in width. If there were more than one rudder only the outboard side of each was to be so marked. Free balloons also were to have two 5 foot (152.40 cm) diameter insignia. These were to be located at each end of a line inclined 45° to the vertical axis of the balloon. Captive balloons were to be marked with two 5 foot (152.40 cm) diameter insignia, one on top and one on the

Below: Some aircraft markings were applied with decalcomania during World War I. The large size of those applied to flying boats required them to be applied in sections as shown.



bottom of the envelope, located on the fore and aft center line at the point of greatest diameter.

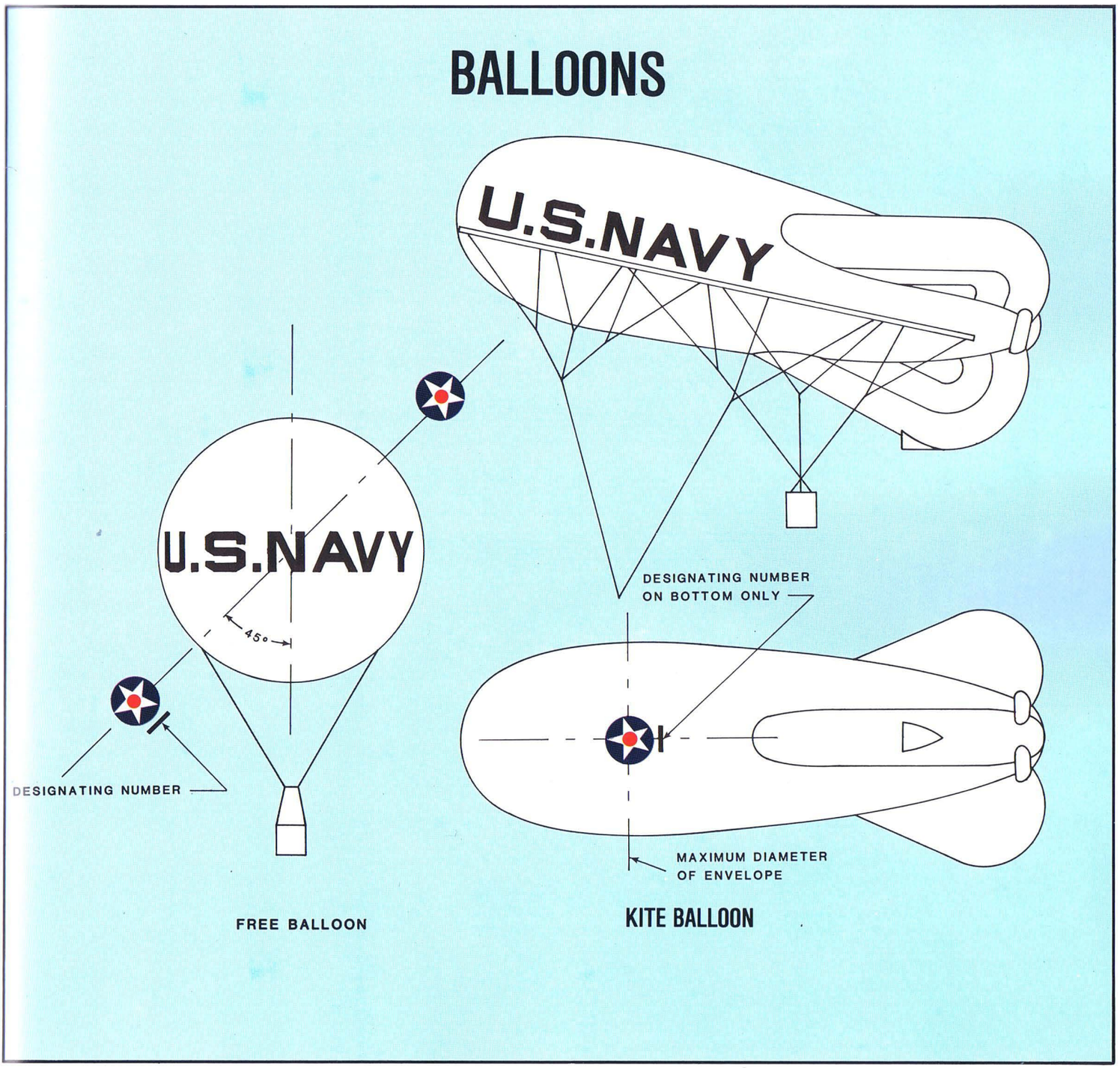
After the Armistice, the general feeling in this country was not to be involved in the affairs of other countries. Perhaps this was a major factor in the decision to revert to the star insignia. On April 11, 1919, the Secretary of the Navy proposed to the Secretary of the Army that the national aircraft insignia revert to the circle in a star within a circle design originally adopted. It was felt that the star insignia was much more distinctive and reports had indicated it was better for distinguishing at a distance than the concentric circles. It was proposed that all new aircraft and lighter-than-air craft delivered after the date such an order was issued should have the star design. Those already in service with the three circle insignia or in the case of lighter-than-air, on fabric panels, would continue to carry the old design until the fabric was repainted or replaced. In no case was the star design to be placed on any aircraft in European waters until after peace was declared. Such a proposal would result in the two insignia being in use simultaneously for an extended period. War Department Order 20 dated May 17, 1919, made this proposal official for the Air Service. Navy Department General Order No. 498, dated August 19, 1919, directed that the national aircraft insignia, on all Naval aircraft, revert to the circle within a star, within a circle as originally specified in General Order No. 299. The placement of this insignia remained the same as in the previous directive. The red, white, and blue rudder stripes once again had the blue stripe nearest the rudder post, the white stripe in the center and the red stripe at the tail of the rudder. No mention was made directly about lighter-than-air craft. It was the intent that the design be changed but the placement would remain the same as before as in the case of aircraft.

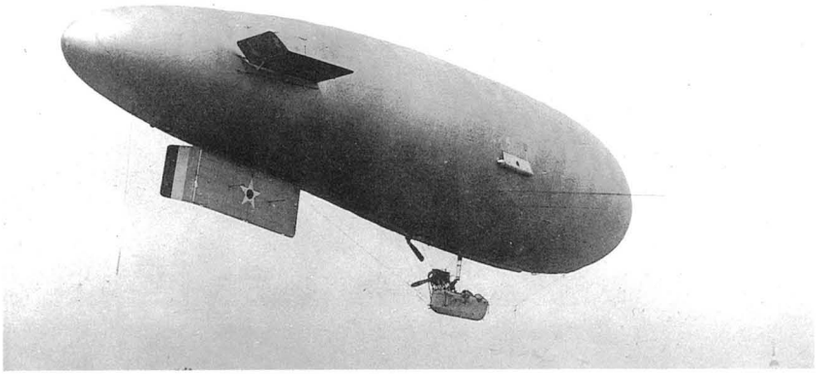
The Bureau of Construction and Repair issued Aeronautical Specification No. 49, dated December 1919, which amplified the instructions on the size and positioning of the insignia. The diameter was specified to be 5 feet (152.40 cm) for all aircraft, except on aircraft horizontal surfaces that were less than 5 feet (152.40 cm), in which case it was to be equal to the chord length. On horizontal surfaces one of the star points was to point directly forward and on vertical surfaces one of the star points was to point directly upward. One of these insignia was to be placed at each end of the upper surface of the top wing and the lower surface of the lower wing located at each wing tip in such a position that the circumscribed circle just missed the aileron.

Both sides of that portion of the rudder, aft of the rudder post, was to be painted with three equal width stripes parallel to the vertical axis of the aircraft and colored red, white, and blue. The blue band was to be at the rudder post, the white band in the center, and the red band at the trailing edge of the rudder. These stripes also were to be applied to the rudders and elevators of dirigibles in the same size and location as before. While this instruction does not specifically state that the stripes were to be applied to both sides of the elevators, the drawings show this was intended.

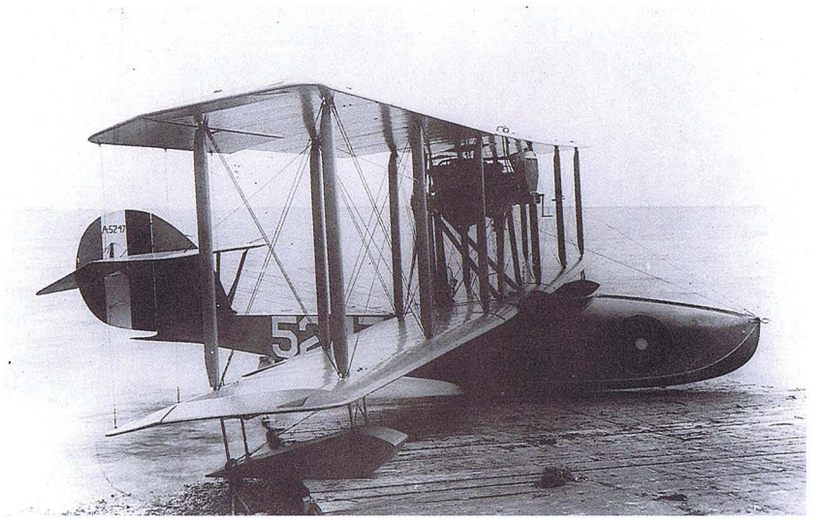
The lower national aircraft insignia on a dirigible was now to be located with its center 3 feet (91.44 cm) back of a point midway between the front of the car and the tip of the bow of the envelope.

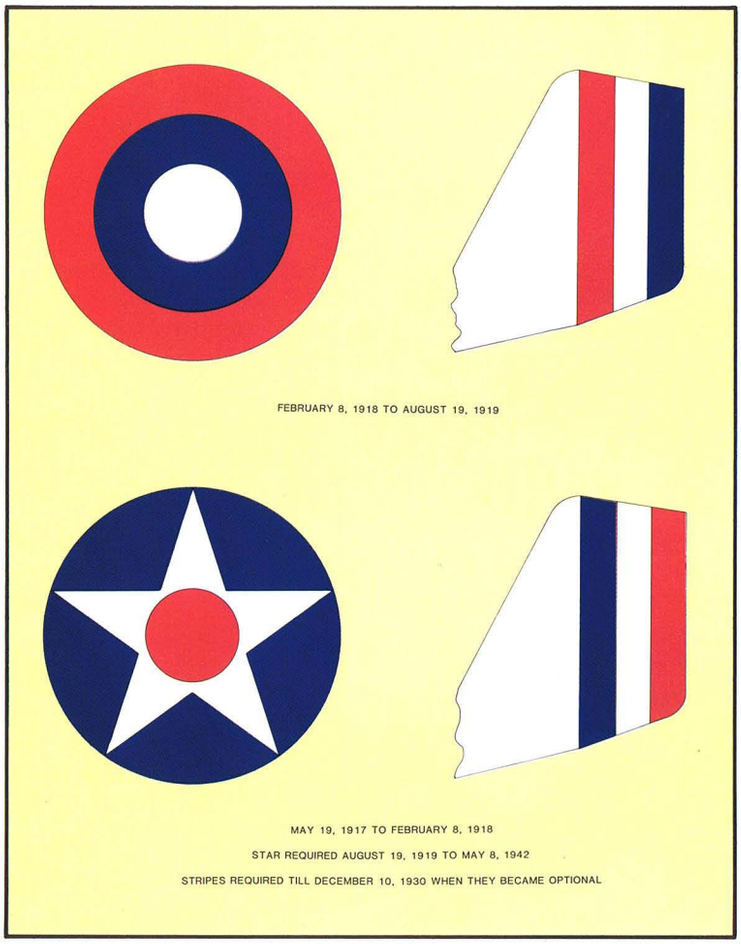
BALLOONS


U.S.NAVY
U.S.NAVY
45°
DESIGNATING NUMBER
DESIGNATING NUMBER
ON BOTTOM ONLY
MAXIMUM DIAMETER
OF ENVELOPE
FREE BALLOON
KITE BALLOON

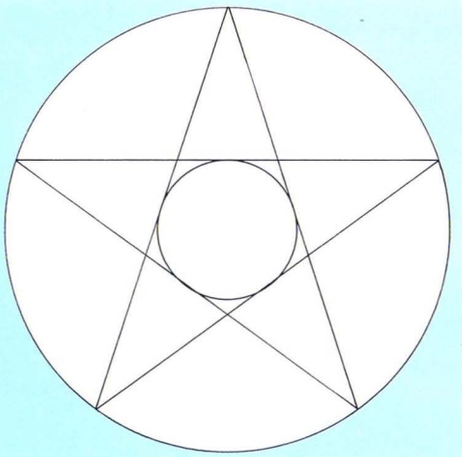



2361
2363
2382





Opposite top: An unidentified nonrigid airship is shown in June 1917 with unusual style and location of the national aircraft insignia. **Left:** A Curtiss N-9 World War I training aircraft shows both the star and roundel style marking being used at the same time. Note reversal of the colors in the rudder stripes. **Top this page:** An Alexandria flying boat. This is an unusual location on the hull for the national aircraft insignia at this time.



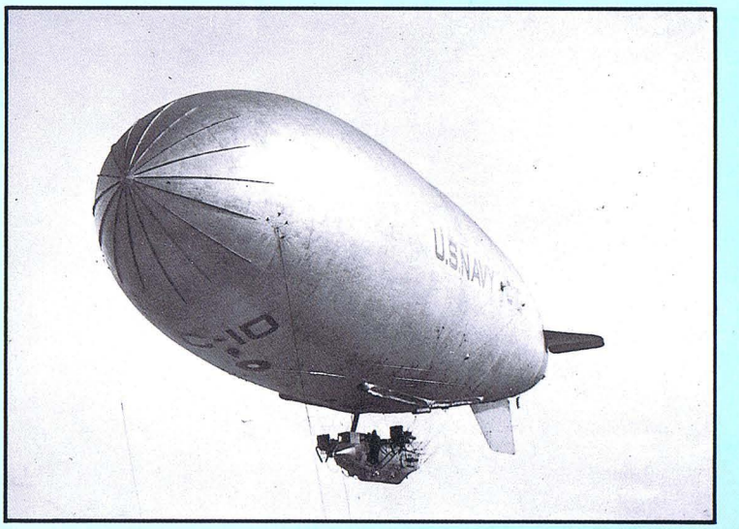
CONSTRUCTION OF INSIGNIA

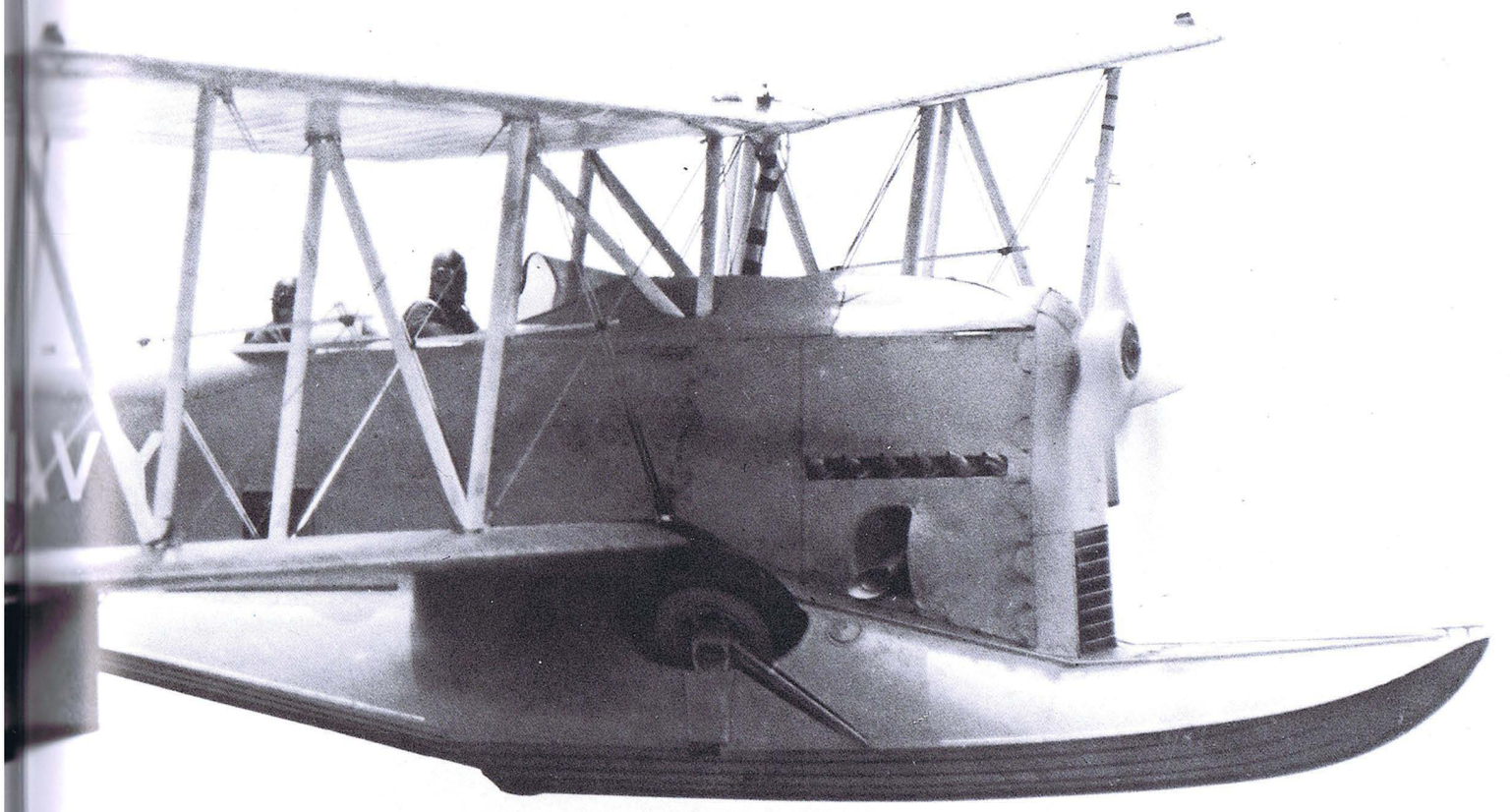
CHAPTER 5 1920–1929

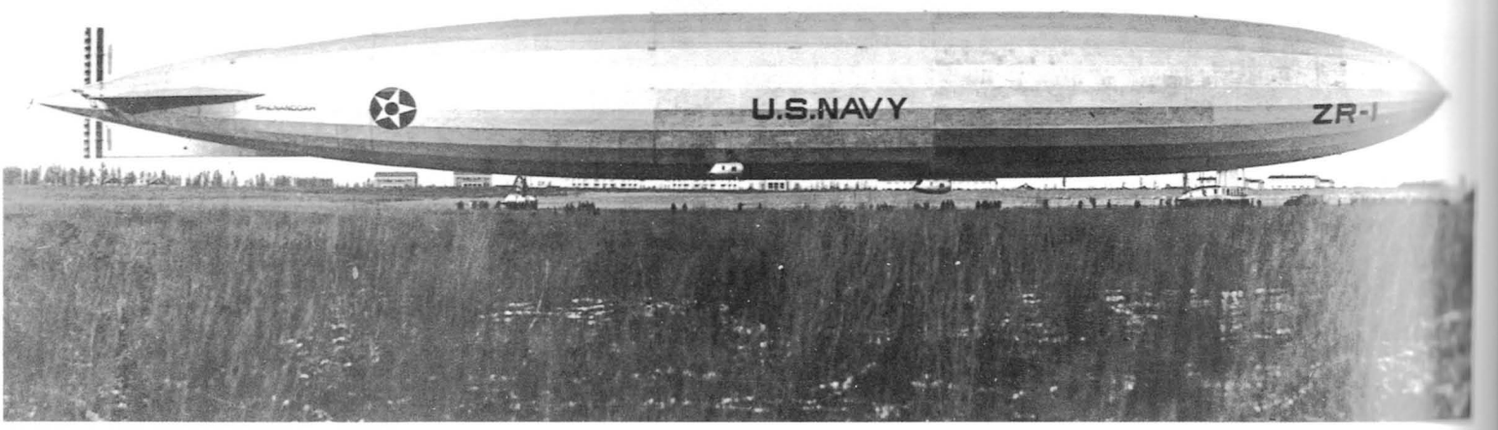
On March 25, 1920, the size of the red circle in the national aircraft insignia was clarified and made easier to plot with the issuance of Navy Department General Order No. 523. "The construction is obtained by marking off five equidistant points on the circumference of the circumscribed circle and connecting each point to the two opposite points. The outer parts of the lines thus obtained form the points of the star and the red inner circle is made tangent to the sides of the pentagon formed by this construction." It should be noted that at no time was the red circle to touch the inner points of the star. "The diameter of the circumscribed circle is 5 feet (152.40 cm), except where located on airplane wings having a chord of less than 5 feet (152.40 cm), in which case the diameter is approximately equal to the wing chord." All new aircraft were to be marked immediately in accordance with these instructions except those already bearing the former cockade insignia. On these aircraft the change could be deferred until the surfaces concerned were next refinished. However, all aircraft in service had to be marked with this star insignia by January 1, 1921. When the aircraft was disposed of to any but a US government department, the national aircraft insignia and serial number were required to be obliterated.

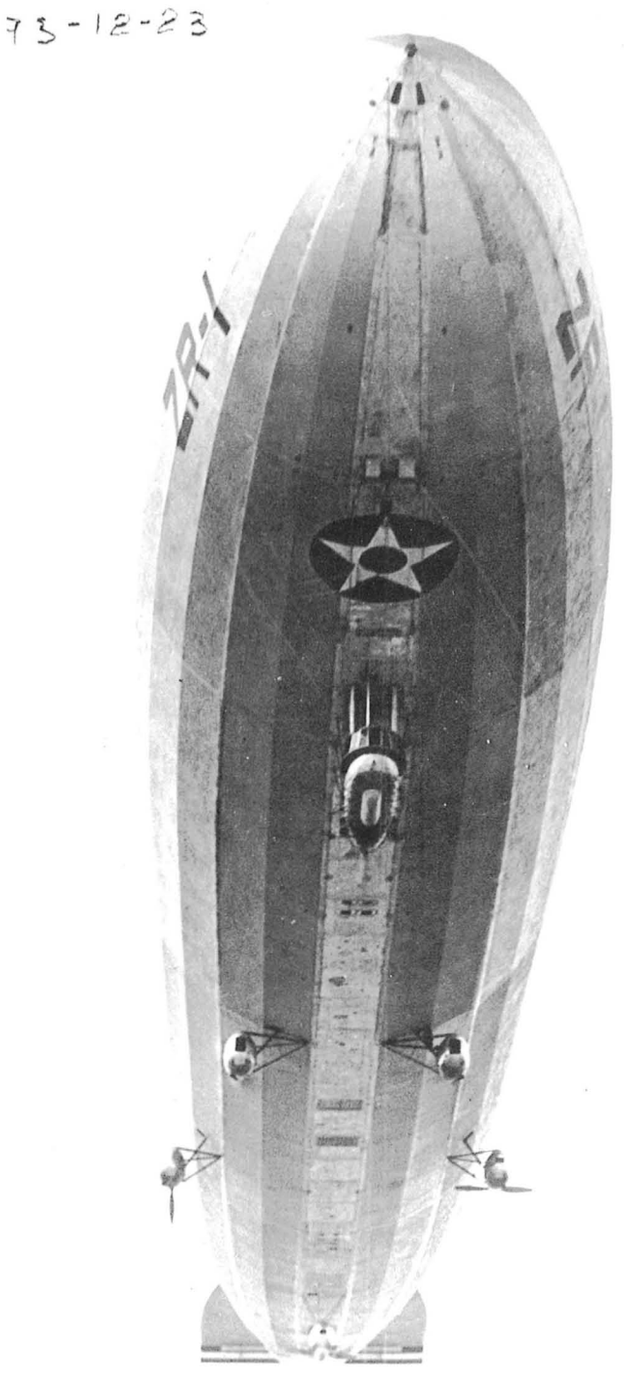
The next change came in December 1923 when the location of the insignia on the wings was modified by Aeronautical Process Specification No. 3. The diameter of the circumscribed circle was now to be equal to the distance between the leading edge of the aileron and the leading edge of the wing, except that the diameter was not to exceed 5 feet

Right: Loening OL-2 is shown in 1925. The rear-sloping rudder post causes the red, white, and blue rudder stripes to be on an angle rather than vertical as specified. **Opposite top:** Roundel style insignia is still applied to the C-10 airship in February 1921. It was difficult to change these markings since they were applied to the envelope and its surface could be damaged easily.

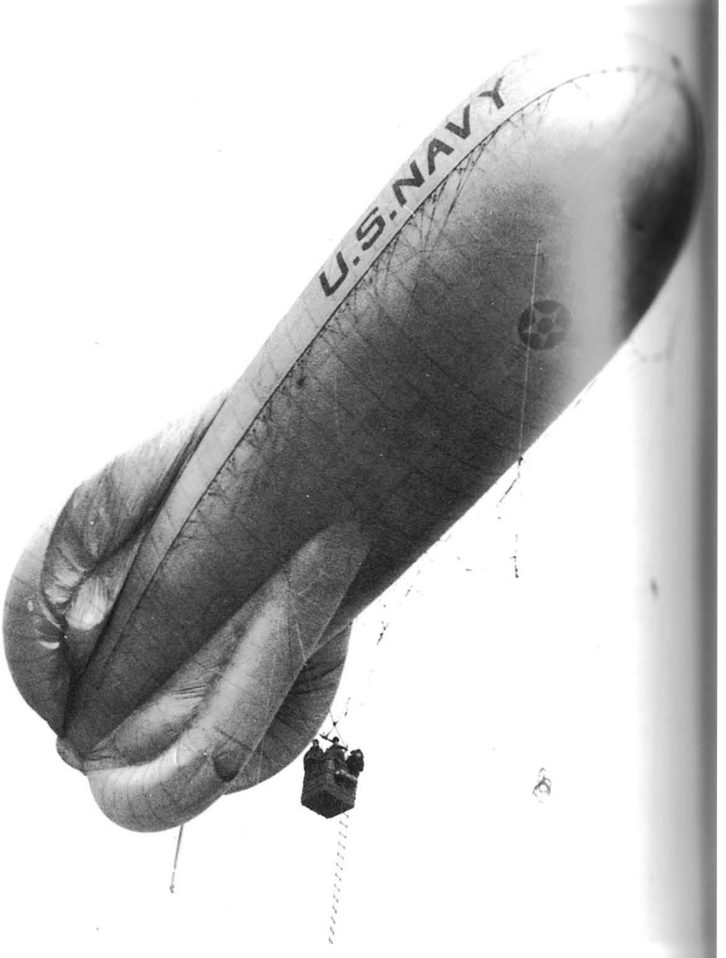

U.S.NAVY
L-10

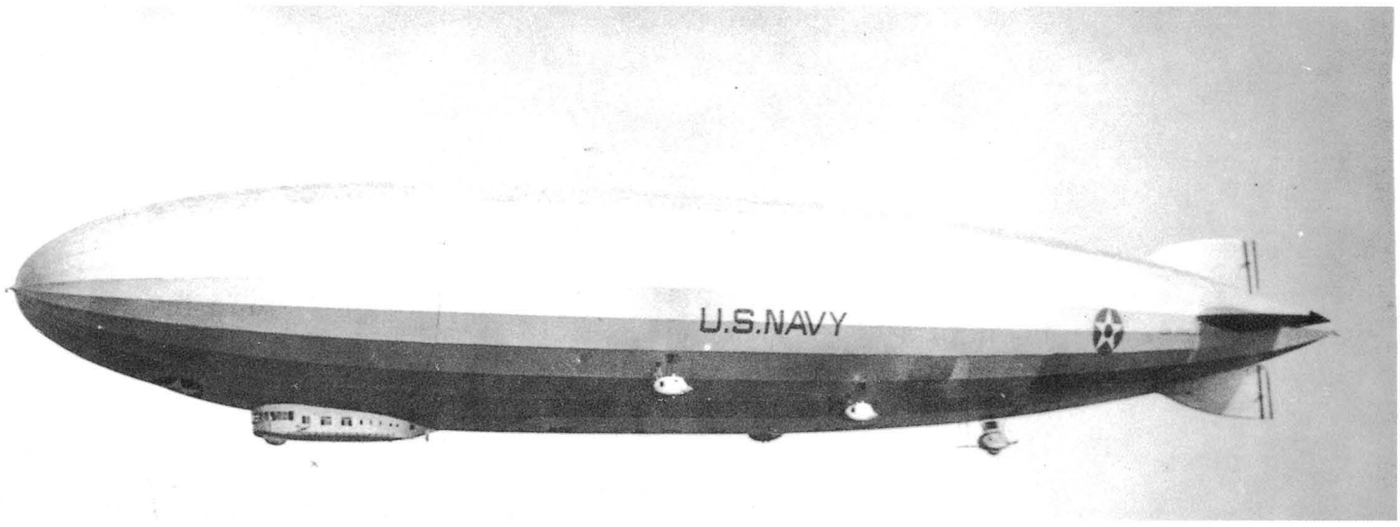






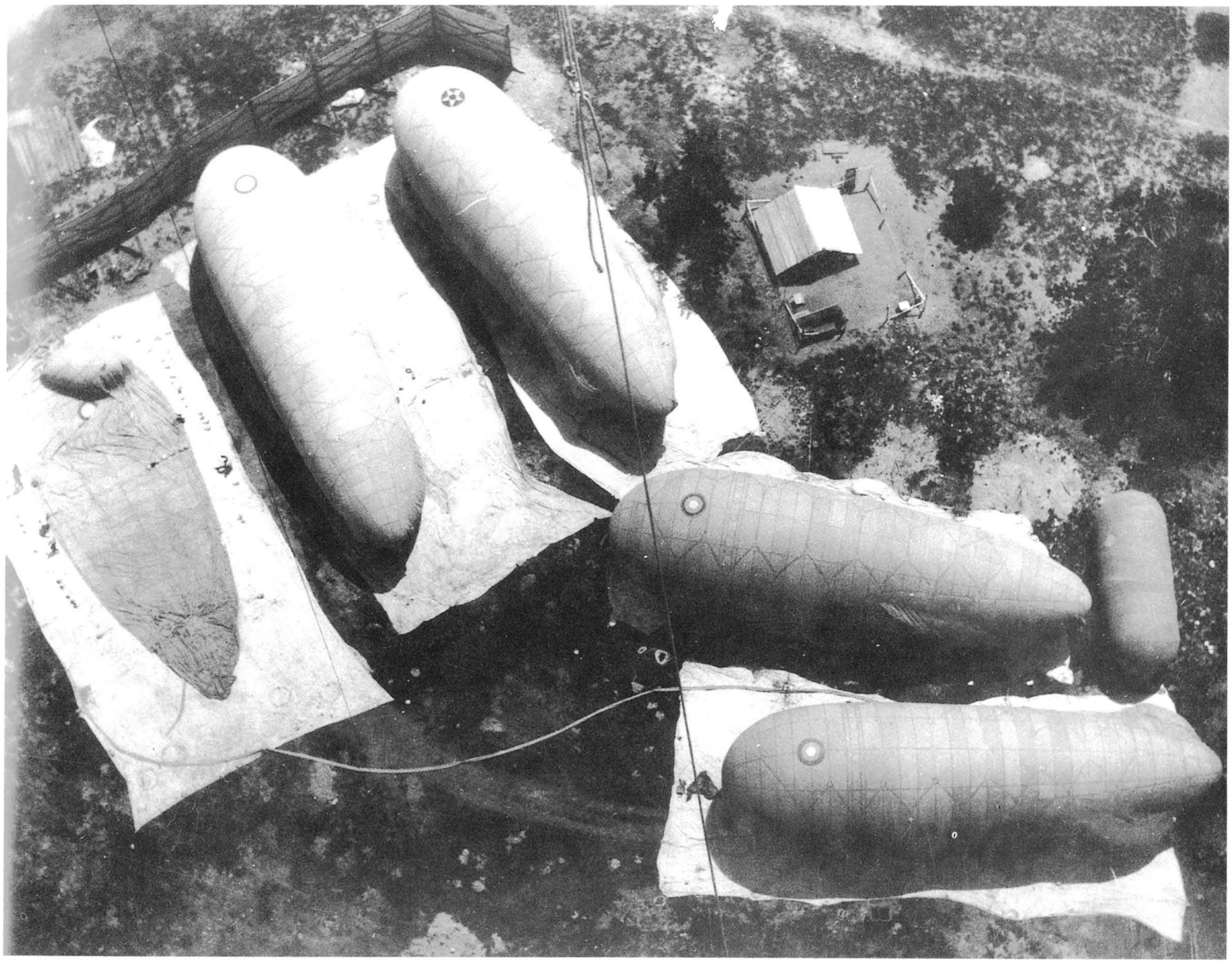
(152.40 cm). Two insignia were to be placed on the upper wing of each airplane, centered on a line drawn through the midpoint of the leading edge of the aileron and parallel to the longitudinal axis of the airplane. The circumference of the circle was to be tangent to the leading edge of the aileron. In cases where the length of the leading edge (of the aileron) is less than the diameter of the insignia, the centerline of the insignia was to be moved inboard until the circumference was tangent to the outboard edge of the wing. There was no requirement for the national aircraft insignia on the lower wing as this space was used for the aircraft identification. Insignia and markings for rigid airships were to be specified in each case by the Bureau of Aeronautics and were to be found in the detail drawings for each airship.

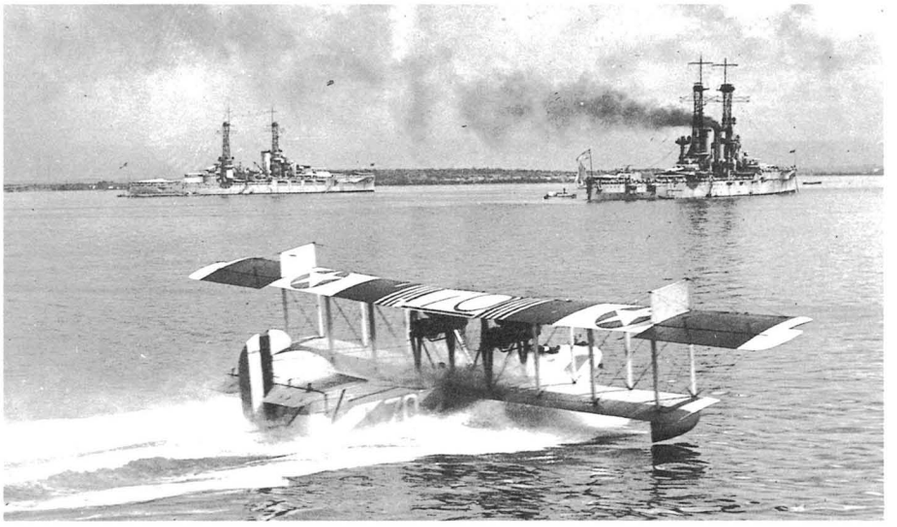




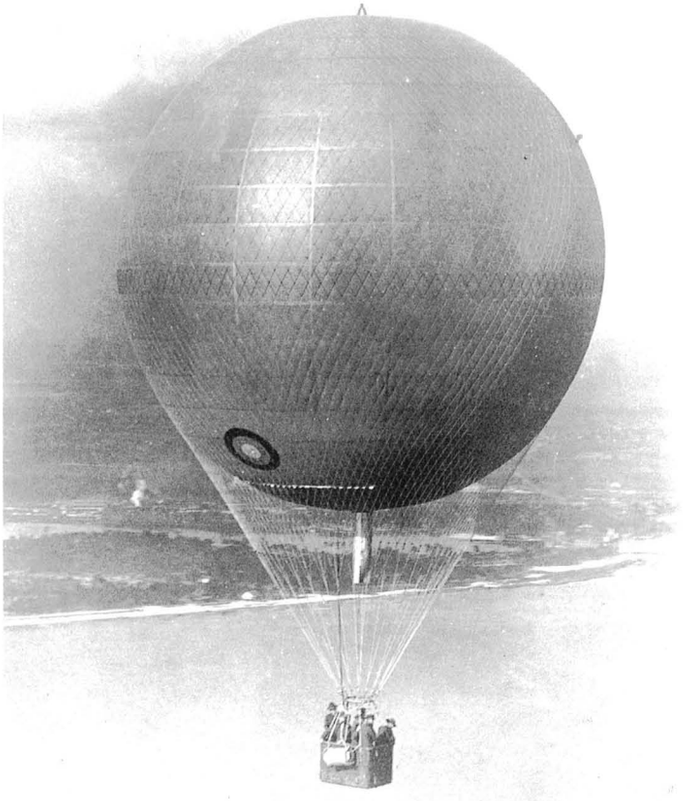
Opposite top: USS Shenandoah ZR-1 is shown in December 1921. The national aircraft insignia has been applied in error as if it were on a horizontal rather than vertical surface. **Opposite far left:** An underview of the USS Shenandoah shows the lower bow insignia location. Note the entrance hatch just below the mooring cone for entrance while the airship is attached to the mooring mast. **Opposite lower:** The underside of a kite balloon in flight shows the position of its national aircraft insignia.

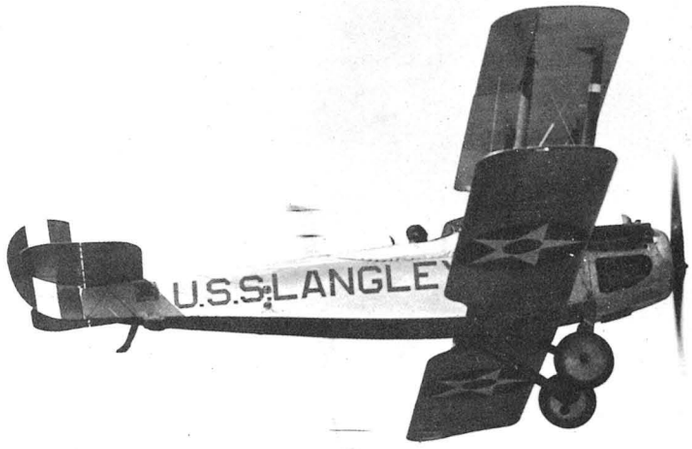
Above: The USS Los Angeles ZR-3 was photographed September 1926. The rigid airships were operated the same as surface vessels with the crew standing watches. Because of this concept each airship had a name which was carried on the envelope. The national aircraft insignia was also located forward on the top and bottom of the envelope. **Below:** Kite balloons, in various stages of inflation at Guantanamo Bay, Cuba, show both types of insignia being used.






U.S.N.





Opposite top: The national aircraft insignia seems almost a secondary marking on the F-5L of the Atlantic Fleet Scouting Squadron on its way to Coco Solo, Canal Zone. Opposite far left: A free balloon is being readied for flight at NAS Lakehurst, New Jersey, April 1924. Left: A free balloon shows the roundel style national aircraft insignia. A second insignia is applied on the upper side on the same 45° axis. Left below: Vought VE-7, August 3, 1923, is shown at Marine Flying Field Reid, Virginia. Note the position of the national aircraft insignia inboard of the ailerons to make them full chord in size. Top this page: This Vought VE-7 was photographed on December 6, 1923, in early markings of aircraft assigned to the newly commissioned aircraft carrier USS Langley. Note the midwing location of the national aircraft insignia. Right: A Curtiss F6C-3 of VB-1B the "Red Rippers" in September 1928. The national aircraft insignia has been applied oversize. Note the designation applied to the upper surface of the wing. Below: A De Havilland DH-4B is shown at Brown Field, Marine Barracks Quantico, Virginia. The national aircraft insignia on the upper surface of upper wing are oversize and too far inboard.

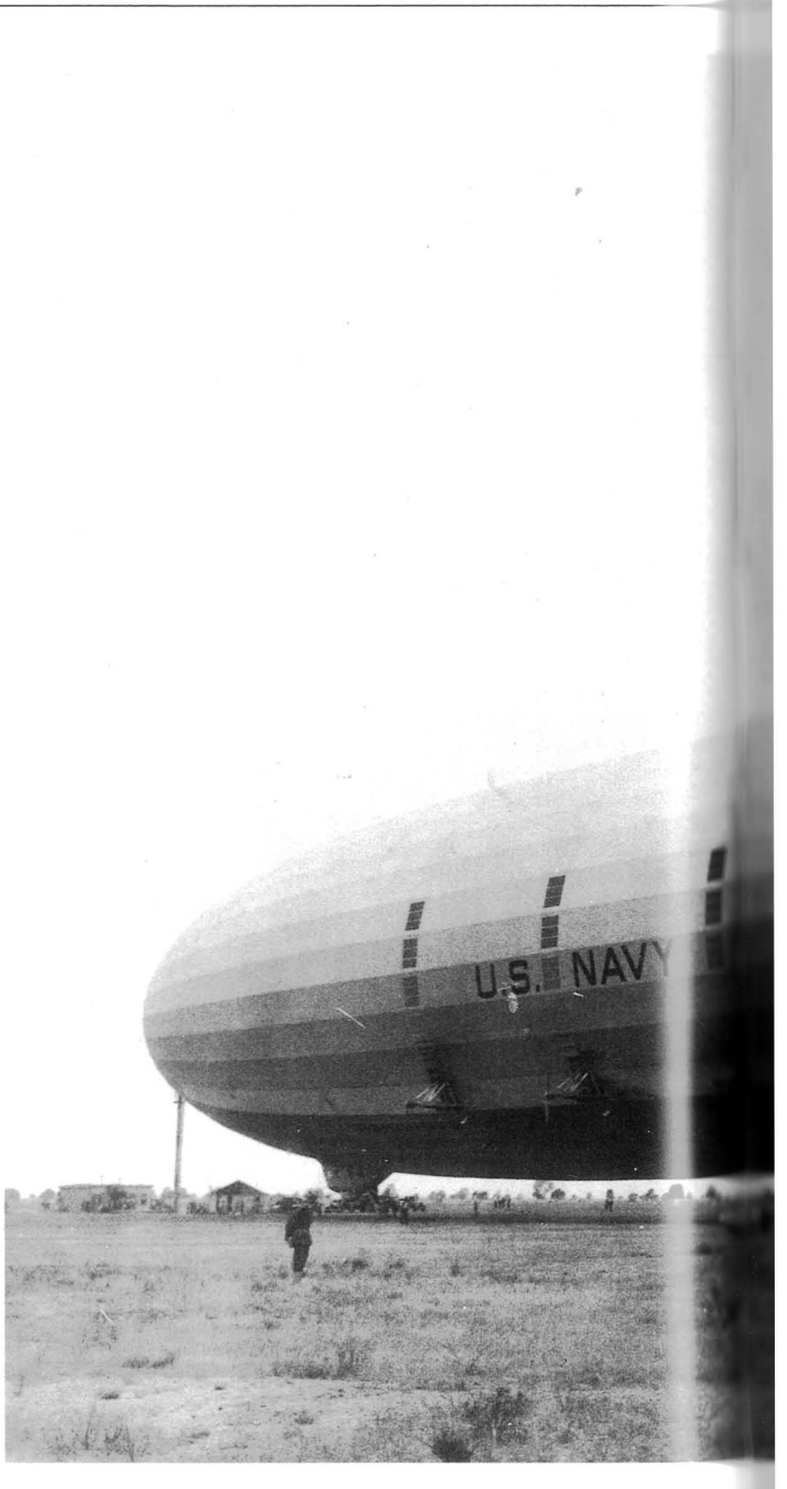
CHAPTER 6 1930–1939

On December 10, 1930, Bureau of Aeronautics letters directed all inspectors of Naval Aircraft and all aviation units ashore and afloat that the following changes, among others, were to be made on all new aircraft prior to delivery, and all aircraft in service at the time of their next overhaul.

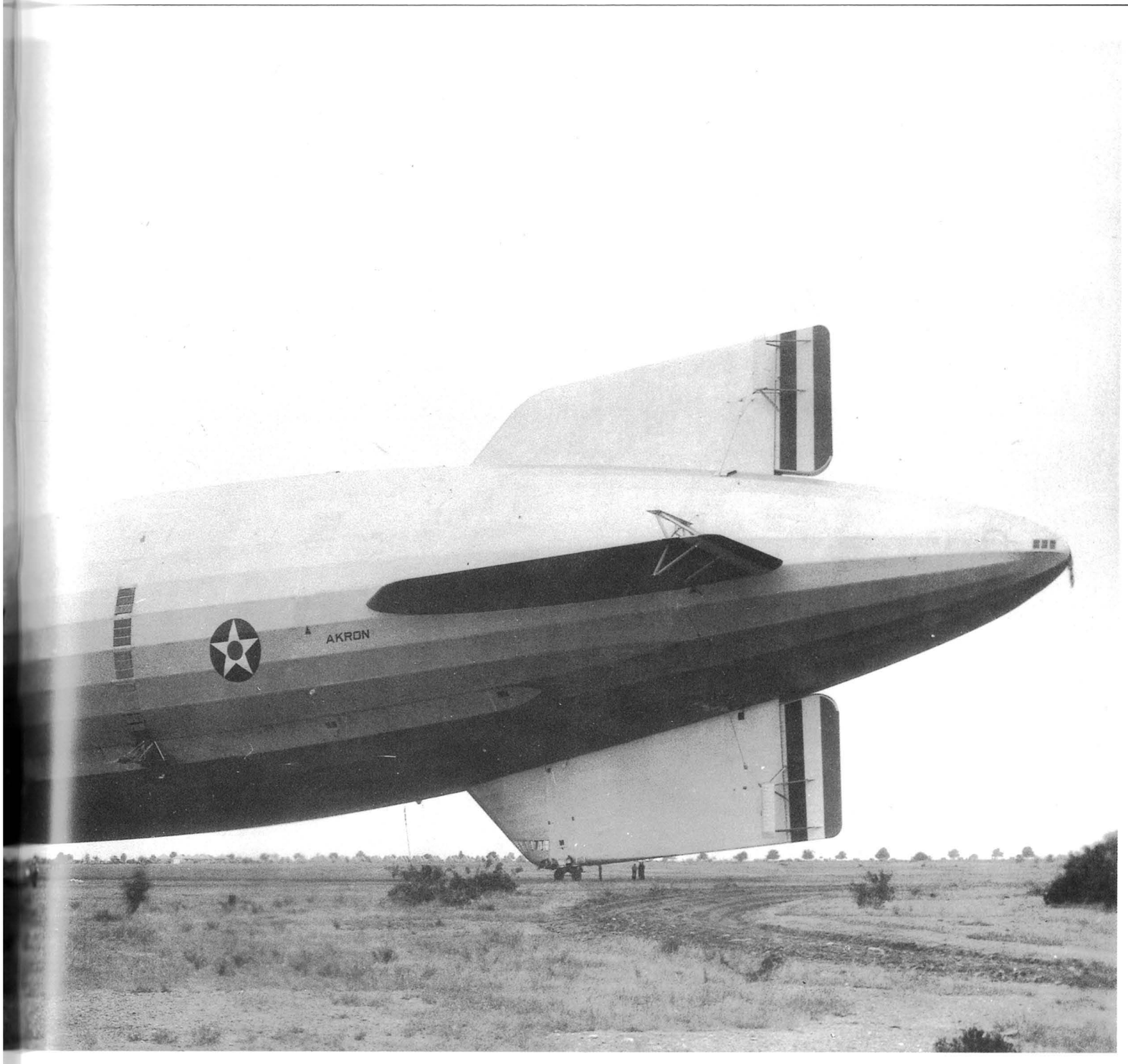
1. Eliminate the red, white and blue striping on the rudder.
2. National aircraft insignia were to be placed on the lower surface of the lower wings as well as on the upper surface of the upper wings. On monoplanes the national aircraft insignia was to be placed on both the upper and lower surfaces of the wing. On biplanes having very small lower wings with considerable overhang on the upper wings, the insignia was to be located on both the upper and lower surfaces of the upper wing.

The red, white, and blue stripes were to remain in use on the tails of rigid airships. While no mention was made regarding tail stripes on nonrigid airships, it was intended that they be continued as subsequent directives continue to use the same drawings which were first used in 1918 to show their location.

As is always the case when painting directives are under revision, there were directives issued in the field that only applied to certain units. In this case it was a directive from Commander Aircraft, Battle Force, dated April 17, 1931, concerning all aircraft units of the Battle Force. This directive made the application of the national aircraft insignia on the lower wing optional. In addition, it required the retention of the red, white, and blue stripes on the rudders of carrier and staff utility aircraft.



Right: The USS Akron ZRS-4 was photographed at the Camp Kearney, California, mooring mast in May 1932. Rudder stripes can be seen on the upper and lower surfaces on the elevators. A good idea of the size of these airships can be seen in the comparison of the man at the lower fin and the secondary control station built into the forward edge of the fin.


AKRON

On May 28, 1931, Commander Aircraft, Battle Force, issued another directive. It was now required that the national aircraft insignia be placed on the lower wing. To assure conformity and avoid conflict in certain cases with wing tip floats, the following table was included in the directive. All aircraft were to be in compliance on the next painting including those then in overhaul at Naval Air Station, San Diego.

Model	Wing	Circle Size	From tip of wing to center of star	From leading edge of aileron well
RS	Upper	60″ (152.40 cm)	8′4″ (254.00 cm)	Tangent
	Lower	60″ (152.40 cm)	8′4″ (254.00 cm)	Tangent
PH,PD, PN	Upper	60″ (152.40 cm)	9′ (274.32 cm)	Tangent
	Lower	60″ (152.40 cm)	6′1″ (185.42 cm)	Center 3′6″ (106.68 cm) from leading edge
OL-8	Upper	48″ (121.92 cm)	4′8″ (142.24 cm)	Tangent
	Lower	48″ (121.92 cm)	2′6″ (76.20 cm)	Tangent
T4M-1, TG-1	Upper	60″ (152.40 cm)	6′7″ (200.66 cm)	Tangent
	Lower	60″ (152.40 cm)	6′7″ (200.66 cm)	Tangent
T2D-1, P2D-1	Upper	60″ (152.40 cm)	8′6″ (259.08 cm)	Tangent
	Lower	60″ (152.40 cm)	8′6″ (259.08 cm)	Tangent
F3B-1	Upper	48″ (121.92 cm)	5′9″ (175.26 cm)	Tangent
	Lower	48″ (121.92 cm)	4′6″ (137.16 cm)	Centered fore and aft
F4B-1, F4B-2	Upper	42″ (106.68 cm)	5′ (152.40 cm)	Tangent
	Lower	36″ (91.44 cm)	3′9″ (114.30 cm)	Centered fore and aft
F8C-4, O2C-1	Upper	48″ (121.92 cm)	5′4″ (162.56 cm)	Tangent
	Lower	48″ (121.92 cm)	5′4″ (162.56 cm)	Tangent
O2U-1, -2,-3,-4 O3U-1	Upper	42″ (106.68 cm)	5′5″ (165.10 cm)	Tangent
	Lower	42″ (106.68 cm)	4′9″ (144.78 cm)	Tangent

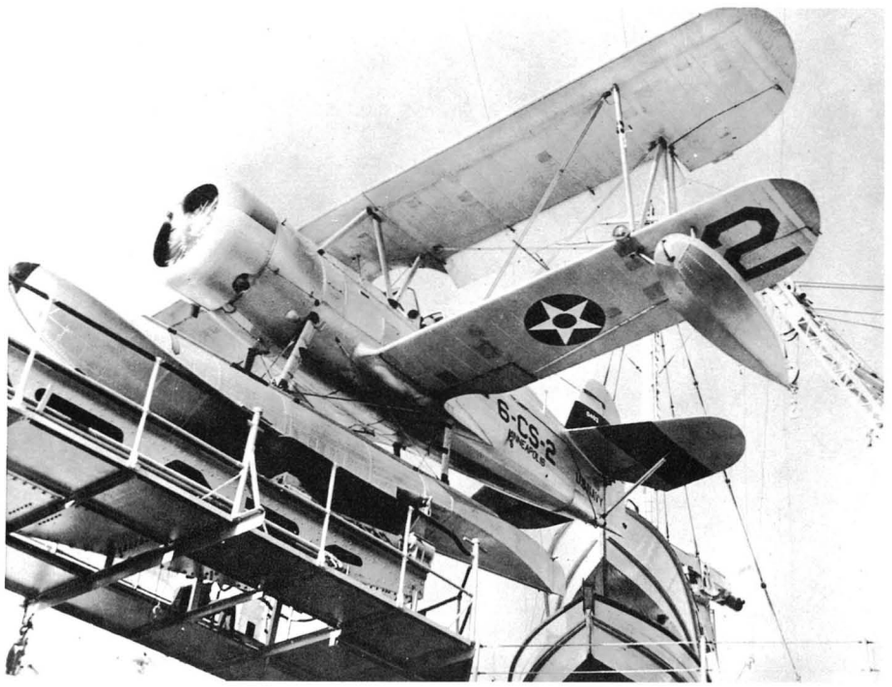
Continued on p. 64

Top: This photo shows the Sikorsky RS-3 amphibian of VJ-6M. Placement of the national aircraft insignia on the under surface of the top wing on this sesquiplane is in accordance with the regulations. **Right:** The placement of the national aircraft insignia on the under surface of the top wing and the aircraft number on the under surface of the lower wing shown on this type aircraft was not in accordance with the painting instructions.


FIGHTING SQUADRON TEN
U.S. MARINE CORPS
AIR STATION SAN DIEGO CAL.


U.S.MARINES

Left: A Boeing F4B-3 of VF-10M is properly marked except for the squadron insignia which should be on the fuselage. Top: A PM-1 of VP-9F is shown in October 1935. The national aircraft insignia on the wing has been moved outboard of the normal position to clear the wingtip pontoon. The Squadron insignia location is unusual for a flying boat at this time. **Right:** A SOC-2 of Cruiser Scouting Squadron 6 (VCS-6) is shown with the national aircraft insignia moved to midwing position to clear the control surfaces and the wingtip pontoons. The aircraft number has been applied to the wing outboard of the wingtip pontoon as an aid to the ship in recovering its aircraft. Below: This photo shows a Vought O2U-1 staff aircraft for a Captain or Commander commanding an aircraft carrier, tender, fleet air base or major air station. National aircraft insignias on the lower wing have been moved inboard to clear the aileron and allow the insignia to be the full chord of the wing.



Left: The maximum size possible for the national aircraft insignia is shown here on the under surface of the Curtiss XF13C-3s wings. **Below:** The SOC-1, a staff aircraft of Patrol Wing Five is shown with the national aircraft insignia applied to the fuselage while the unit was participating in the neutrality patrol. **Right:** A Curtiss BFC-1 of VB-5B is shown in March 1935 with all insignia and markings properly placed. **Opposite right below:** This depicts an unusual use of the Aircraft One insignia and aircraft number. The legend AIRCRAFT ONE FMF QUANTICO on the fuselage identifies this Bellanca XRE-3 as a station rather than a squadron aircraft.

These markings were to become effective as soon as practicable but not later than July 1, 1931.

It was not until SR-2, *Specification for Aircraft Insignia and Markings,* was issued on June 1, 1931, that specific instructions were given for the application of the national aircraft insignia. This instruction specified that the star insignia be applied by pigmented nitrate dope, or an approved lacquer. The two approved methods were:

1. "Pigmented Dope—When the panel is finished the area within the circumscribed circle shall be doped with the necessary coats of clear dope but shall be left free of pigmented dope. When white is dry, spray the star area with blue pigmented dope, using a mask to give sharp outlines. When blue is dry, spray the area within the inner circle with red pigmented dope, using a mask to give sharp outlines.

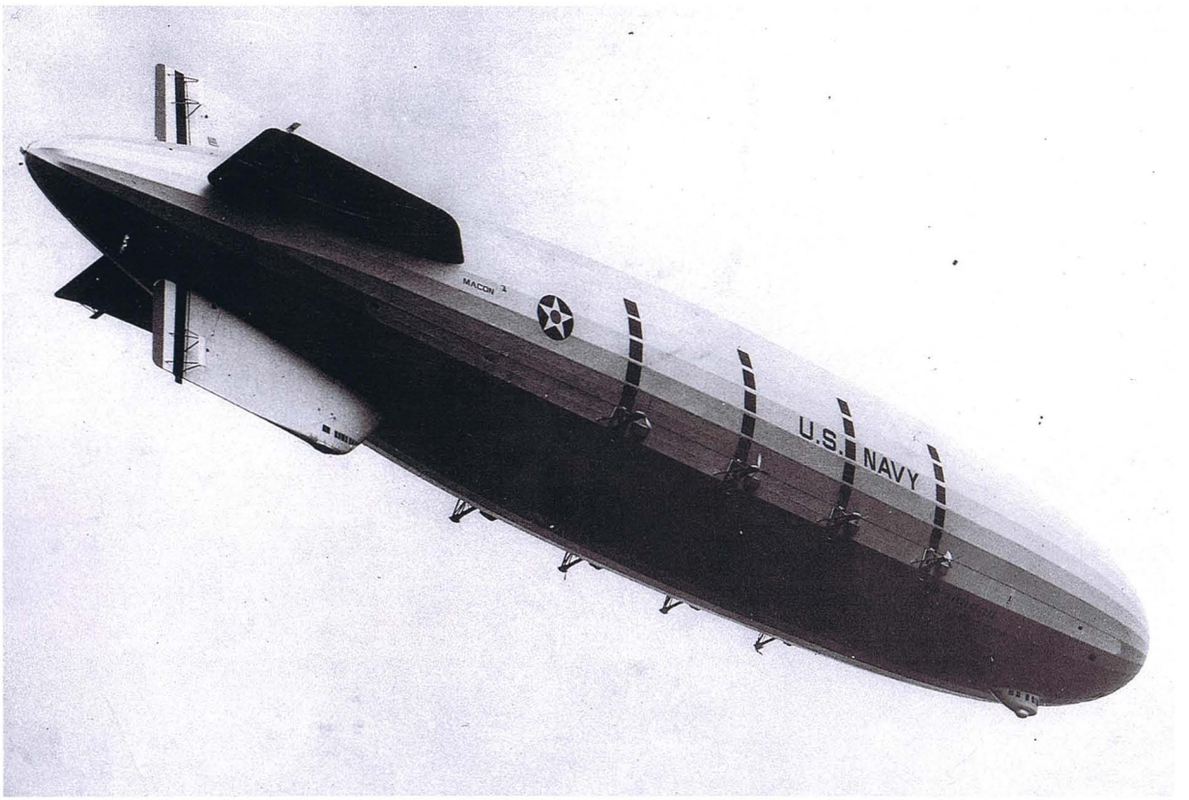
2. "Lacquer—These colors may be brushed or sprayed and shall be used after the fabric has been completely doped, and never applied over clear dope. When brushed, the colors may be applied contiguous to one another before drying. When sprayed, a mask shall be used to give sharp outlines."

SR-2 required that once again 4 insignia were to be used on the wings of all Naval aircraft, one at each wing tip on the upper surface of the upper wing, and on the under surface of each lower wing. The center of the insignia were to be located in from the wing tip a distance equal to the mean aerodynamic chord length of the wing on which it is applied. The circumscribed circle was to be tangent to the forward edge of the aileron, the diameter to be equal to the distance between the leading edge of the aileron and the leading edge of the wing, provided this distance was not in excess of 60

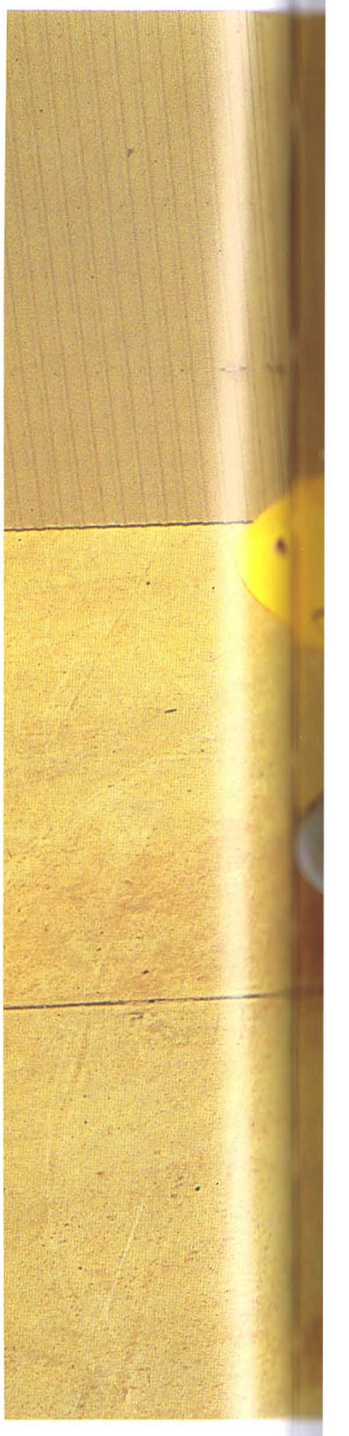
Continued on p. 68

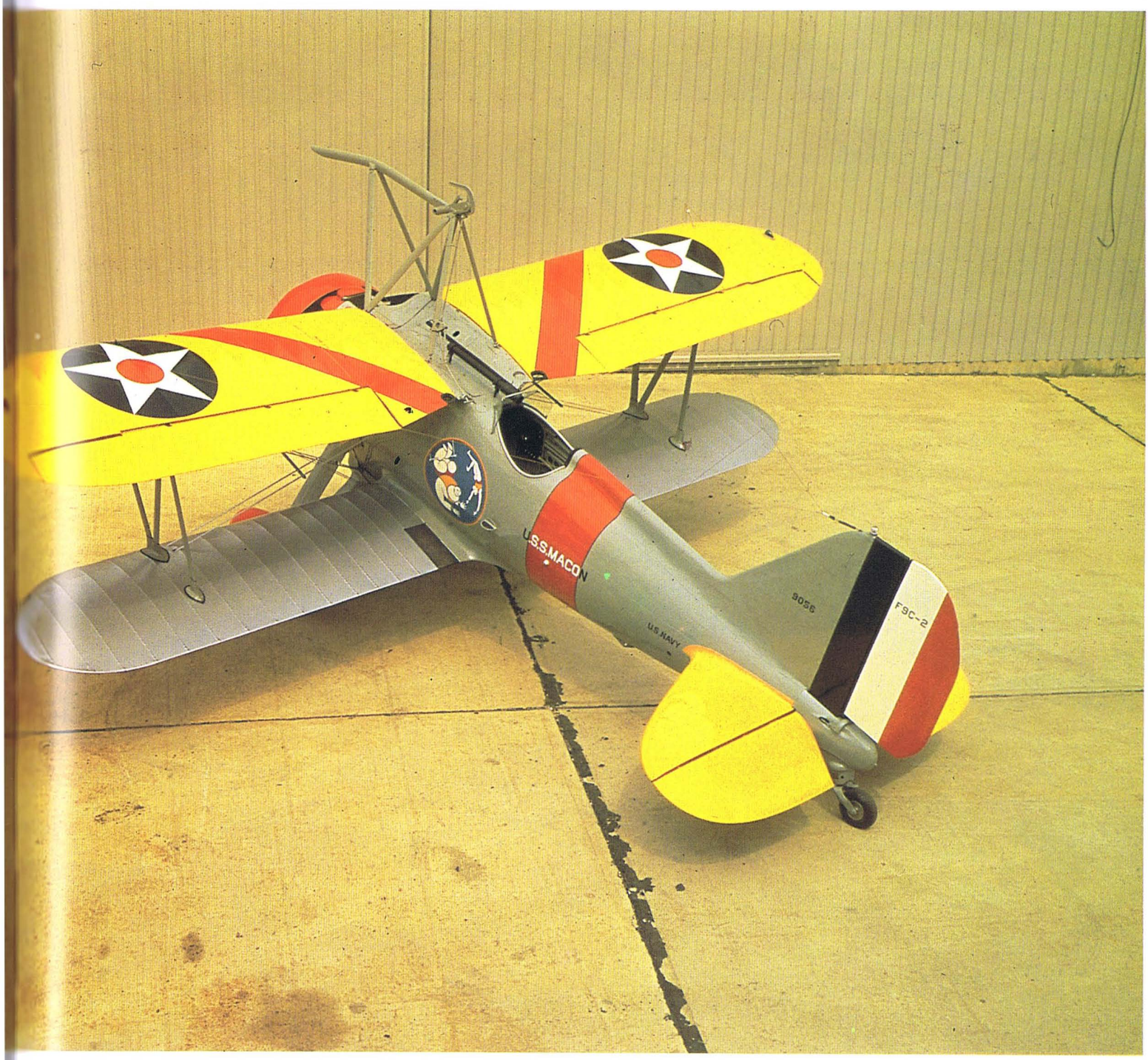

U.S.NAVY


XRE3
9341
U.S.MARINES
AIRCRAFT ONE
F.M.F.
QUANTICO, VA
XRE-3 9341



Above: The USS Macon ZRS-5 was photographed during October 1935. The black stripes on the envelope are not markings but part of the water recovery system to condense water vapor from the engine exhaust for the use as ballast. **Right:** The only remaining example of the Curtiss F9C-2 "Sparrowhawk" is shown as restored by the National Air and Space Museum, Smithsonian Institution, Washington, D.C. The merging of the Curtiss F9C-2 "Sparrowhawk" aircraft with the lighter-than-air airships USS Akron (ZRS-4) and USS Macon (ZRS-5) was a program unique to US naval aviation. While the launching of an aircraft from a lighter-than-air vehicle had been demonstrated several times previously, the concept of a weapon system which could both launch and recover aircraft was new. The original idea of a lighter-than-air aircraft carrier was never realized due to economic constraints and the fact that each aircraft carrier could carry only five aircraft. In actual practice the Akron could carry only three aircraft due to structural members obstructing the aft two locations in the hull hanger area. This handicap was corrected in the Macon but the fifth aircraft was seldom carried since it was stowed on the trapeeze and, in the event of a launch problem, it would have blocked the remaining fighters. These aircraft could greatly extend the normal range of the airship as it scouted ahead of the fleet in much the same way as destroyers were normally employed. Before the advent of radar this combination of a mother airship with four aircraft, each searching an area ahead and to the side, gave the greatest coverage of any vessel in the Scouting Fleet. Technology advanced more rapidly than airship carrier development rendering the concept stillborn before its merits could be proved.




U.S.S. MACON
3056
F9C-2
U.S. NAVY

inches (152.40 cm). In no case was the size of the insignia on Naval aircraft to exceed 60 inches (152.40 cm). Carrier-based aircraft were to have their tails painted a distinguishing color for unit recognition purposes. Based on this requirement, the Bureau of Aeronautics had requested that they be allowed to deviate from the approved Army/Navy standard of tail stripes. The Army Air Corps had changed the markings on the rudder from the standard three vertical red, white, and blue stripes to a vertical blue and thirteen horizontal stripes, alternating red and white in 1926. Upon approval by the Chief of Naval Operations the use of vertical rudder stripes became optional on shore-based aircraft. This latter marking continued to be used by the Marine Corps until February 1941, but was no longer considered to be part of the national aircraft insignia. The vertical red, white, and blue stripes also continued to be used on lighter-than-air aircraft.

The difficulty of writing a directive that would cover all the various aircraft configurations was realized by the Bureau of Aeronautics. Amendment 1 to SR-2, dated November 6, 1931, contained the following statement: "The distinguishing insignia and marking herein described and no other shall be used on all United States Naval Aircraft. The impossibility of specifying exact locations and sizes for the markings to suit all classes and models of aircraft is recognized, and it is therefore intended that sufficient latitude be permitted as necessary to meet differing conditions and yet conform to the general requirements of this specification."

This modification opened the door for many interpretations for placement of the national aircraft insignia, as well as other markings, and yet these variations are all within the broad meaning of the instructions.

On February 1, 1933, SR-2a, was issued. One of the modifications in this instruction was the requirement for the use of only pigmented lacquer in the application of insignia. It was still to be applied only after the fabric had been completely doped and in no case over clear dope.

Top: A Grumman F3F-1 of VF-7 while on neutrality patrol. Note the thin Insignia White stripe to separate the Insignia Red section markings from the Light Gray of the cowl and fuselage. **Right:** Although VF-7 has applied the national aircraft insignia to the fuselage of its Grumman F3F-1 while participating in the neutrality patrol, it is doubtful if it was very visible to the vessels being observed which was the purpose of this marking. This view shows the remaining markings on their aircraft in 1939.

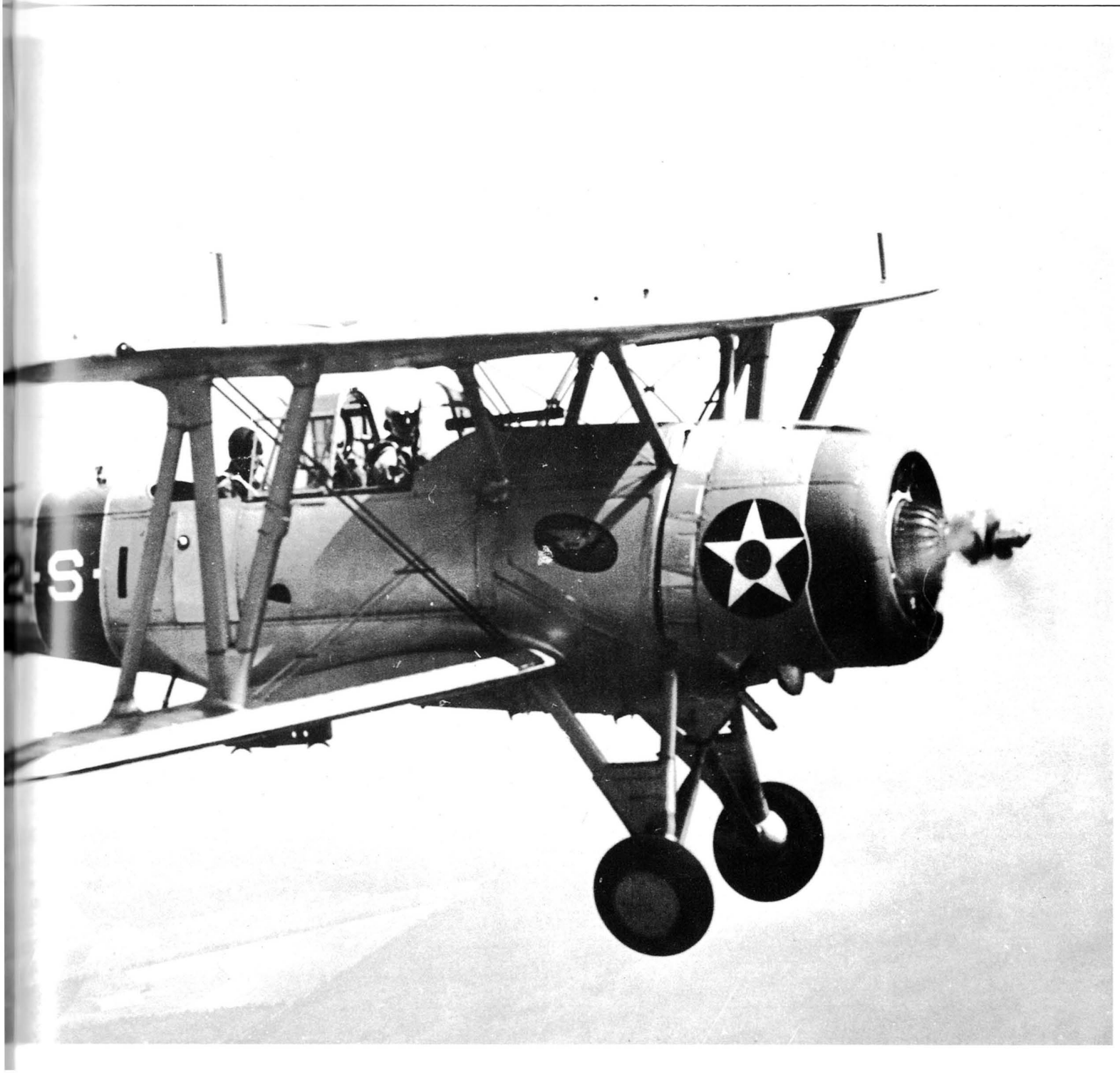
As World War II activities came closer to the United States coast, the Navy began a neutrality patrol on both the water and in the air. In order for foreign merchantmen to be able to recognize the aircraft participating in this patrol as friendly, the Bureau of Aeronautics, on December 16, 1938, issued the following dispatch:

> "Accordance with Opnav letter five December apply three foot [91.44 cm] diameter star insignia with point of star up to both sides of hull at bow of Prep Baker Yoke [PBY] airplanes engaged in neutrality patrol x lower circumference of insignia to be about four inches [10.16 cm] above mooring platform and between turret and windshield with after circumference tangent to outer edge of reinforcing around pilots ventilator."

While this dispatch was directed specifically to those operating PBY aircraft, other types were also used on this patrol. They too were to carry the national aircraft insignia on the hull or fuselage. This was the beginning of the hull and fuselage placement for the national aircraft insignia.

The instructions issued by the State Department on the use of the fuselage/hull insignia required the aircraft to approach to one side of the vessel at comparatively low altitude and on a parallel course to afford ample opportunity for the vessel to establish the identity of the aircraft. At no time was the aircraft to fly directly over the vessel.

Right: A Vought SBU-1 of VS-42 from the USS Ranger is shown while on neutrality patrol. The national aircraft insignia was painted as large as possible to ensure good visibility. Note how it encroaches on the Insignia Red cowl marking but does not cover any of the cowl flaps which could change the shape and ease of recognition when the flaps are open.



SECTION 3

IDENTIFICATION, RECOGNITION MARKINGS

CHAPTER 7 1911–1919

When the US Navy acquired its first aircraft, a system for designating them had to be developed. A logical starting point for such a system would evolve along the lines of that employed to designate vessels. In identifying vessels, letters denoting vessel class followed by a sequential hull number within each class were assigned as vessels were acquired. The aircraft system used letters to identify manufacturers followed by a number, issued in sequence, as aircraft were procured from each manufacturer. The system naturally started with A-1 which designated the first aircraft purchased from Curtiss Aircraft and Motor Co. Additional Curtiss aircraft were designated A-2, A-3, etc. The first Wright aircraft was designated B-1. The system, however, failed to identify different types by the same manufacturer. Consequently, when a flying boat was obtained from Curtiss, the letter C was assigned to show this variation, and when an amphibian was developed, the letter E was assigned. It is easily seen that a system assigning multiple letters to each manufacturer would soon get out of hand. It did expand to the following:

A Curtiss (Land & Hydro)

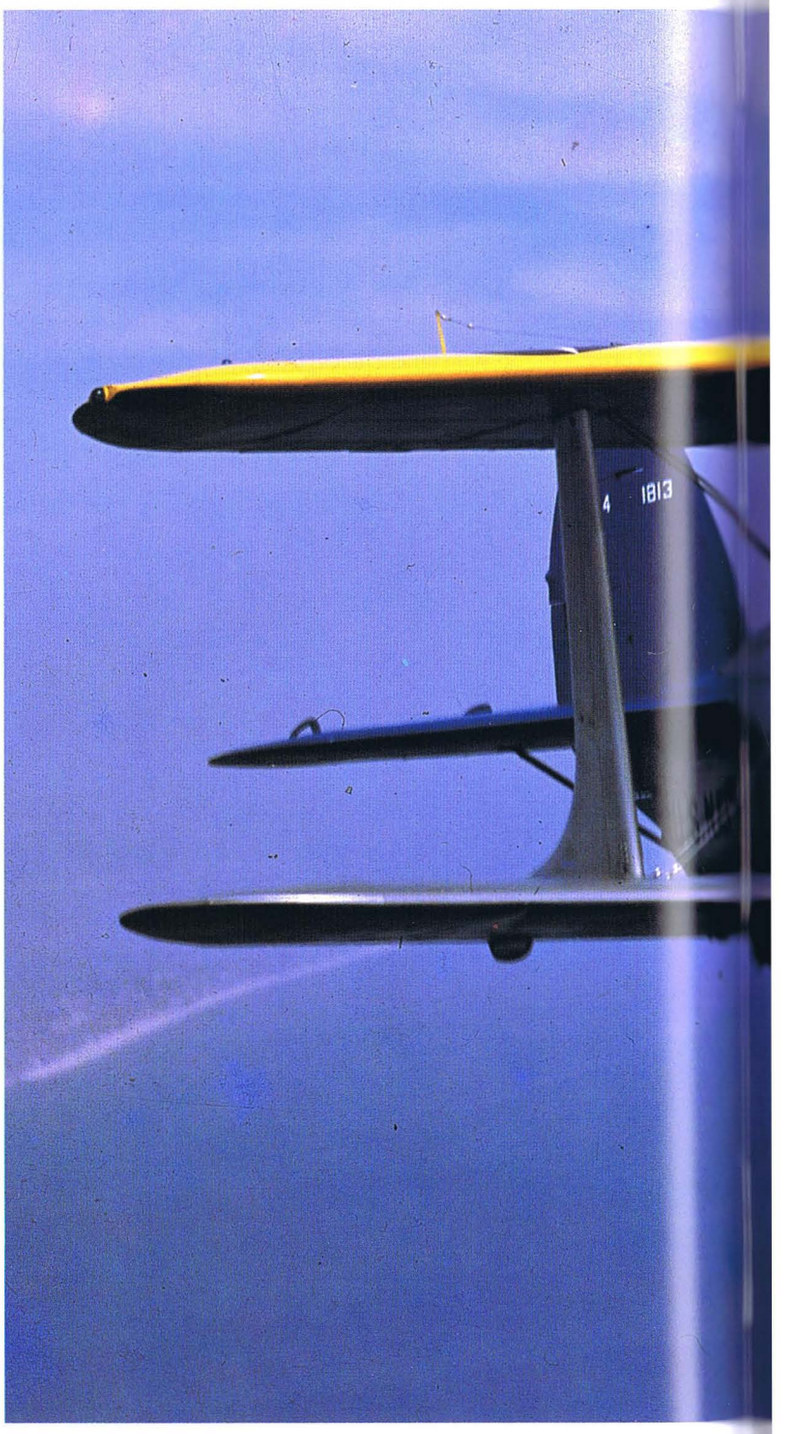
B Wright (Land & Hydro)

C Curtiss (Flying Boat)

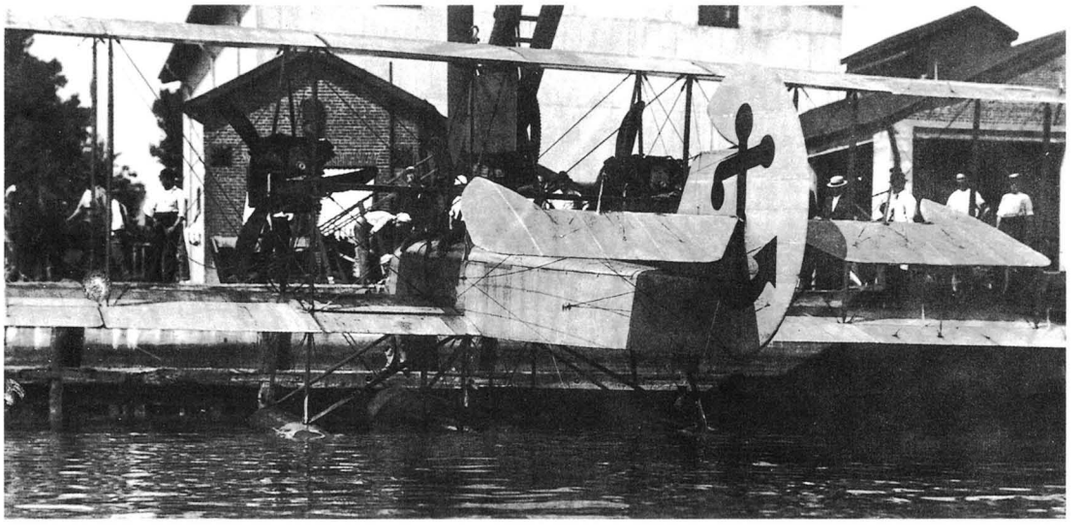
D Burgess & Curtiss (Hydroplane)

E Curtiss (Amphibian)

Although no directive has been found applying this designation to aircraft, photos do, for example, show C-3 on the tail of a Curtiss flying boat.



Right: A Curtiss SBC-4 attached to the New York Naval Air Reserve.



Left: The Richardson seaplane at the Washington Navy Yard shows the blue anchor insignia that was the first emblem directed to be placed on US Navy aircraft to identify them as such. **Opposite bottom:** The Burgess-Dunne AH-10 was photographed at Naval Aeronautic Station, Pensacola, Florida, on September 26, 1916. Both the aircraft serial number on the fuselage and fin as well as the anchor insignia was in dark blue. **Right:** This drawing dated April 15, 1916, is the first directive to specify an insignia to identify US Navy aircraft as well as the color and sizes of the characters used.

Navy General Order No. 88 dated March 27, 1914, established a new system whereby all aircraft were designated by two letters and a number. The first letter designated the Class, the second letter the Type within the class, and the numerals the serial number of the aircraft of that class and type. Four classes were established as follows.

A Airplanes

D Airships or dirigibles

B Balloons

K Kites

The following types were established within each class.

Class A	
Land machine for use over land only	L
Hydro machine for use over water only and using floats	H
Boat machine for use over water only	B
Combination machine for use over land and water	X
Convertible machines; that is for use over land or water, being readily convertible	C
Class D	
Rigid type airship	R
Nonrigid type airship	N
Class B	
Captive type balloon	C
Free type balloon	F
Class K	
Box type kite	K
Cellular type kite	C
Tetrahedral kite	T

All aircraft in service were to be renumbered in accordance with this directive. This resulted in the A-1 being designated AH-1, C-1 to AB-1, etc. Some of the early aircraft were no longer in existence and obviously many of the designations were not utilized.

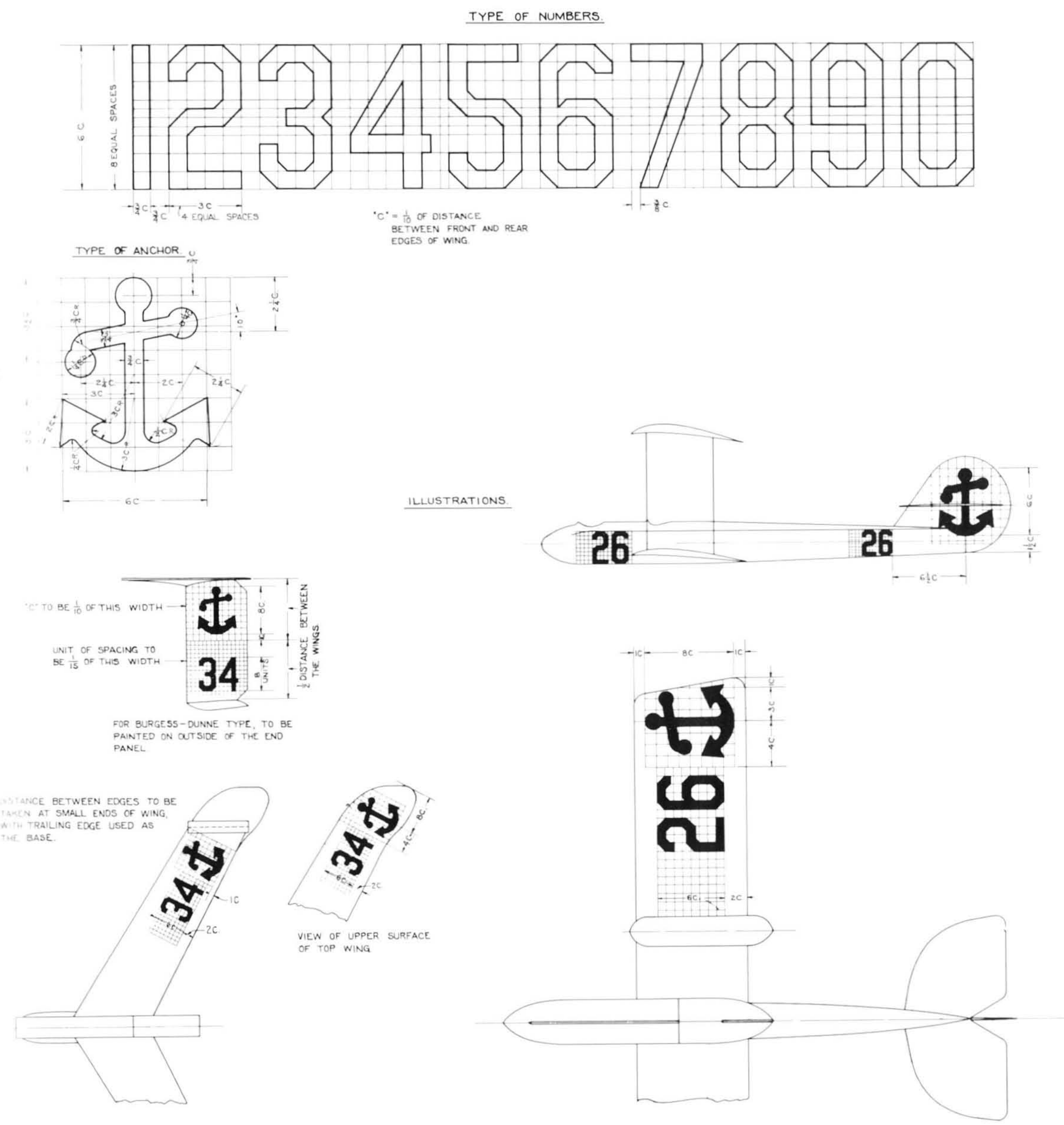
These early aircraft did not have a national aircraft insignia, of course, as it had not been adopted at this time. Nor has any directive been located which specified US Navy be applied to aircraft. However, in 1916 an anchor was applied to the tail and wings in accordance with the Bureau of Construction and Repair drawing No. 46318 *General Type Plan Distinguishing Marks for Naval Aeroplanes* dated April 15, 1916. This drawing required the anchor to be applied on both sides of the tail and at the outboard ends of the top surface of the top wing and bottom surface of the bottom wing. These anchors were to be Dark Navy Blue on a White background and as large as possible. This drawing for the first time also gave style and size of the lettering to be used in identifying Naval aircraft.

On February 10, 1916, the Bureau of Construction and Repair directed that a designating number be assigned to all aircraft under construction and that these numbers be used for identification purposes until the aircraft were placed in service. Henceforth the standard designation provided by General Order No. 88 was to be used. Subsequent correspondence indicates that there was considerable confusion in the implementing of this procedure.

Numerous photos exist that show early Naval aircraft with the assigned serial number in large characters on the side of the fuselage, hull, or tail. This number prefixed by a letter was assigned by the Navy Department and specified in the contract for the purpose of referring to a specific item of aeronautical equipment such as the car or envelope of a dirigible or an airplane. Through usage, this became known as the Bureau Number as early as 1922.

Navy Department General Order No. 299, dated May 18, 1917, specified that the building number be placed in figures 3 inches (7.62 cm) high on each side of the rudder at the top of the white rudder band. This is the first known directive on the designation of specific aircraft in the US Navy. On August 4, 1917, the Bureau of Construction and Repair directed various commands to assure the proper placement of the letter "A" preceding the numerals in the designating number to denote an aircraft.

With the expansion of Naval aviation for World War I, the designations assigned by General Order 88 became too cumbersome. From some unknown date in 1917 until March 29, 1922, aircraft in Naval aviation were known by the



SCHEDULE OF ALTERATIONS.

MARK	DATE	DISCRIPTION	APPROVED

SCHEDULE OF MATERIAL.

PC Nº	NAME	Nº PC	GR'P	MATERIAL	PAT OR DWG	REMARKS	WHERE MADE

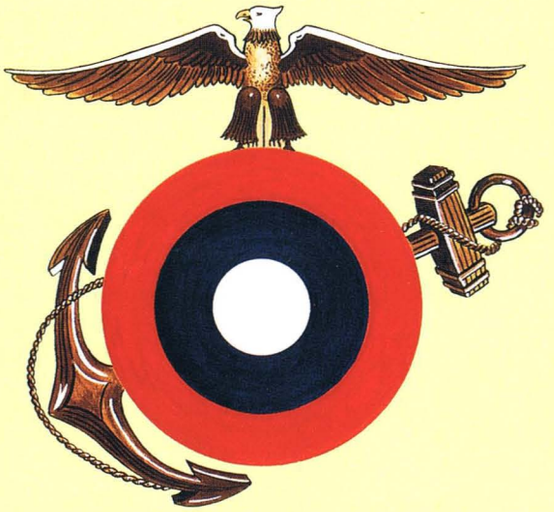
GENERAL NOTES.

1. ANCHOR AND NUMERALS TO BE PAINTED SOLID, WITH A DARK NAVY BLUE WATERPROOF PAINT, ON A WHITE BACKGROUND.
2. WINGS ARE TO BE MARKED ON BOTH OUTBOARD ENDS, OF THE TOP SURFACE OF THE TOP WING, AND BOTTOM SURFACE OF THE BOTTOM WING, AS SHOWN, ANCHORS OUTBOARD.
3. IF THE SURFACES INDICATED ARE NOT OF SUFFICIENT SIZE TO PERMIT THE PAINTING OF THE DISTINGUISHING MARKS OF THE SIZE CALLED FOR, A DIFFERENT SIZE MAY BE USED, PROVIDED IT IS MADE AS LARGE AS POSSIBLE.
4. SIZE OF NUMBERS IS INTENDED TO BE FUNCTIONS OF DISTANCE BETWEEN FRONT AND REAR EDGES OF WINGS, WHERE POSSIBLE.
5. CONSTRUCTION CROSS SECTION LINES ILLUSTRATE METHOD OF LAYING OFF MARKS AND ARE NOT TO BE SHOWN.

General Type Plan
DISTINGUISHING MARKS FOR NAVAL AEROPLANES

Navy Department
Bureau of Construction and Repair
Washington, D. C. April 15th 1916.

D W Taylor
CHIEF CONSTRUCTOR U.S.N.
CHIEF OF BUREAU



Left: The Marine Corps insignia for aircraft of the Day Wing, Northern Bombing Group in France is shown here. This is the earliest known, officially approved unit insignia in US naval aviation.

manufacturers' designations such as the Curtiss N-9 and HS-2L.

On May 21, 1918, the Chief of Naval Operations granted permission for NAS Pensacola, Florida to place squadron designating marks on seaplanes used for training. These marks had to be removed if the aircraft was transferred.

The marking of individual aircraft within a squadron or larger unit appears to have been a very haphazard affair based on the ideas or requirements of each unit. Photos indicate some units used the first letter of the name of the base plus sequential numerals, but there was no established policy at this time.

For example, the four Marine Corps squadrons (7th, 8th, 9th, and 10th) comprising the Day Wing, Northern Bombing Group, used a system of its own to designate the DH-4 and DH-9A aircraft just as they had devised a unique Marine Corps emblem. This system consisted of a letter-number designation. All DH-4s were designated by the letter "D" and the numbers 1 to 17. The DH-9As were designated by the letter "E" and numbers 1 to 21. These aircraft were used jointly by the various squadrons as needed. The designation had no significance other than to show the type and numerical sequence in which they were received by the Wing.

At first these markings were 10 inches (25.40 cm) high, white, block letters and numerals on each side of the vertical stabilizer. Message No. 15403 from Major A. A. Cunningham, Commanding Officer of the Day Wing, dated October 2, 1918, revoked these instructions. In their place 10 inch (25.40 cm) white letters and numerals were to be painted on top of the fuselage midway between the vertical stabilizer and the observer's seat, front of the letters toward the observer's seat. The same number was to be painted on the side of the fuselage midway between the pilot's and observer's seat in black letters 2½ feet (76.20 cm) high. Message No. 12508 dated October 8, 1918, revoked the provisions of Message No. 15403 and reverted to painting the Group numbers 10 inches (25.40 cm) high on each side of the vertical fin. Obviously, few aircraft, if any, actually were painted with the designation on the top and sides of the fuselage.

As the Army DH-4s were received, the Air Service number was removed and the Navy serial number was painted in small black characters at the top of the white stripe on each side of the rudder. The DH-9As were to be treated in the same manner; however, to date no photos have been located that show they were so designated. The original British serial number, which began with an "E," is painted on the aft portion of the fuselage in all known photos.

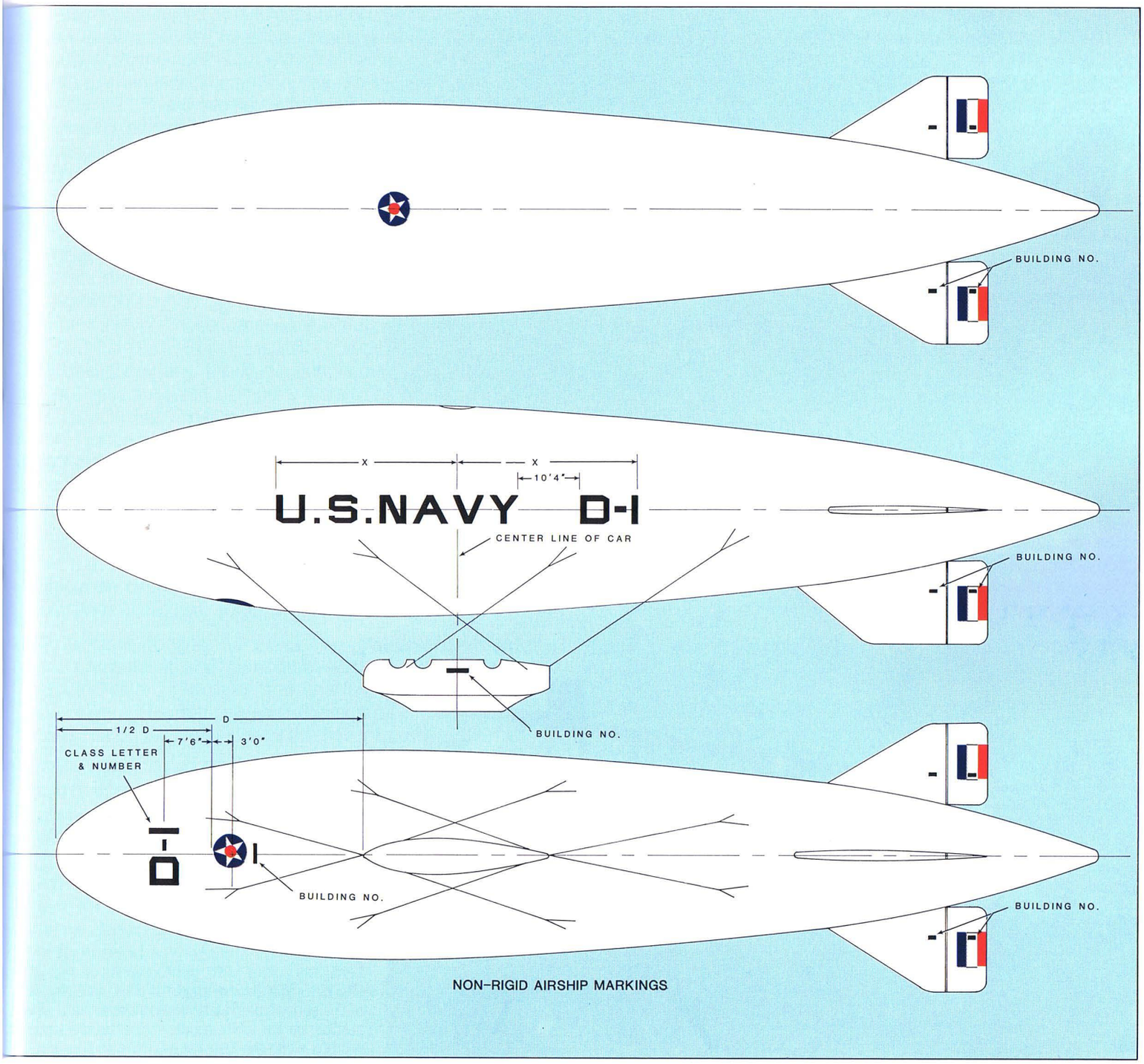
One of the most colorful as well as the most distinctive markings on Marine Corps aircraft has been the Marine Corps emblem in its various forms. Yet its history is obscured by lack of records. When the First Marine Aviation Force was preparing to depart France in 1918 most of its records were burned including those of the first Marine Corps emblem to be used on aircraft. The following has been pieced together through contacts with those who served in France, including its designers, and the few remaining records.

Shortly after arriving in France, Major Alfred A. Cunningham, the Commanding Officer of the Day Wing, Northern Bombing Group, expressed his desire for a distinctive emblem for the First Marine Aviation Force's aircraft. The design chosen was made by Quartermaster Sergeant John J. Engelhardt, Wing Camoufleur and Sergeant James E. Nicholson, Wing Administration Chief. This design consisted of the red, white and blue roundel, the national aircraft insignia then being used on American aircraft, replacing the globe in the Marine Corps emblem. The eagle and anchor were painted in shades of brown and white as used on the organization colors. This is the earliest use of the Marine Corps emblem on an aircraft, and, in fact, is the oldest approved unit insignia in US Naval aviation. From photographic evidence it seems that the emblem was always placed just aft of the rear cockpit of the DHs. They were used in pairs as all Marine Corps emblems on aircraft have been. That is, a right and left hand emblem as worn on the uniform collar, which when properly applied causes the anchor and the eagle to point forward on both sides of the aircraft. Photos do show aircraft with the anchor facing aft but these "dragging anchors" are in error. The rules of heraldry require an emblem to face the enemy.

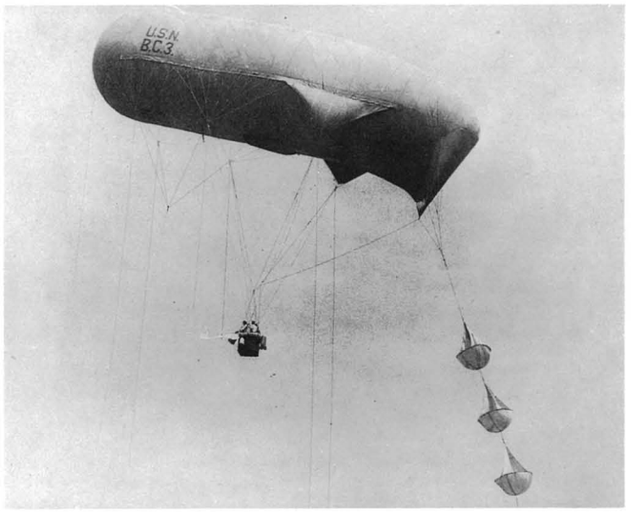
This emblem, during World War I, was used only on the DHs of the Day Wing, Northern Bombing Group. The 1st Marine Aeronautic Company operating seaplanes in the Azores had no such distinctive Marine Corps marking, nor was one used on the aircraft in the United States.

As dirigibles have both an envelope and a control car which

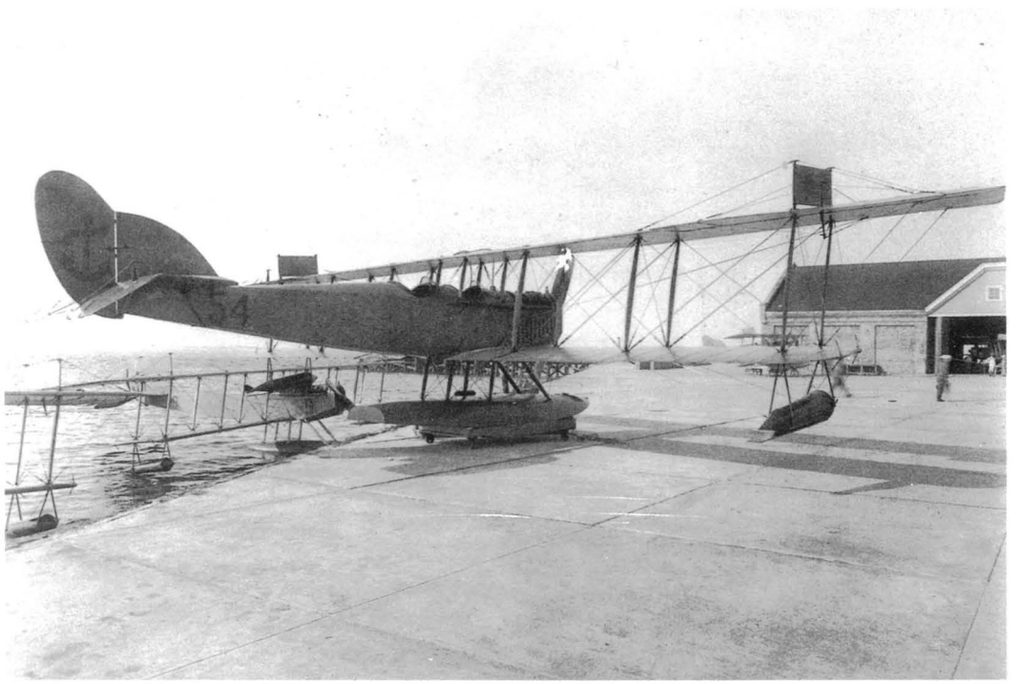
Right: The Gallaudet AH-61 is shown in January 1917, with the aircraft serial number applied to both the front and rear fuselage. This should read A-59. Note the midship position of the propeller on this unusual aircraft.

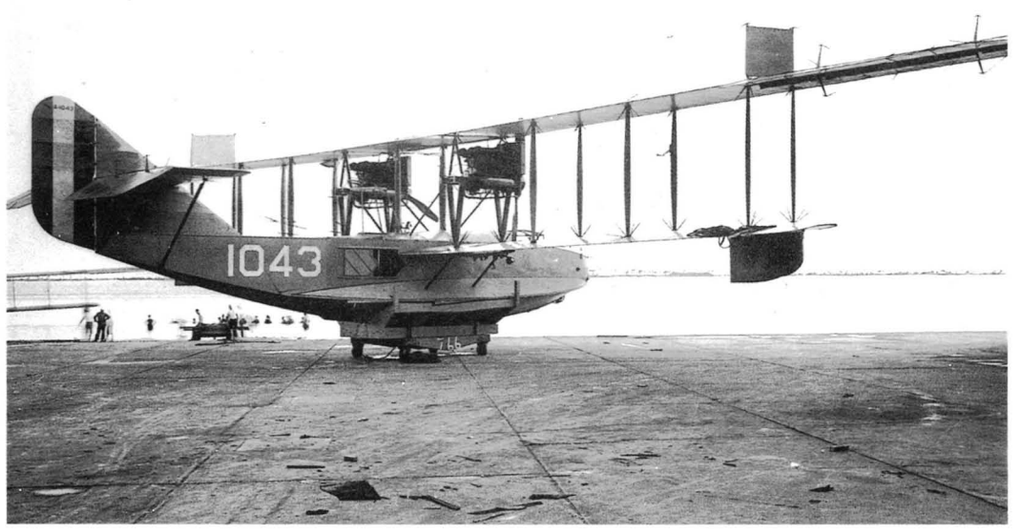


NON-RIGID AIRSHIP MARKINGS

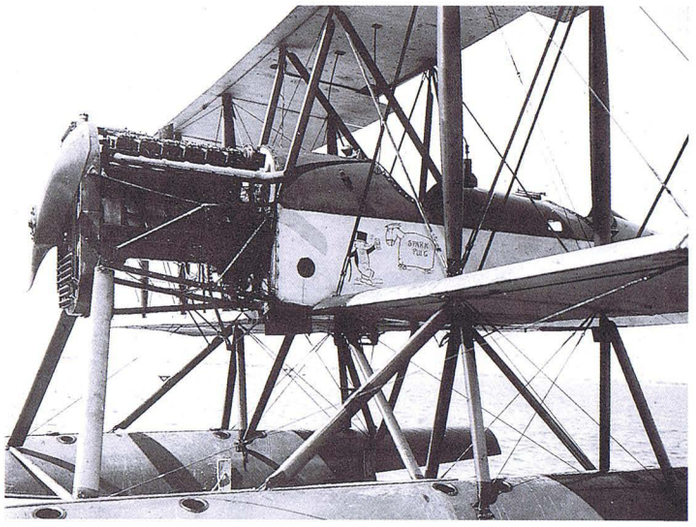


Left: A kite observation balloon was flown from a ship at sea in 1917. Note the sea anchors to help stabilize it. The chart of aircraft types shows this to be number 3 captive balloon. **Below:** The blue anchor on the tail was standard for this early period. However, the numbers on the rear and forward fuselage are local identification numbers, not the aircraft serial number.





Left: This Curtiss H-16, photographed on August 23, 1918, is a good example of the inconsistency of the early markings. Note that the aircraft serial number on the white rudder stripe has the letter A prefix while the fuselage designation does not.



Right: The early aviators applied many personal decorations to their aircraft such as this rough example of the cartoon character Barney Google and his horse Spark Plug on this Curtiss R-6.

were manufactured by different concerns, a building number had to be assigned to each component. Those numbers assigned to the control car were prefixed with a letter "A" as if it were an airplane. The envelope numbers were prefixed with a letter "E." These two series of numbers ran independently giving no indication in themselves to the type or class of the airship, the complete dirigible being known by the building number of the control car.

On October 18, 1918, the Bureau of Construction and Repair proposed to the Chief of Naval Operations to assign letters in alphabetical order to each of the current classes and to continue with subsequent airships. Under this system the first dirigible built by the Connecticut Aircraft Company was to be known as A-1. Those following of 77,000 to 84,000 cubic feet (2180.40 to 2378.61 m^3) capability built by Goodyear Tire and Rubber Company, the B. F. Goodrich Company, and the Connecticut Aircraft Company were to be known as B-1 to B-16 inclusive. The twin airships being built by the Goodyear and Goodrich companies were to be known as C-1 to C-10 inclusive, and the new design of twin engine airships was to be D-1 to D-20 inclusive.

These designations would not interfere with the building numbers. For instance the car A-4118 and envelope E-103 were assembled to form the first twin engine dirigible which would be dirigible C-1 under this system. Car A-4119 and envelope E-132 was to be dirigible C-2.

To facilitate recognition in the air it was also proposed to paint the Class letter and number of each dirigible in blue or shaded letters, the same size and form as those used on destroyers. This marking was to be located centrally on each side and on the lower side of the bow of each bag.

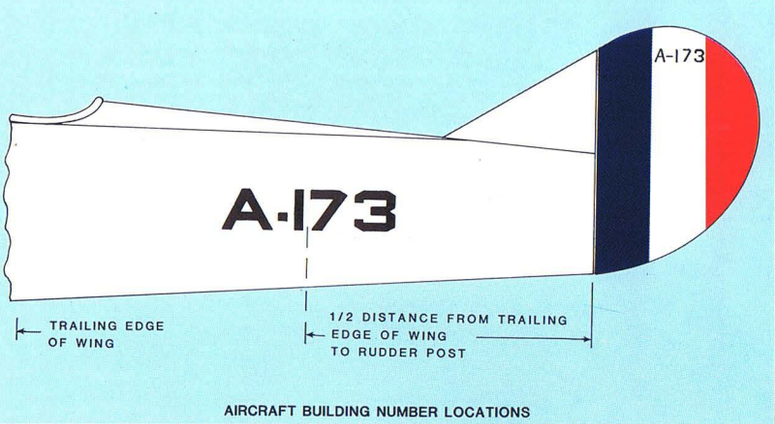
The Chief of Naval Operations concurred on November 14, 1918, in the designation of the C Class and subsequent airships and the method of marking. However, as some of the dirigibles which would come under the Class A and B designation were already out of service, these classes retained their present designating numbers. While these airships may never have carried the A or B designation, they were used for record keeping and appear in correspondence of the period.

Nothing has been located which directed the designation of Navy aircraft during this period.

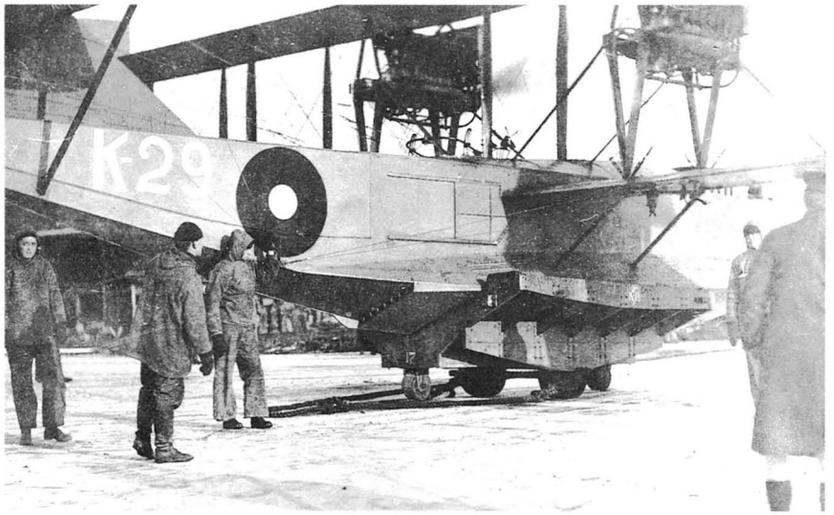
Aircraft Specification No. 49, dated November 30, 1918, specified that the building letter and number be painted on each side of the rudder, 3 inches (7.62 cm) below the top edge of the white rudder stripe in 3 inch (7.62 cm) black figures. The top and bottom of the fuselage would carry the designation in 12 inch (30.48 cm) black figures midway between the wings and rudder. The figures were to read from front to rear with the bottom of each figure being towards the rear.

The designating letter and number for dirigibles also was to be painted on each side of the rudder at the top of the white stripe in 3 inch (7.62 cm) black figures. This number also was applied in 12 inch (30.48 cm) black figures on the bottom and 120° up on each side, approximately midship. On kite and free balloons this designating letter and number was applied just below or aft of the lower insignia in black figures 3 inches (7.62 cm) high.

On April 5, 1919, the Chief of Naval Operations directed all Naval Air Stations that U.S. NAVY was to be applied on each side of all Navy airships in blue letter 108 inches (274.32 cm) high. The letters were to be painted on fabric and affixed to the envelope in a position established by the intersection of a horizontal longitude axial plane with the envelope and forward of its greatest diameter. It is doubtful that any airships were marked with these large letters as a new directive was under preparation which reduced this marking to one half the size.



AIRCRAFT BUILDING NUMBER LOCATIONS



Left: The first letter of the base name and a sequential numerical aircraft number were typical identification on the US Navy aircraft in Europe as shown on this F-5L at Killingholm, England, during World War I.

On May 10, 1919, preliminary copies of Aeronautical Specification No. 49 were circulated to various manufacturers and commands for comments. Instructions issued to the field based on this document were approved by the Bureau of Construction and Repair when they complied with the final version which was being compiled. Therefore it is not possible to establish a date that U.S. NAVY was first applied to dirigibles, free and kite balloons.

When the revised Specification No. 49 *Aircraft Insignia and Marking* was issued in December 1919, it contained detailed instructions for the marking of dirigibles, free and kite balloons. The class letter and number designating each airship, assigned by the Navy and specified in the contract, along with U.S. NAVY was to be painted on light empennage fabric and affixed to the envelope. Fabric of the same color as the envelope was preferred but not required.

Three sets of class letter and number were to be affixed to the dirigible envelope, preceded by the words U.S. NAVY. One set was to be on each side, the center of the lettering to be over the center of the car. One was also to be under the bow, with the center being 10 feet 6 inches (320.04 cm) forward of the center of the lower national aircraft insignia. The characters were to be dark blue 54 inches (137.16 cm) high.

Building letters and numbers designating each set of control surfaces and corresponding stabilizers or fins were to be black letters 3 inches (7.62 cm) high on each side. Letters and numbers on the under surfaces were to be placed so that the bottoms of the characters were inboard. On the upper surface they were placed so the bottoms of the characters were outboard. On the vertical surfaces they were to read from forward aft on the left side and aft forward on the right side. The characters on the elevators were to be painted in the white band so that the tops of the letters and numbers were 3 inches (7.62 cm) from the inboard edge of the band. On the rudders they were to be 3 inches (7.62 cm) from the top edge of the white band. The building numbers painted on the fins or stabilizers were to be in a direct line with the letters and numerals on the control surfaces and 6 inches (15.24 cm) forward of the rear edge of the fin or stabilizer. The building letter and number of the car were to be black characters 3 inches (7.62 cm) high on each side of the car about midpoint of its length and level with the top longitudinal member.

The building letter and number of the envelope were to be black characters 3 inches (7.62 cm) high only on the lower side and just aft of the lower national aircraft insignia. The top of the letter and number were to be towards the insignia. In the event the color of the envelope was such that the black characters would not be readily distinguishable, there was to be a white background painted with a 1 inch (2.54 cm) margin around the characters.

The words U.S. NAVY were to be painted on fabric and affixed to the envelope of each free balloon in the same manner as used on dirigibles. This identification was to be applied on opposite sides of the balloon in a horizontal plane at the largest diameter. The letters were to be dark blue 54 inches (137.16 cm) high.

The building letter and number were to be painted on the envelope 3 inches (7.62 cm) below the lower insignia in black letters 3 inches (7.62 cm) high. As in the case of the dirigible a white background with 1 inch (2.54 cm) margin around the characters was to be painted on a dark fabric to increase the contrast and readability.

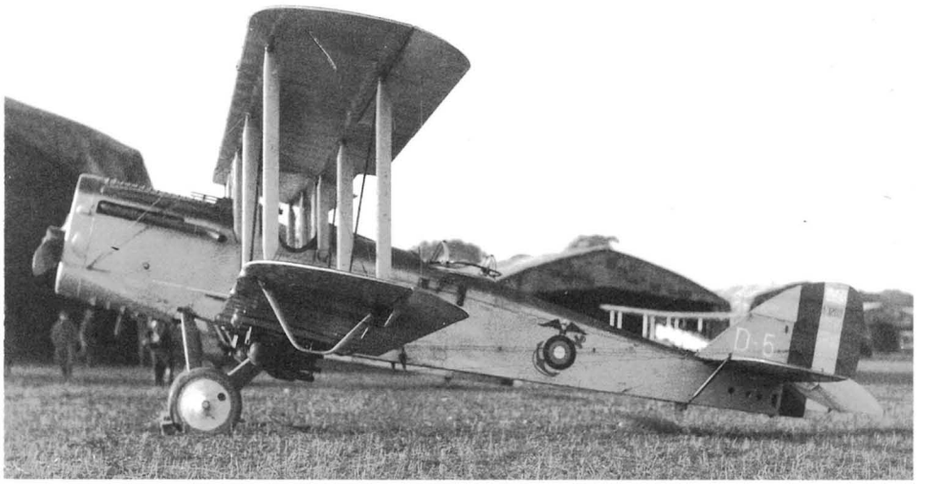
Kite balloons were to have the words U.S. NAVY painted on light empennage fabric and attached to the envelope on the longitudinal center line approximately midway between the nose and forward end of the empennage. The letters were to be dark blue 54 inches (137.16 cm) high.

The building letter and number was painted on the envelope 3 inches (7.62 cm) aft of the lower national aircraft insignia in black characters 3 inches (7.62 cm) high. As in the case of the dirigible and free balloon, a white background was to be painted on the envelope if the fabric were a dark color.

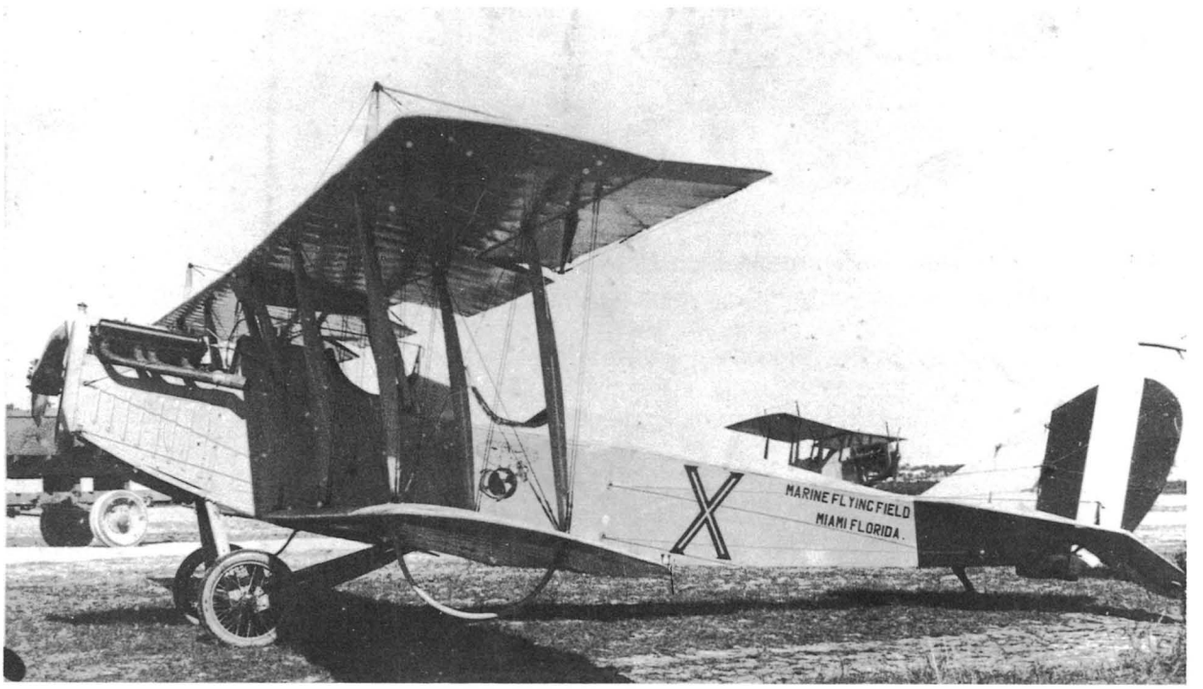
Free balloons and kite balloons used by the Marine Corps normally carried the U.S. NAVY designation.

The building letter and number location on the fuselage was also changed by Aeronautical Specification No. 49, dated December 1919, to be midway between the wings and rudder on each side of the fuselage. Color and size remained the same.

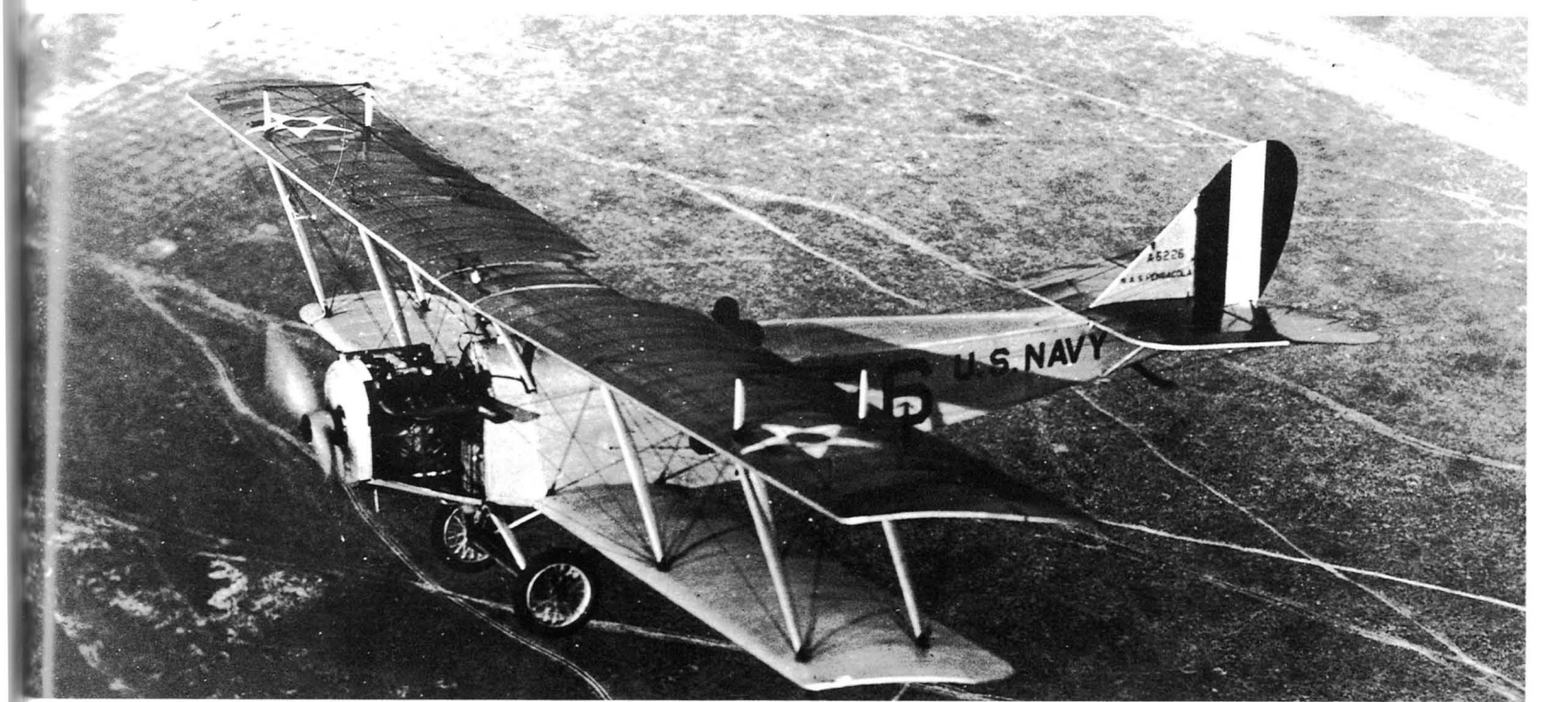
The directed form of the letters and numerals to be applied to both heavier-than-air and lighter-than-air aircraft were to be as shown.

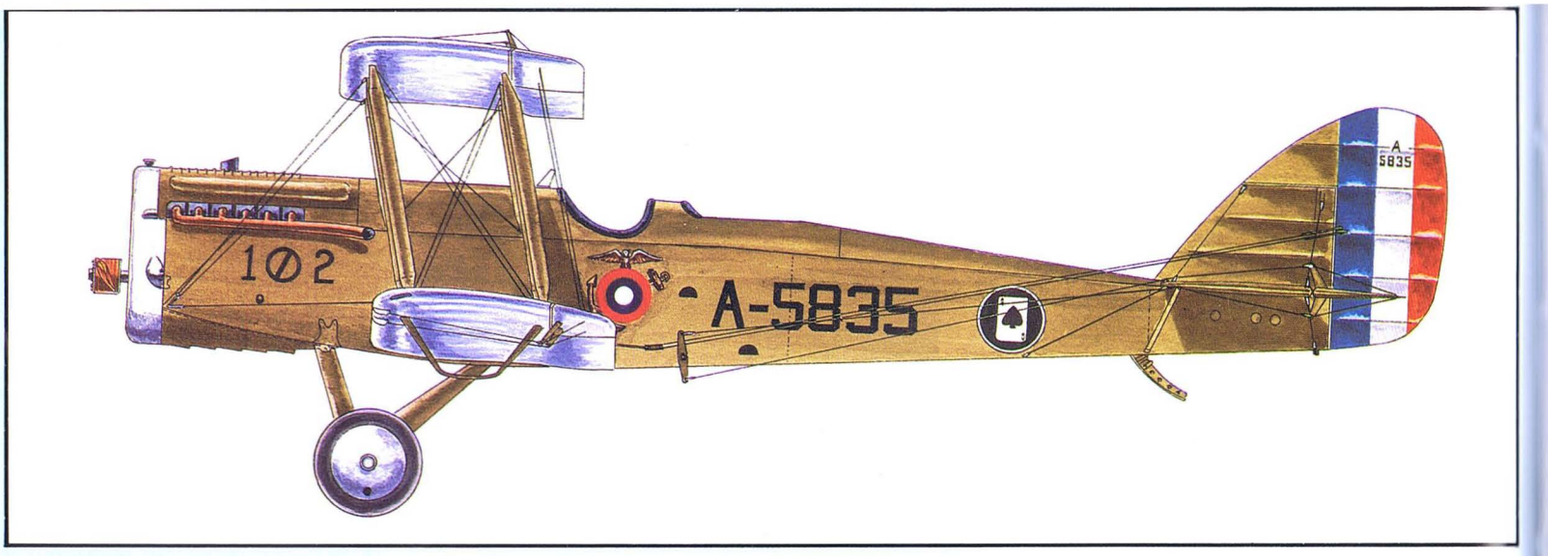


Right: This distinctive Marine Corps insignia, combining the American roundel and the Marine Corps emblem, was applied only to the DH-4s and DH-9s of the Day Wing, Northern Bombing Group in France during World War I as shown on this De Havilland DH-4.



Right: A Curtiss JN-4 is shown circa 1918. A rough version of the Marine Corps insignia has been applied under the rear cockpit. The significance of the X is unknown. **Below:** This Curtiss JN-4H was assigned to the Naval Air Station Pensacola, Florida, as shown by the designation on the tail fin.





CHAPTER 8 1920–1929

The Bureau of Construction and Repair letter of May 21, 1920, requesting information on any special painting and/or markings being used in the field showed most units to be painting their aircraft as specified. However, the reports show variations had been adopted locally by nearly every installation. Aircraft of the Atlantic Fleet Air Detachment were identified by a system of black and white stripes or squares on the hull of each flying boat. These had been developed to aid in joining up for squadron formations, allowing each aircraft to be recognized almost as far as it could be seen. This, of course, was not possible with the small serial numbers. The actual design was considered of no importance so long as the various designs were distinctive.

One aircraft was left with the original painting to which the last two digits of the serial number were painted on the sides of the hull. These numbers were repeated on the bottom of the hull, with the tops forward, in numerals 4 feet (121.92 cm) high.

While this system was satisfactory for the 6 flying boats of the detachment, its use in a larger force was questioned. To investigate a system that could be expanded to meet such a need, two aircraft were painted as a test—one with all struts, skid fins, and wing tip floats painted Bright Red, and on the other they were painted Bright Yellow. Limited trials showed these markings to be more clearly visible from an all around view than the system of stripes. It was suggested that all aircraft of one division be painted red as above, another division yellow, another aluminum, etc. The pilot easily could find his own division, after which the markings on the hull sides would enable him quickly to take his proper position in the formation.

Right: This Vought O2U-1 from VS-4B assigned to the light cruiser USS Omaha in 1928 is shown ashore on wheels in place of its normal floats. Note the manufacturer's name on the rudder and the E for proficiency in machine gun. The dark color of the metal surfaces may be due to the film used.

Illustration at top: The number 2 De Havilland DH-4B was assigned to Marine Observation Squadron One (VO-1M) based at Santo Domingo, Dominican Republic. The design developed for the Northern Bombing Group was now applied to all Marine Corps aircraft. The squadron number, type, and aircraft number applied to the nose was due to indecision regarding where these markings were to be applied even though the system had been approved.

Left: This Vought UO-1 has been assigned to the reserve squadron at Great Lakes, Illinois. The designation on the side of the fuselage combines the station designation, squadron and aircraft number.

F-5Ls of the Pacific Air Detachment at NAS San Diego were painted in accordance with regulations then in effect with the addition of yellow on the upper surface of the upper wing and skid fins. The bottom of the hull and bottom of the wing tip floats were painted with anticorrosive copper paint.

There were no deviations in painting and marking of lighter-than-air craft.

A more elaborate scheme had been developed by Pacific Air Detachment in Hawaii. Each type of aircraft was given a number as follows:

N9—10	HS— 40
F— 20	F-5L—50
R— 30	

Each individual aircraft was assigned a number from 1 to 10 which was added to the type number. Each base on the four main islands had been assigned a letter as follows:

Kaui—K	Pearl Harbor—P
Maui—L	Hawaii— H

Using this system N-9 number 1 from Pearl Harbor would be P-11, HS-1L number 5 from Hawaii would be H-45. These distinguishing numbers were to be applied in five locations: each side of the hull or fuselage, undersurface of each lower wing, and upper surface of upper wing center in block characters 24 inches (60.96 cm) high. The characters were to be white with a 1 inch (2.54 cm) Black outline.

As with other Pacific Air Detachment aircraft, the upper surface of the upper wing was painted yellow.

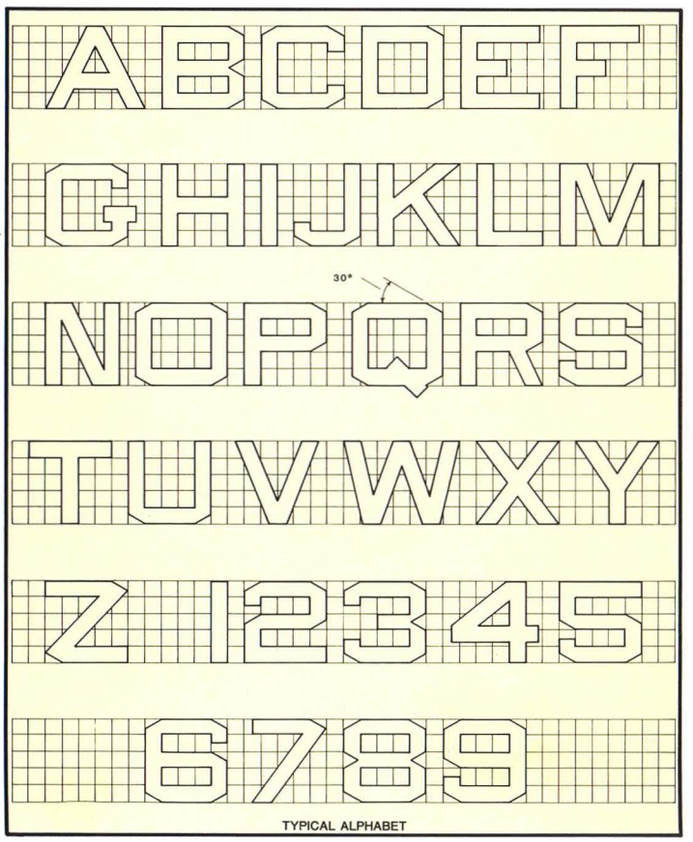
In order to quickly identify aircraft on the bombing range as well as student aviators, Pensacola had developed a system of large numerals which varied as to the aircraft type. This is described as follows.

1. On the N-9s the numerals were painted on both sides and bottom of fuselage and upper engine panel in black numerals 16 inches (40.64 cm) wide and 20 inches (50.80 cm) high with individual strokes 3 inches (7.62 cm) wide.

2. On the R-9s the numerals were painted on both sides of fuselage and upper engine panel in black numerals 20 inches (50.80 cm) wide and 24 inches (60.96 cm) high with individual strokes 4 inches (10.16 cm) wide. Black numerals on the bottom of the fuselage were 16 inches (40.64 cm) wide and 20 inches (50.80 cm) high with individual strokes 3 inches (7.62 cm) wide.

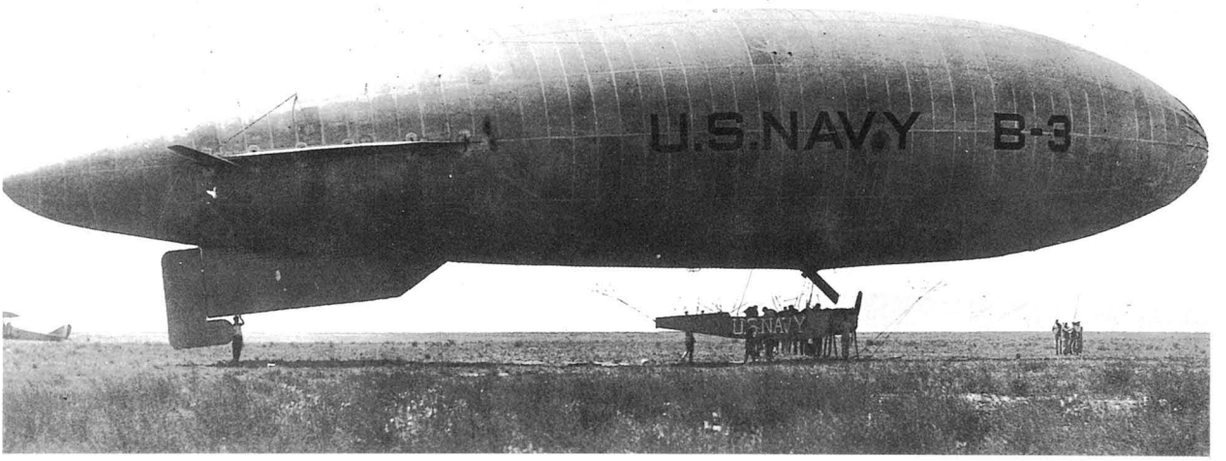
3. On the H-16s the numerals were painted on both sides of hull with white numerals 20 inches (50.80 cm) wide and 24 inches (60.96 cm) high with individual strokes 4 inches (10.16 cm) wide. The last two characters of the number were to be painted on the bow in white, 16 inches (40.64 cm) wide and 20 inches (50.80 cm) high with individual strokes 3 inches (7.62 cm) wide. The last two characters of the number in black were applied to the upper engine panel and under surface of the lower left wing 43 inches (109.22 cm) wide and 60 inches (152.40 cm) high with individual strokes 8 inches (20.32 cm) wide.

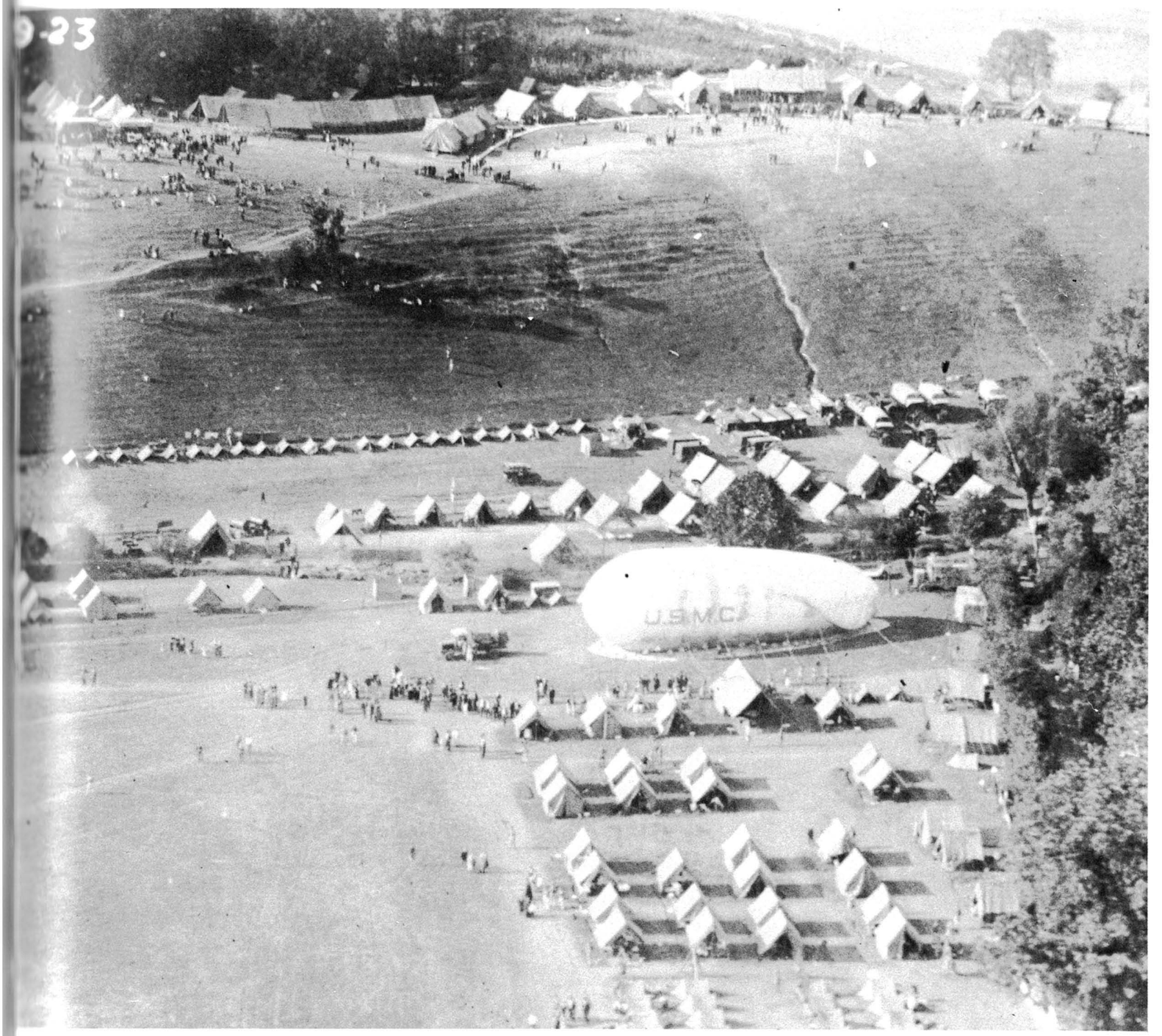
4. On the HS type the numerals were painted on both sides of the hull with white numerals 20 inches (50.80 cm) wide and 24 inches (60.96 cm) high with individual strokes 4 inches

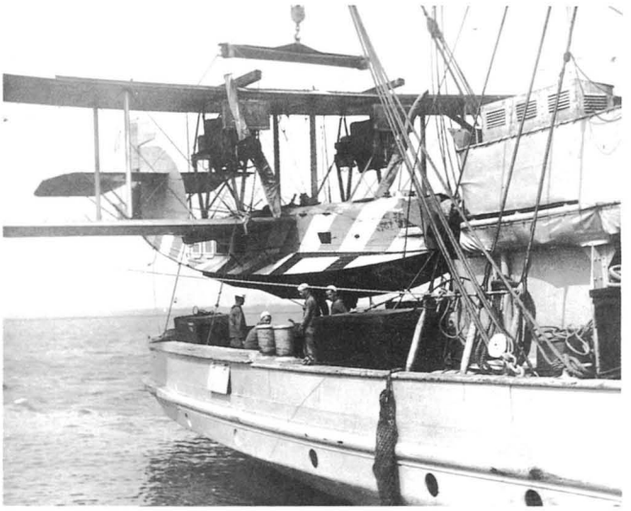


TYPICAL ALPHABET

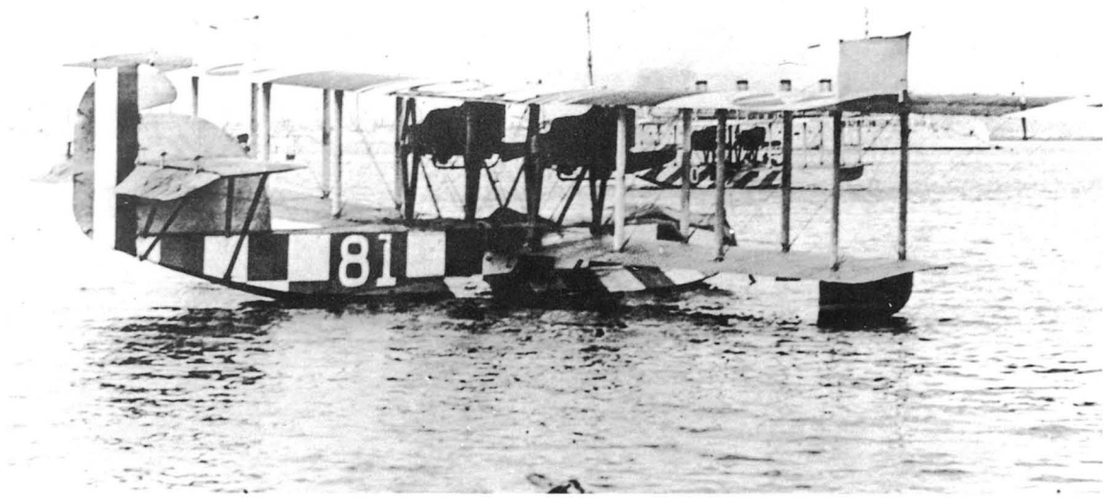
Right: This non-rigid airship B-3 was photographed in 1921 at NAS San Diego, California. Note that both the envelope and gondola are identified, as the control car can be detached and used with a different envelope. In such a case the control car designation would be the controlling number. **Below:** One of the very few captive balloons operated by the US Marine Corps is shown in 1923 during the summer maneuvers in the Shenandoah Valley where the Civil War battle of New Market was being re-enacted.



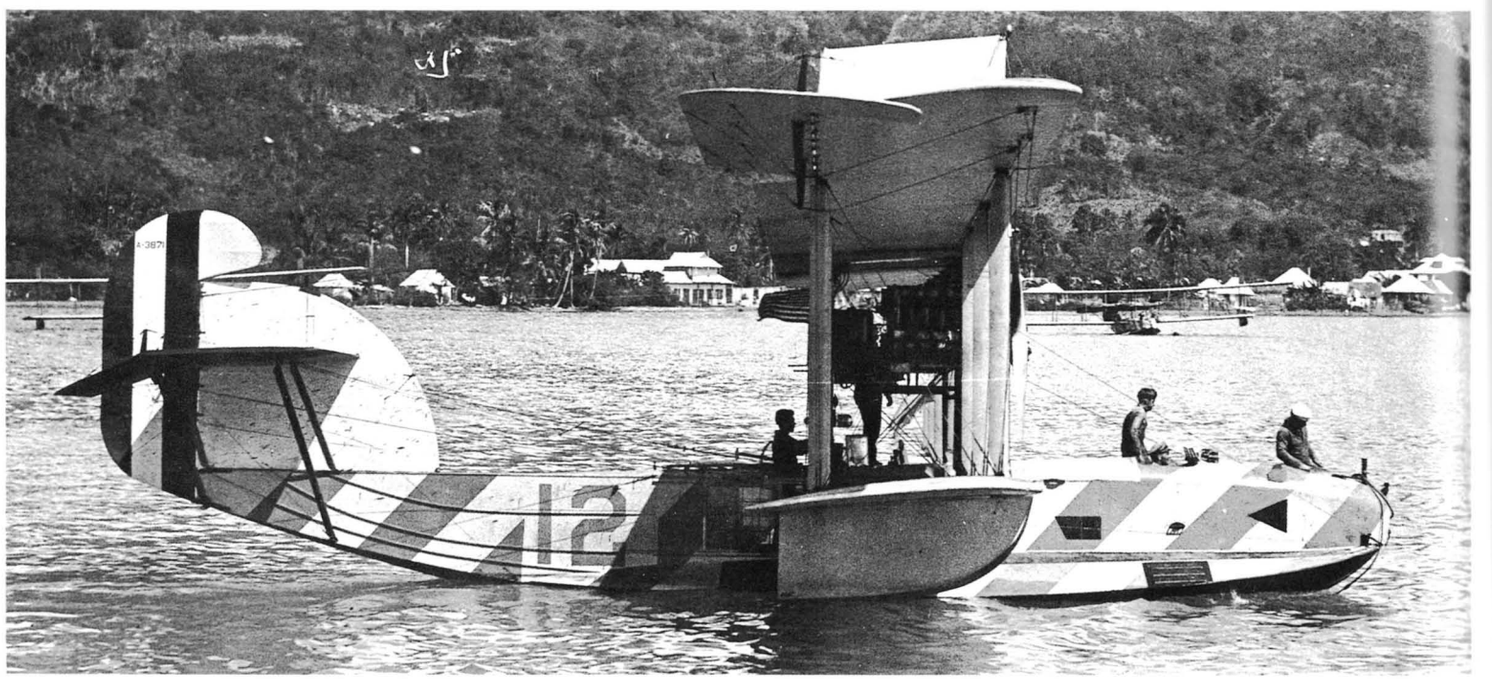


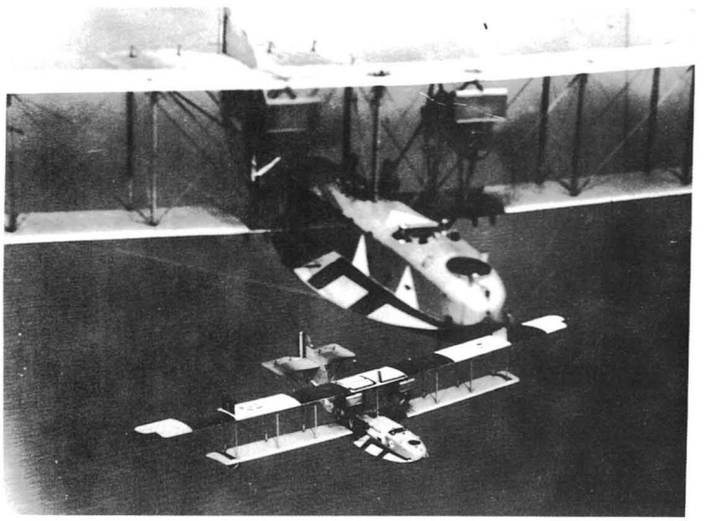


Left: A Curtiss F-5L of the Atlantic Fleet Scouting Squadron One with their early stripe recognition system is being hoisted aboard its tender. Note that the aircraft number 90 is applied on the forward bottom of the hull as well as on the side of the hull.



Left: Another Curtiss F-5L of the Atlantic Fleet Scouting Squadron One is identified with a checkerboard paint scheme. **Below:** A third design from the Scouting Squadron One recognition system has been applied to this F-5L shown on January 1, 1924, at St. Louis Bay, Haiti, on the way to Culebra, Puerto Rico, for fleet maneuvers. The large number 12 is a squadron-assigned aircraft number and has no relationship to the aircraft's serial number of A-3871. Note the gunnery pennant award on the bow.





Right: This Curtiss F-5L of Scouting Squadron One shows the wing stripes that were applied to aid in spotting an aircraft forced down at sea during the first flight from Norfolk, Virginia, to Coco Solo, Canal Zone, in January 1921. These were in addition to the stripe-and-checkerboard recognition system.

(10.16 cm) wide. Numerals under the lower wing were to be viewed from the front. The first two characters on the left wing and last two on the right were painted black 30 inches (76.20 cm) wide and 40 inches (101.60 cm) high with individual strokes 6 inches (15.24 cm) wide. Aircraft used for bombing had their numbers in the same location except that the black characters on the lower wing were 30 inches (76.20 cm) wide and 54 inches (137.16 cm) high with individual strokes 6 inches (15.24 cm) wide.

Marine Flying Field Quantico, Virginia requested that a circle approximately 24 inches (60.96 cm) in diameter be painted on each side of the fuselage abaft the rear cockpit, enclosing a letter designating the base from which the aircraft is permanently flown, such as "Q" for Quantico. While this marking never was applied to any of the Quantico aircraft, they did have an insignia consisting of a black cat and the number 13 painted on the side of one JN-4 to indicate the only aircraft in which stunting was allowed.

The Commanding Officer of the Naval Air Station Norfolk, Virginia thought that special markings for local identification were a necessity in addition to those required by General Order No. 523. The first letter of the station name or a design (triangular, circular, etc.) should be placed at the center of the top surface of the upper wing and forward of the present number on the side of the hull or fuselage. These markings were recommended more to show the station to which the aircraft belonged than as a recognition aid for rendezvous purposes.

With the end of World War I all aircraft were left in France as the Marine Corps units returned to the United States. Demobilization and reorganization occupied the next few months. Then in August 1920 a directive was promulgated specifying that the First Marine Aviation Force designed insignia was to be placed on all Marine Corps aircraft. It is not known the degree of compliance although photos do show that some aircraft in Haiti and Santo Domingo carried this marking. It is rather odd that such an insignia would be used at this time as Navy Department General Order No. 498, dated August 19, 1919, had directed that the national aircraft insignia revert to the circle within a star within a circle.

The Aircraft Squadron's Atlantic Fleet F-5Ls which made the first flight to Panama in January 1921 had the upper wing's upper surface painted in large black and white stripes to make them more readily seen by the other aircraft in the event of a forced landing at sea.

Technical Note No. 213 dated March 29, 1922, changed the system of designating Naval aircraft, adding the identify of the manufacturer to the model designation. Heavier-than-air craft were designated by the Type Letter "V." To this the following letters were added to make up the Class Designation.

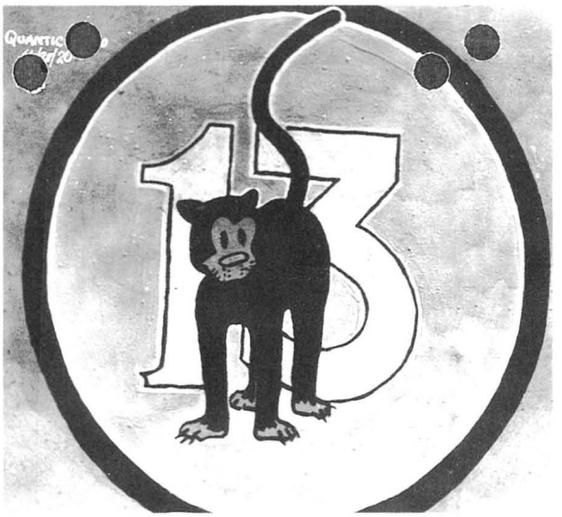
F—Fighting Plane
O—Observation Plane
S—Scouting Plane
P—Patrol Plane
T—Torpedo and Bombing Plane
G—Fleet Plane
A—Training Plane
M—Marine Expeditionary Plane

When a contract was given to build an airplane, the model was designated by a key letter designating the manufacturer, followed by the Class Designation Letter shown above. The Type Letter "V" is not used in this case but is used in correspondence. For example: the first Davis-Douglas torpedo plane would be designated DT. If there were major alterations to this basic design, it then would become DT-2 (the use of -1 for the initial model was not adopted until later). If the same company received another contract to build another design of the same class, such as the torpedo plane in the previous example, it then would be known as the D2T. Major modifications to it would then be D2T-2, D2T-3, etc.

The following key letters were assigned to the various contractors.

A	Aeromarine	K	J. V. Martin
B	Aerial Engineering Corp.	L	Loening Aero. Eng. Corp.
C	Curtiss A & M Corp.	M	Glen L. Martin Co.
D	Davis-Douglas Co.	S	Stout Engineering Laboratories, Inc.
E	G. Elias & Bros. Inc.	T	Thomas-Morse Aircraft Co.
F	Fokker	U	Lewis & Vought Co.
G	Gallaudet Aircraft Corp.	W	Dayton-Wright Co.
H	Huff-Dalland Co.		

This system with one basic modification continued in use until September 18, 1962.



Left: This black cat and the number 13 was painted on the fuselage of the only JN-4 authorized for aerobatics at Marine Flying Field, Reid, Virginia in 1920. **Right:** A Douglas DT-1 of Torpedo and Bombing Squadron One with no apparent US Navy designation.

Naval Aeronautic Organization for Fiscal Year 1923, dated June 17, 1922, specified a new code system to denote the squadron number, squadron Class and the aircraft number. This system lasted until January 5, 1943, when the squadron number was dropped for security reasons. The first figure was the number of the squadron, followed by a letter designating the class of squadron, followed by the number of the particular airplane in that squadron. The class designator for observation was an oblique line so as not to be confused with the zero in either the squadron or aircraft numbers. At this time there was no mention of Marine Corps aviation in the Naval Aeronautic Organization letter.

Under this system the various squadron aircraft would be marked as follows.

1S1	First plane in Scouting Plane Squadron 1
1T3	Third plane in Torpedo & Bombing Plane Squadron 1
3/8	Eighth plane in Observation Plane Squadron 3
2F18	Eighteenth plane in Fighting Plane Squadron 2

This order also changed the method of designating squadrons. Squadrons no longer were numbered to conform to the number of the squadron of ships they served. Under the new system all squadrons were numbered sequentially within each class in the order of the authorization for organizing them.

On July 20, 1922, the Major General Commandant wrote the Chief of Naval Operations outlining his proposed Aeronautic Organization of the Marine Corps in which each squadron was assigned its new title and the designation of aircraft indicated. The organization and designation followed those prescribed for Naval aviation. This letter appears to be the first that specified a circle around the class designator to indicate a Marine Corps unit. The recommendation was approved by CNO on August 3, 1922. The Major General Commandant then issued an order on August 17, 1922, to all Marine Corps Aviation units giving the new designation to be used in correspondence for each squadron and the system to be used in marking Marine Corps aircraft. No precise method of marking aircraft had been given in the June 17, 1922, directive, nor were any instructions given in the Marine Corps directive as to location, size nor color for these markings. Marine Corps unit designations appeared for the first time in these letters. Each squadron was to report to Headquarters the location and size used. Thus Marine Corps aircraft were to be marked in the following manner:

1 Ⓕ 1 First plane in Fighting Plane Squadron (1)
2 Ⓞ 6 Sixth plane in Observation Plane Squadron (2)
1 Ⓢ 3 Third plane in Scouting Plane Squadron (1)

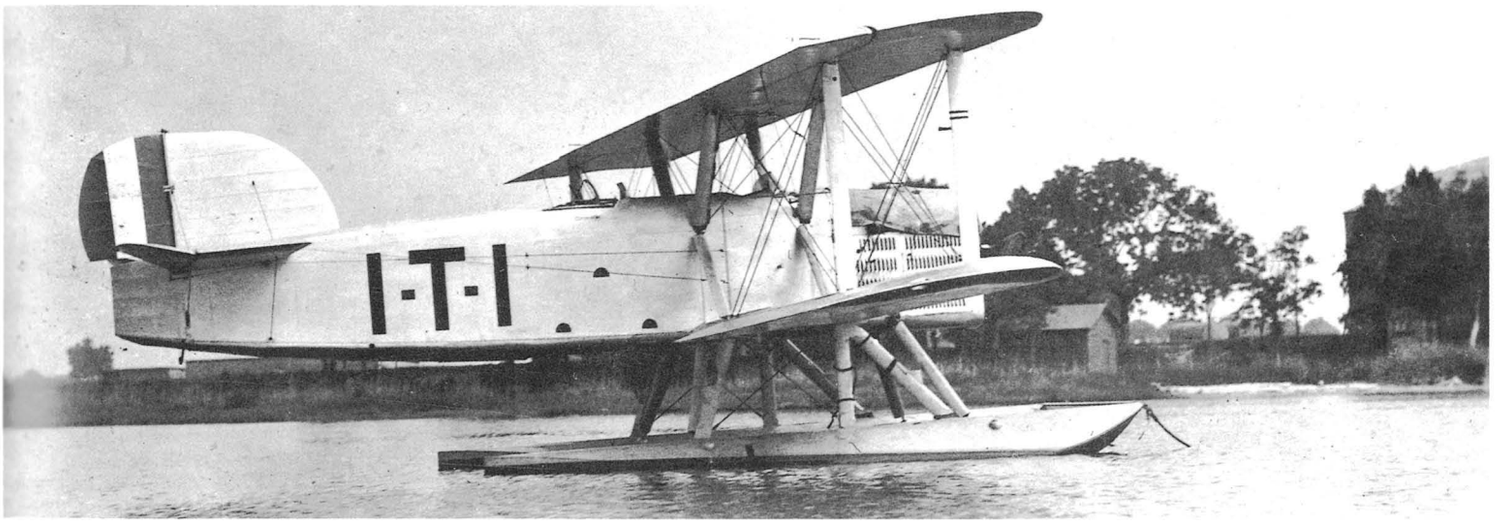
This lack of instructions resulted in some unusual markings. For example, Marine Corps Observation Squadron 1 at Santo Domingo City, Dominican Republic painted its markings on each side of the engine cowling of their DH-4Bs in 9 inch (22.86 cm) black characters.

Perhaps because of the conflict between the insignia on the wings and the Marine aviation emblem on the side of the fuselage, the Marine aviation emblem was cancelled. A letter effective upon receipt, issued in November 1922 stated:

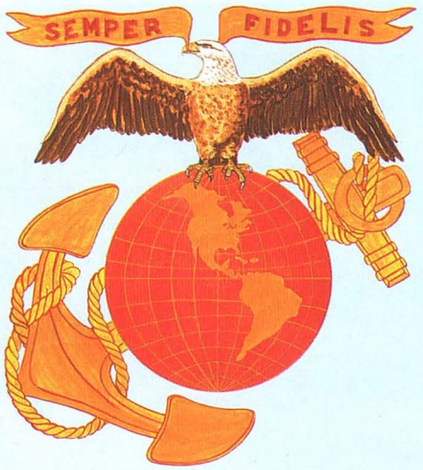
> "Upon receipt of this letter the Marine Corps device will be placed on the fuselage or hull of all airplanes, seaplanes and flying boats at your station in the manner described below. The device will be identical with the officer's collar ornament (without the rope or ribbon sometimes placed in the eagle's mouth). The entire device will be in brilliant red, of the same shade as the red stripe on the rudder, with the exception of the continents of North and South America which will be in yellow."

No specific size nor location was given, but it appears they were made as large as possible and normally were placed on the fuselage just under or aft of the cockpit. As few squadron painters were artists, a great variety of emblems were produced both as to shape and accuracy. Because of this most units used a stencil for this emblem.

Commander Aircraft Squadrons, Scouting Fleet on November 9, 1922, wrote the Bureau of Aeronautics concerning the markings to be applied to the new F-5Ls of Scouting Plane Squadron One. It was proposed that the hull would be painted a distinctive color to identify aircraft within each of the three divisions, also that they continue using the same six individual



Right: The squadron insignia of Scouting Plane Squadron One is shown on its number 1 PN-7. The significance of the pennant is unknown. However, it is believed that it was a local design combining the national aircraft insignia with the Broad Command Pennant to signify the senior aviation unit of the Atlantic Fleet. **Below:** This Curtiss JN-4 was upgraded to a JN-6HG. Note the unofficial Second Aviation Group insignia and style of Marine Corps insignia applied in 1925. **Left:** A typical Marine Corps marking was this written-out squadron designation also listing where the unit was based, in addition to the normal designation on the side of the fuselage.



Left: This official Marine Corps insignia was to be applied to all Marine Corps aircraft after November 1922. They were provided as decalcomania to eliminate the variations due to the local painters skill. **Below:** A Douglas OD-1 was assigned to Observation Squadron 1M (VO-1M) in 1926. Note that it carries the official style of the Marine Corps emblem. The / for observation is placed within a circle to designate a Marine Corps observation squadron.

markings in each division as was currently being used. These markings would then be:

Division One	Slate hull with white markings
Division Two	Blue hull with yellow markings
Division Three	Yellow hull with black markings.

The black and white upper wing's upper surface for visibility purposes would be continued. In addition it was recommended that the bureau number on the hull of the aircraft be replaced by its squadron designation of 1-S-1 to 1-S-18. The bureau number was to be retained on the top of the rudder.

This color scheme for identification purposes was approved by the Bureau on December 1, 1922. The replacement of the serial number with the squadron numbers was also approved. This is the first reference that this designation was applied to the fuselage sides.

While no directive has been located requiring the squadron number to be painted on the fuselage side, except for the above mentioned individual squadron authorization, this became the accepted practice. On May 1, 1923, the Commander Aircraft Squadrons, Battle Fleet recommended that the instructions be modified so that the bureau number be painted on the longeron in the pilot's cockpit and the rudder, as squadrons receiving aircraft must paint out the bureau number and repaint the proper squadron number in its place.

On July 12, 1923, a change notice to Aeronautical Specification No. 49 was issued. A portion of this notice said, "Inasmuch as the operating forces find it desirable to place squadron designating numbers on the sides of fuselage and hulls in the position specified for the navy building number, the Bureau directs that paragraph 16, 'Marking' be modified by striking out the last sentence which reads, 'Also the building letter and number shall be placed, in 12-inch [30.48 cm]

Right: The all metal ZMC-2 experimental airship was photographed on September 12, 1924. Not all of the rudders carried the red, white, and blue vertical stripes. **Bottom left:** This Vought UO-1 was assigned to the battleship USS Tennessee in July 1924. The battleship and cruiser names were prominently displayed during the later half of the 1920s. Battleships were named after states, cruisers after cities. The population of the city determined whether it was applied to a heavy or light cruiser. **Bottom right:** A Vought FU-2 of Fighting Two (VF-2B) being catapulted from the stern of a battleship. All pilots of this squadron, with the exception of the commanding officer, were enlisted. Note that the squadron insignia on the tail consists of a Chief Petty Officer Pilot-rating badge.

black figures, on the sides of the body, midway between wings and rudder....' " This change was to be incorporated on all aircraft not delivered at the time of receipt of the notice.

Aeronautical Process Specification No. 3, *Aircraft Insignia and Marking*, dated December 1, 1923, replaced Aeronautical Specification No. 49. The building letter and number, assigned by the Bureau in the contract, was now to be painted on each side of the fin rather than at the top of the white rudder stripe, these characters to be Insignia Blue 3 inches (7.62 cm) in height. While the instructions fail to mention the application of U.S. NAVY on heavier-than-air craft, the accompanying drawings show it is to be placed 3 inches (7.62 cm) below the building number on the fin in 3 inch (7.62 cm) letters. The exact shape of the letters and numerals was no longer specified, other than that they be of the block type.

Operating squadrons and stations were required to apply the unit identification group on the aircraft when placed in commission. These characters were to be Insignia Blue and as large as permissible. This identification group was to be placed on both sides of the fuselage or hull, on the upper surface of the upper wing and bottom surface of the lower wing. On the upper wing the bottom edge of the characters was to be towards the leading edge of the wing. On the lower wing the bottom edge of the characters was to be towards the trailing edge of the wing.

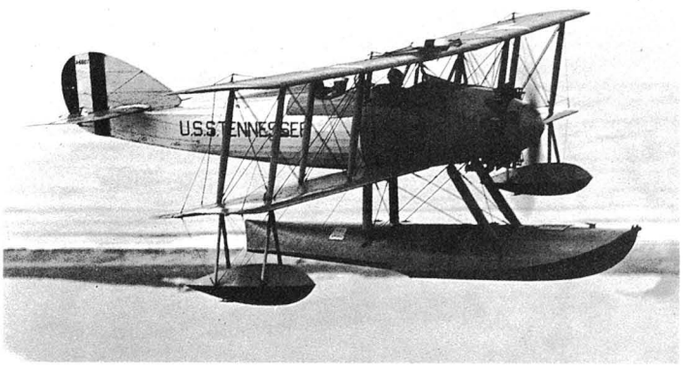
For squadrons this identification group remained the same as prescribed in the Naval Aeronautic Organization for Fiscal year 1923 directive. The designation for Naval Air Stations was slightly different. The first figure was the number of the squadron, followed by letters abbreviating the name of the station (where the name of a station consisted of two words the first letter of each word was used, where the name consisted of a single word the first and last letter of that word was used), followed by the number of the particular aircraft in the squadron. In the event such a squadron was assigned a specific function such as fighting, torpedo and bombing, observation or scouting the appropriate letter designating the type of squadron was inserted between the station abbreviation and the aircraft number. Each segment of this identification group was separated by a dash.

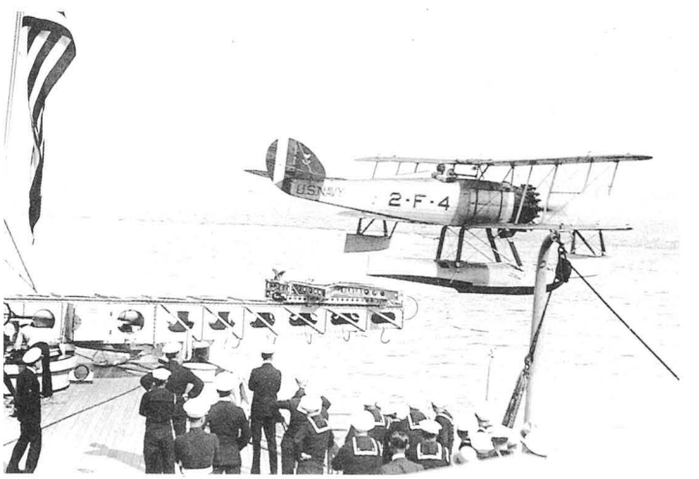
When seaplanes were assigned to a ship or station and not a part of a squadron, the identification group consisted of the name of the ship or station followed by the number of aircraft on the ship or station. Aircraft sections which were a part of a squadron, but based on a ship were to continue to use the proper identification group for their parent squadrons.

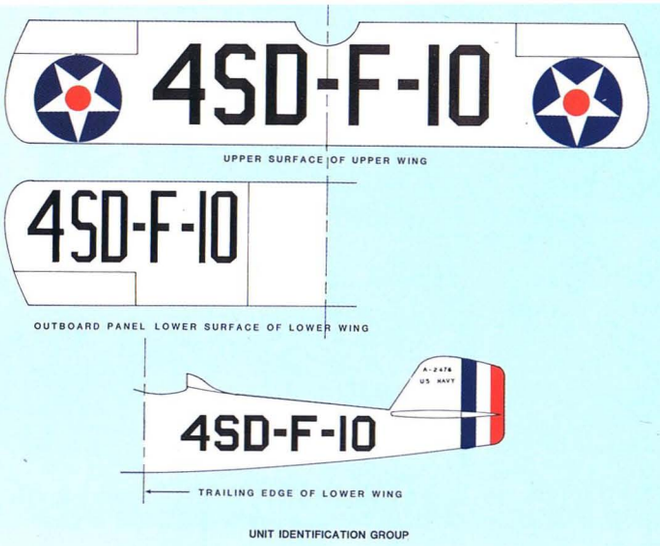
Examples of identification groups

2/10	10th aircraft in Observation Squadron Two
2HR-3	3rd aircraft in 2nd Squadron, Hampton Roads
2-T-10	10th aircraft in Torpedo and Bombing Squadron Two
4SD-F-10	10th aircraft in 4th Squadron (fighting) San Diego

USS CALIFORNIA 2 U.S. NAVY
NAS ANACOSTIA







Left: The prescribed markings designate the 10th aircraft of Fighting Plane Squadron One based at NAS San Diego, California. **Below left:** The same squadron would be identified in this manner if not assigned to a specific station. **Below right:** The unit and aircraft designation was to be applied to the bow of flying boats in this manner.

For the first time an individual squadron insignia was authorized to be applied to an aircraft. If used, it was to be applied to both sides of the fuselage or hull forward of the identification group provided it did not obscure or interfere with the identification group. However, normal practice of Marine Corps squadrons that did display an insignia was to locate it aft of the identification group or on the fin.

On March 10, 1923, Technical Note No. 235 modified the system of designating aircraft models by reversing the order of the letters in the combination, placing the class letter first and the manufacturer's letter last. With this revision the designation FB indicated a fighter built by Boeing. This modification applied only to new aircraft and did not change designations already assigned; however, this system remained in effect until 1962. The class symbol for training was changed from A to N, J was added for transports and G for fleet plane was dropped.

Aeronautical Process Specification No. 3A, dated August 1, 1924, required that operating squadrons, when placing aircraft in commission, paint in Insignia Blue the designation U.S. NAVY on both sides of the fuselage or hull, in line with and immediately following the identification group. The letters were to be as large as the space permitted but in no case to be less than 8 inches (20.32 cm) in height. While not mentioned in the text, the accompanying illustration for the first time shows the identification group placed forward on the bow of flying boat hulls.

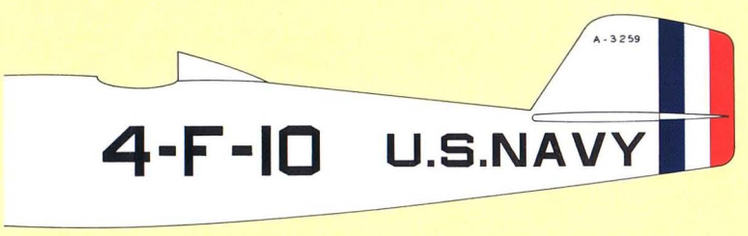
The Marine Corps "policy" was to disregard the required U.S. NAVY on the fuselage. For the first time an official painting directive specified that the class designation letter be within a circle to denote a Marine Corps squadron.

This directive specifically stated that the name or trademark of the manufacturer was not to appear on the aircraft in any conspicuous location other than the required identification plate on the instrument panel, without specific approval in writing from the Bureau. A diligent search of the records failed to find any such correspondence. However, the painting of the manufacturer's name across the red, white and blue rudder stripes was a common practice until the early 1930s. Curtiss and Vought did this more than any other manufacturer. Others such as Loening, Martin, Great Lakes, Berliner-Joyce, Keystone, Hall-Aluminum and Consolidated are known to have done so on occasion. It is strange that none of the west coast manufacturers applied their names in this manner.

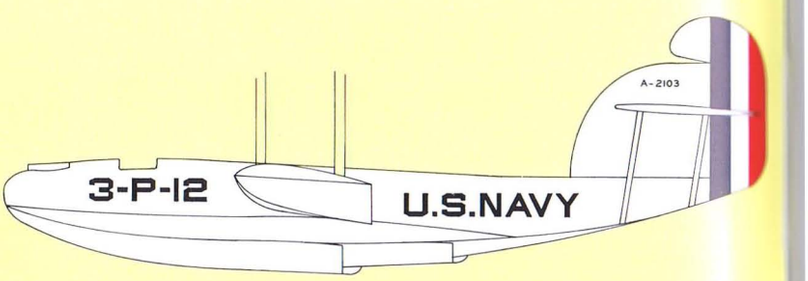
Aeronautical Process Specification No. 3B, dated December 15, 1924, changed the position of the identification group on the upper surface of the upper wing to read from the rear and at the same time changed the designation on the under surface of the lower wing so that the top of the characters were towards the trailing edge so as to be able to read them as the aircraft passed overhead.

Fighting Plane Squadron One requested on May 16, 1925, that they be allowed to experiment with nonstandard markings to aid in distinguishing groups of aircraft during a squadron rendezvous. Their recommendation was that similar types of aircraft of different squadrons have a distinguishing color on the fuselage. Aircraft of different groups (sections) within a squadron were to have a distinguishing color to the empennage, or a band of color around the fuselage aft of the cockpit.

Continued on p. 96

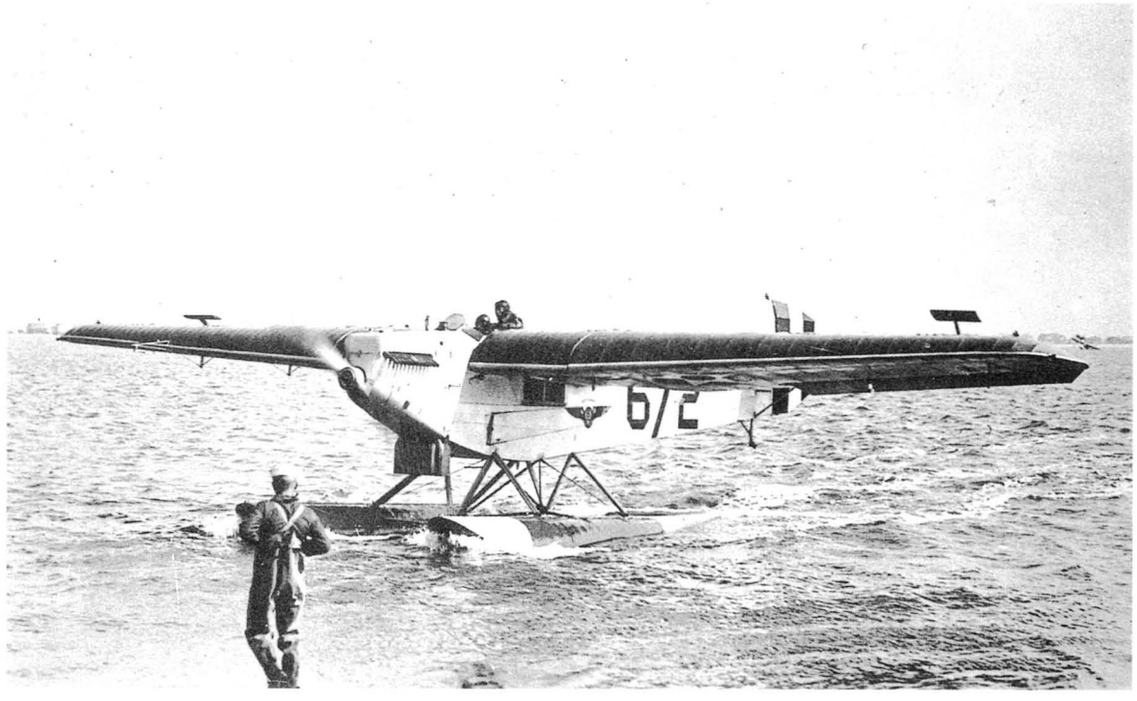


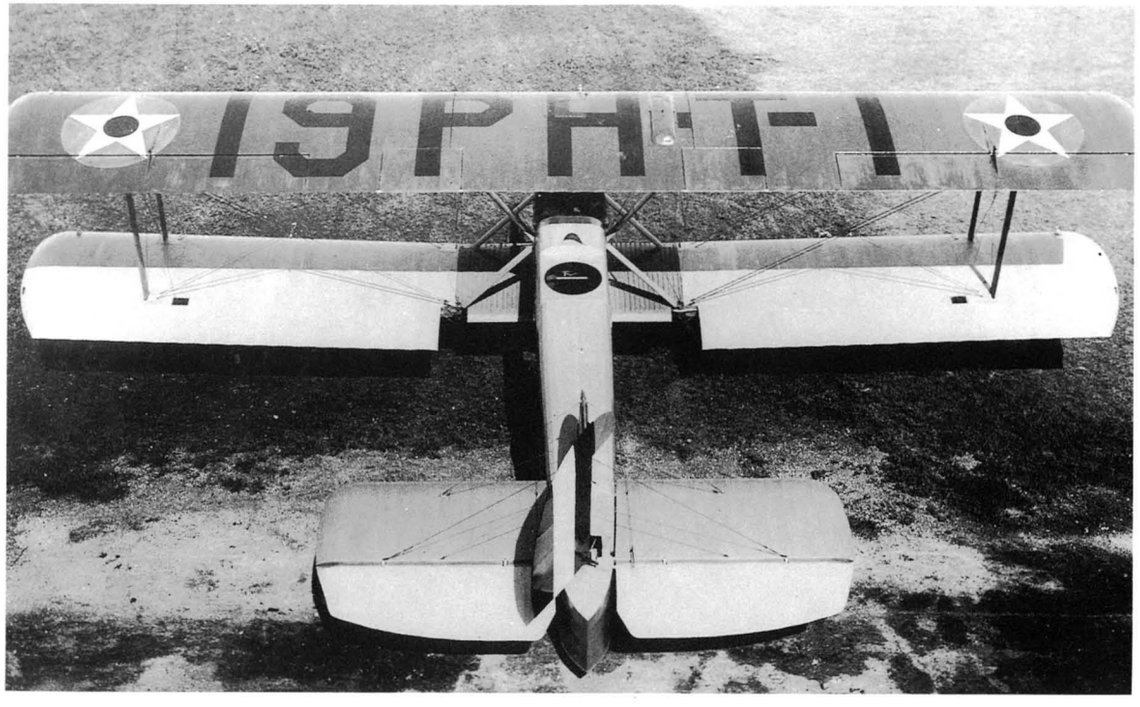
STANDARD FUSELAGE MARKINGS



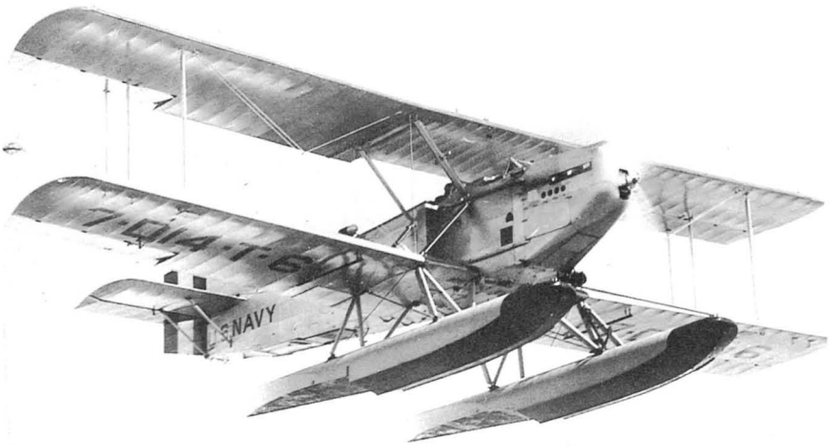
FLYING BOAT MARKINGS

Right: Some commands applied a distinctive local marking on specific airplanes such as this De Havilland DH-4B configured as a photo aircraft at Naval Air Station Anacostia, Washington, DC.

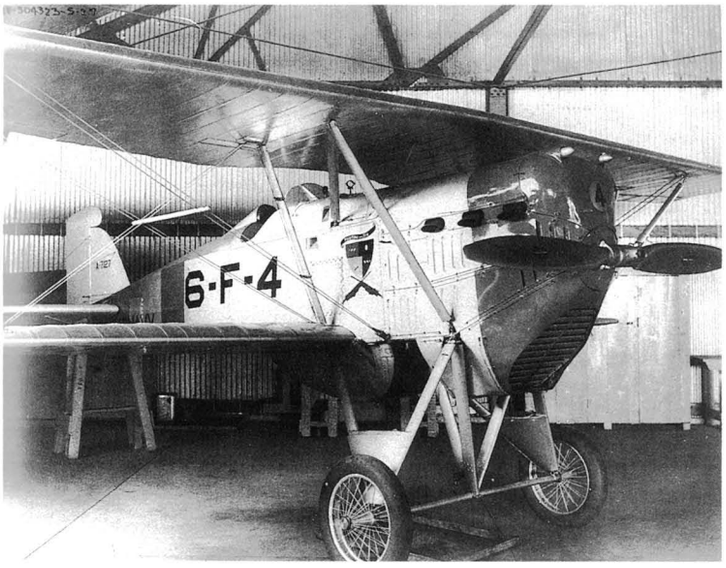




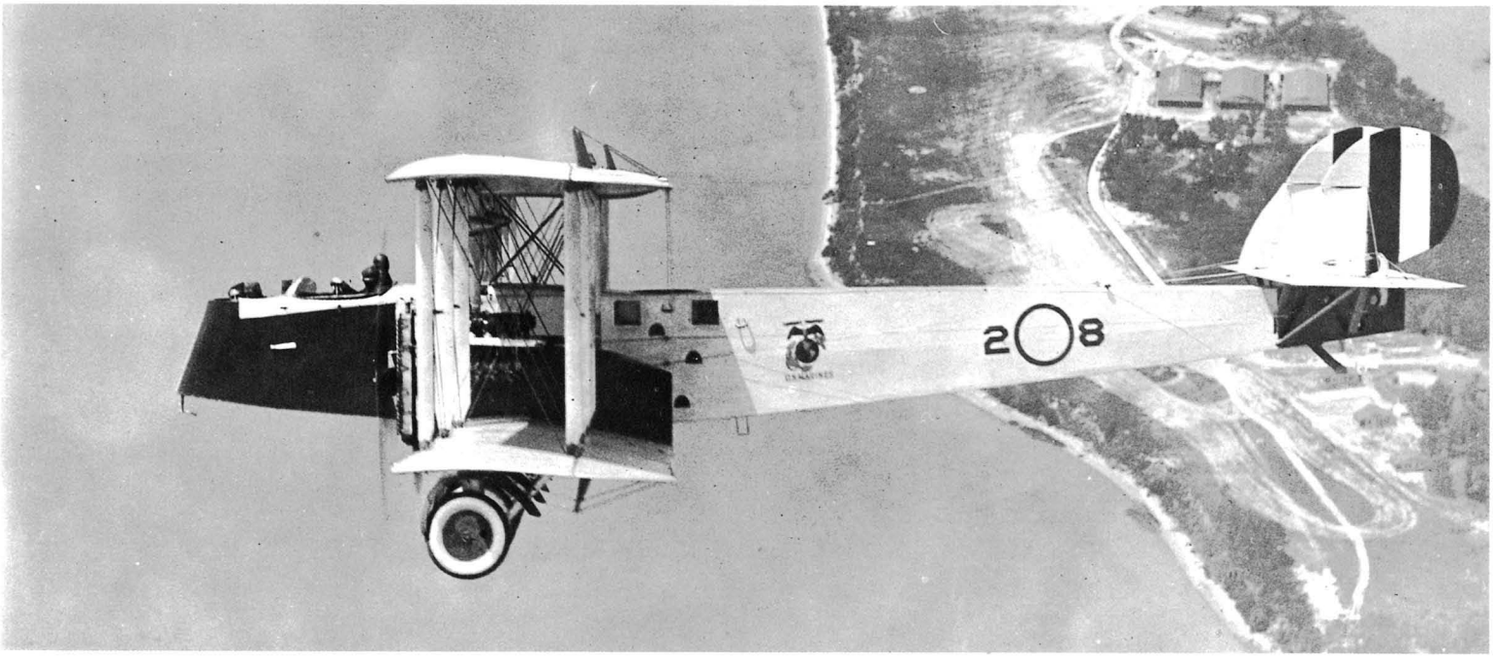
Middle right: This Martin MO-1 was photographed in 1924. The / was used by itself as an early designation for observation on Navy airplanes and eliminated any confusion that could arise between the letter O and the numeral zero. This designation shows aircraft 2 of VO-6. **Right:** The unusual wing markings on this Douglas DT-2 in 1925 show that it is the number one aircraft of Torpedo Squadron 19 assigned to Pearl Harbor.



Top: A Martin T4M-1 of VT-7 assigned to Pearl Harbor carries the full designation on the under surface of both wings. The Pearl Harbor squadrons later dropped the Naval District 14 designation from its aircraft markings. Note the painted tip of the pontoons as a recognition marking as well as the black bottom finish. **Above:** The white cowl on this Vought VE-7 was an early attempt to identify the various squadrons at Marine Flying Field, Quantico, Virginia, in 1925. **Below left:** The Wright NW-2 racer used in the Schneider Trophy Races held at Cowes, England. Note the Bureau of Aeronautics emblem and special race identification on this official US Navy entry. **Bottom right:** A Boeing NB-2 assigned to NAS Anacostia, Washington, DC in 1926.



Top: A Boeing FB-5 assigned to Fighting Six (VF-6B) as shown by the squadron insignia but not yet painted with the squadron designation and aircraft number. **Above right:** Another VF-6B Boeing FB-5 shows the locally applied color code system. Several squadrons experimented with recognition color systems before the Bureau of Aeronautics decided on the official scheme. **Below:** A Martin MT assigned to Marine Fighting Squadron 2M (VF-2M) as a utility aircraft. The letter F designating fighter was later painted in the circle. **Above left:** A Boeing FB-5 of Fighting Six (VF-6B) in 1927. The dark fuselage band and cowl are an early section marking system being evaluated.

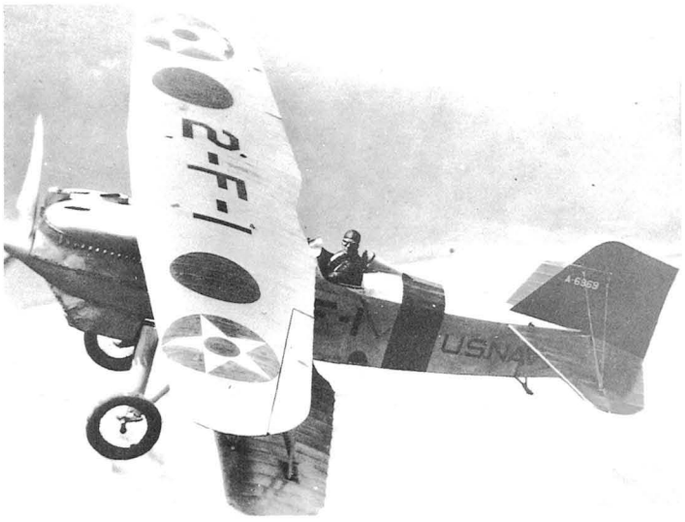


It was also proposed that it might simplify the markings by assigning groups of numbers to different squadrons such as listed here.

VF-1	0-40
VF-2	60-90
VF-3	100-140
VO-1	160-190
VO-2	200-240

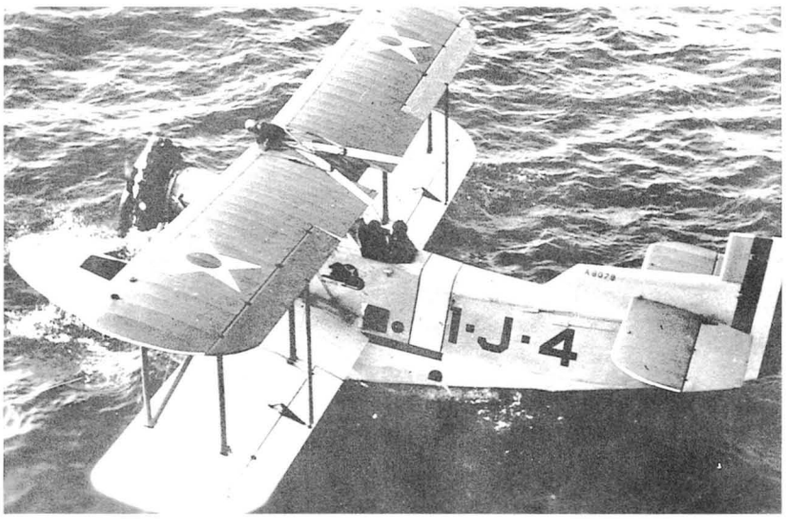
Continued on p. 104

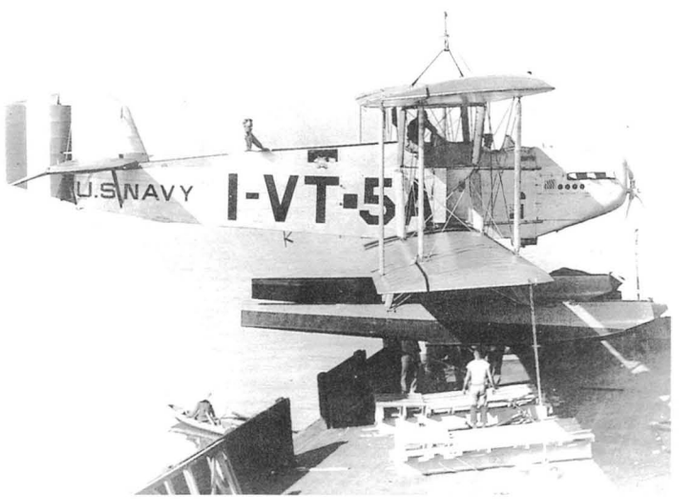
Top: This Vought O2U-1 was assigned to the first aircraft carrier USS Langley in 1927. Note the distinctive diagonal stripes used by the Langley aircraft. **Left:** This is believed to be the Ford XJR-1 at Quantico, Virginia, on September 21, 1927. Note the unusual manner in which NAVY was applied to the under surface of the Wing. **Below:** A Boeing O2B-1 of Marine Observation Squadron 10M (VO-10M) in China. The enlisted pilot has added a personal touch with the dragon on the rear fuselage in addition to his name and the name of the crew chief forward of the cockpit.

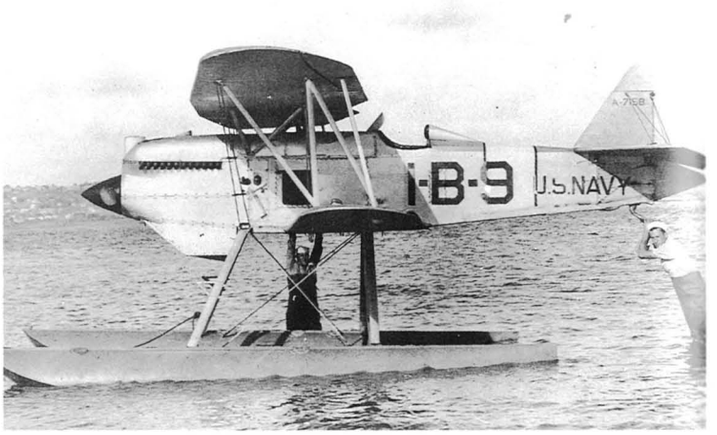


Right: An unusual identification used on the number one aircraft of Fighting Squadron Two (VF-2B). Tail, fuselage band and wing circles are Insignia Red. Note that these markings can only be read from an aircraft approaching from above and ahead.

Above right: A Curtiss F6C-3 of VF-1M shows the Marine Corps emblem and squadron designation locations reversed. Pilot L.H.M. Sanderson and the crew chief name can be seen forward of the cockpit. **Right:** The same Curtiss F6C-3 now assigned to VF-4M, the second fighting squadron at the Marine Flying Field Quantico, Virginia, shows the squadron commanding officer's name Lt. W.O. Brice just forward of the cockpit.

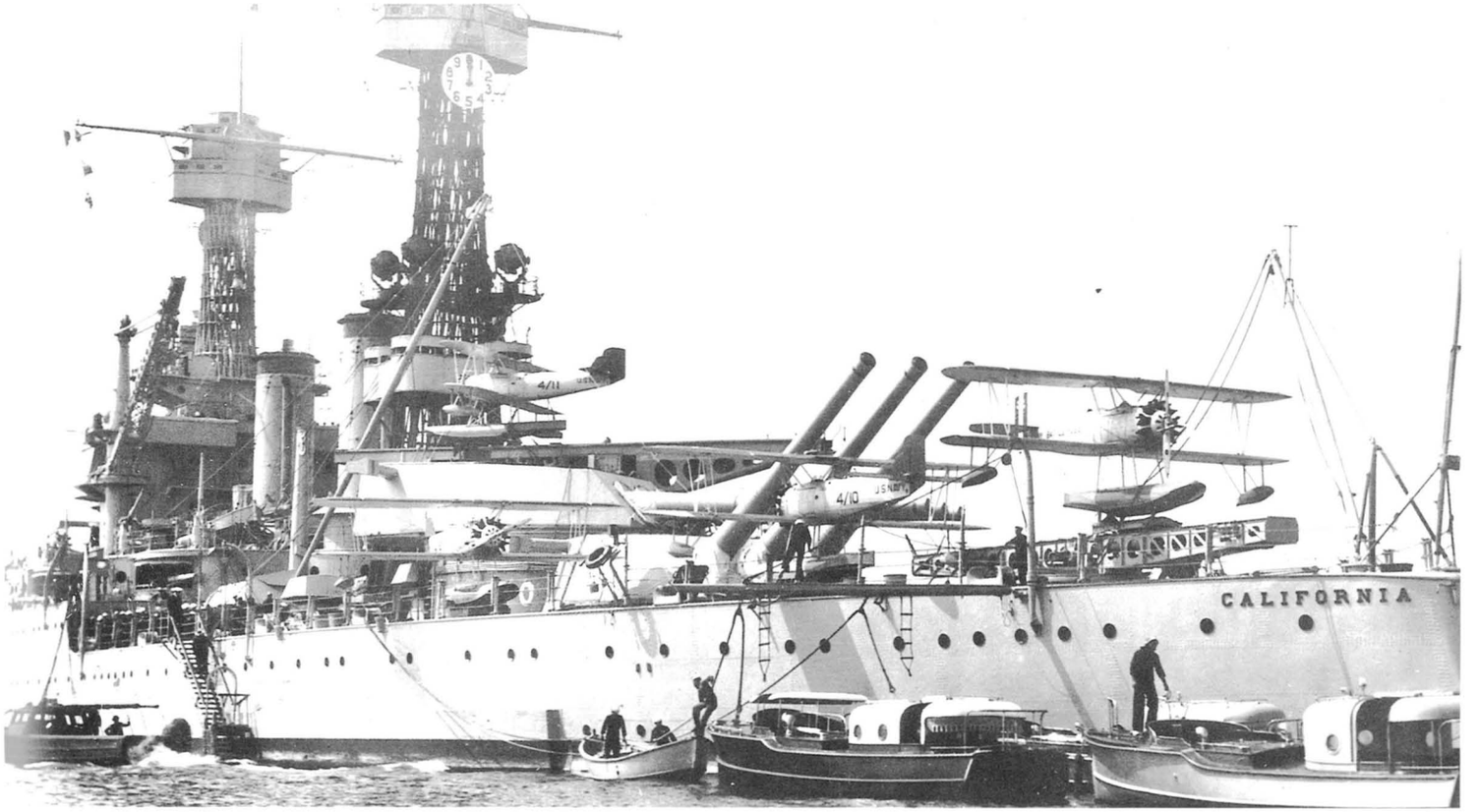


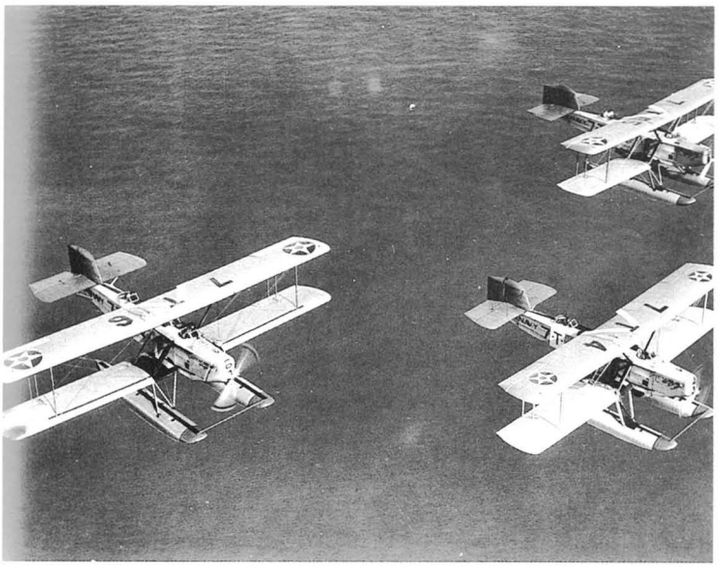


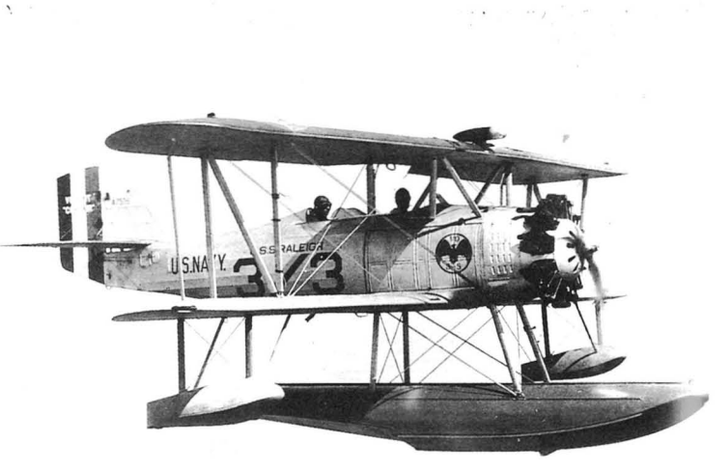


Top: A Loening OL-8 of Utility Squadron One (VJ-1B) shows the early use of a wing chevron and section leader fuselage band. The fuselage band should be placed so that the letter J would be superimposed on the stripe. **Above:** This Martin T3M-2 shows an incorrect designation for VT-5A. It should read 5-T-1. The A designating Asiatic Fleet and the V for heavier-than-air was not to be applied to the aircraft. **Above right:** While VB-1B operated its Curtiss F6C-3s from floats for a short time in 1928, they were also experimenting with a color code system. Number 9 aircraft was not a section leader but is shown with either a white or yellow fuselage band. **Below right:** Martin T4M-1 of VT-9S is shown here. The nonregulation small S to denote Scouting Fleet was used for a short time during 1927/1929. The section fuselage band is a local marking system. **Below left:** The idea of section leader fuselage bands was being used by VT-2B on its Martin T3M-2s as can be seen in this photo, though the sequence of colors was different from that finally approved. Note the variation in placement of the Gunnery Trophy Pennant.

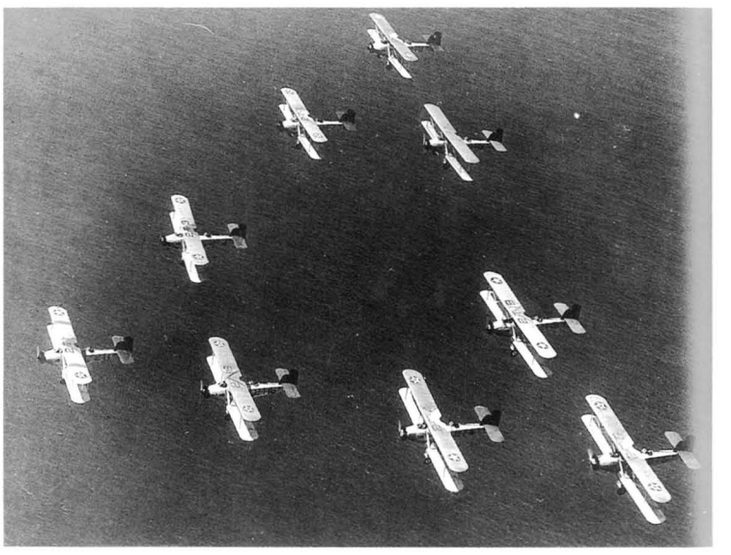
Right: A Vought O2U-1 "Corsair," photographed on September 5, 1928. While the squadron designator does not show, it must be VS-1B assigned to the USS Langley. The unusual tail stripes are believed to be special maneuver markings and possibly to show clearly that Admiral W.A. Moffett, Chief, Bureau of Aeronautics is aboard. **Below:** Vought O2Us of VO-4B are shown amid the typical cluttered operating area on the stern of a battleship. The USS California was the flagship of the Battle Fleet at this time. Note the Battle Fleet CO's aircraft on the stern catapult. **Bottom right:** Martin T3M-2s of VT-7 at Pearl Harbor not only carried the designation on the upper wing but color coded the forward end of the twin pontoons. **Bottom left:** Martin T3M-2s of VT-7 second section are shown here. In addition to the squadron designation on the upper wing, the aircraft number is applied to the front of the engine cowl.



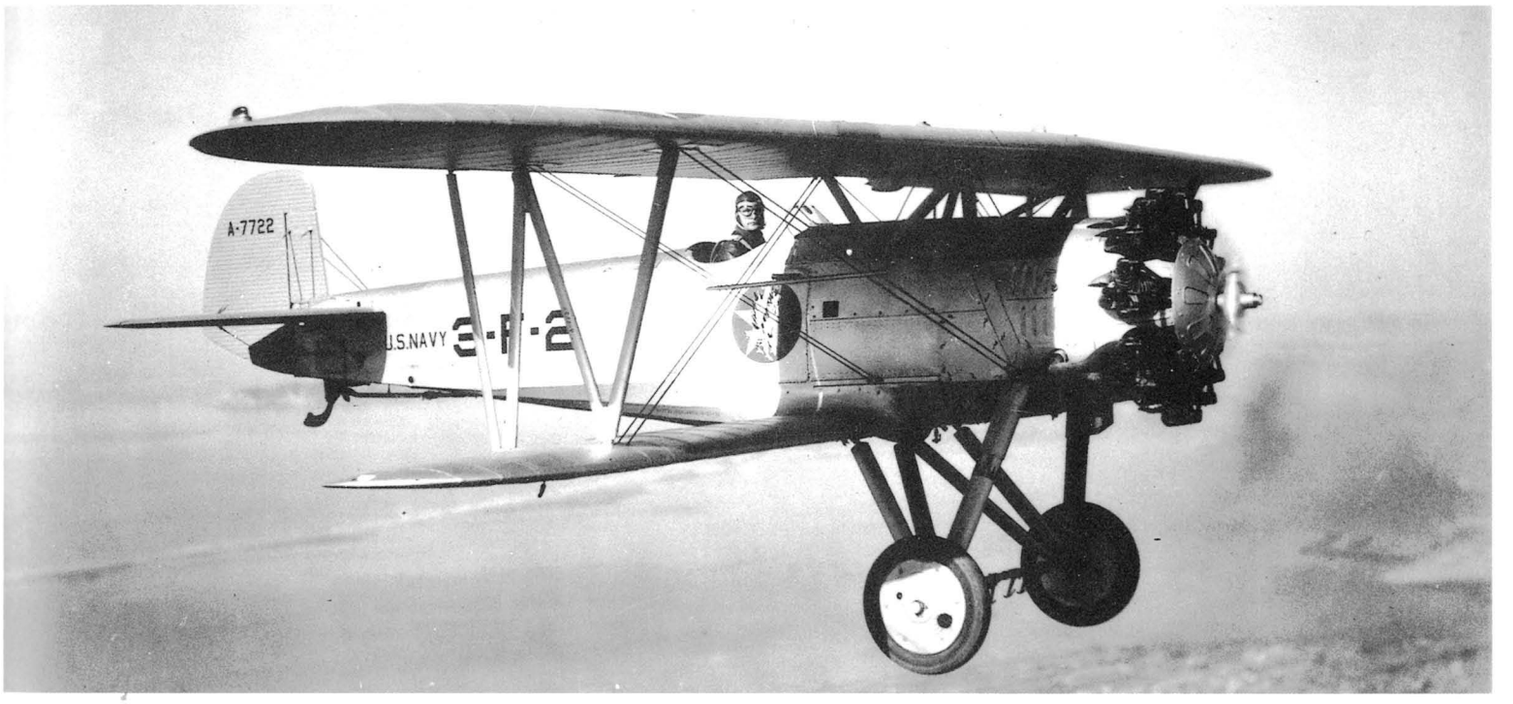


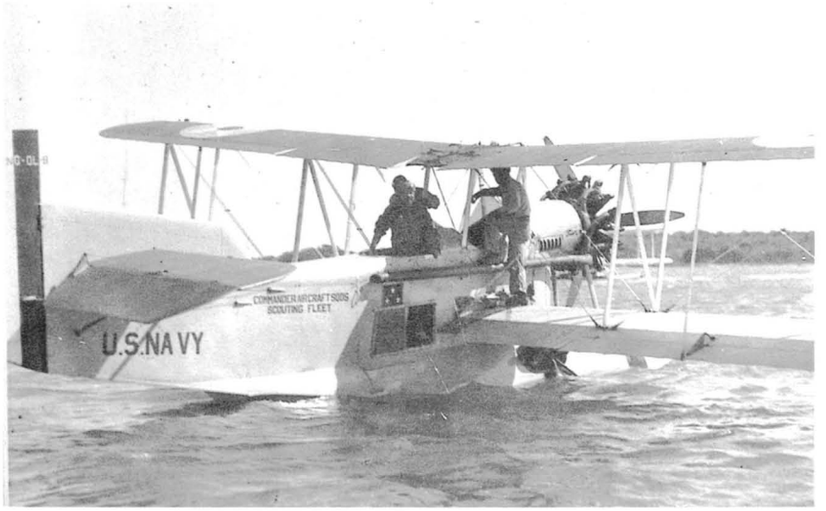


Top: This photo shows Curtiss F6C-3 of Bombing One. As can be seen in other photos of VB-1B, they were using a system of colored fuselage bands in the late '20s that was completely different from what was finally adopted Navy wide. It appears that the "Red Rippers" also color coded the propeller spinner of its aircraft. The pilot of this aircraft has shown his proficiency in machine gun competition. **Above:** This Vought OS2U-1, photographed in March 1928, was attached to the light cruiser USS Raleigh. Note the VO-3S in the squadron insignia. The USS Richmond carried number 1 & 2 aircraft of VS-3S at this time. **Above right:** Photographed in July 1928, this Vought O2U-1 was attached to the USS Marblehead. The small letter S after the 3 denotes that VO-3S is attached to the Scouting Fleet. The squadron number is superimposed on the body of the bat in the squadron insignia. **Below:** VF-3B and VB-1B aboard the USS Lexington about January 1929 prior to standardization of markings. The chevron on VF-3Bs F3B-1s are reversed and the ailerons appear to be painted white. The F6Cs of VB-1B in the upper right hand corner show 1-B-A, 1-B-C, and 1-B-D. No explanation for such markings has been found. Perhaps it was a separate series to eliminate any confusion over aircraft numbers as they picked up their new F3B-1s which also show in the photo. **Below right:** A division of Torpedo Squadron 2B (VT-2B) in 1929. Note the fore and aft wing stripes, chevron and solid triangle markings on the wings being used at the same time as well as the squadron and aircraft number on the upper wing.



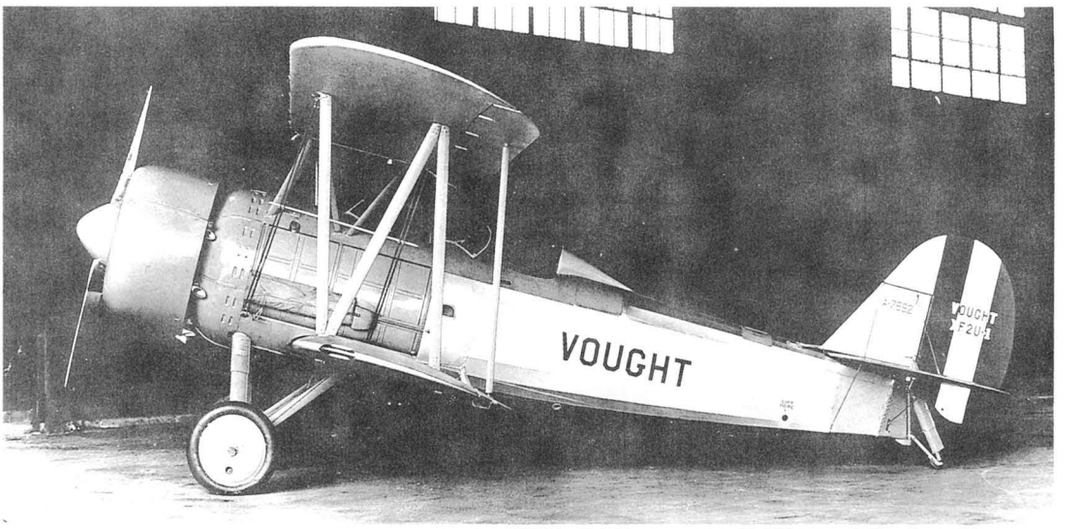
Right: A Boeing F3B-1 of VF-2 with the enlisted pilot and plane captain names under the squadron insignia. The winged turtle forward of the squadron insignia signifies that the aircraft has flown across the equator. **Below:** This is a good inflight view of a Boeing F3B-1 photographed January 7, 1929. The end of one leg of the chevron on the upper surface of the top wing can be seen showing that the point of the "V" points aft rather than the normal position. Note that the model designation does not appear on the narrow fin of the F3B-1. **Bottom right:** A Loening OL-8A of the Alaskan Survey is being unloaded from its tender the USS Gannet on June 19, 1929. Each of the aircraft participating in the survey was named after a different town in Alaska and each carried the distinctive survey insignia of a winged seal. **Bottom left:** A free balloon on a training flight in 1929 clearly shows its US Navy designation.

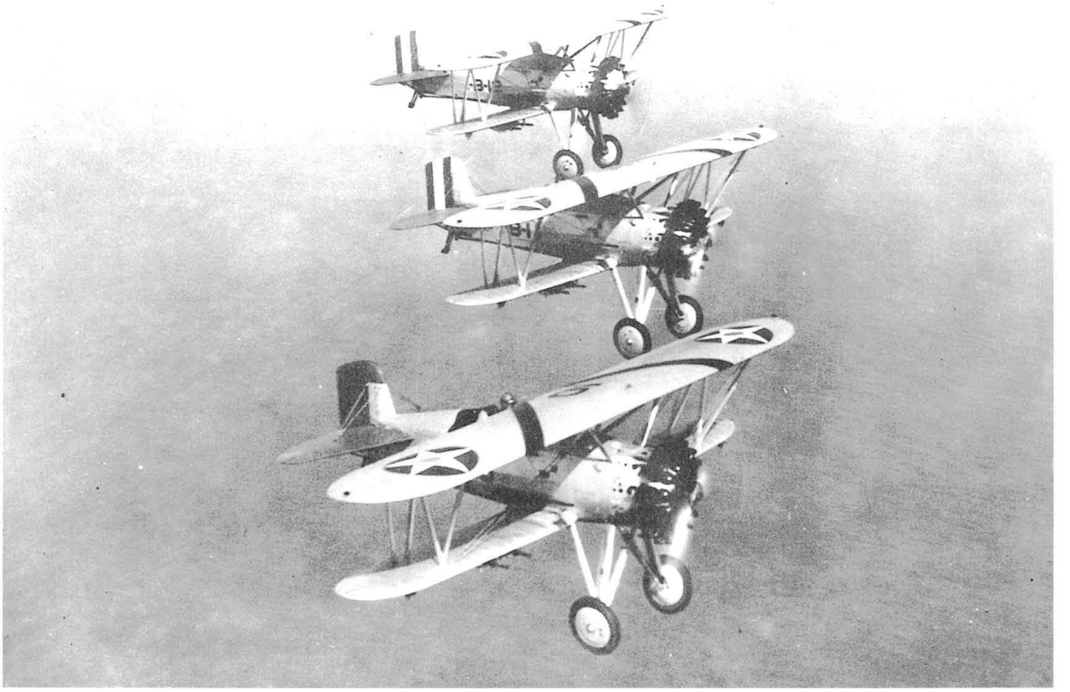


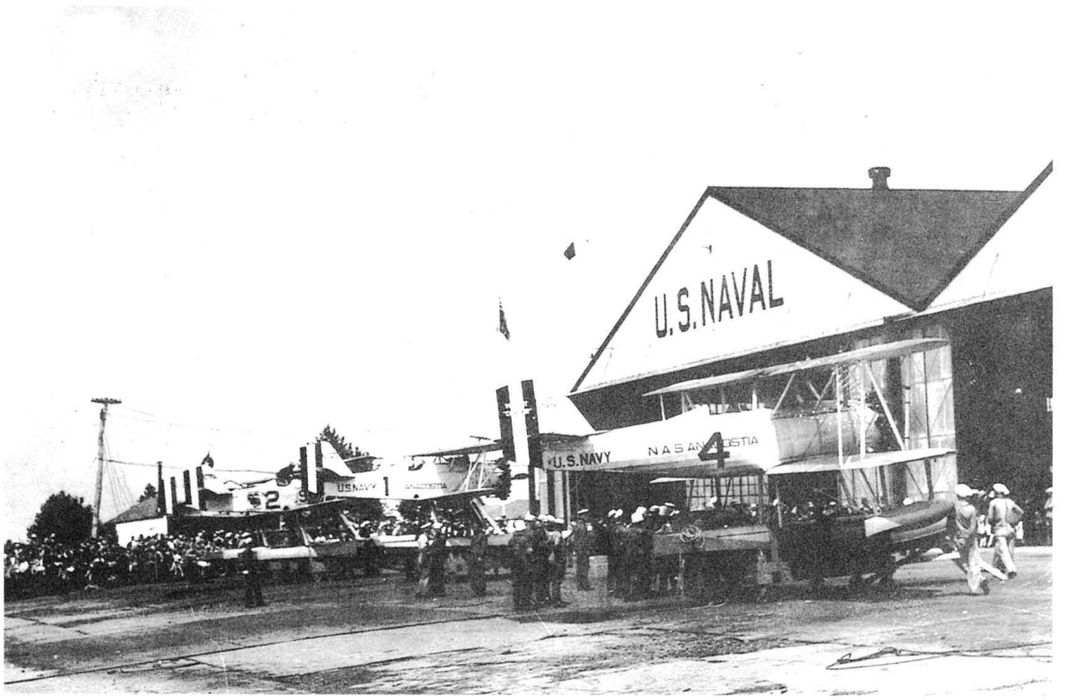


Top: In 1929 this Loening OL-8 was assigned to the Commander Aircraft Squadrons, Scouting Fleet as a staff aircraft. In this photograph the Vice Admiral is aboard as shown by his three-star flag.

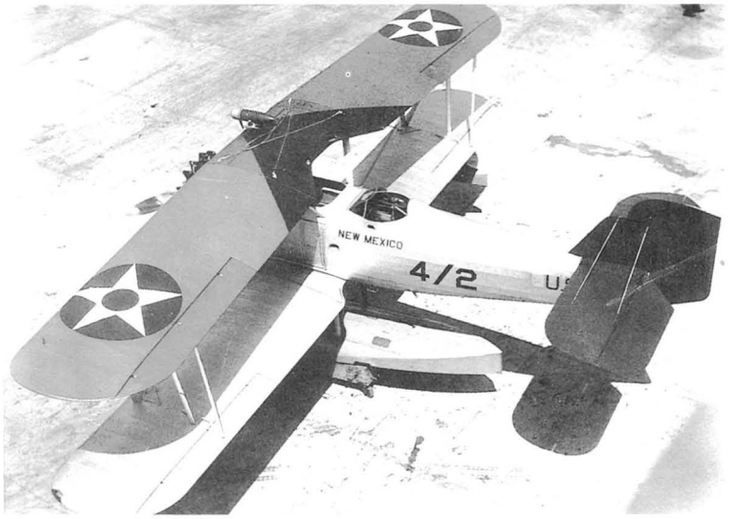
Above: The Assistant Secretary of the Navy for Air is being flown in this Vought O2U-2 of VS-2B during October 1929. Note his flag on the side of the fuselage. **Above right:** The Rear Admiral commanding Aircraft Squadrons, Battle Fleet is being flown in his staff aircraft from NAS North Island, San Diego, in October 1929. Note the oversize windscreen and headrest provided for additional comfort. **Below:** A Boeing F3B-1 of Fighting Three (VF-3B) is shown here. The horizontal stripe on the tail appears to be a special marking for use in a maneuver as no such markings are known to have been in general use at this time. The metal surfaces appear to be far too dark. Note that the aircraft serial number 7720 is painted vertically on the fin due to its narrow width.







Top: It never hurts to advertise, and the Vought Corporation made the most of the opportunity while the XF2U-1 was under evaluation. **Middle:** This shows three Boeing F4B-1s of VB-1B in 1929. It is interesting to note that there is no problem with the cutout in the upper wing and yet the chevron is reversed. It would appear that this was a matter of preference, rather than a space problem for the aircraft number. Note the change being made in tail colors. **Right:** These four Navy/Marine Corps aircraft painted for a race (circa 1929) at NAS Anacostia, Washington, DC, show the inconsistency of early naval aircraft markings. Even the base aircraft were not marked in the same manner.



Left: This Vought 02U-1 was photographed in March 1929 when it was assigned as number 2 aircraft of VO-4B aboard the battleship USS New Mexico, which was the flagship of Battleship Division Four. A solid triangle is being used on the upper wing in place of a chevron. **Bottom:** The Curtiss F7C-1 photographed on July 20, 1929, was assigned to the Commanding Officer, Aircraft Squadrons, East Coast Expeditionary Force, Quantico, Virginia. Pilot and crew chief names are applied to the side of the fuselage for morale purposes. The forward fuselage, wheel disks and headrest are Insignia Red.

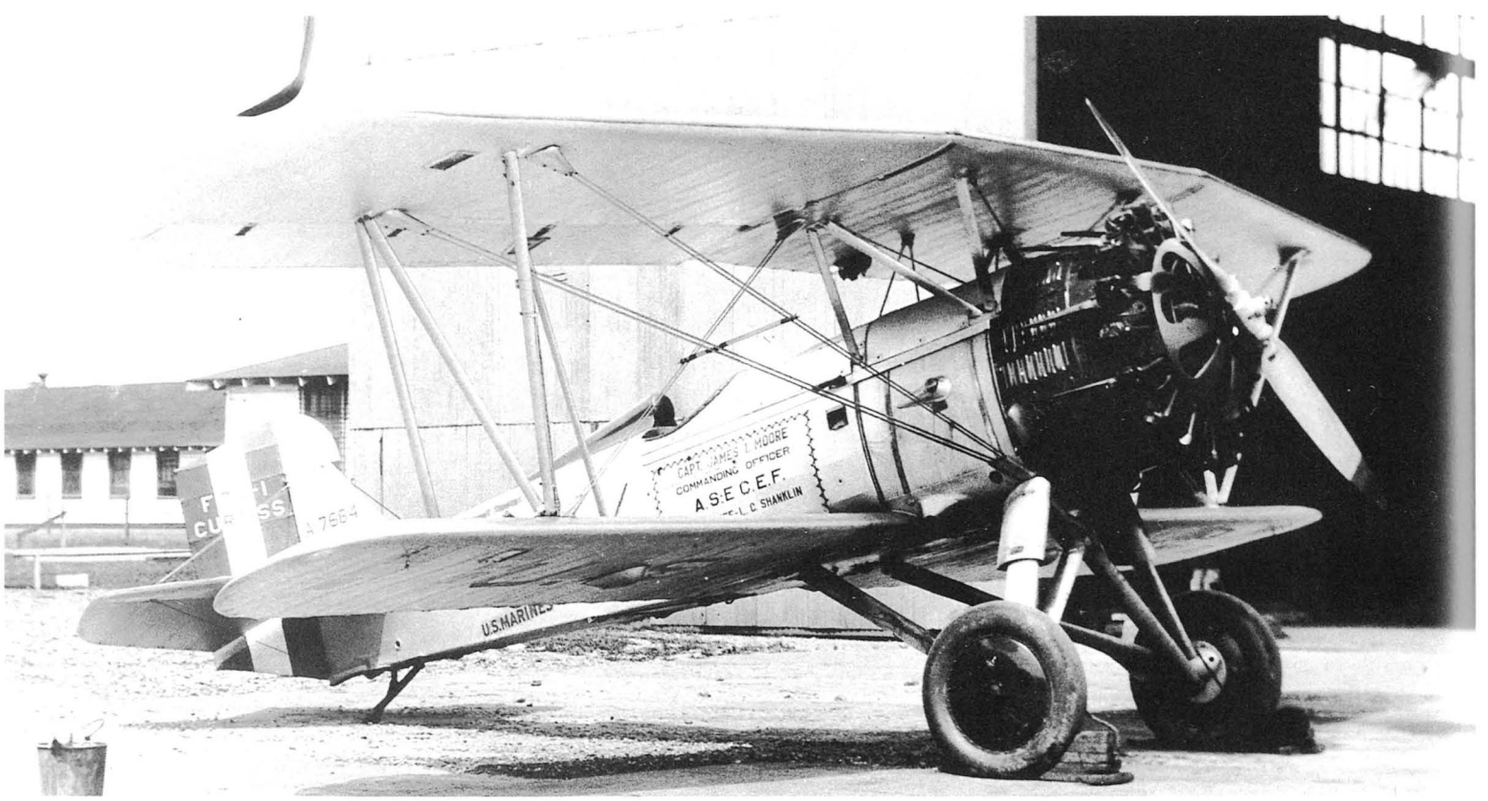
On May 28, 1925, Major General Commandant John J. Lejeune approved the new form for the standard United States Marine Corps emblem. o directive has been located that specified the use of this new insignia on aircraft.

However, it was applied on some aircraft in 1925 and was always a Bureau of Aeronautics supplied decalcomania. The normal location on the fuselage was approximately under the cockpit rim. Numerous photographs, on the other hand, show it much further forward, while on some transport aircraft it was placed well aft on the fuselage. Bureau of Aeronautics Technical Order No. 106, dated June 25, 1925, did however, specify that aircraft for use of the Marine Corps were to be left unmarked (that is U.S. NAVY was not to be applied to the fuselage) so that the Marine Corps emblem could be added by the unit receiving the aircraft.

The Bureau of Aeronautics on June 24, 1925, authorized VF-1 to experiment with the various color markings and to report the results of their use in actual operations. This was the beginning of the colorful marking of Naval aircraft that was such a prominent feature up to the beginning of WW II. It has, however, caused considerable confusion when viewing photos and trying to determine section colors. It must be remembered that these early experiments did not use section colors in the sequence they were prescribed when the system became official in 1930. A block numbering system similar to their proposal was also adopted after WW II.

General Order No. 161, dated March 5, 1927, established a new system of designating squadrons which included a letter after the squadron number to denote the assignment of the squadron. These assignment letters were as follows.

B Battle Fleet
S Scouting Fleet
A Asiatic Fleet
F Fleet Base Force
C Control Force (submarines)
D Naval District (to be followed district number)



Right: This shows a Curtiss OC-1 "Falcon" of VO-6M. The non-regulation small observation designation and letter M below seems to indicate a style used at Brown Field, Quantico, Virginia, in 1929. **Bottom:** This Vought 02U-1 was photographed August 5, 1929. A seldom seen squadron insignia depicts the VS-7S squadron designation and a Concord Minuteman. Placement of the ship name is unusual.

M United States Marine Corps
R United States Naval Reserve
X Experimental
U United States Fleet (further assignment of unit to fleet not yet made)

By adding this assignment letter to the class letter and squadron number the new designations were as shown in the following examples.

VO-1B	Observation Squadron One, Battle Fleet
VO-3S	Observation Squadron Three, Scouting Fleet
VT-6A	Torpedo Squadron Six, Asiatic Fleet
VF-9M	Fighting Squadron Nine, Marines

After two years of experimenting by VF-1 and VF-2, the Bureau of Aeronautics on April 26, 1927, wrote to both Commander Aircraft Squadrons, Battle Fleet; and Commander Aircraft Squadrons, Scouting Fleet directing implementation of a marking system. On June 1, 1927, Commander Aircraft Squadrons, Battle Fleet reported that all fighting planes had been divided into tactical groups (sections), and that the tail surfaces of each group were painted the same color. The leader of each group was identified by a band around the fuselage the same color as the tail surfaces. The colors used were red, yellow, light blue, and black. All had proven satisfactory with the exception of the black which was difficult to maintain in a neat appearance. Green was to be substituted for black. This marking system had proven satisfactory in the torpedo and bombing squadrons also.

It is known that four of the Marine Corps OL-6s of VP-3M stationed at Sumay, Guam in March 1929 were identified with red, yellow, green, and blue noses. Neither the sequence in which these colors were used nor if any of the remaining OLs were color coded has been determined.

CHAPTER 9 1930–1939

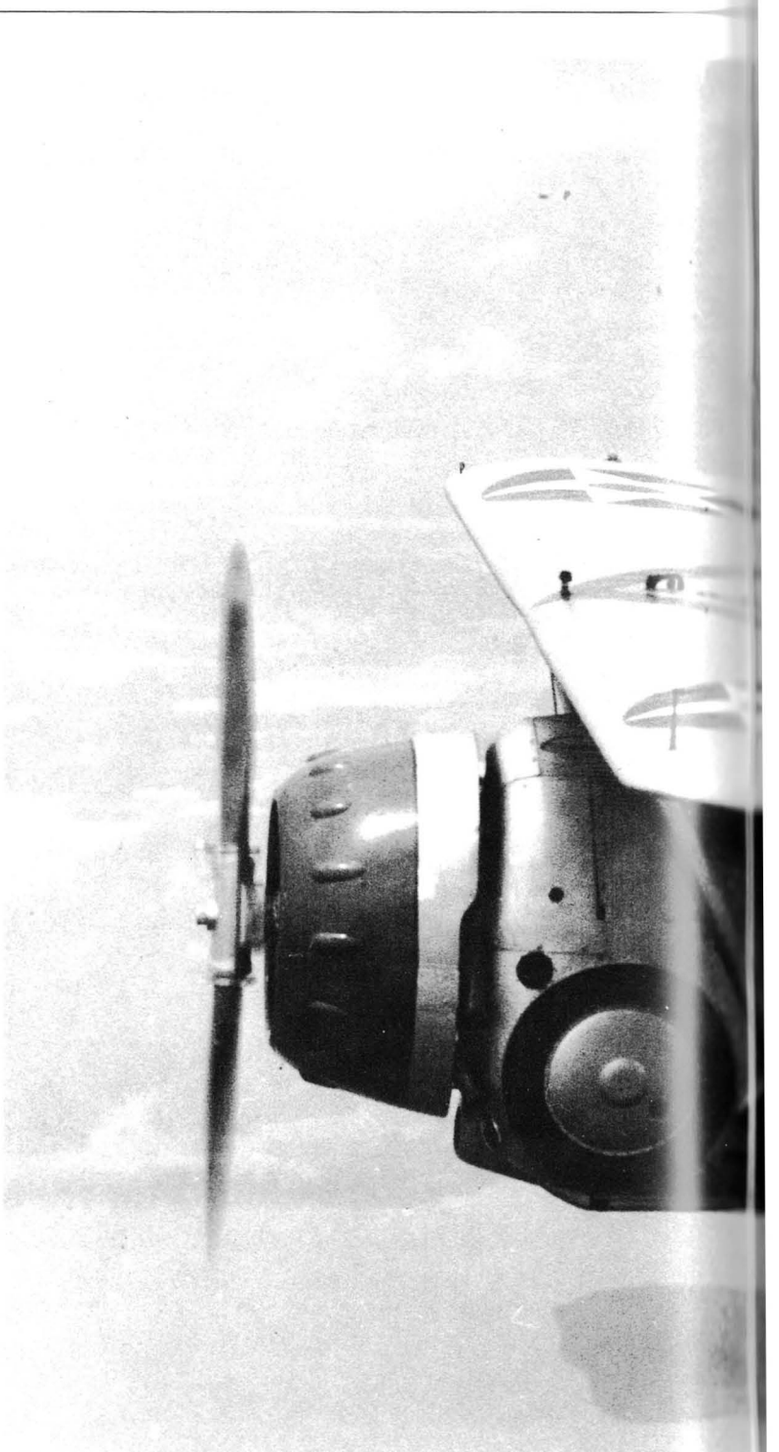
One of the problems involved with the painting of the empennage a solid color for identification purposes was the joint agreement of 1919 for all US Military aircraft to have the rudder painted with three vertical red, white, and blue stripes. It was not considered that it would be difficult to obtain a release from this agreement as the Air Service had been marking its rudders with one vertical blue stripe and thirteen horizontal alternate red and white stripes since 1926. This release was attained early in 1930.

Based on experimental systems which had been in use by squadrons of the Battle Fleet for two years, the Bureau of Aeronautics on February 24, 1930, issued a preliminary set of instructions for a formal color coded marking system for Naval aircraft. One of the major delays had been the revision of General Order No. 161 to give the Bureau discretionary power in prescribing the application of markings.

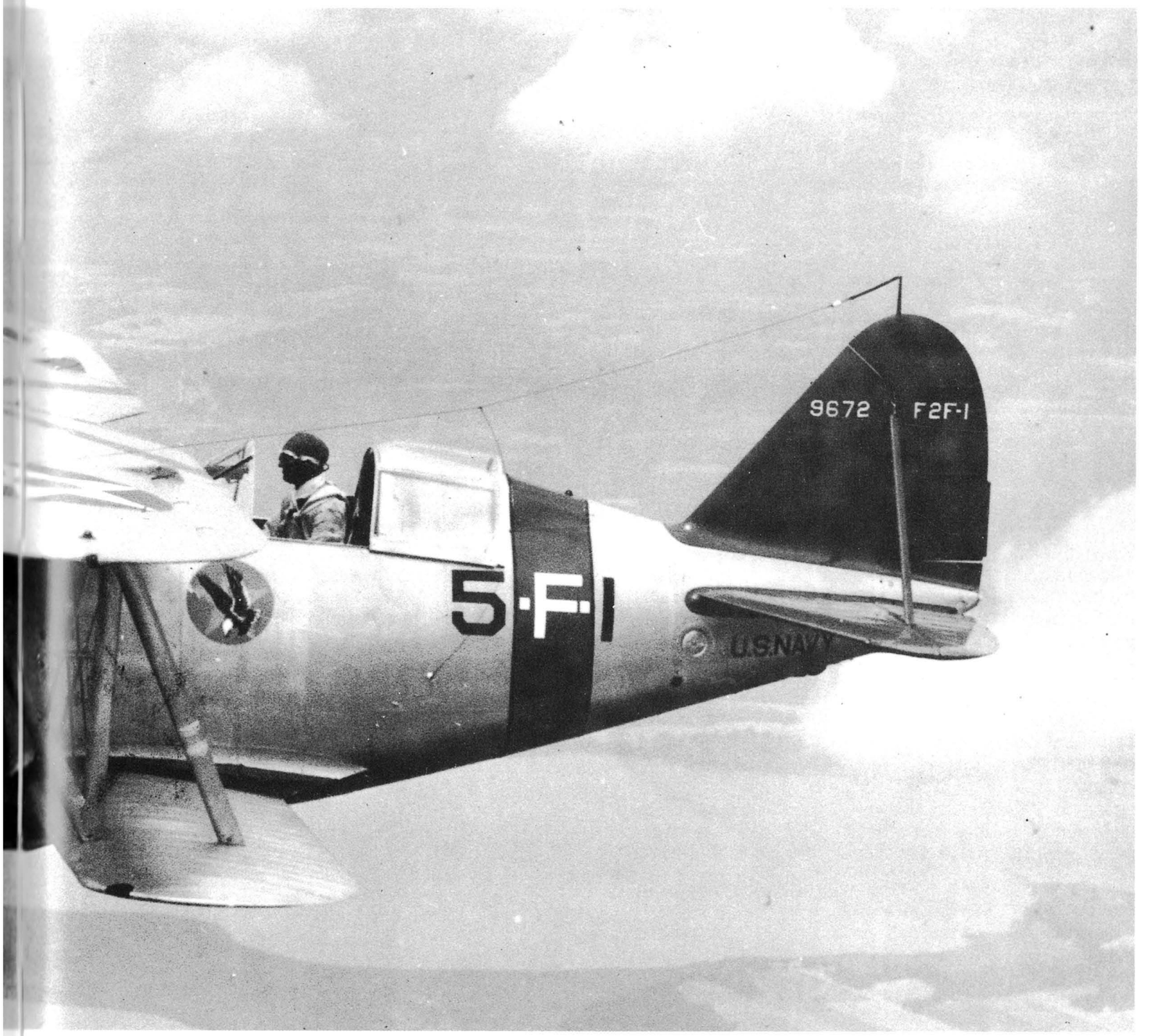
U.S. NAVY was still to be applied on both sides of the fuselage aft of the unit identification. However, those aircraft assigned to the Marine Corps were to be marked U.S. MARINE CORPS. Recognizing the formation of Naval Aviation Reserve units, the aircraft so assigned were to be marked U.S. NAVAL RESERVE. In actual practice it appears that the word "RESERVE" was never applied.

Utility aircraft not attached to a squadron, such as those attached to a carrier, were to have the name of the ship in the location normally occupied by the unit designation. U.S. NAVY was to be placed below the ship's name.

All other aircraft were to use the unit designation including reserve units and training squadrons. This, of course, could result in a duplication of numbering. Plane number one in



Right: The biplane Grumman fighters were among the most colorful and appealing aircraft of the '30s. This fully marked F2F-1 of Fighting Five (VF-5B) from the USS Yorktown in July 1938 shows the standardized markings of the period. The tail color is Insignia Red.


9672
F2F-1
5-F-1
U.S.NAVY

Left: The small circle around the letter F with the letter M below shown on this Curtiss F7C-1 of VF-9M is not a regulation marking and was only used at Quantico, Virginia for a short period.

Training Squadron One at Pensacola, Florida would be designated 1-N-1 as would the first aircraft in Reserve Training Squadron One at Squantum, Massachusetts. However, the aircraft at Pensacola would have U.S. NAVY after the unit designation while the Squantum aircraft would have U.S. NAVAL RESERVE.

As so often happened, the directive authorized a procedure that had been in unofficial use in the fleet. In this case it was the application of the pilot's name on the side of the fuselage below the cockpit.

In order to easily recognize section leaders so they could be readily distinguished in the air for purposes of rendezvous, a colored band approximately 20 inches (50.80 cm) wide could be painted around the fuselage aft of the cockpit of the section leaders aircraft. The following colors were designated for each section.

1st Section—Red
2nd Section—White
3rd Section—Blue (light)
4th Section—Black
5th Section—Green
6th Section—Yellow

When fuselage bands were used to designate section leaders, a chevron of the section color was to be painted on the upper surface of the center section of the upper wing of each aircraft in the squadron. The individual aircraft number was to be painted within this chevron in black characters.

The empennage of all aircraft were to be the same color as the fuselage. There was, however, an exception to this rule. Whenever two or more squadrons of the same class were operating together the entire empennage could be painted a distinguishing color. It was suggested that the use of colors conform to the section colors, i.e. the 1st or lowest numbered squadron of a particular class red, 2nd or next numbered squadron white, etc. This procedure could be varied as necessary to suit the needs of the operating forces.

The Bureau number of each aircraft was to be painted on each side of the fin without the prefix letter "A" and the type designation on each side of the rudder. The name of the manufacturer was not to be applied to the external surface of the aircraft.

Whenever distinguishing colors were used, the nose cowling forward of the engine on aircooled aircraft or a band 1 foot (30.48 cm) wide beginning at the nose on watercooled aircraft were to be painted as follows.

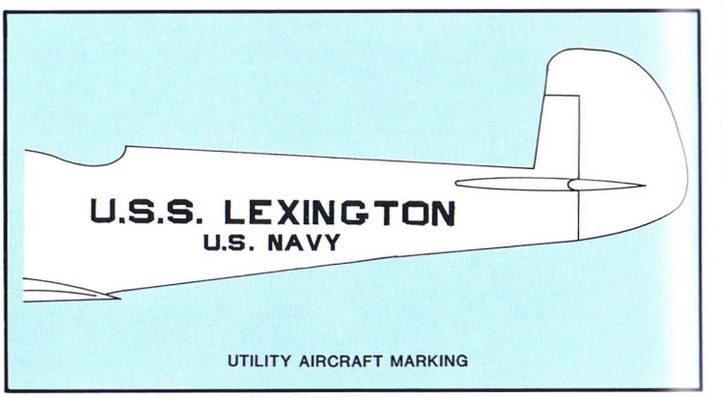
Section leader—complete band
No. 2 aircraft—upper half
No. 3 aircraft—lower half

On air cooled engines this reference to cowling forward of the engine can only refer to the "face plate" of the engine and not any type of cowl around the engine. A small number in the upper half of the cowling could also be used to indicate the aircraft in the squadron.

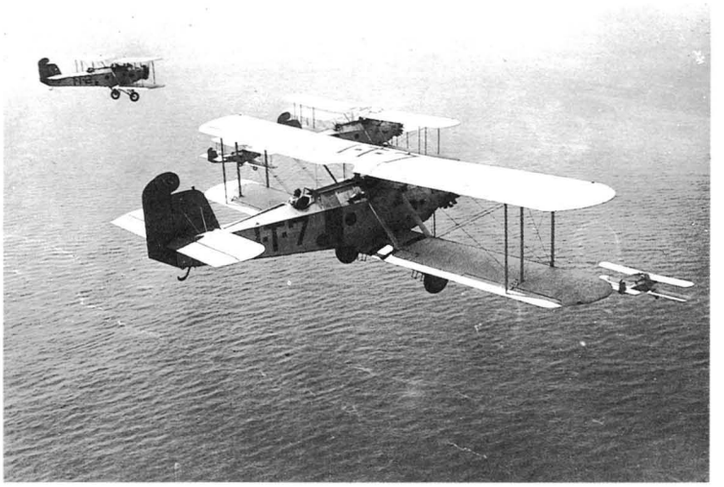
In anticipation of the adoption of these instructions the Bureau of Aeronautics on December 10, 1930, directed all Inspectors of Naval Aircraft to have all aircraft then under construction painted to conform with the pending instructions. Thus, new aircraft arriving in the fleet should have had the vertical tail stripes eliminated, no manufacturer's name on the rudder, the aircraft serial number without the "A" prefix on the fin and model designation on the rudder.

A cleaned-up version of the preliminary marking directive was issued on December 10, 1930, to Commander Carrier Divisions, US Fleet; Commander Carrier Division One, US Fleet; Commander Battleship Division, US Fleet; Commander Scouting Fleet; Commanding Officer, Naval Air Station Hampton Roads, Virginia and Commanding Officer, Naval Air Station San Diego, California.

The use of colors was defined in more detail. Colors used for



UTILITY AIRCRAFT MARKING



Top: This is a photo of a Vought O2U-1 assigned to the Commander United States Fleet and normally operating from the battleship USS Texas in addition to VO-3B. The Texas was the flagship of the U.S. Fleet at this time. Above left: U.S. MARINES has been applied to the upper wing instead of the rear of the fuselage of this Curtiss OC-2 of VO-8M in August 1931. Of interest is the placement of the Marine Corps emblem and squadron designation. Above: Martin T4Ms of VT-1 from USS Lexington (circa 1930). Note that the section leader fuselage stripe is forward of the rear cockpit and that not all aircraft have a triangle on the upper wing in lieu of a chevron. Below: This Curtiss XF8C-4, photographed on April 25, 1930, is shown at the factory prior to delivery to the Navy. Its experimental status is shown by the X prefix to the model designation.

Left: A Standard NT-1 training aircraft is shown with the manufacturer's name in addition to the normal markings for a trainer. The application of the manufacturer's name was soon prohibited.

lettering were to be either black or white depending on which would give the greatest contrast to the background color and provide the maximum visibility. White was to be used on red or blue, and black on white, gray, aluminum, green or yellow.

All markings used to designate squadrons or sections within a squadron were to conform to the following color system described here.

1st section or lowest numbered squadron	—Insignia Red
2nd section or 2nd lowest numbered squadron	—White
3rd section or 3rd lowest numbered squadron	—Insignia Blue
4th section or 4th lowest numbered squadron	—Black
5th section or 5th lowest numbered squadron	—Green
6th section or 6th lowest numbered squadron	—Lemon Yellow

With the issue of this directive all fleet aircraft, with the exception of certain cruiser-based and staff aircraft, were to have their cowlings painted in the following manner.

Full cowl painted on aircraft 1,4,7,10,13, and 16
Top half painted on aircraft 2,5,8,11,14, and 17
Bottom half painted on aircraft 3,6,9,12,15, and 18

There was no seventh section or section color. The normal squadron complement was 18 aircraft. The 19th, when assigned, carried no section color or wing chevron and was used for instrument training and general utility work.

The branch of service on Marine Corps aircraft was changed to read U.S. MARINES.

In the event chevrons are not used on the upper wing the individual aircraft number was to be the largest practicable size.

With the approval for VF-1 in 1925 to conduct experiments in the field with various color markings and two preliminary directives being issued to the fleet, it is easy to see that some conflict and confusion could result. This was not long in showing up.

Commander Carrier Divisions, Battle Fleet on January 20, 1931, requested modification of the tentative marking instructions to conform with what was being done in the Battle Fleet.

The system of colored tails was the biggest problem. No directive has been located to determine just when the empennage of carrier-based aircraft was first painted in a formal system. However, by the time this letter was written the following system had been established: USS LEXINGTON, blue and yellow; USS SARATOGA, red and white; USS LANGLEY, green.

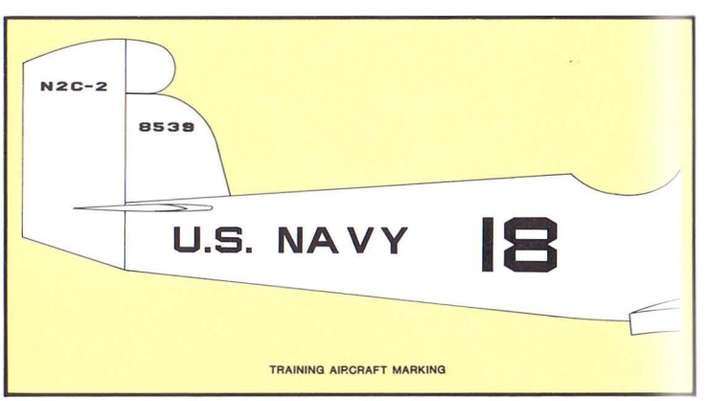
The large unit designation was still applied to the under surface of the lower wing which did not leave enough room for the national aircraft insignia now required in that location.

It was recommended that the chevron be painted to face in either direction. On a wing with the trailing edge of the center section cut out for better visibility, it is impractical to apply a chevron pointing forward which would contain a sizeable aircraft number. It had been found advantageous in certain instances to apply a solid triangle. In other instances fore and aft bands on the upper wing had been used to advantage to designate division leaders in VT squadrons and VS squadron liaison aircraft.

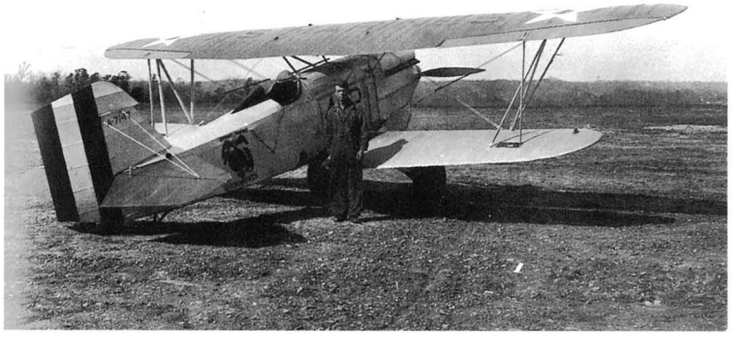
The use of vertical red, white, and blue rudder stripes was current practice to designate carrier utility aircraft and "staff" utility aircraft.

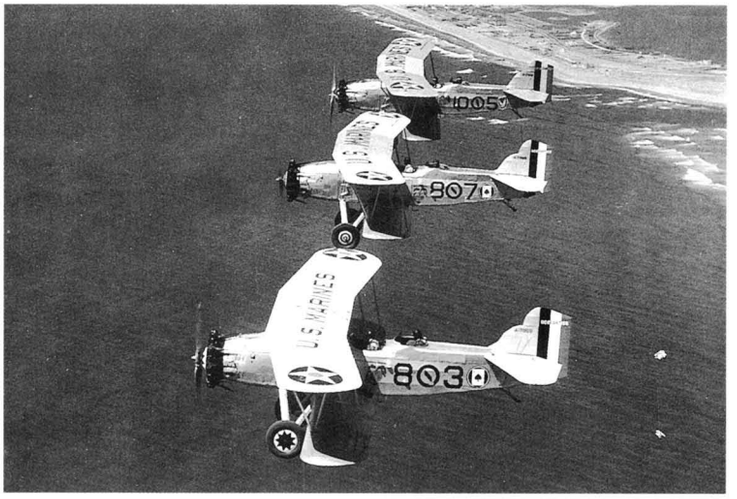
A Bureau of Aeronautics dispatch, number 9513-1230 of April 1931, amended the provisions of color usage to permit the use of the specified colors in any order desired. As of this

Continued on p. 114

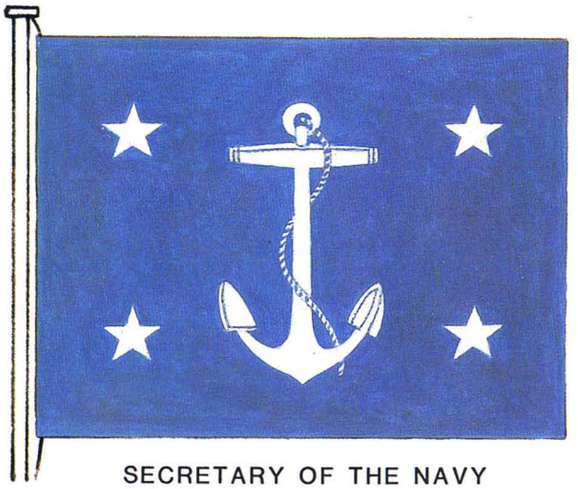


TRAINING AIRCRAFT MARKING

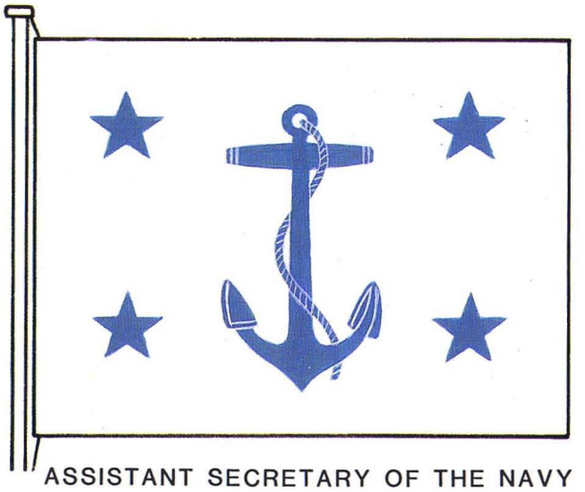




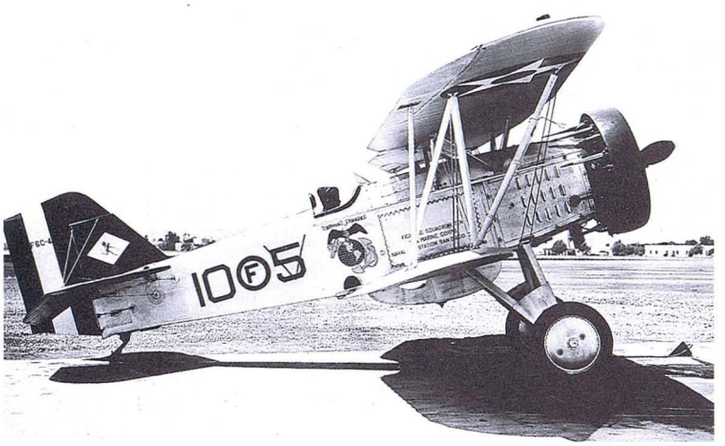
Top: The complex marking on this Sikorsky RS-3 in March 1930 denotes the 4th aircraft of VJ-5 attached to the 11th Naval District at NAS San Diego, California. **Above left:** Curtiss F6C-1, Serial No. A-7147 is shown in its normal paint scheme at Brown Field, Quantico, Virginia, prior to being modified for racing. The two racing modifications can be seen in the section on US Naval Racing Aircraft. **Above:** This photo shows three Curtiss OC-2s of VO-8M and VO-10M. Even the nonregulation U.S. MARINES on the upper surface of the top wing of these west coast squadrons was not always painted in the same form within a squadron. **Below:** This is an in-flight view of a Curtiss F8C-4 of Fighting One with its famous High Hat insignia. Fuselage band and tail are Willow Green.

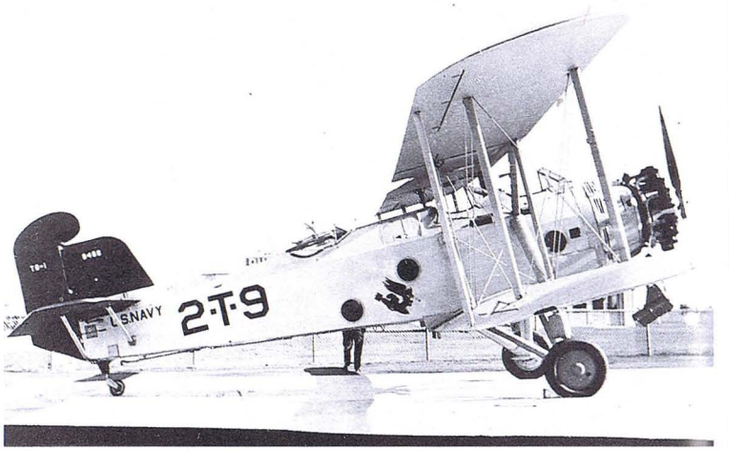


SECRETARY OF THE NAVY

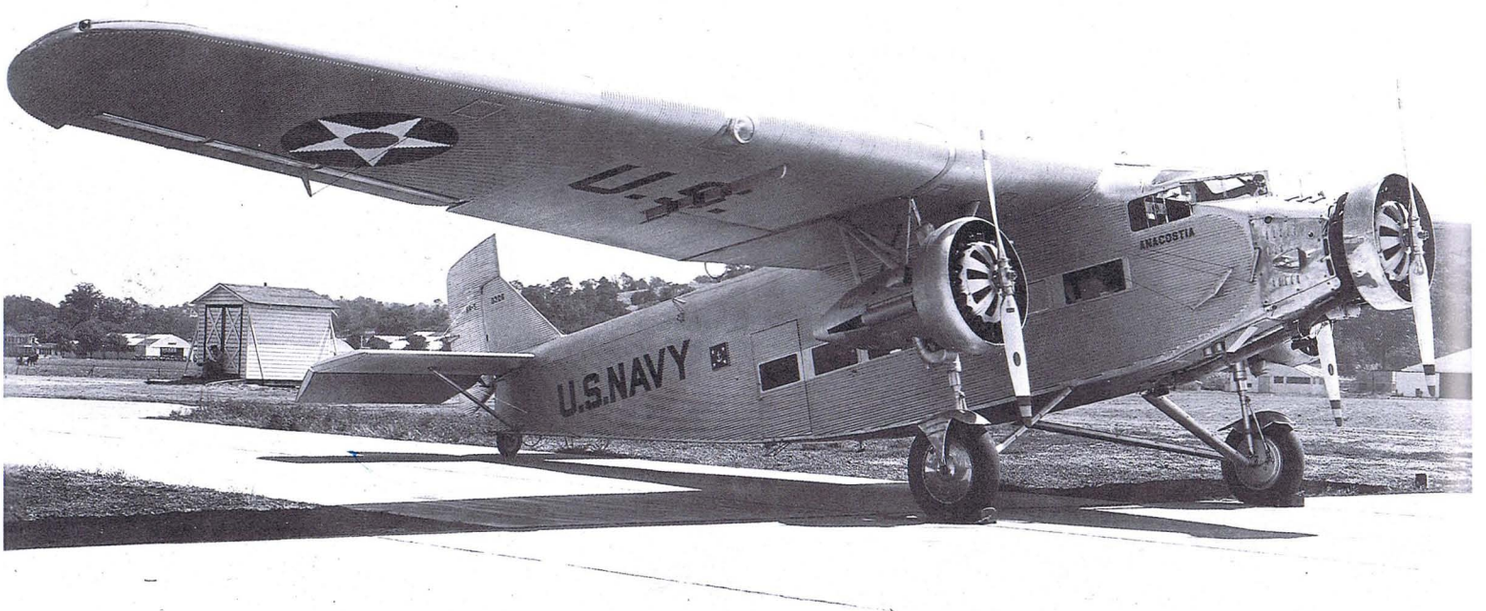


ASSISTANT SECRETARY OF THE NAVY

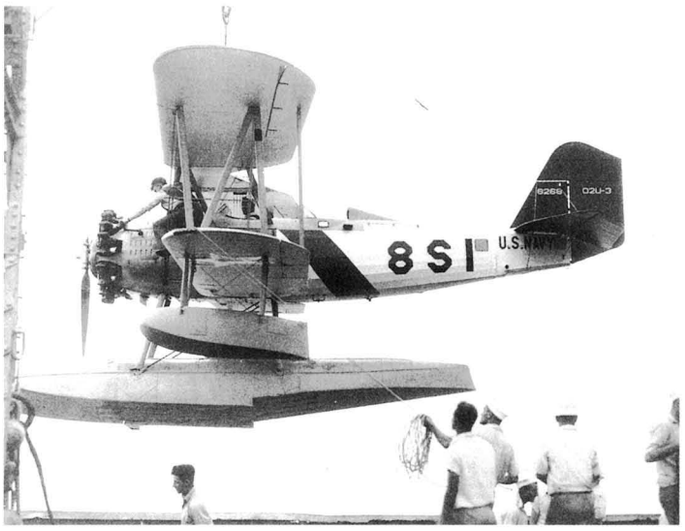




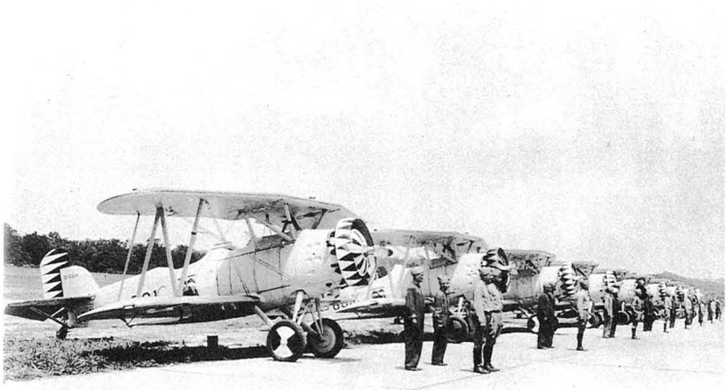
Above: This Curtiss F8C-4 was photographed during 1931. A non-regulation colorful painting scheme has been applied to this "Red Devil" airplane. Cowl and vertical fin have been painted Insignia Red in addition to the normal markings. Squadron insignia on the tail was a common Marine Corps practice as was the data on the laced panel. The national aircraft insignia should be on the undersurface of the lower wing. **Above right:** A Great Lakes TG-1 torpedo bomber of VT-2B is identified by a red tail while assigned to the USS Saratoga. **Below:** A Ford RR-5 transport is shown at NAS Anacostia, Washington, DC, on August 22, 1932. Note the Secretary of the Navy flag just behind the passenger door. The design is the same as previously shown on the Boeing F4B-1 for the Assistant Secretary of the Navy for Air, except that the colors are reversed, making the field blue and the stars and anchor white.

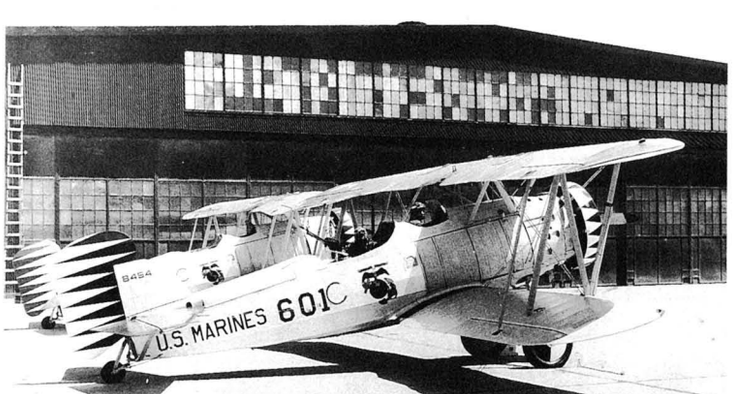


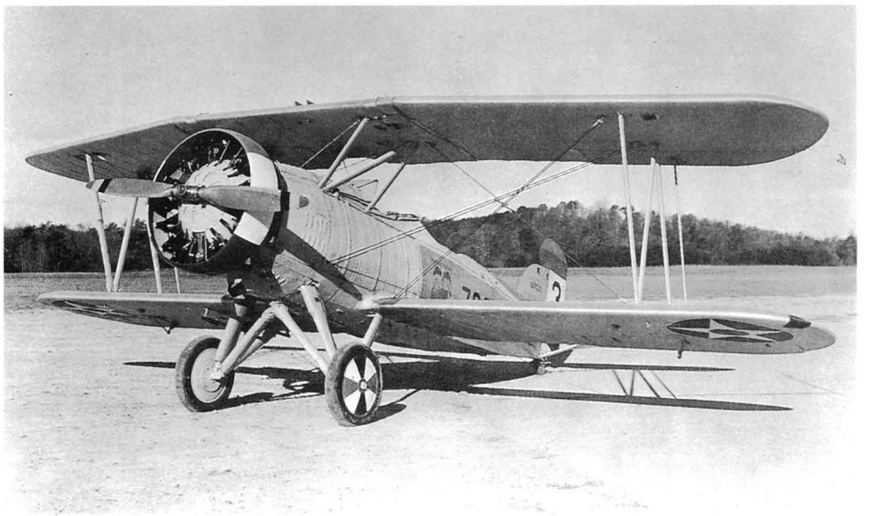
Right: This shows number one aircraft of Scouting Squadron 8 (VS-8A) of the Asiatic Fleet aboard the tender USS Jason on February 1932. The significance of the diagonal stripe is undetermined. It may have been a local version of a section leader fuselage stripe, in which case there should have been one for the number four aircraft as the second section leader. Tail assembly, fuselage stripe and engine plate are believed to be Insignia Red. **Below:** This Curtiss N2C-2 was assigned to VJ-7M. The application of U.S. MARINES to the upper wing was a common practice at San Diego. The Marine Corps emblem is in the location specified for the squadron insignia, while the squadron insignia is where the branch of service should be. Numerous technical markings can be seen on this aircraft. **Below left:** Curtiss O2C-1s of VO-6M are shown in the colorful markings derived from the game board for "Acey Deucy." These markings were in the normal section colors and were applied when the squadron flew in the Canadian Air Races of 1932.



Below: These Curtiss O2C-1s of VO-6M were photographed on July 10, 1932. The possibility of confusing an "O" for a zero is readily apparent in this photo. Also note the changes in the tail markings reflecting the use of section colors. "Acey Deucy" (Backgammon) was a popular game during off-duty hours. The markings on the game board was the inspiration for these colorful tail and cowl markings.







Left and below: These are Curtiss O2C-1s of VO-7M, the second observation squadron at Quantico, Virginia. Not to be outdone by VO-6M, VO-7M had its own colorful nonregulation paint scheme in red, white and blue. Note the confusion caused by the use of a zero in the squadron designation to denote observation rather than the approved / as well as the lack of a dash between characters.

date the squadrons assigned to the USS LEXINGTON and USS SARATOGA and their colors were as shown.

USS LEXINGTON		USS SARATOGA	
VF-2B	Lemon Yellow	VF-1B	Insignia Red
VF-5B	Insignia Blue	VF-6B	White
VS-3B	Insignia Blue	VS-2B	White
VT-1B	Lemon Yellow	VT-2B	Insignia Red

The USS LANGLEY was now a component of the Scouting Fleet and carried VF-3S green and VS-1S green.

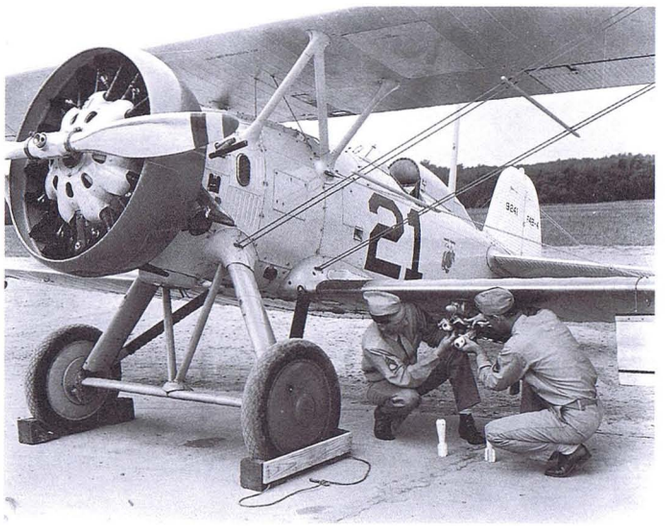
The long awaited directive finally was issued on June 1, 1931. The old Aeronautical Specification was superceded by SR-2 *Specifications for Aircraft Insignia and Marking.* This was the beginning of an entire new series of specifications in aviation, all with the SR prefix.

There were few changes from the preliminary instructions. The location for the branch of service on the fuselage was made quite specific. U.S. NAVY or U.S. MARINES was to be painted on each side of the fuselage, midway between the top and bottom longerons and parallel to the longitudinal axis of the aircraft. The last letter was to be located approximately 12 inches (30.48 cm) forward of the rudder hinge. Letters used for this marking were to be as large as space permitted, but in no case less than 8 inches (20.32 cm) in height.

All letters and numbers were to be either black or white, depending on the color of the background upon which they were applied. The color used was to be the one of greatest contrast. White was to be used on red or blue and black was to be used on white, gray, aluminum, green, and yellow.

Aircraft intended for delivery to the Marine Corps were to have the Marine Corps insignia placed on each side of the fuselage. Decalcomanias for this were provided by the Bureau of Aeronautics.

For the purpose of uniformity of markings, aircraft were divided into three general categories: 1. attached to squadrons, 2. not in regularly organized squadrons, 3. training aircraft.



Right: This photo shows a Boeing F4B-4 of VF-9M, the third tactical squadron at Quantico. VF-9M had its own non-regulation paint scheme with sections supporting solid red, white or blue tails and red cowl and wheels. This aircraft is now on display at the National Air and Space Museum, Smithsonian Institution, Washington, DC. **Below:** The Boeing F4B-4 of VF-9M was restored and is on exhibit at MCAS Quantico, Virginia, in 1962.

Aircraft attached to squadrons were to have the unit designation consisting of three markings of appropriate size painted on each side of the fuselage. Each designation was separated with a dash, except in the case of Marine Corps aircraft. These markings were to be forward of the branch of service and to show squadron number, class and individual aircraft number within the squadron. The branch of service and unit designation were to be so positioned that the centers of the two groups were on a horizontal axial plane.

If a squadron had an insignia which had been approved by the Bureau of Aeronautics, it could apply such to each side of the fuselage forward of the unit designation on airplanes and forward of the branch of service on flying boats. In actual practice squadron insignia were applied to the bow of flying boats.

The serial number of the aircraft, less the letter "A," was painted on each side of the vertical fin in figures 3 inches (7.62 cm) high. The letters and numerals designating the model were painted on both sides of the rudder, on the same line as the serial number, in characters 3 inches (7.62 cm) high.

The designations indicating the class to which the aircraft belonged were in accordance with the following list.

Bombing	VB
Fighting	VF
Ambulance	VH
General Utility	VJ
Training	VN
Observation	VO
Patrol	VP
Transport	VR
Scouting	VS
Torpedo	VT
Experimental	VX

Colors for identification purposes changed slightly with Royal Red in place of Insignia Red, True Blue for Insignia Blue, and Willow Green for Green. Royal Red and Insignia Red were

Left: The Pitcairn XOP-1 autogyro was being evaluated the Marine Corps in 1933, but does not show the VJ-6M squadron designation. The national aircraft insignia was applied to the wings just inboard of the tipped up wing tips. It proved to be unsuitable for observation work in the field and was not retained.

considered close enough to the same color and in the interest of uniformity the Army-Navy Standard AN Insignia Red was shortly specified as the proper color and Royal Red was dropped from the requirements.

The empennage could be painted a solid color but no markings could be obliterated by this color coding. Any such markings had to be repainted using the color of greatest contrast as previously stated.

When fuselage bands were used to identify section leaders' aircraft, a chevron of the same color had to be painted on the upper surface of the center wing section as described in the preliminary instructions. When the wing shape was such that there was insufficient space within the chevron for the aircraft number, either a chevron pointing aft or parallel bands could be substituted.

Aircraft not attached to regularly organized squadrons were to have the station or ship name painted on the fuselage in the location normally used for the unit designation with U.S. NAVY placed centrally beneath it. The use of the red, white, and blue vertical rudder stripes was optional for use on carrier utility or "staff" aircraft. When used, they were to be of equal width with the blue nearest the rudder hinge, white in the center, and red at the trailing edge. The Marine Corps continued to use these stripes until the camouflage paint schemes just prior to WWII.

SR-2 was the first instruction by the Bureau of Aeronautics that specified markings for training aircraft. The number of the aircraft within the squadron was to be painted on each side of the fuselage. This was the only figure on the fuselage of primary trainers. The branch of service was to be applied on the rear of the fuselage as prescribed for fleet aircraft.

There were no changes in the markings to be applied to nonrigid airships, free and kite balloons. U.S. NAVY as well as the building number on all nonrigid airships and free and kite balloons were now to be applied in Insignia Blue rather than Black. Markings to be applied to the rigid airships were specified in the contract and airship drawings.

Modification No. 1 to SR-2 was issued on November 6, 1931. Actual application on aircraft in the fleet had shown that the size lettering specified for the branch of service was too large for use on a small fighter aircraft and resulted in a crowded appearance. The lettering now specified for the branch of service marking was to be of an appropriate size and congruous with other markings applied. In no case was it to be less than 4 inches (10.16 cm) in height.

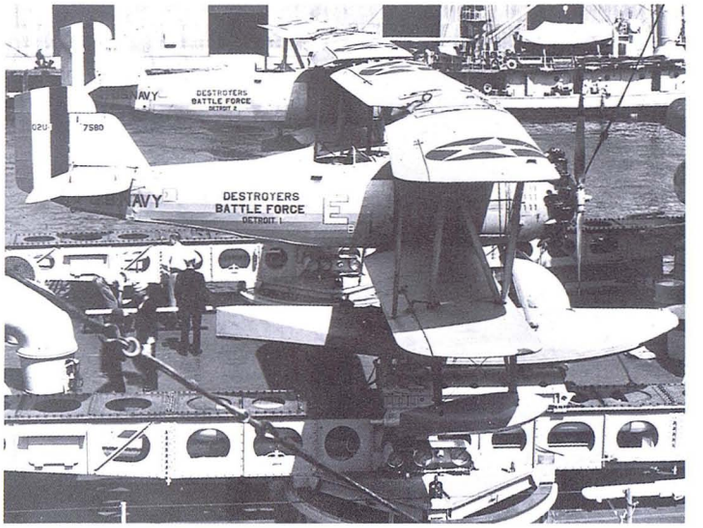
The branch of service U.S. NAVY or U.S. MARINES was to be painted in modified block letters of the largest practicable size on the under surface of the lower wing of all aircraft. U.S. was to be placed under the right wing and NAVY or MARINES under the left, with the top of the letters toward the leading edge of the wing. This marking was to be applied to all aircraft, including those attached to the Naval Reserve, with the exception of training aircraft.

For the purpose of identification, the number assigned to each aircraft by a station or ship could be painted immediately following the name of the station or ship, such as USS LEXINGTON 3. This had been in effect prior to SR-2 and must have been an oversight when the instruction was issued.

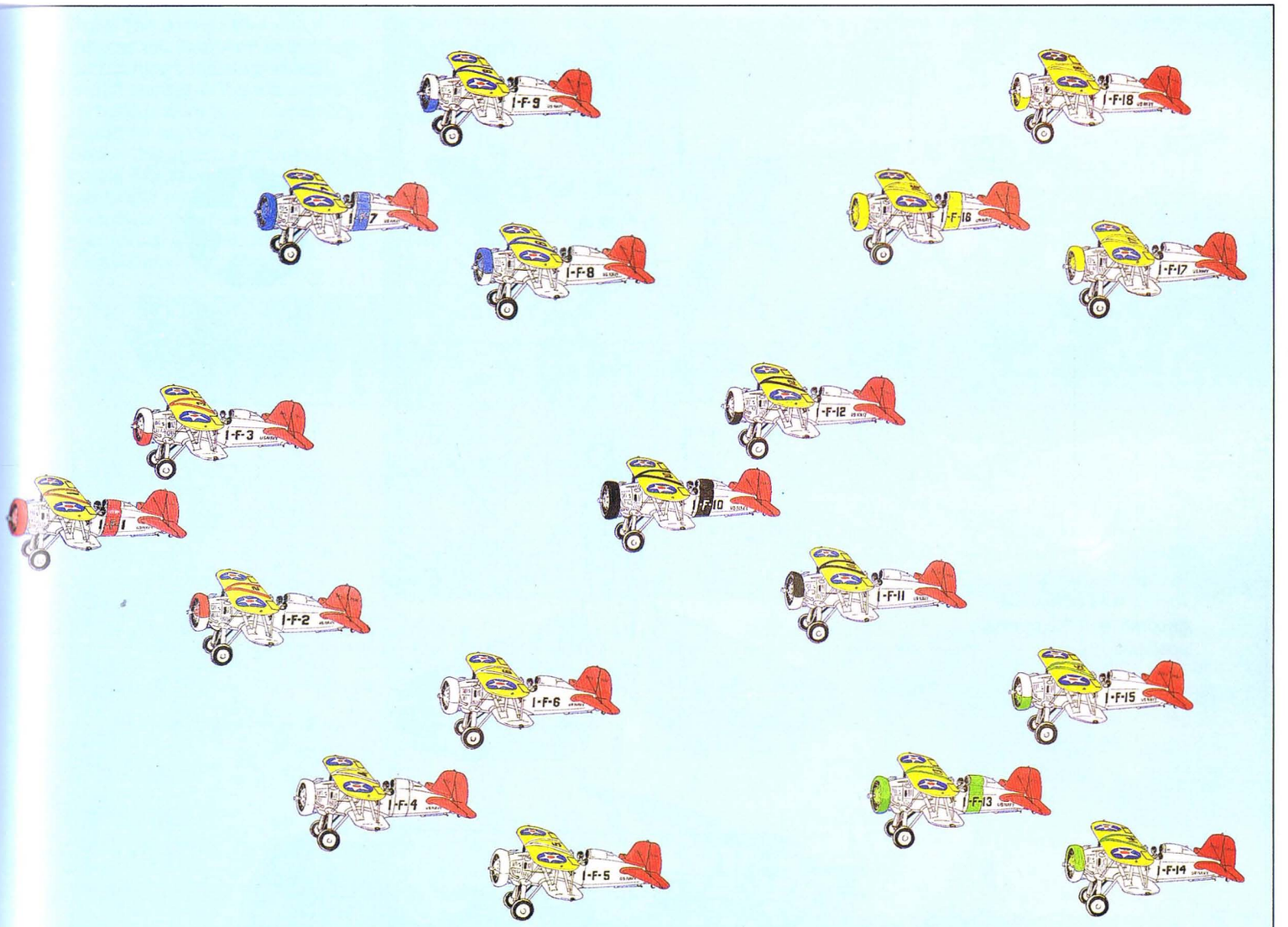
Perhaps the most important change, as far as the study and understanding of Naval aircraft markings, is paragraph 6(a) which stated, "The distinguishing insignia and marking herein described and no other shall be used on all United States Naval Aircraft. The impossibility of specifying exact locations and sizes for markings to suit all classes and models of aircraft is recognized, and it is therefore intended that sufficient latitude be permitted as necessary to meet differing conditions and yet conform to the general requirements of this specification." This philosophy has continued to the present and explains the reason for so many apparently differently painted aircraft. The instructions that might be appropriate for a multi-engine flying boat do not lend themselves in detail to a small single seat fighter. Yet they are all "correct" within the broad meaning of the specification and the individual interpretation of the instructions.

In November 1931 two Marine Corps Squadrons were formed to fill out the carrier complement and in addition provide carrier training for Marine Corps pilots. As such these squadrons came under the direct control of the Chief of Naval Operations and not the Major General Commandant. These were the only Marine Corps aircraft at the time which were painted in accordance with the carrier aircraft paint scheme. VS-14M was assigned to the USS LEXINGTON

Continued on p. 120

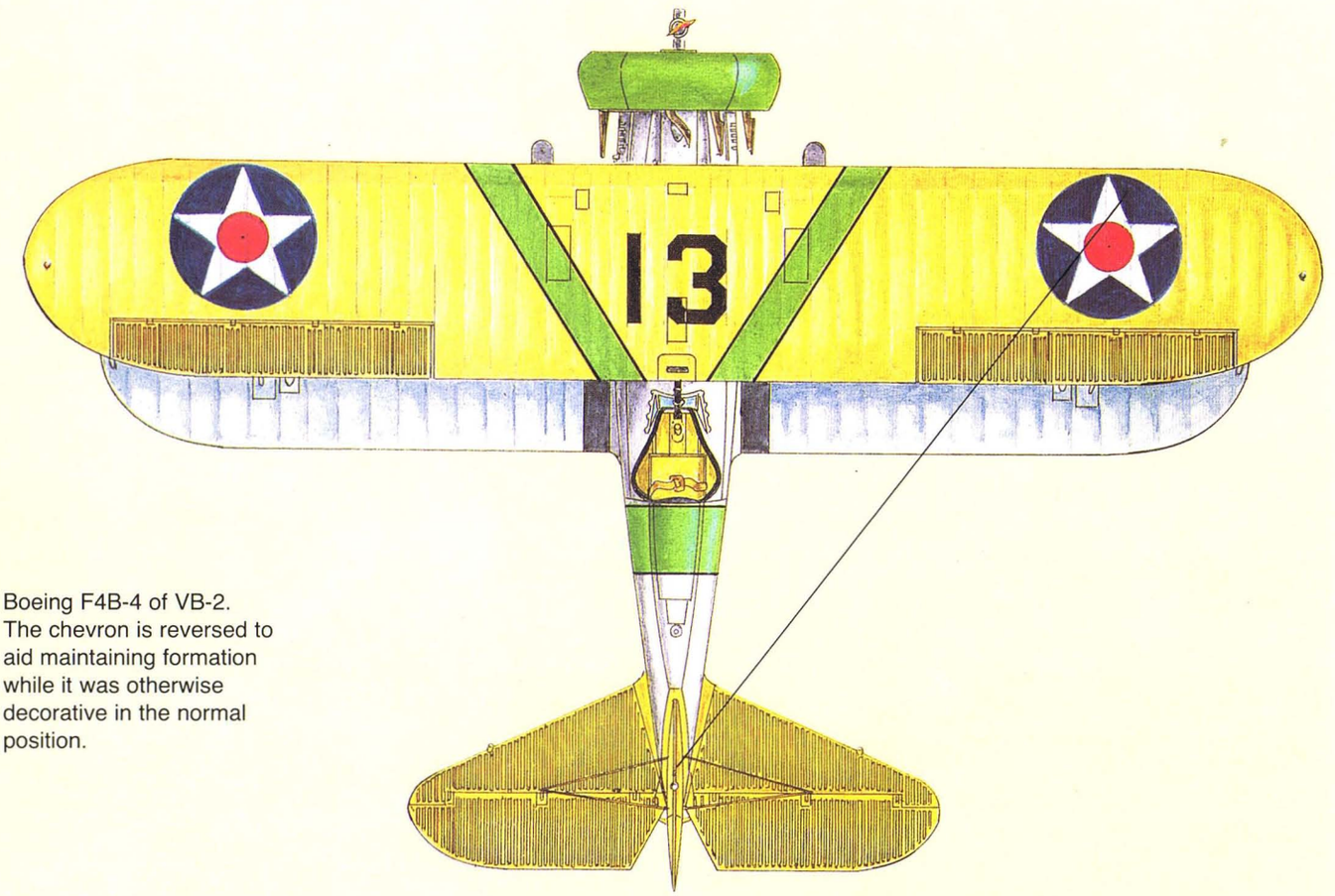


Shown here are the two Vought OS2U-1 assigned to the Commander Destroyers, Battle Force on his flagship the light cruiser USS Detroit. The pilot of number two aircraft was proficient in bombing practice. Note how close together the two catapults were on the stern of these ships.

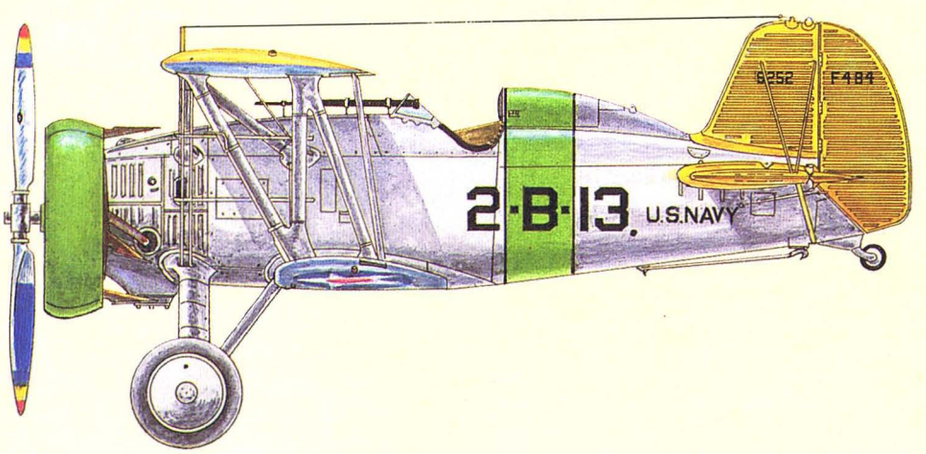


Above: With the standardization of section colors and cowl markings, a normal 18-plane squadron would be painted as shown. The section colors were Insignia Red, Insignia White, Insignia Blue, Black, Willow Green, and Lemon Yellow. The squadron was divided into two divisions of three three-plane sections. The section leader of each section had a band around the fuselage as well as the entire engine cowl painted in the appropriate section color. The number two aircraft of each section was identified by having the top half of the engine cowl painted, while the number three position in each section was identified with the lower half of the engine cowl painted in the section color. In the case of the four plane sections on the larger cruisers, the fourth airplane had a fore-and-aft stripe of the appropriate color painted on the top and bottom of the engine cowl. All airplanes had a chevron in the center of the upper surface of the top wing in its section color. The empenage was painted in the color assigned to the carrier to which the squadron was attached or some other system for aircraft of patrol squadrons or ship based squadrons. This marking system was not used on aircraft assigned to shore establishments. The Commanding Officer normally flew number one aircraft, while the Executive Officer lead the second division in number ten. Any aircraft assigned in excess of the normal 18 were not painted in accordance with this system.

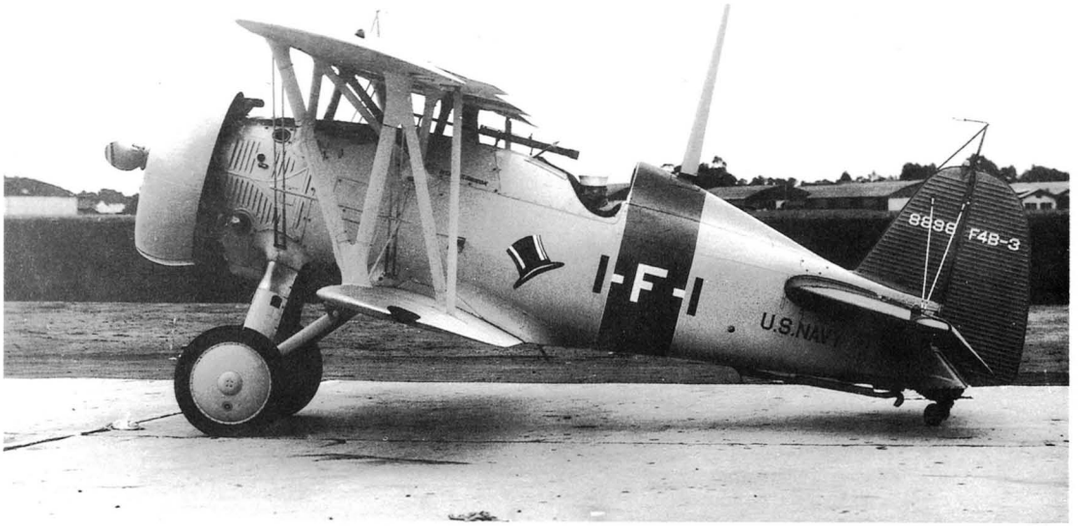
Left: A Boeing F4B-4 of VF-3B correctly painted as the second section leader with an Insignia White fuselage band and full cowl and the Willow Green tail of the USS Ranger.



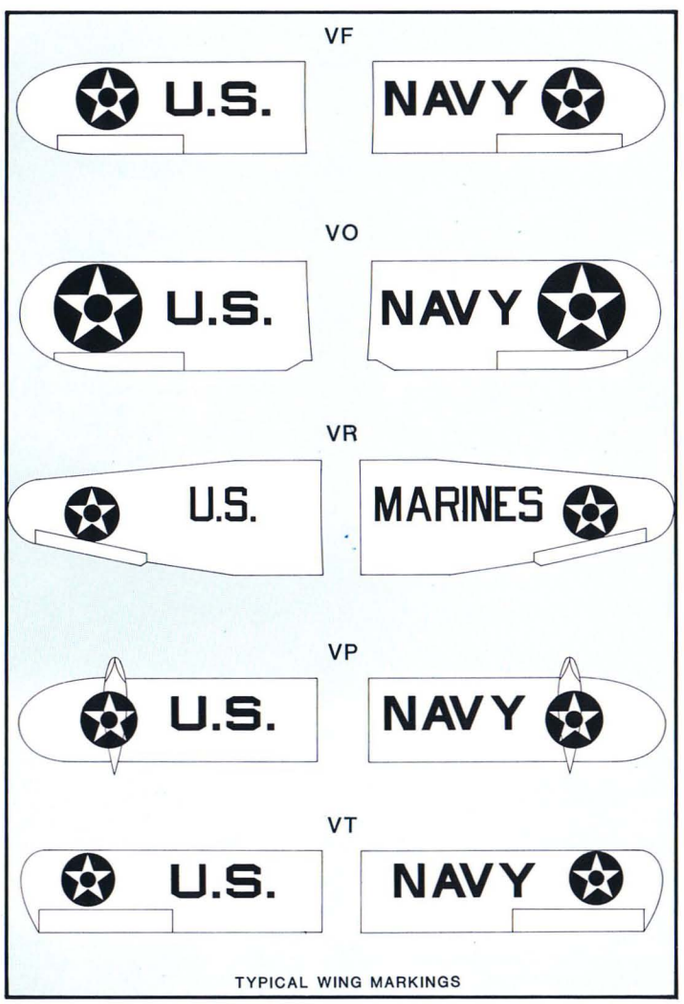
Boeing F4B-4 of VB-2. The chevron is reversed to aid maintaining formation while it was otherwise decorative in the normal position.



Right: This Boeing F4B-4 was assigned to a Fleet Air Base as a fast staff transport and assigned base aircraft number 4. This was a quite common practice to use obsolescent aircraft for such utility duties.
Below: This squadron commander's Boeing F4B-3 apparently has a borrowed cowl. Note forward of the cockpit the pilot name Lt. Cmdr. T. Sherman, who became so well known during World War II.



Left: This shows a Curtiss N2C-2 trainer assigned to VJ-6M at Quantico, Virginia. This aircraft was used extensively in the training of reserve pilots and for general utility work.



TYPICAL WING MARKINGS

with Insignia Red empennage while VS-15M was assigned to the USS SARATOGA with True Blue empennage. During the 3 years they were in existence they were assigned to other carriers but retained these tail colors.

From time to time complaints had been made about the difficulty in seeing the rigid airships, especially under low visibility conditions. While camouflage was considered a valuable military feature, the Bureau was anxious to forestall additional crticism or possible accident. In an attempt to provide maximum visibility without spoiling the general appearance of the airship or adding undue weight, the following markings were specified by the Bureau on February 18, 1932.

1. Fins, after-engine car and control car were to be Chrome Yellow.
2. Star shaped figure at bow was to be Chrome Yellow outlined with Blue.
3. Two national aircraft insignia were to be on forward part of airship with an additional one on top center line midlength of airship.

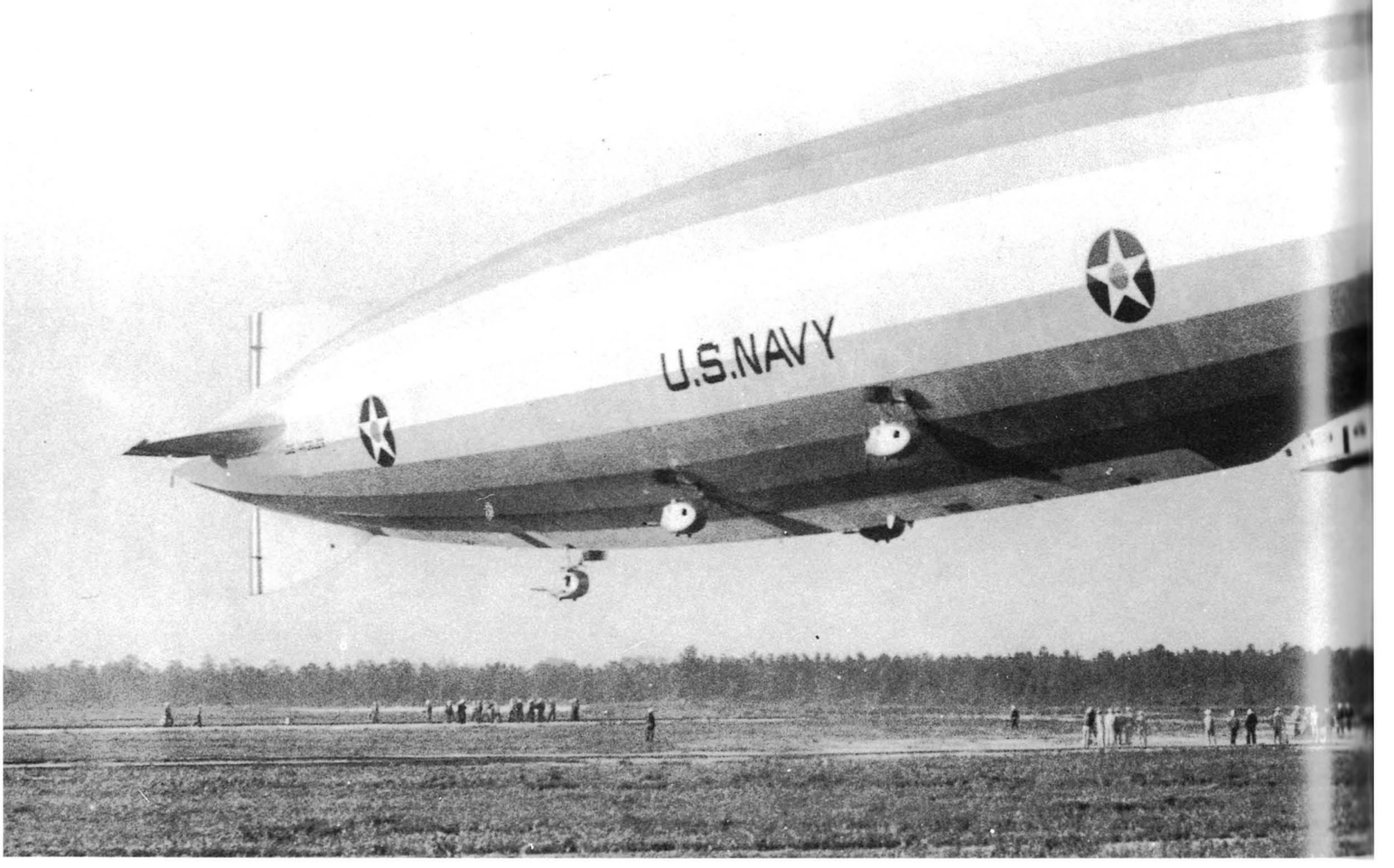
The exact dimensions of the star at the nose and location of the two star insignias was left to the judgement of the Commanding Officer of the ZR-3 USS LOS ANGELES. The Chrome Yellow was to be the standard pigmented dope as applied to the upper surface of aircraft wings.

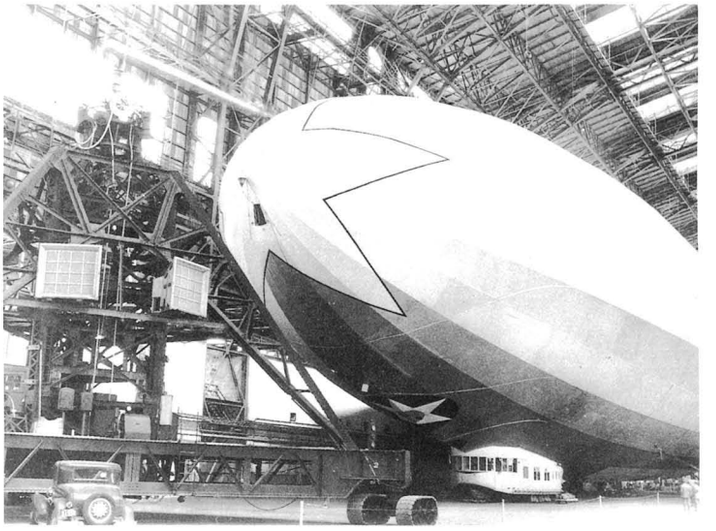
On June 20, 1932, the Commanding Officer of the ZR-3 reported that these markings had been applied and that data was being collected from observers regarding the effectiveness of these distinctive markings. It is believed that only one flight was made after this date before the airship was decommissioned, and that no report was submitted on these markings.

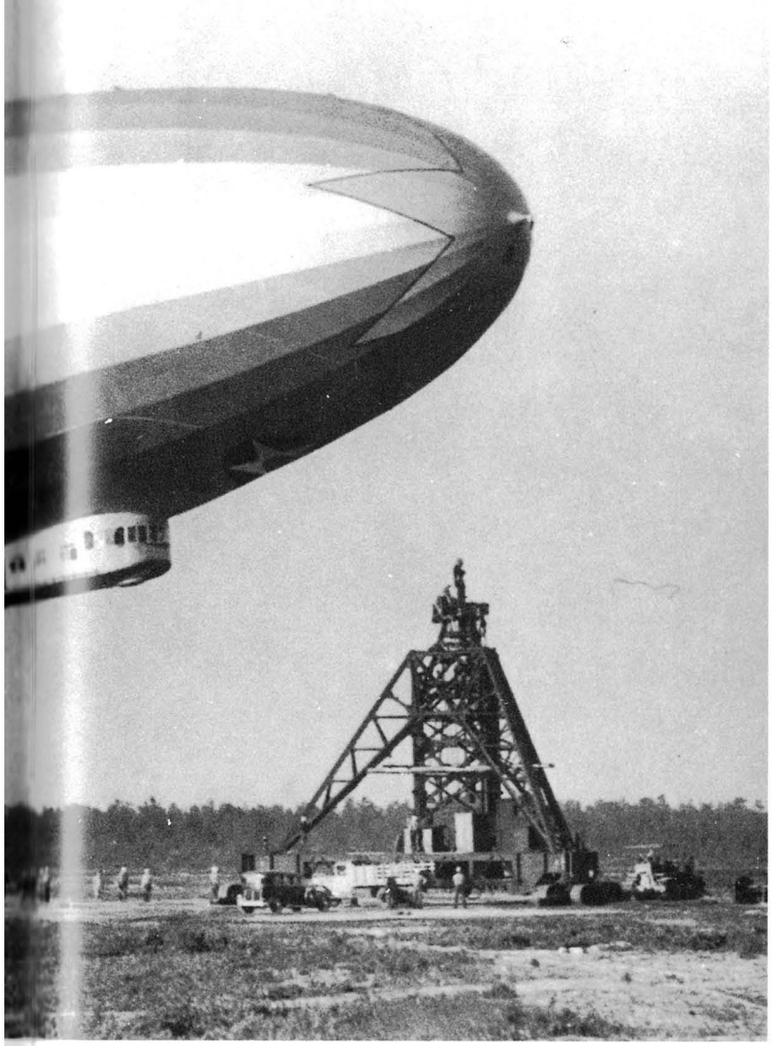
On January 9, 1932, the Bureau of Aeronautics issued a dispatch directing that the painting of U.S. NAVY on the under surface of the lower wing be suspended pending further instructions. Wings already painted with this marking did not need to be repainted. It is interesting that no mention was made at this time concerning U.S. MARINES on Marine Corps aircraft. However, Technical Order 168 was issued on July 8, 1932, which cancelled the requirement of painting both U.S. NAVY and U.S. MARINES on the under surface of the lower wings. The marking continued in use for a considerable period until all wings finally were recovered or required repainting. In some cases U.S. MARINES was applied to the upper surface of the top wing.

The Marine Corps fighter and observation aircraft based at Quantico were painted in nonregulation colors while participating in the air show circuit for several years. This might explain why they were allowed to continue for so long. The six Curtiss F9C-2 aircraft comprising the Heavier-Than-Air Unit for the airships USS AKRON and USS MACON also were painted in nonregulation markings. It was claimed by the unit that these bright and distinctive markings were required for

Top: This photo shows a Vought SU-2 of VS-15M, the second carrier-based Marine Corps squadron, from the USS Lexington. The Marine Corps emblem has been reduced in size to conform with the height of the designating letters. **Right:** This is a Squadron leader's aircraft of carrier-based VS-14M. Cowl and fuselage band are Insignia Red, while the tail is True Blue. **Below:** Two full sections of VS-14Ms Vought SU-1s are shown in correct markings. These two squadrons were assigned to the fleet under control of the CNO and were correctly marked in accordance with fleet directives. While they did help fill the requirements of the carriers, they also carrier-qualified approximately 60 percent of the Marine Corps pilots on active duty at the time.


U.S.NAVY





recognition due to their unique operations with the airships. However, esprit de corps was most likely the primary consideration.

When fully marked, each of the six aircraft was painted as a section leader, complete with full cowl, fuselage band, chevron on the upper wing, and wheel pants in the appropriate color. The rudders were painted with red, white, and blue stripes. This caused considerable correspondence between the unit and Bureau of Aeronautics. It appears that no one at the Bureau would make a firm decision one way or the other. However, they were finally required to paint the tail surfaces black when that color was assigned the USS MACON in 1934.

SR-2a was issued on February 1, 1933. The letters to indicate the class assignment of an aircraft were modified to the following expanded listing.

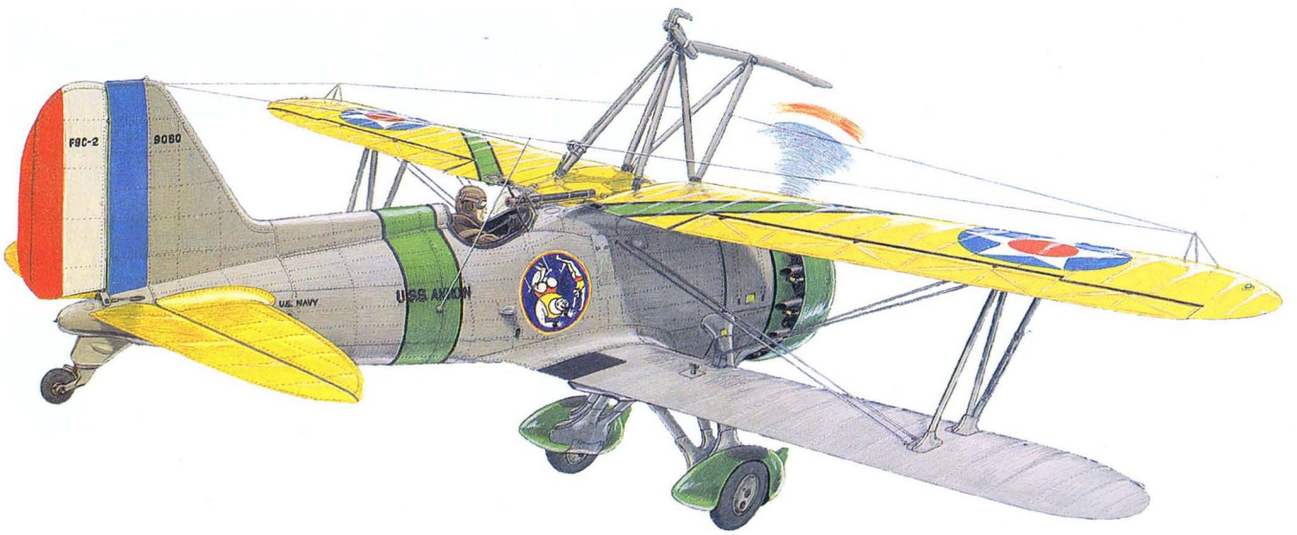
	Airplane	Rigid Airship	Nonrigid Airship	Kite Balloon
Bombing	VB			
Fighting	VF			
Ambulance	VH			
General Utility	VJ			
Training	VN	ZRN	ZNN	ZKN
Observation	VO		ZON	ZKO
Patrol	VP	ZRP	ZNP	
Transport	VR			
Scouting	VS	ZRS	ZNS	
Torpedo	VT			
Experimental	VX			

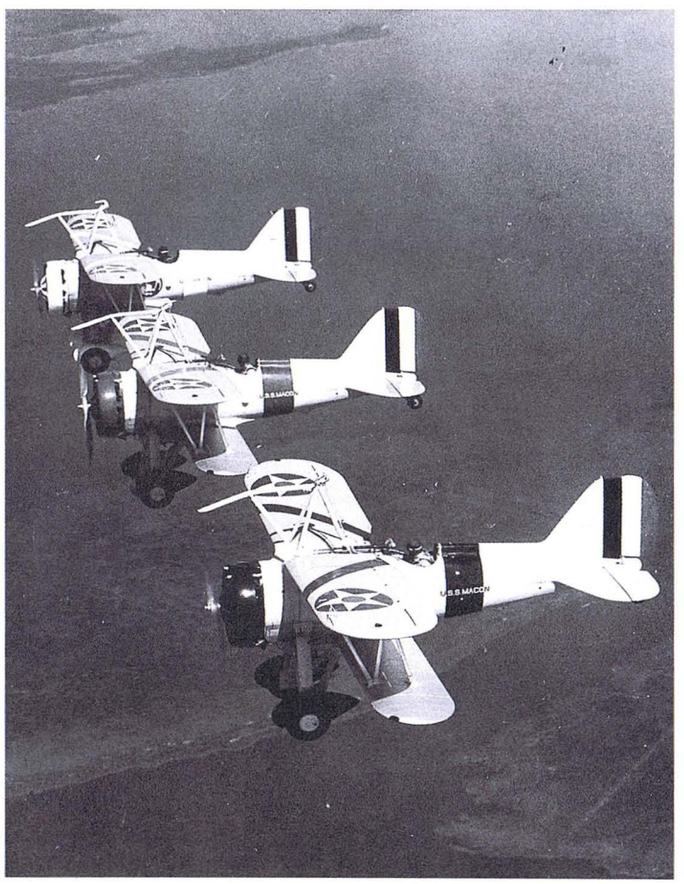
It should be remembered that these designations did not appear on the aircraft in this form.

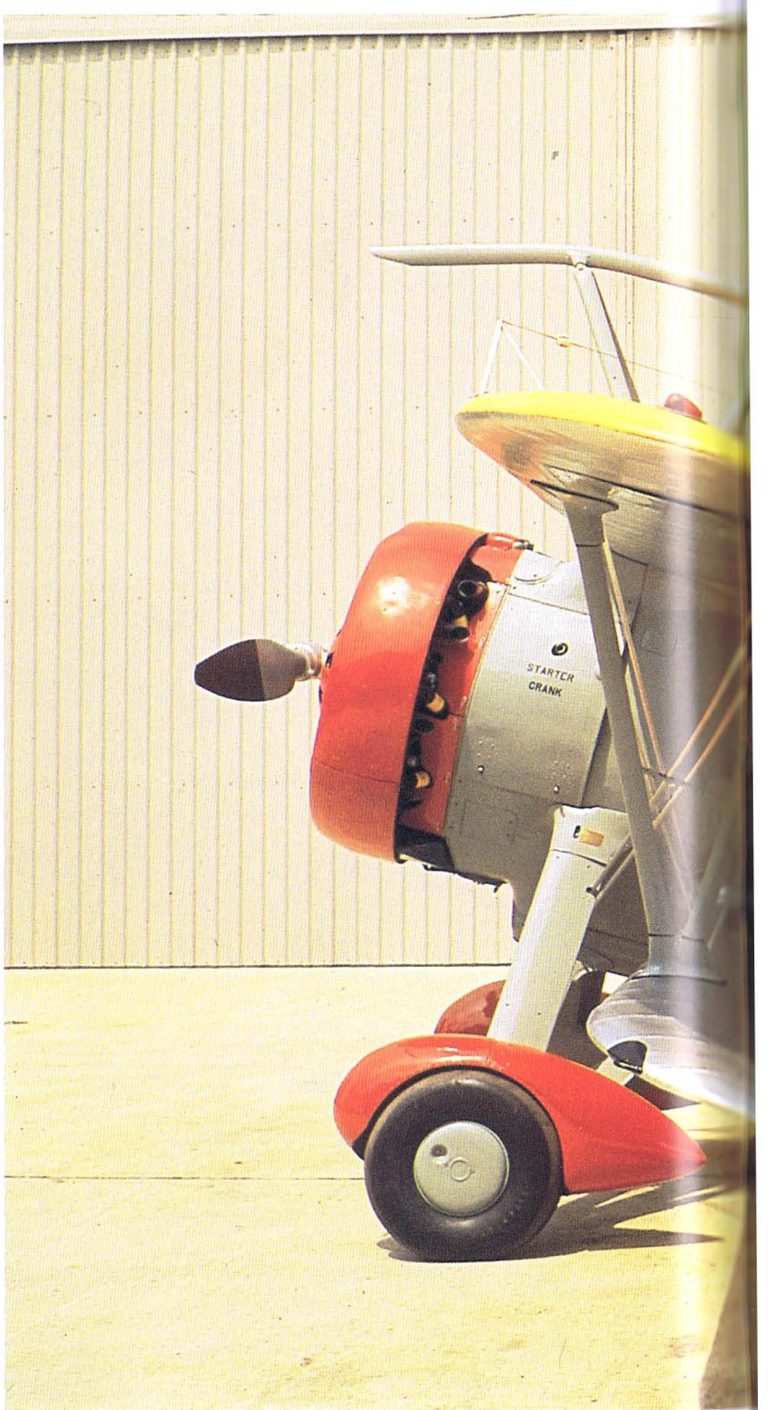
It has not been determined just when the practice of painting the ship name under U.S. NAVY on cruiser and battleship-based aircraft started. It is believed that this was a Fleet

Continued on p. 126

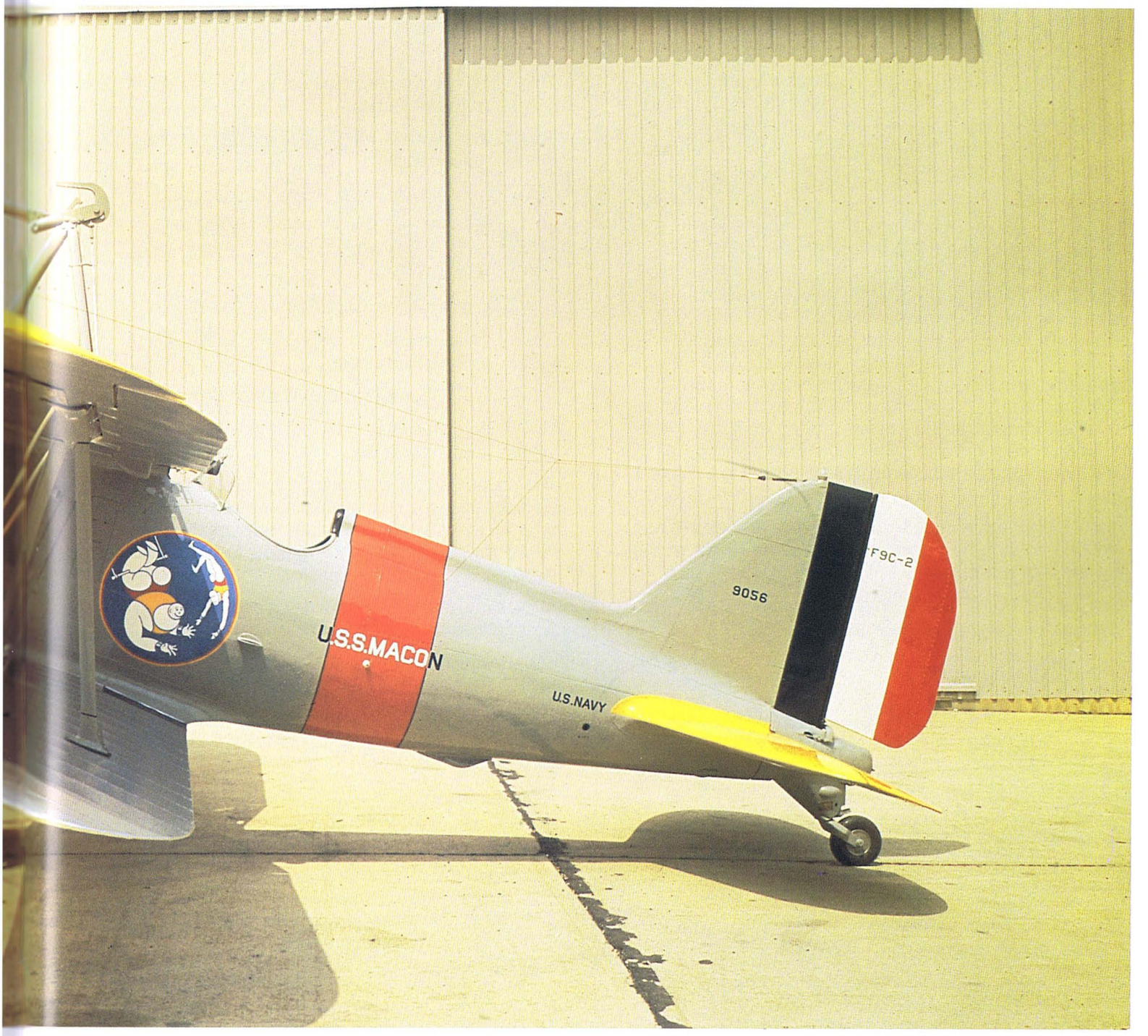
Left: The USS Los Angeles ZR-3 on June 23, 1932, with additional national aircraft insignia and yellow markings applied. This may have been its last flight prior to being deactivated. **Above:** A close-up of the USS Los Angeles shows the yellow six-point star outlined in black which is applied to the nose and the yellow control car.







Top illustration: This shows a Curtiss F9C-2 "Sparrowhawk" assigned to the ridgid airship USS Macon. The distinctive squadron insignia of "the man on the flying trapeeze" depicts the small aircraft being caught by the large airship trapeeze. **Above:** These Curtiss F9C-2s were assigned to the USS Macon. Each aircraft was painted with full cowl and fuselage band in the various section colors. While these colorful markings remained in use as long as they were assigned to the airships, the solid Black tails later were prescribed for the HTA Unit. **Right:** The Curtiss "Sparrowhawk" was restored by the National Air and Space Museum, Smithsonian Institution, Washington, DC. This aircraft is really the X model and as such was never assigned to one of the airships. However, it was configured by the Navy to be as near as possible the same as the production models. Since this is the only example of this popular and unique aircraft, it was decided to paint it as one of the production models and fully identify to the public its actual status while in the Navy.


U.S.S.MACON
U.S.NAVY
9056
F9C-2

Left: This is a Curtiss O2C-1 of VJ-6M, Aircraft One, Quantico, Virginia. The large aircraft number on the rudder and Aircraft One insignia on the vertical fin are unusual.

directive as it fails to show up in SR-2a or any other known Bureau of Aeronautics directive of the time. However, it was in practice by 1933. In order to be able to mark one of these aircraft correctly it therefore is necessary to know the position of the vessel within the Cruiser Division or Battleship Division to which the squadron is assigned. To further complicate the problem it must be remembered that the early cruisers carried only two aircraft.

Thus, section leaders flew aircraft 1,3,5,7, and 9. For example, the section leader of the third section of VS-6B in early 1933 would be in aircraft 6-S-5 with True Blue section markings, USS MILWAUKEE under U.S. NAVY and red fore and aft stripes on both the upper and lower surfaces of the horizontal tail surfaces and both sides of the vertical tail surfaces. The squadrons based on the battleships had the normal three plane sections and their markings were in accordance with SR-2 with the addition of the vessel name under U.S. NAVY. Care must also be taken in determining the correct markings for these aircraft as the vessels shifted from division to division or went into a shipyard for overhaul periods, all of which necessitated a movement of the aircraft to a different ship.

About 1934 the size of the Marine Corps insignia decals was reduced so that the insignia was the same height as the squadron designation.

On October 11, 1934, the Commander Aircraft, Battle Force reported the following tail color assignments.

USS LEXINGTON		USS SARATOGA	
VF-2B	Lemon Yellow	VB-2B	Insignia Red
VF-5B	True Blue	VF-6B	White
VS-3B	Lemon Yellow	VS-2B	White
VB-1B	Lemon Yellow	VT-2B	Insignia Red

USS RANGER		USS LANGLEY	
VF-3B	Willow Green	VS-14M	Insignia Red
VS-1B	Willow Green	VS-15M	True Blue
VB-3B	Willow Green		
VB-5B	Willow Green		

USS MACON

HTA Unit Black

This listing represents changes, in both squadron designations and color names.

On October 16, 1934, the Base Force reported the following tail color assignments.

Fleet Air Base, Pearl Harbor-based squadrons

VP-1F	solid Insignia Red	VP-8F	solid White
VP-4F	solid Lemon Yellow	VP-10F	Black stripes
VP-6F	solid True Blue		

Fleet Air Base, Coco Solo-based squadrons

VP-2F	White stripes	VP-5F	Black stripes
VP-3F	Insignia Red stripes		

San Diego-based squadrons

VP-7F	solid True Blue	VJ-1F	solid Willow Green
VP-9F	solid Insignia Red	VJ-2F	solid Lemon Yellow

The squadrons using stripes on the horizontal and vertical surfaces used the normal aluminum finish as a background color for the tail surfaces. Stripes were approximately 2 feet (60.96 cm) wide and were applied to both sides of the surfaces.

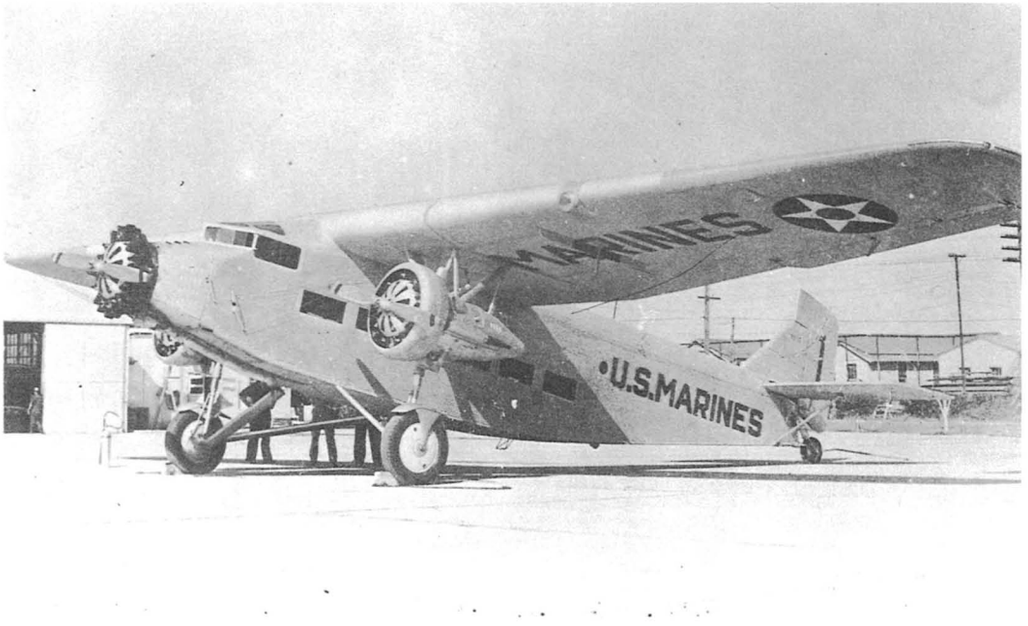
At the same time the VO squadrons aboard battleships were painting their tails using the following schemes.

VO-1B	Insignia Red	VO-3B	True Blue
VO-2B	White	VO-4B	Black

Cruiser-based VS squadrons used a wide stripe on both sides of the vertical and horizontal tail surfaces.

VS-5B	True Blue	VS-6B	Insignia Red
VS-9S	White	VS-11S	Willow Green
VS-10S	Lemon Yellow	VS-12S	Black

The addition of aircraft to the new "Treaty Cruisers" with the capability of carrying four aircraft required additional recognition marking for the fourth aircraft in each section. Commander Cruisers, Scouting Force proposed, on April 8, 1935, to mark the fourth aircraft aboard each ship with a 12 inch (30.48 cm) wide stripe in the center of the cowl in the section color. The aircraft number was to be painted in 3 foot (91.44 cm) block numerals on each lower wing in the section color



Top: The Vought 03U-1 aircraft of Commander Aircraft, Scouting Force is painted in regular fleet scheme rather than the special staff dark blue markings. This photo was taken between December 10, 1930, and April 1, 1933, when the title was abolished. **Right:** A Ford RR-5 assigned to VJ-6M at Brown Field, Quantico, Virginia, shows a late usage of U.S. MARINES under the wing and the lack of a squadron designation other than the number 1 on the rudder. **Below:** Squadron leader's Berliner-Joyce OJ-2 of VS-6B in 1933. The section leader's fuselage band is forced forward of its specified location by the excessively large U.S. NAVY. This large size and ship name beneath were standard on the Scouting Squadrons aircraft assigned to Cruiser Division Two and Three of the Battle Force at this time.

of all aircraft. These markings were approved by the Bureau of Aeronautics on May 3, 1935.

These 4 aircraft sections also required a revision of section leader markings in the VS cruiser-based squadrons. Section leaders in these squadrons flew aircraft numbered 1, 5, 9, and 13. All other colors and markings were the same as directed for regular fleet aircraft.

On May 16, 1935, the Bureau of Aeronautics issued instructions specifically for the marking of aircraft assigned to Naval Reserve Bases or Units. These instructions were mandatory and rescinded all previous instructions not in accordance. This system was effective upon receipt of replacement aircraft or at the next overhaul. They could be put into effect earlier at the discretion of the Commanding Officers. Because of the manner in which these instructions were worded, there is no date that can be considered an effective date for their implementation.

All Reserve aircraft now were required to have U.S. NAVY painted on the rear of the fuselage in the same manner as aircraft assigned to fleet units. Aircraft intended for delivery to Reserve Aviation Bases or Units were to have the standard Reserve insignia placed on each side of the fuselage forward of the aircraft number. The name of the base or station to which the aircraft was assigned was painted on the arms of the anchor. Decalcomanias of the standard Reserve insignia were provided by the Bureau of Aeronautics.

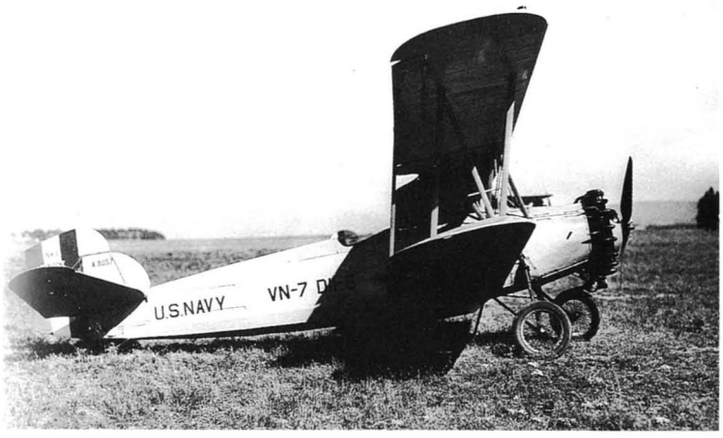
The number of the aircraft in the Reserve Base or Unit Organization was painted on the sides of the fuselage in block numerals approximately 12 inches (30.48 cm) high. No exact location for these fuselage markings was specified as their location was influenced by the design of the particular aircraft to which they were applied. They were, however, to be placed so as to be readily distinguishable and present a balanced appearance.

Section leader fuselage bands were optional, but if used, were to conform with the instructions for fleet aircraft. The aircraft number was applied to the upper wing, and if section leader fuselage bands were used, was to be within a chevron.

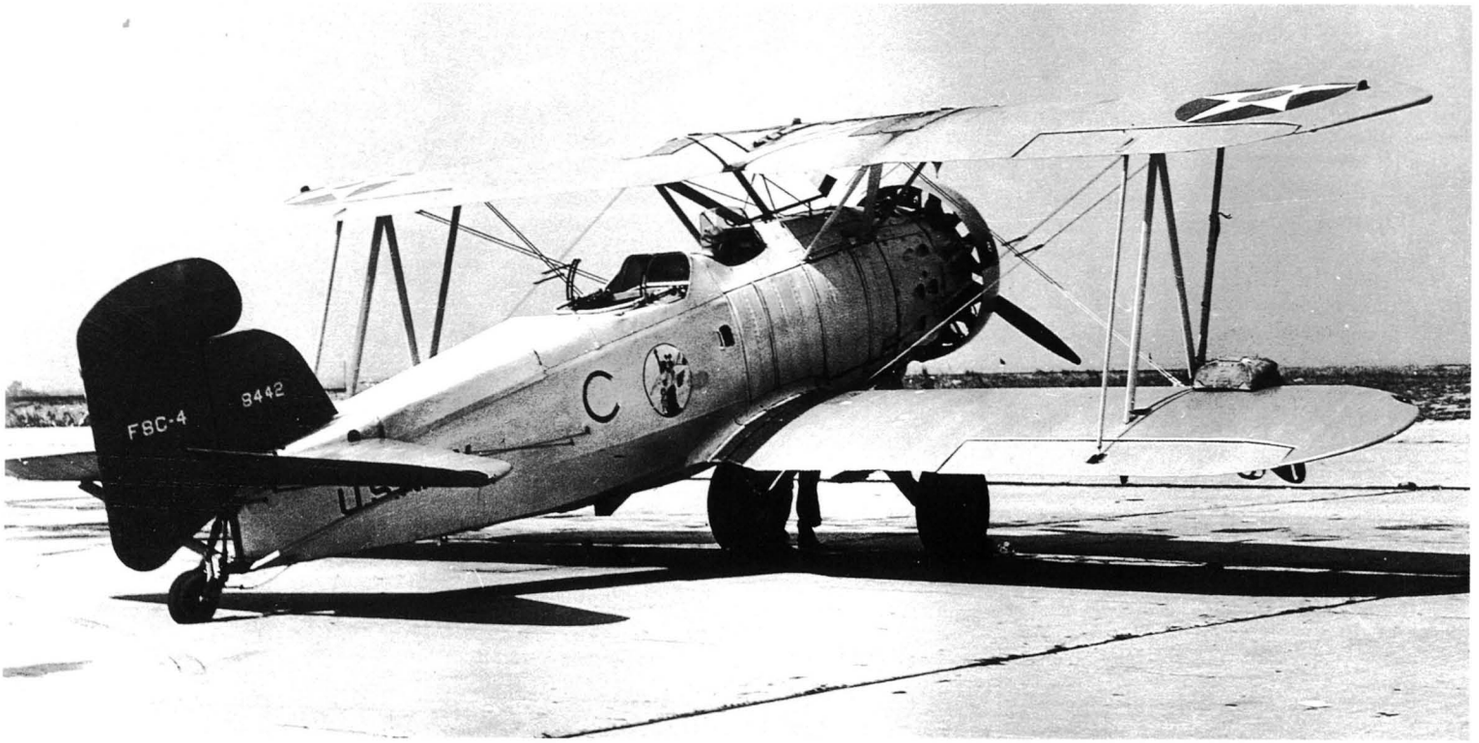
Tail surfaces could be the color of the fuselage or could be painted a distinguishing color for each Reserve Base. If a distinguishing color was used, it was to conform to those specified for section markings. As with fleet aircraft there was no restriction regarding the color assigned to a squadron and they could be used in any sequence desired. Red, white, and blue vertical tail stripes could also be used if desired.

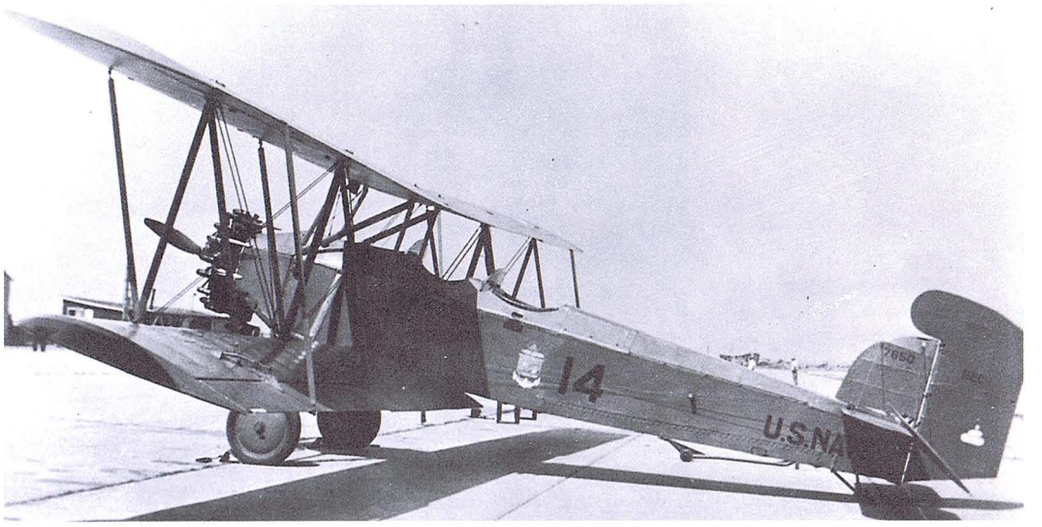
Commander Aircraft, Battle Force on October 22, 1935, directed that due to the large number of squadrons attached to the Battle Force, it was impractical to continue the system of assigning tail colors that permitted identification of squadrons within a carrier group. The new policy assigned a color to each carrier, and all aircraft attached would have the

Top: This is a consolidated NY-2 assigned to the Navy Reserve Training Squadron VN-15RD 13 and Marine Reserve Squadron VO-9MR at Seattle, Washington. The Navy reserve squadrons included the Naval District in their designations, while the Marine reserve squadrons were numbered the same as the active duty squadrons with an R suffix. **Left:** This is the Naval reserve aviation insignia which was to be applied to the fuselage of all reserve aircraft. The base name was painted on the flukes of the anchor.



Top: A J-4 nonrigid airship is pictured sometime in 1934. Note the national aircraft insignia on the top of the envelope. Rudder stripes are not carried on the top controls. **Above:** A Keystone NK-1 is pictured here. The lengthy markings show that this is aircraft number 5 of Navy Reserve Training Squadron 7, located in the 11th Naval District. **Above right:** A Martin T4M-1 torpedo plane which was assigned to the Naval Reserve Air Base, New York, as the number 10 aircraft. No squadron is identified on the aircraft since they were flown on alternate weekends by the different squadrons assigned to the base. **Below:** This Curtiss F8C-4 also was assigned to the Naval Reserve Air Base in New York. The chevron on the upper wing appears to be white, outlined with black, but the upper half of the cowl shows that it should be a dark color. What appears to be a letter "C" behind the station insignia is an inspection panel, not a marking.





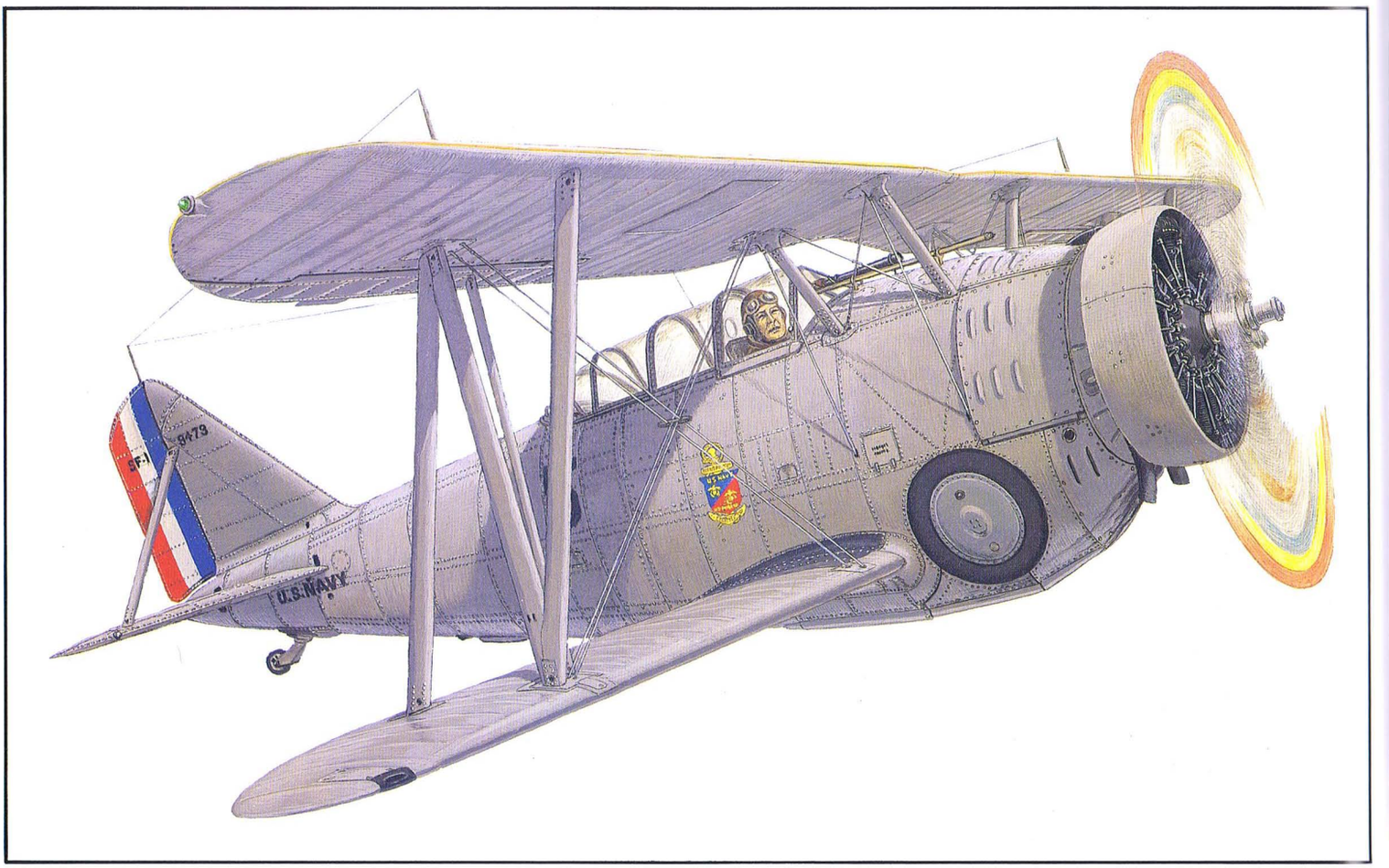
Left: A Curtiss N2C-2 is shown assigned to an undetermined Naval Reserve Air Base. **Below:** An illustration of the Grumman FF-1 which was assigned to the Naval Reserve Air Base, Seattle, Washington. The only unit identification is Seattle, on the flukes of the anchor in the reserve insignia.

same color tails. These assignments were as follows:

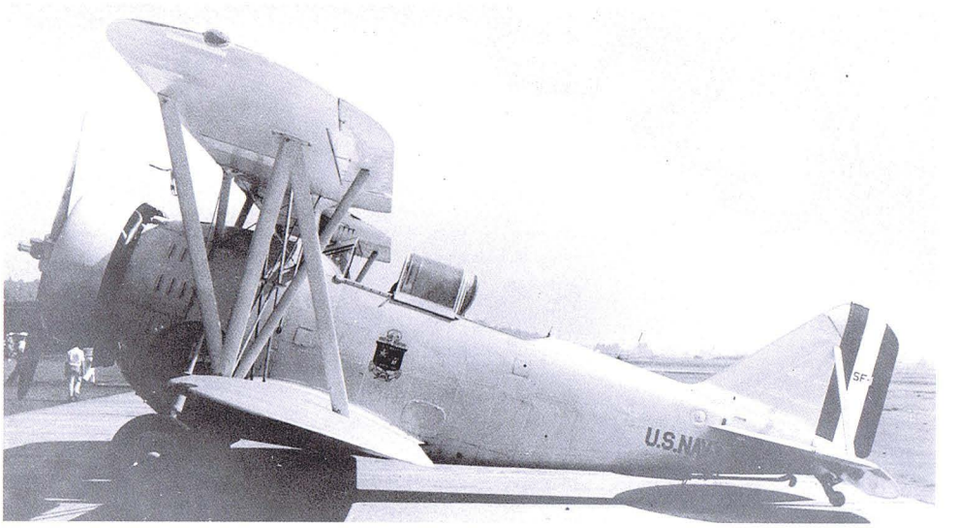
Lexington	Lemon Yellow
Saratoga	White
Ranger	Willow Green
Langley	Insignia Red
Yorktown	True Blue
(when commissioned)	
Enterprise	Black
(when commissioned)	

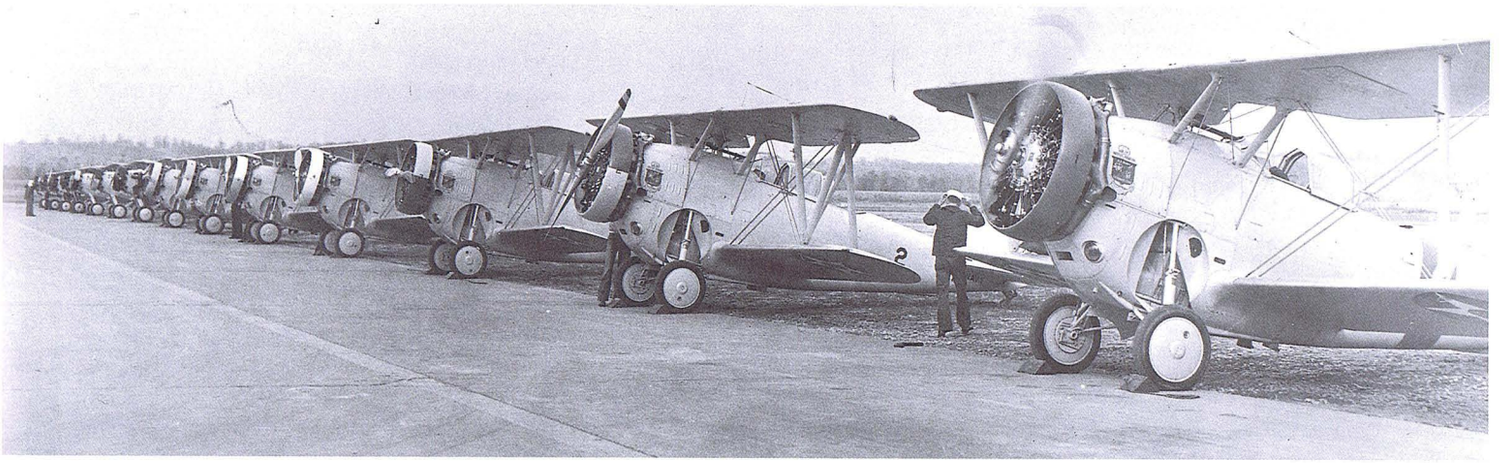
New or overhauled aircraft being assigned to Aircraft, Battle Force were to be painted with the new tail assignment. In order not to overtax the squadron facilities, aircraft currently attached to Aircraft, Battle Force were to retain their present tail colors until turned in for overhaul.

On March 16, 1936, Major General Commandant John H. Russell approved a new style Marine Corps emblem. This new style also always was applied by decal provided by Bureau of Aeronautics. As with the earlier change in size, the replacement of the old with the new style was a long, drawn out process. Money was still tight in the military. An emblem that was still in good condition would not have been replaced until it was necessary to replace the fabric or repaint the fuselage of the new metal-skinned aircraft. Then too, good supply practice would dictate the expenditure of all old stock before the issue of new. Photos show aircraft with the old style



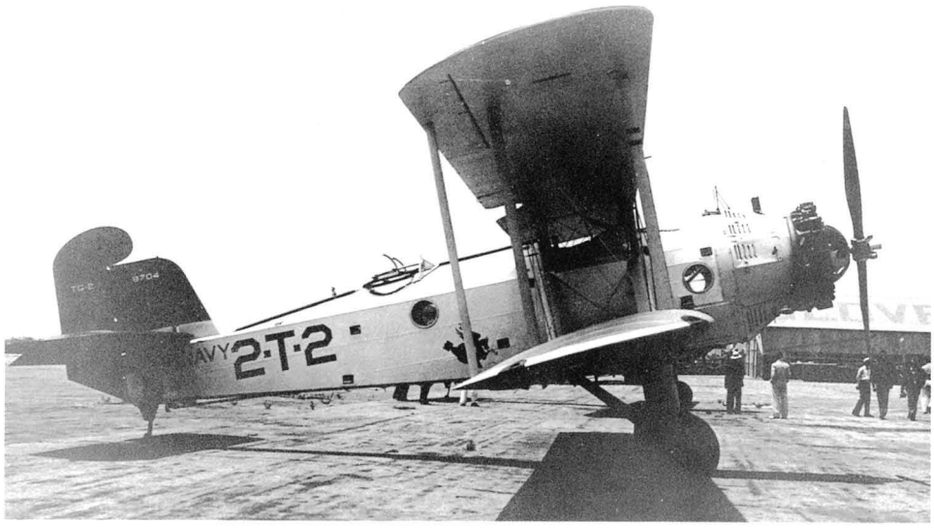
Right: Many of the Grumman SF-1s were assigned to reserve units at the end of their regular service careers. This one was operated by the reserve squadron at NAS Hampton Roads, Virginia. **Below:** Several Grumman FF-2s of VS-12R based at Long Beach, California are shown here. Note the nonregulation aircraft number on the cowl as an aid for the plane captain. All pilots and most of the enlisted personnel of the squadron were employees of Transcontinental and Western Air, Inc. (TWA). **Below:** In 1931 the first US military aircraft with retractable landing gear, the Grumman FF-1, also boasted 20 mph greater speed than any other fighter of its time. This photo, taken in June 1966 at Calverton, Long Island, New York, shows a restored aircraft with solid Insignia Red Cowl and fuselage band and True Blue empenage.






9253
F4B-4
6-F-3


F4B-4 9253
2-B-14



Right: A Great Lakes TG-2 of Torpedo Two (VT-2) is shown here. Note how far aft the squadron designation is placed as well as the location of U.S. NAVY. Tail is Insignia Red for USS Saratoga.

emblems still in use as late as 1940.

Commander Cruisers, Scouting Force on February 1, 1937, issued a directive specifying the tail colors to be used on aircraft in the Cruiser Scouting Force as follows.

VS- 9S	plain aluminum with no stripe
VS-10S	Lemon Yellow stripe
VS-11S	Black stripe
VS-12S	Willow Green stripe

It will be noted that only VS-10S retained its previous color, while VS-11S and VS-12S exchanged colors. This is a good example of the problem of documenting the numerous changes in marking of US Naval aircraft. These new colors were to be accomplished as soon as practical.

A complete revision of Naval Aviation unit designations was issued by the Chief of Naval Operations on March 9, 1937, with an effective date of July 1, 1937. These new instructions applied only to heavier-than-air squadrons since there were no current or prospective lighter-than-air squadrons in the Navy. The use of suffix letters to indicate organizational assignment was discontinued.

Carrier-based squadrons were numbered the same as the carrier's hull number, with additional digits as necessary if more than one squadron with the same primary mission was assigned to the same carrier. The carrier identification numbers were as follows.

Lexington	2	Yorktown	5
Saratoga	3	Enterprise	6
Ranger	4	Wasp	7

The Langley was no longer an aircraft carrier, having completed conversion to a seaplane tender in February 1937.

Example: VF-3 attached to Saratoga;
VS-41 and VS-42 attached to Ranger

Cruiser-based squadrons carried the number of the Cruiser Division to which they were attached. To distinguish them from a carrier-based scouting squadron the letter C was placed between the heavier-than-air designator V and the primary mission designator S.

Example: VCS-2 attached to Cruiser Division Two

Battleship-based squadron numbers were the same as the battleship division to which they were attached.

Example: VO-4 attached to Battleship Division Four

Patrol squadrons and Utility squadrons were numbered serially by the Navy Department.

Marine Corps squadrons had the same number as the Aircraft Group of the Fleet Marine Force of which it was a component. Squadrons not assigned to these organizations were numbered by the Navy Department. The letter M for Marine no longer followed the squadron number but preceded the primary mission letter. The primary mission letter was no longer within a circle to denote a Marine squadron.

Example: VMF-2 Marine Fighting Squadron 2 attached to Aircraft Two, Fleet Marine Force

Naval District and Shore Station aircraft squadrons were numbered serially by the Navy Department with the letter D and the appropriate Naval District number to which the squadron was assigned.

Example: VJ-4D5 Utility Squadron Four, Fifth Naval District

Navy and Marine Corps Reserve squadrons were numbered serially by the Navy Department with the letter R following the squadron number to denote a Reserve Squadron.

Example: VS-1R Reserve Scouting Squadron One
VMO-6R Marine Reserve Observation Squadron Six

While it was not specified in this directive, the practice of showing battleship and cruiser names on the VO/VCS aircraft changed at this time. The name of the battleship to which the aircraft was assigned was not applied after the squadron designation, while the name of the cruiser to which the aircraft was assigned was applied below the squadron designation and across the fuselage band, when one was used.

Opposite above and left: This is an excellent example of the Boeing F4B-4. These two photos are a good example of the free interpretation of the painting instructions. The same aircraft is shown, but with the chevron on the upper wing reversed after it was transferred from Fighting Six to Bombing Two. Clearly there was no space requirement for this change but just a preference.

Left: A Douglas P2D-1 patrol aircraft photographed on August 2, 1935, was assigned to VP-3F at Coco Solo, Canal Zone. Note the red propeller warning a stripe on the pontoons and the Insignia Red tail stripe.

Responding to recommendations from the Fleet, the Chief of Naval Operations, on March 10, 1937, revised the system of tail markings. The specific colors to be assigned a particular squadron, except in the case of carrier squadrons, was left to the discretion of the Commander-in-Chief. All squadrons on a specific carrier were to have the same color tails. The assignment of colors to the carriers reflected the deletion of the Langley and addition of the Wasp. The new assignments were as follows.

Lexington	Lemon Yellow
Saratoga	Insignia White
Ranger	Willow Green
Yorktown	Insignia Red
Enterprise	True Blue
Wasp	Black

The new designs and colors authorized for tail markings are as listed below.

Design	Color
Tail solid	Insignia Red Insignia White True Blue Black Willow Green Lemon Yellow
Horizontal and vertical stabilizers only, solid.	Insignia Red True Blue Black Willow Green Lemon Yellow
Horizontal and vertical tail control surfaces only, solid.	Insignia Red True Blue Black Willow Green Lemon Yellow
Fore and aft stripe across all vertical and horizontal tail surfaces. Width of stripe to be prescribed by Force Commander.	Insignia Red True Blue Black Willow Green Lemon Yellow

It will be noted that the use of white has been eliminated except in the case of solid tail color.

Amendment 1 to SR-2a was issued on March 18, 1937. In addition to adding all the marking changes to the basic instruction which had been approved by letters, was the following statement. "Designs and colors for tail painting of other Fleet squadrons are assigned by Commander-in-Chief, U.S. Fleet. Responsible Commanders assign designs and colors for tail painting as necessary for squadrons not in the Fleet."

On June 25, 1937, the Commander-in-Chief, United States Fleet issued Fleet Memorandum 11M-37 which specified the U.S. Fleet Aircraft Tail Markings. These were to be effective July 1, 1937, and are listed as follows.

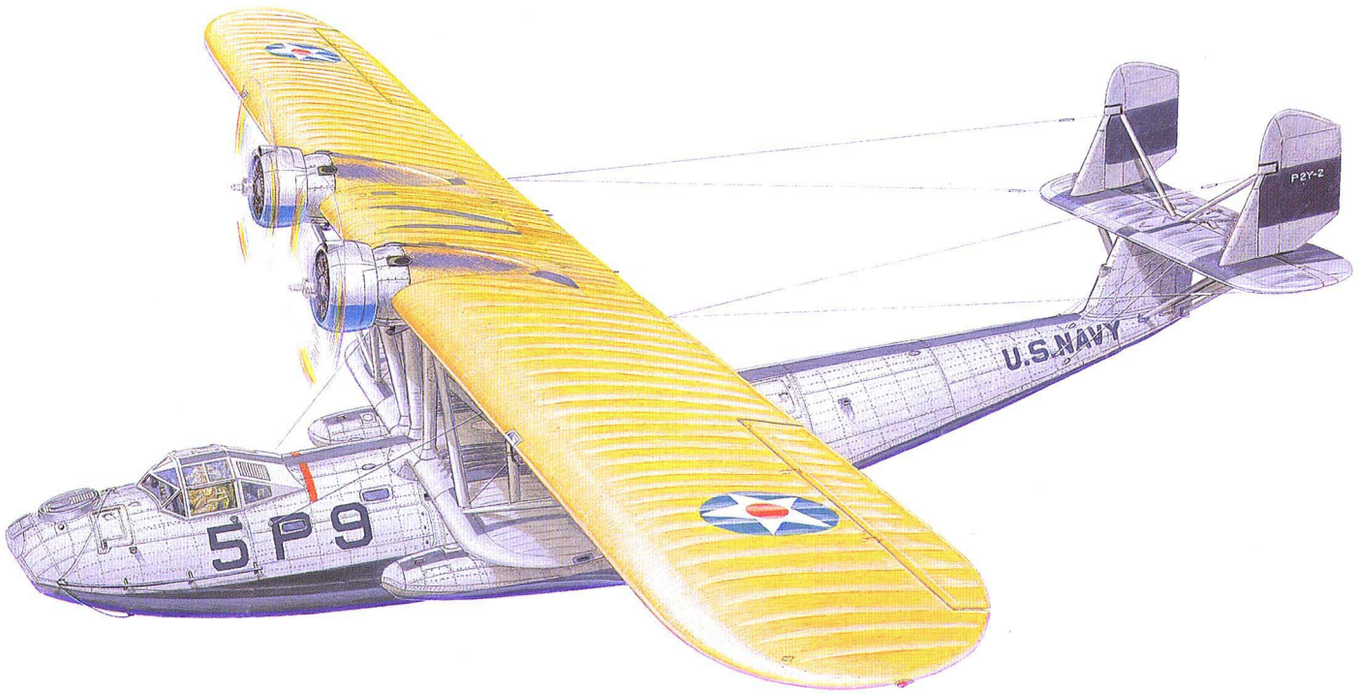
VO-1	Insignia Red	(solid)
VO-2	Insignia White	(solid)
VO-3	True Blue	(solid)
VO-4	Black	(solid)
VCS-2	True Blue	(stripe)
VCS-3	Insignia Red	(stripe)
VCS-4	Aluminum	(solid)
VCS-5	Lemon Yellow	(stripe)
VCS-6	Black	(stripe)
VCS-7	Willow Green	(stripe)

Aircraft assigned to USS DETROIT to have tail markings of VCS-2.

Aircraft assigned to USS RALEIGH to have tail markings of VCS-3.

Lexington	all squadrons	Lemon Yellow	(solid)
Saratoga	all squadrons	Insignia White	(solid)
Ranger	all squadrons	Willow Green	(solid)
Yorktown	all squadrons	Insignia Red	(solid)
Enterprise	all squadrons	True Blue	(solid)

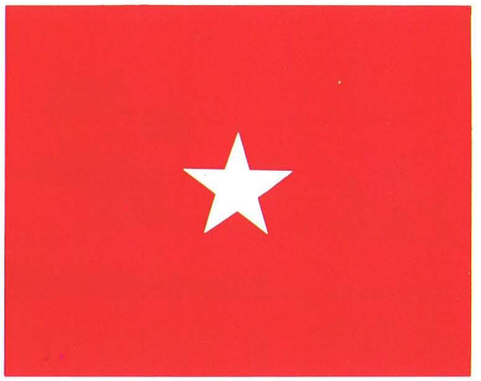
VJ-1	Willow Green	(solid)
VJ-2	Lemon Yellow	(solid)
VP-1	Insignia Red	(solid)
VP-2	Willow Green	(single stripe)
VP-3	Insignia Red	(single stripe)
VP-4	Lemon Yellow	(solid)



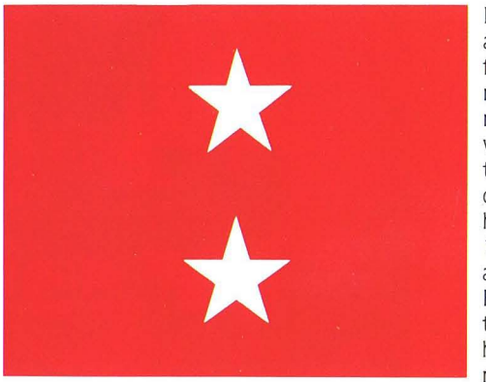
Consolidated P2Y-2 of
Patrol Squadron Five (VP- 5).

VP-5	Black	(single stripe)
VP-6	True Blue	(solid)
VP-7	True Blue	(double stripe)
VP-8	Aluminum	(solid)
VP-9	Insignia Red	(single stripe)
VP-10	Black	(checker)
VP-11	Willow Green	(double stripe)
VP-12	Lemon Yellow	(double stripe)
VP-14	Lemon Yellow	(single stripe)
VP-15	Insignia Red	(solid)
VP-16	True Blue	(checker)
VP-17	Insignia Red	(checker)
	Prospective Squadrons	
VP-18	Willow Green	(solid)
VP-19	Lemon Yellow	(checker)
VP-20	True Blue	(solid)
VP-21	Willow Green	(checker)

Acting again on recommendations from the Fleet, the Chief of Naval Operations, on August 28, 1937, modified the color and designs authorized for tail markings. The tail of the aircraft was defined as the area comprising the horizontal and vertical stabilizers and the horizontal and vertical control surfaces. The new combinations were as follows.



BRIGADIER GENERAL



MAJOR GENERAL

Left: USMC staff flags for a Brigadier General (left) and Major General (right). The Brigadier General's flag was used originally for boat, post and automobile, but by 1937 the auto flag was modified by moving the star to the bottom center and adding a white silhouette of the eagle, globe and anchor of the USMC at the top. The Major General's flag was designed originally with the two stars aligned horizontally for boat and automobile use, but by 1937 the post flag took the above form while the automobile flag was similar to the Brigadier's. However, it had two horizontally positioned stars at the base. The Lieutenant General's flag (not shown) had three stars arranged horizontally across the middle for both boat and auto use.

Design	Color
Tail	Insignia Red Insignia White True Blue Black Willow Green Lemon Yellow Aluminum
Horizontal and vertical stabilizers only, solid.	Insignia Red True Blue Black Willow Green Lemon Yellow
Horizontal and vertical control surfaces only, solid.	Insignia Red True Blue Black Willow Green Lemon Yellow
Fore and aft single stripe across tail surfaces. Width of stripe to be prescribed by Force Commander.	Insignia Red True Blue Black Willow Green Lemon Yellow
Fore and aft double stripe across tail surfaces. Width of stripe to be prescribed by Force Commander.	Insignia Red True Blue Black Willow Green Lemon Yellow
Checker tail markings for VP squadrons only. Dimensions of squares—20 inches (50.80 cm) on a side.	Insignia Red True Blue Black Willow Green Lemon Yellow

As with the other markings, there were numerous variations in these tail colors. The frequent transfer of aircraft, and the cost and time involved in changing markings provided an excuse for not making changes in tail color markings. Due to the size of the aircraft and problems of painting the tails, this practice was more prevalent in the VP units than with the smaller aircraft.

The Chief of the Bureau of Aeronautics on December 9, 1937, approved the painting of the individual aircraft number on the under surface of the lower wings of the aircraft in Patrol Squadron Three (VP-3). This authorization was expanded on May 7, 1938, to include all patrol squadrons. No specific size or location was given for this marking.

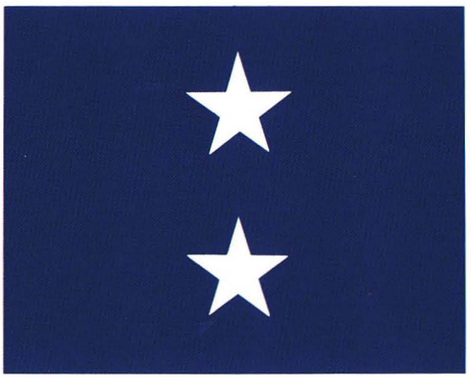
A dispatch from the Commander-in-Chief, US Fleet in May 1938, with an effective date of July 1, 1938, directed the following changes in tail markings for cruiser-based squadrons. All heavy cruiser aircraft were to have a single tail stripe; all light cruiser aircraft were to have double stripes. The new markings were to be:

VCS-2 plus USS DETROIT and USS RALEIGH, double blue stripe.
VCS-3 plus USS RICHMOND, double red stripe.
VCS-4 single blue stripe.
VCS-8 double black stripe.
VCS-9 double green stripe.

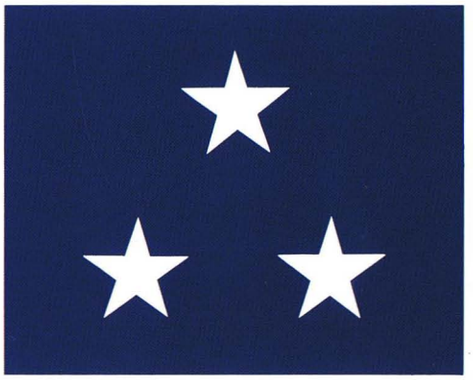
Based on recommendations from Commander Aircraft, Scouting Force, a new system of designating Patrol squadrons became effective July 1, 1939. Under this system the squadrons were given two-digit numbers. The first numeral was the number on the wing to which the squadron was assigned, while the second numeral was the number of the squadron within the wing. Under this system 13-P-6 was the sixth aircraft in the third squadron in the First Patrol Wing.

The *Naval Aeronautical Organization for Fiscal Year 1940* (July 1, 1939 to September 30, 1940) shows the changes as follows.

Old	New
Patrol Wing One	
VP-7	VP-11
VP-9	VP-12
VP-18	VP-13
	VP-14*
Patrol Wing Two	
VP-1	VP-21
VP-4	VP-22
VP-6	VP-23
VP-8	VP-24
VP-10	VP-25



REAR ADMIRAL



VICE ADMIRAL

Right: USN staff flags for a Rear Admiral (left) and Vice Admiral (right). Not shown are flags for the Admiral and Commodore. The former displayed four stars arranged in a diamond, while the latter's flag took the form of a so-called swallow-tailed pennant with one star positioned in the center.

Patrol Wing Three	
VP-2	VP-31
VP-3	VP-32
VP-5	VP-33
Patrol Wing Four	
VP-16	VP-41
VP-17	VP-42
VP-19	VP-43
VP-20	VP-44
VP-21	VP-45
Patrol Wing Five	
VP-12	VP-51
VP-14	VP-52
VP-15	VP-53
VP-11	VP-54

*To be commissioned end of 1939

As new ships were added to the Battle Fleet, new squadrons were formed to man them. VO-5 was assigned solid yellow tails on October 11, 1939, to become effective upon the squadron being commissioned.

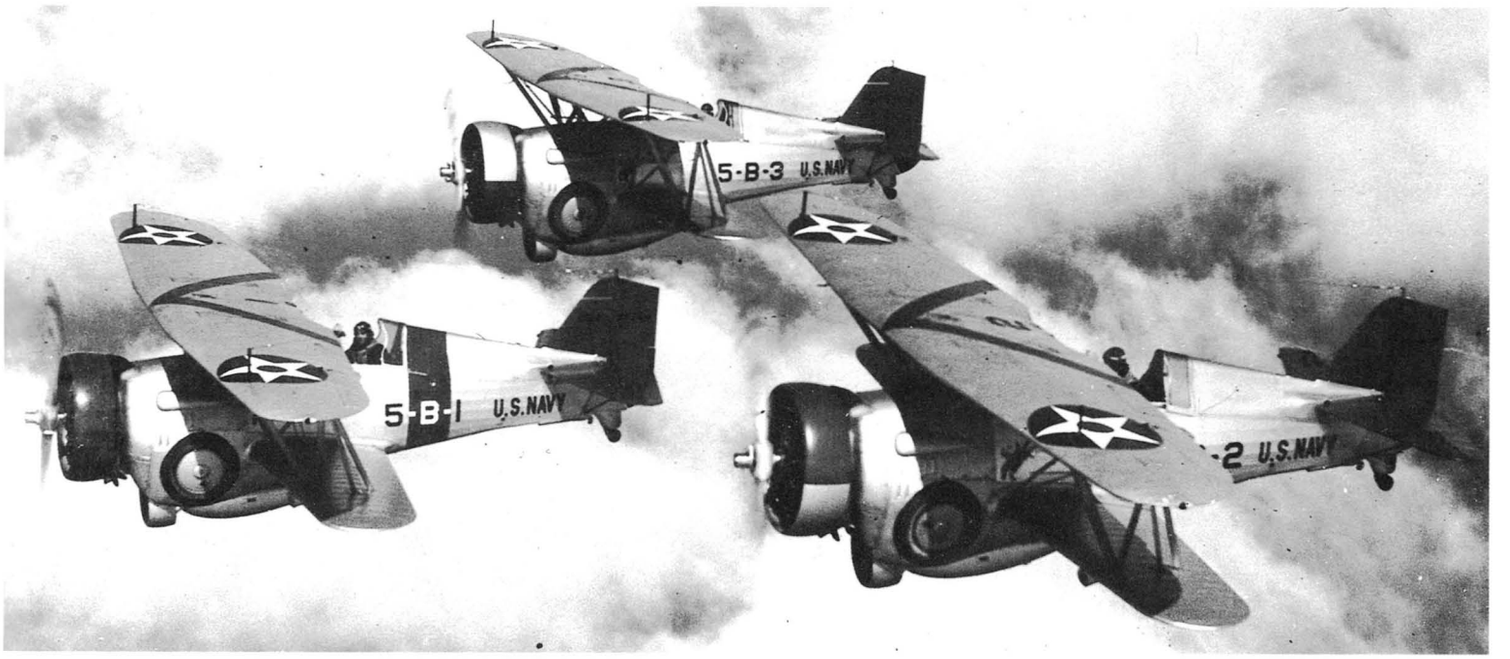
The Commander-in-Chief, United States Fleet, on August 17, 1939, authorized the Fleet Aircraft Tactical Unit to paint the tail of its aircraft solid Insignia Blue. Also, an Insignia Blue band around the fuselage with yellow block lettering spelled out the following words.

U.S. FLEET
AIRCRAFT
TACTICAL
UNIT
(aircraft number)

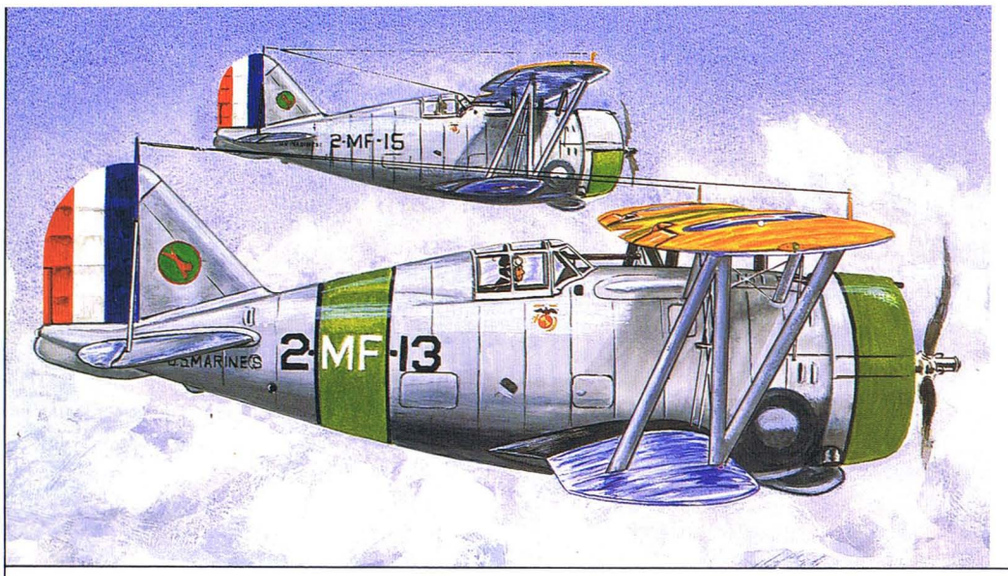
Below: The Vought O2U-3 number 2 utility aircraft assigned to the USS Yorktown is shown being hoisted aboard through the side hanger deck access port. These aircraft belonged to the aircraft carrier and had no relationship with any of the squadrons aboard.

Left: A new style Marine Corps emblem was approved on March 16, 1936. This design was issued in the form of a decalcomania and was directed to be placed on all Marine Corps aircraft. This style remains in effect today and was used as long as the emblem was authorized for use on aircraft. **Right:** An example of the practice of using cartoon characters in a squadron insignia. This insignia was approved for use by VS-14M, but was never applied to its aircraft since the squadron was deactivated prior to final approval. It was requested that the insignia be continued in the records in the event the squadron was reformed.

Left: It is difficult to understand how the Quantico aircraft were able to be painted with no regard to the instructions for so long when they were only 30 miles from Washington, DC. Even the aircraft assigned to Aircraft One carried nonregulation markings as shown by their number 4 aircraft, a Douglas RD-3. Aircraft One, Quantico, Virginia, surrounds the Marine Corps emblem on the nose. **Below:** Eventually pressure was brought to bear, and the colorful individualistic markings were a thing of the past. On this Great Lakes BG-1 of VB-6M note how the type of squadron-designating letter is painted white on a dark fuselage band for greater visibility. **Opposite right:** These Curtiss BF2C-1s of the first section of VB-5B are correctly marked. Note that the squadron insignia on aircraft number 2 is in a diving position. Later, when used in a fighter squadron, it was changed to a climbing attitude. **Opposite bottom:** On aircraft with a deep cowl, such as this Great Lakes BG-1, the section marking was applied only to the first 18 inches of the cowl.


5-B-3 U.S.NAVY
5-B-1 U.S.NAVY
-2 U.S.NAVY

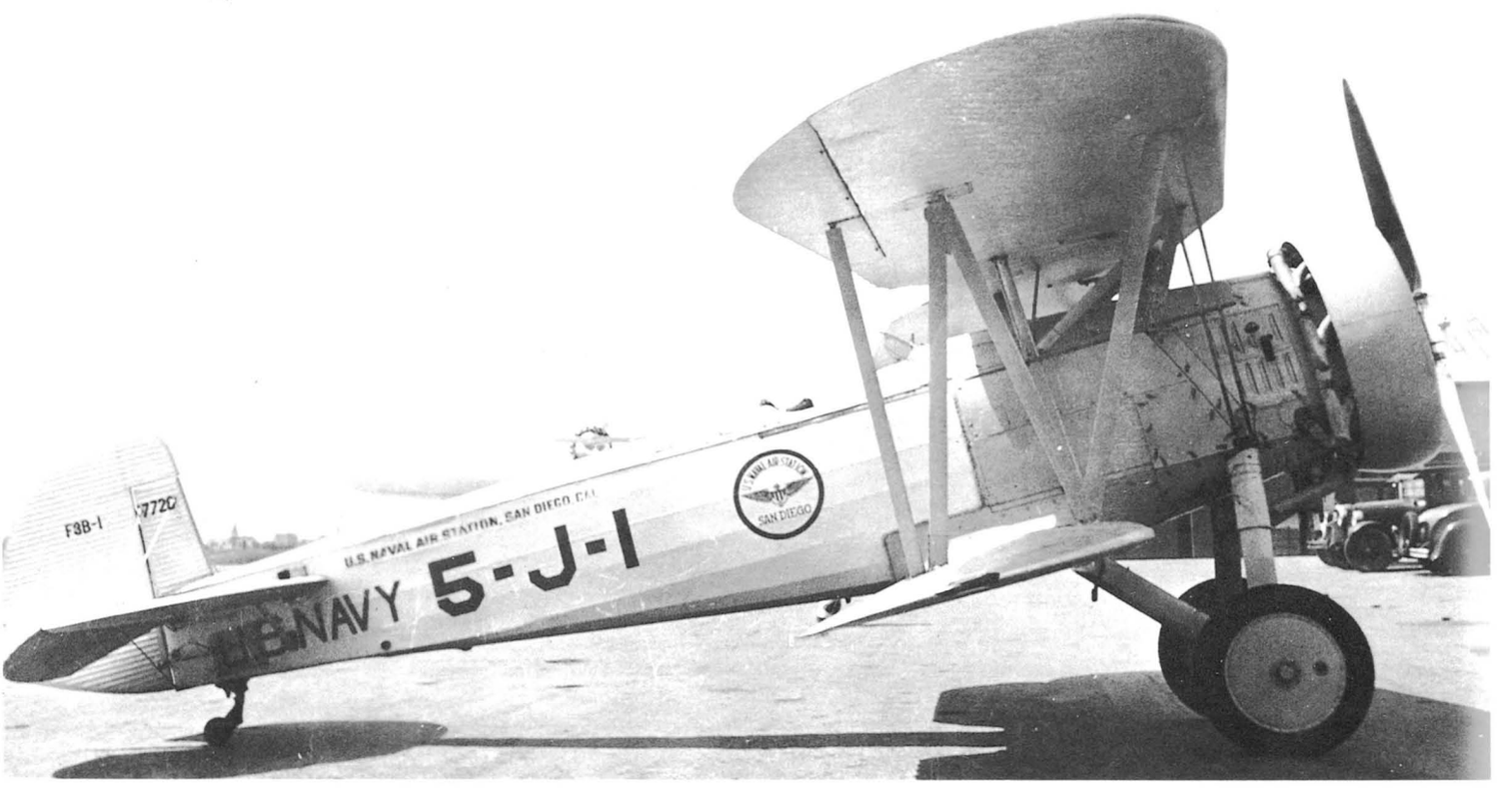

9841
BG-1
6-B-2
U.S.MARINES

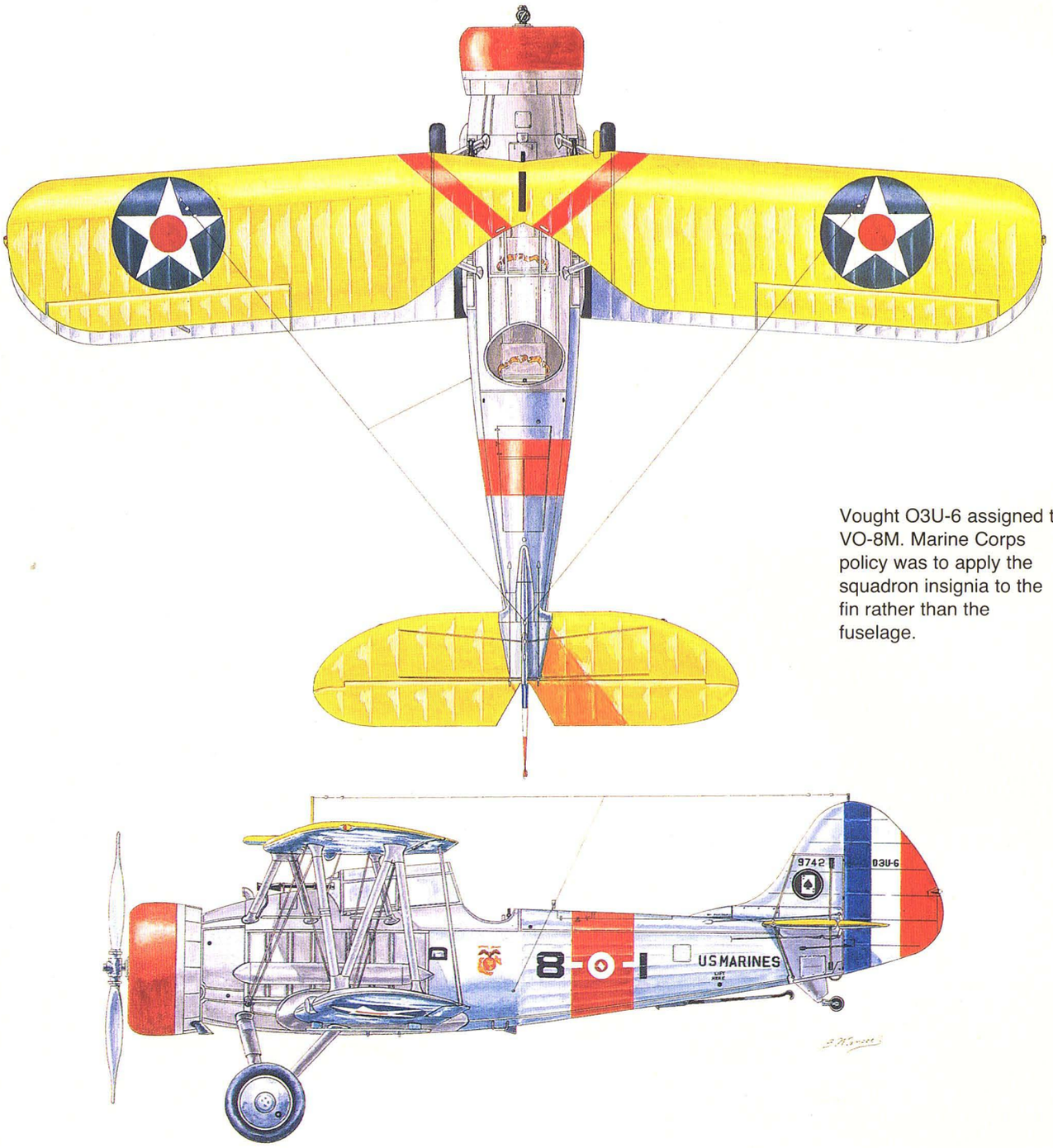


Left: Illustration of F3Fs from VMF-2. **Below:** This shows a Grumman F3F-1 of the newly formed VF-4M. These seldom-seen markings were only used between January and July 1937 when the designation system for all naval aviation was changed and the squadron became VMF-2. **Opposite top:** A Grumman F2F-1 of VF-2B is identified as the number 2 aircraft of the 3rd section by the upper half of the cowl painted True Blue outlined in Black. **Opposite bottom:** This Grumman F2F-1 of VF-2B is the number 3 aircraft of the 4th section with the lower half of the cowl painted Black outlined in White. A narrow border of a contrasting color was frequently used to make the section markings stand out.

Left: This Vought O2U-3 was photographed during April 1937. Obsolescent aircraft frequently spent the last of their service lives as utility aircraft for Air Stations and Bases as in the case of this Coco Solo aircraft. **Below left:** This nonrigid airship G-1 was photographed on July 1, 1936. Note the American flag flying from the stern as if it were a surface vessel. This was common practice in the lighter-than-air fleet. **Below:** This Douglas RD-3 was assigned to a Fleet Air Base as its number 1 aircraft for transport and utility work.

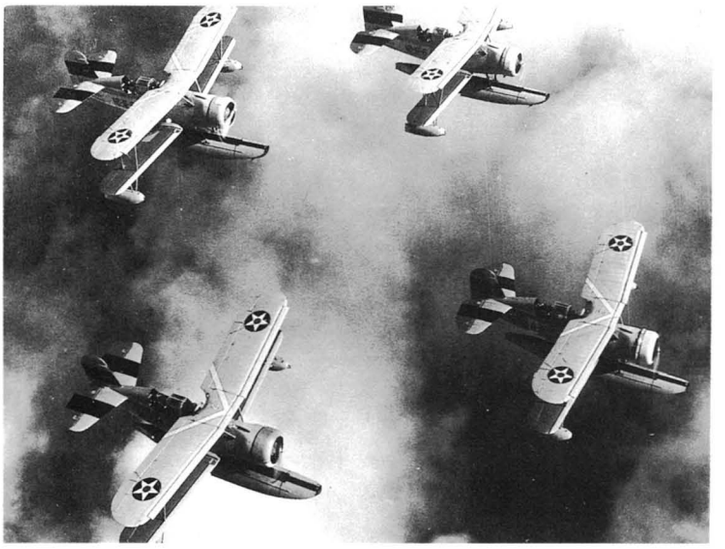
Below: This Boeing F3B-1, assigned to Utility Squadron Five (VJ-5), carries an unusual assortment of markings. Note the unorthodox placement of the base name, which is not required, and the use of the Naval Air Station insignia on a squadron aircraft.

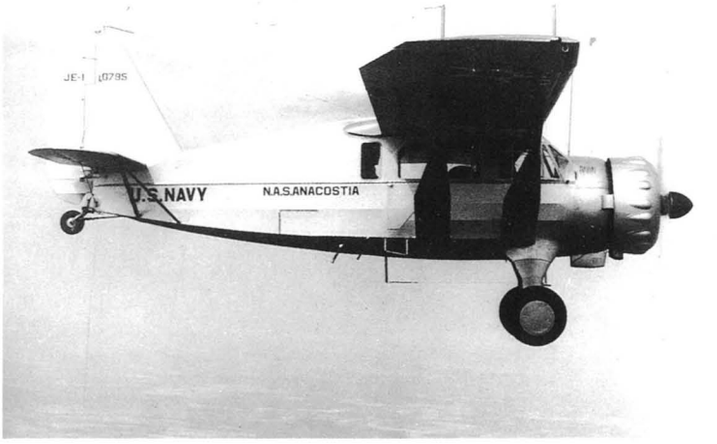




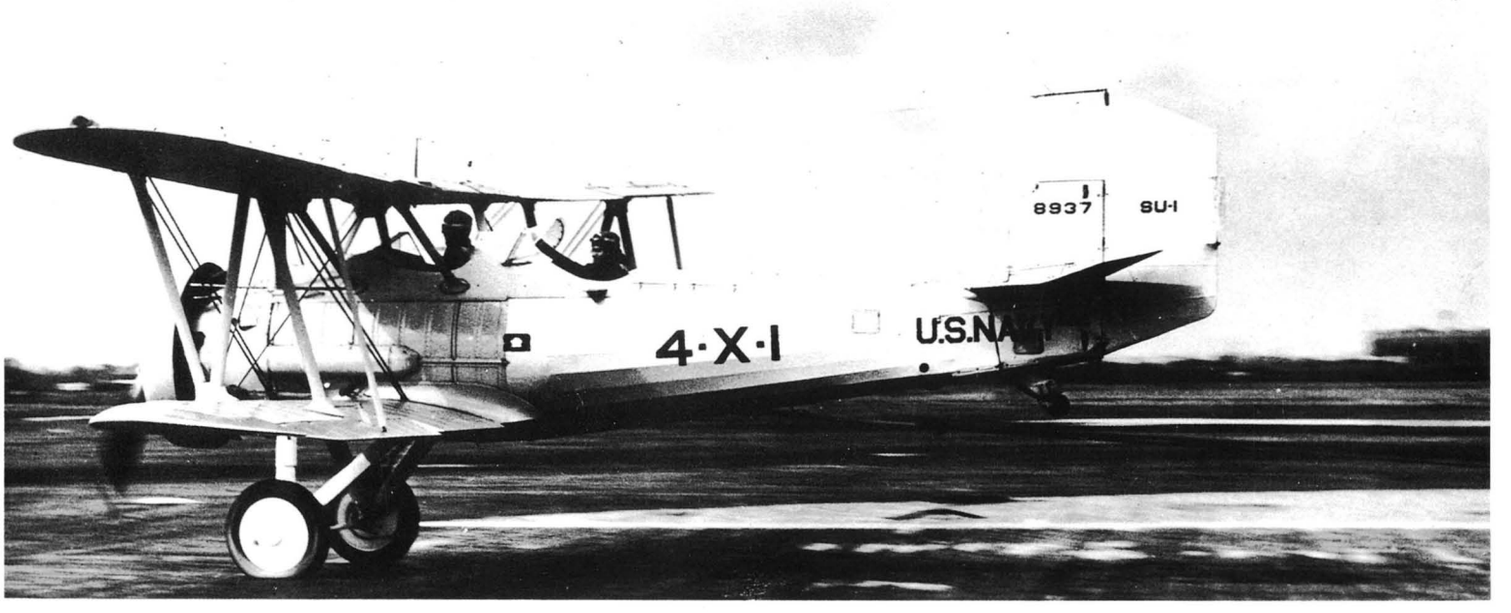
Vought O3U-6 assigned to VO-8M. Marine Corps policy was to apply the squadron insignia to the fin rather than the fuselage.

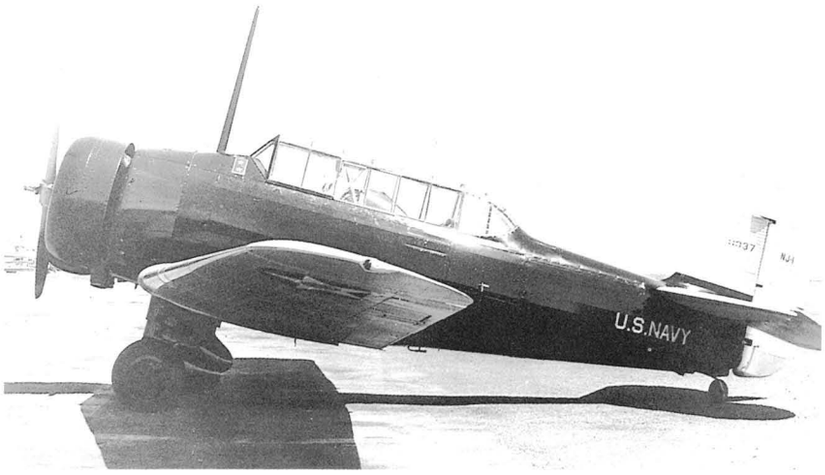
Left: This Vought O3U-3 number 1 utility aircraft is shown aboard the USS Ranger. It is an unusual photo for the period, showing the arresting cables being held off the deck by the fiddle bridges so that the aircraft's tail hook can engage them. **Below:** A Bellanca JE-1 utility transport assigned to the Naval Air Station Anacostia, Washington, DC shows the base name in the location normally used for the squadron number, type, and aircraft number.





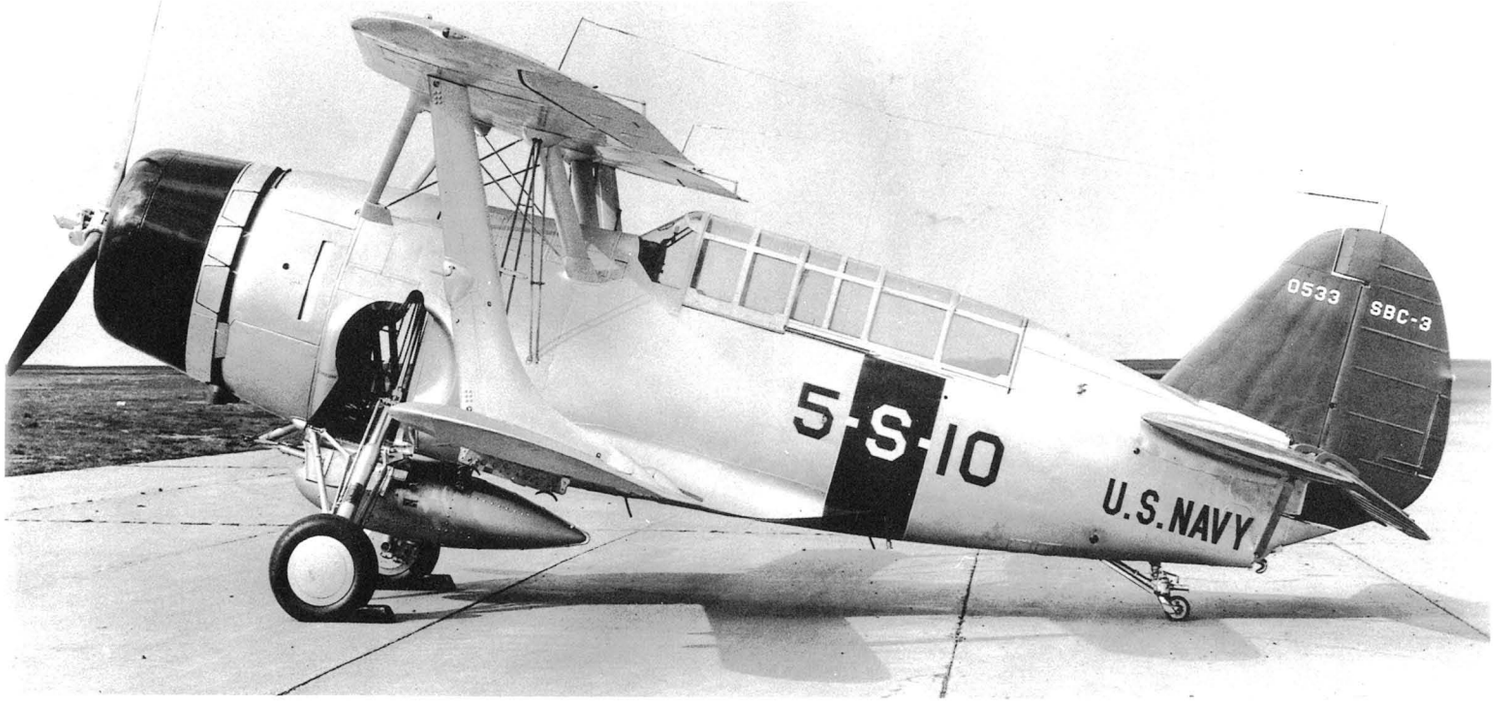
Above: Four Curtiss SOCs from VCS-6 show all four cowl markings for the four-plane section from one of the new "Treaty Cruisers" capable of carrying four aircraft. **Below:** Experimental Squadron 4 (VX-4) number 1 aircraft landing on the simulated aircraft carrier deck which was used for catapult-launching and arrested-landing equipment development work at the Naval Aircraft Factory, Philadelphia, Pennsylvania.





Right: A North American NJ-1 is painted in the special staff aircraft paint scheme and assigned to a unidentified Rear Admiral.

Above: This photo of October 13, 1937, shows a North American NJ-1, assigned to the training command for instrument training. Note the red bands around the wing and fuselage denoting an instrument trainer. It is believed that the tail and engine cowl are also Insignia Red. **Above right:** The number four aircraft of VS-9S assigned to the heavy cruiser Salt Lake City is indicated by the fore and aft Insignia White cowl stripe. The ship was number two in Cruiser Division Nine, so the designation on the side of the fuselage should read 9-S-8. **Below:** This is a Curtiss SBC-3 of VS-5, assigned to the USS Yorktown. The section color is Black, while the tail color is Insignia Red.



Above: These three photos show three of the VO squadrons assigned to the battleships. A check with the charts will identify the tail colors for each squadron. Note that unlike the SOCs that were based on cruisers, these aircraft carry the ship name aft of the squadron designation. **Below:** VO-4 was the fourth VO squadron assigned to the battleships. It should be pointed out that the squadron number for the squadrons assigned to the battleships and cruisers was always the same as the ship division. For example, the USS West Virginia was the flagship of Battleship Division Four.

From the photographs on this page it can be seen clearly that the individual aircraft number is dependent on the number of aircraft assigned to the vessel and its position within its division. **Below right:** This depicts a view of a Curtiss SOC-3 of Cruiser Scouting Squadron Three (VCS-3). Note that the scouting squadrons assigned to cruisers are identified as Cruiser Scouting by the CS in the squadron designation. The scouting squadrons aboard the aircraft carriers carried only the S designation.

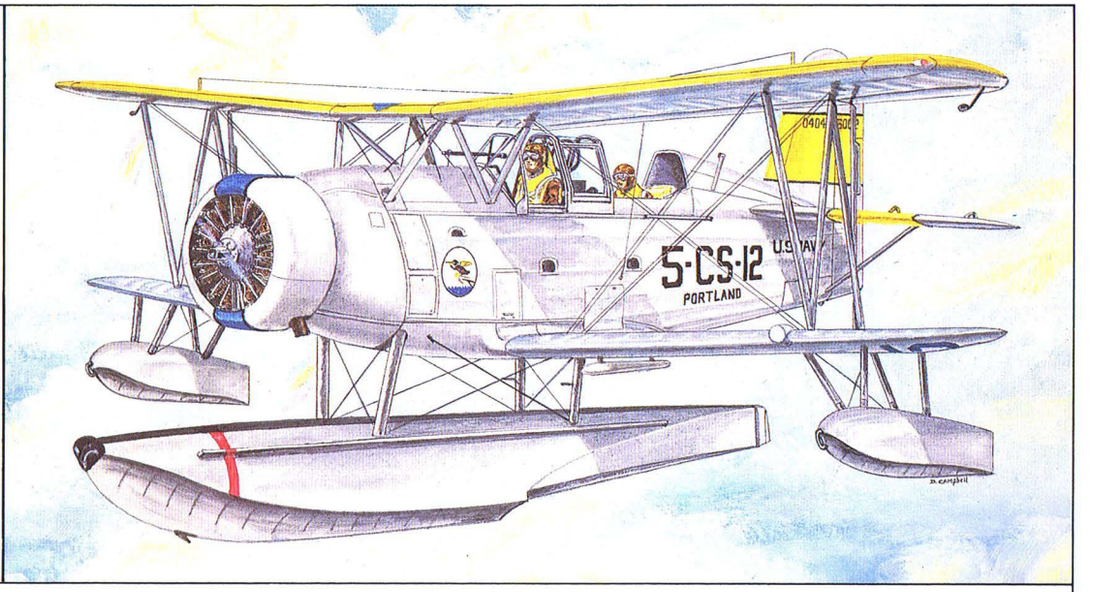
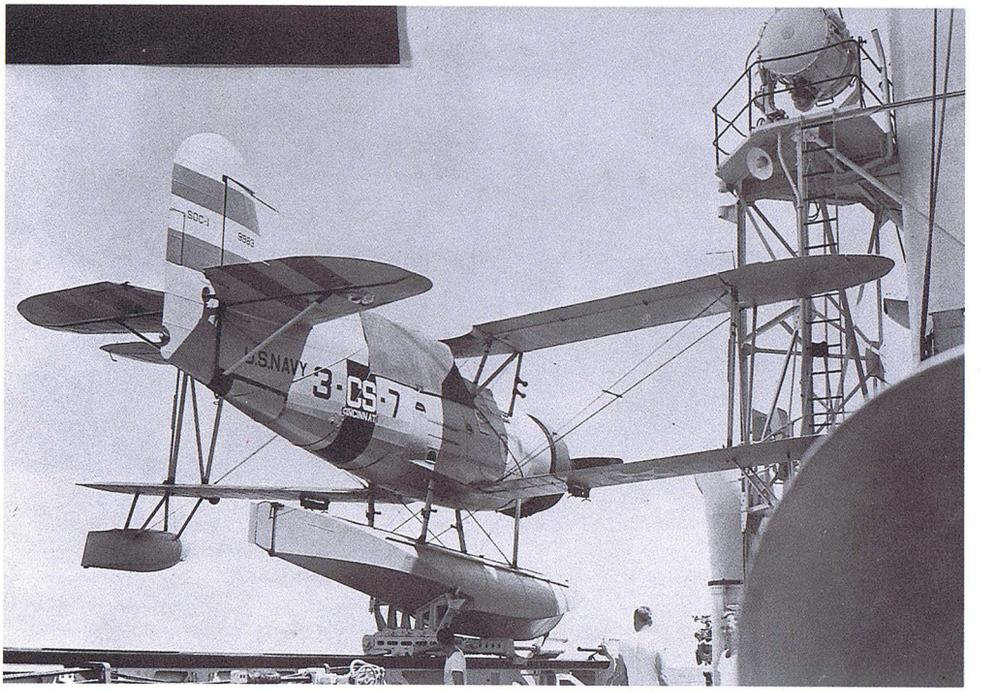
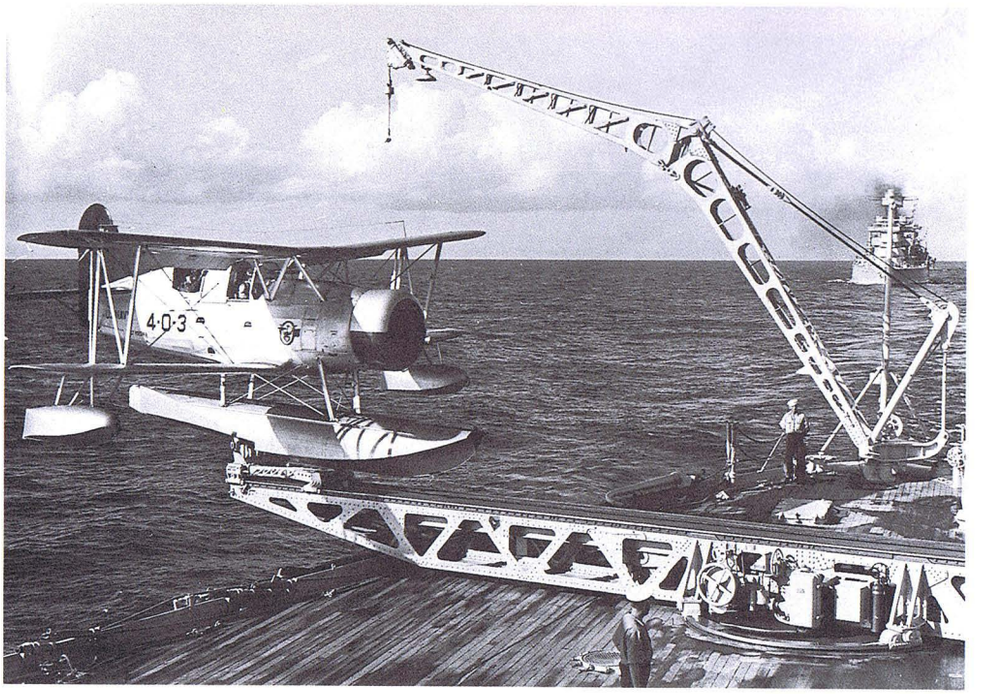
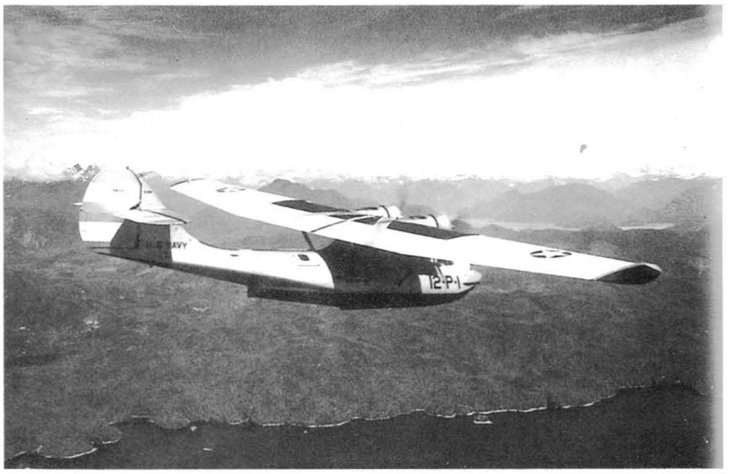


Illustration at top: This Curtiss SOC-3 of Cruiser Scouting Squadron Five (VCS-5) was assigned to the heavy cruiser USS Portland. From these markings one can tell that the Portland carries four aircraft, and is number three ship in Cruiser Division Five. The duck in the squadron insignia being shot off a catapult well illustrates the operation of the cruiser-based squadrons as well as the aircraft's characteristics. **Right:** The Curtiss SOC-1 section leader sits in its catapult cradle aboard the light cruiser USS Cincinnatti. Note that the stripes on the tail surfaces are applied to both upper and lower sides. Also note the midwing position of the national aircraft insignia due to the wing tip floats. **Below:** The number three airplane of VO-4 is shown aboard the battleship USS West Virginia ready to be launched cross wind from the stern catapult. Half the length of the catapult is visible in this photo. When the plane reaches the end of the track, it will be traveling at flying speed.

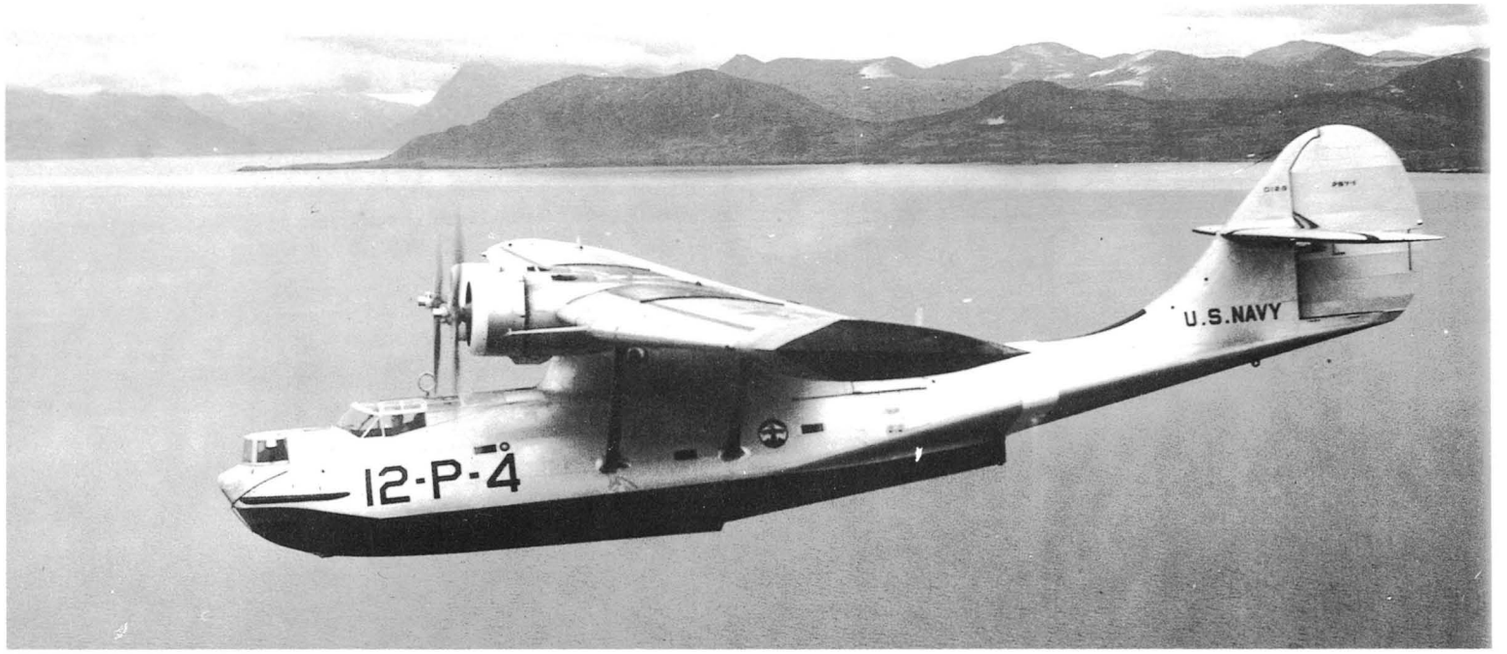


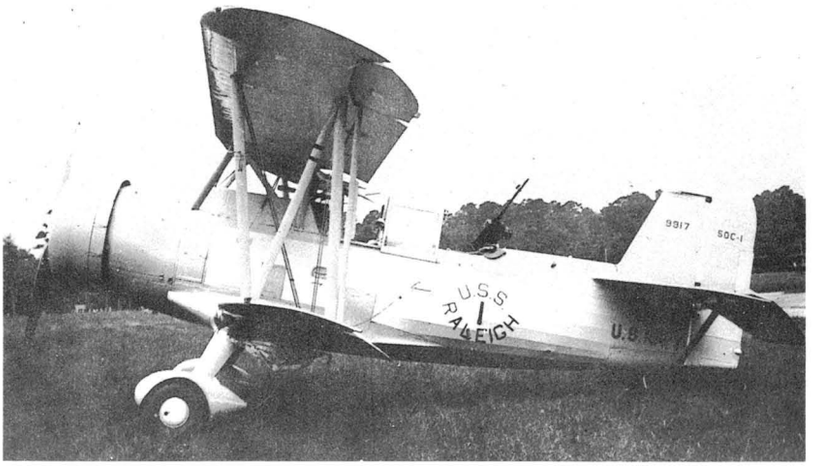


Left: This Sikorsky JRS-1 was used for a short time by the Marine Corps as a troup transport. This VMJ-1 airplane was improperly marked by the manufacturer. There should be a dash between the squadron number 1 and the squadron designation MJ. Note how the black bottom of the wing-tip pontoons terminates at the chine as it does on the hull.

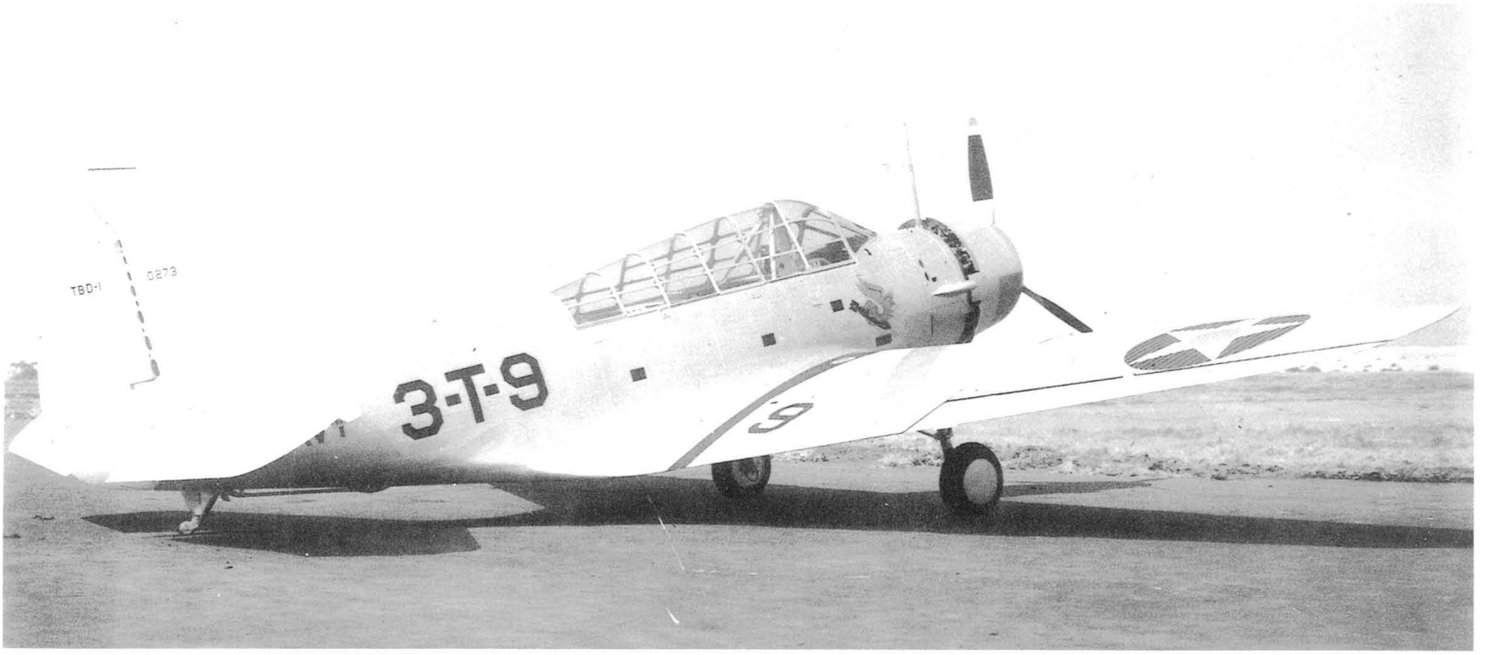


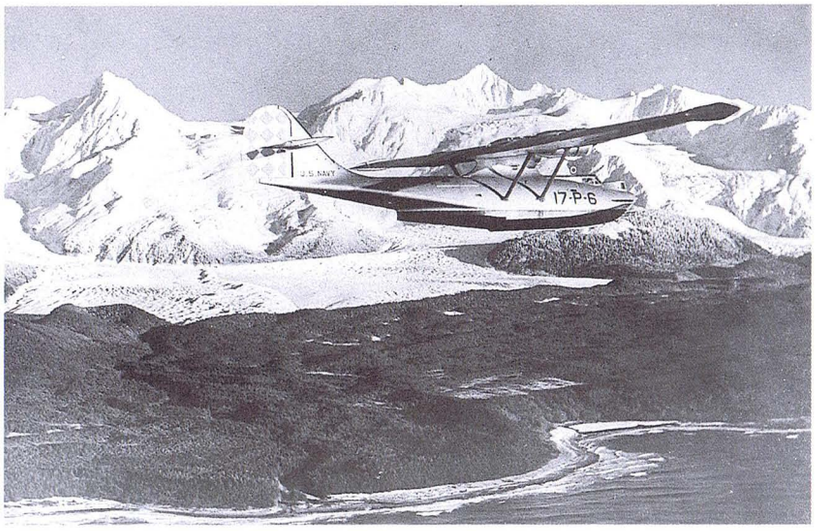
Above: In April 1939 this SOC-2 was assigned to the Naval Air Station Anacostia, Washington, DC for use as a utility aircraft. Such aircraft would only carry the base name but none of the cowl or fuselage stripe markings. **Above right:** This Consolidated PBY-1 with Insignia Red fuselage band and full cowl of the 1st aircraft in the 1st section of VP-12 was photographed in July 1937. The Insignia Red chevron on the wing is outlined with Insignia White to help make it stand out against the Chrome Yellow of the upper surfaces. The Horizontal tail stripes are Lemon Yellow. **Below:** The section leader of the second section of VP-12 shows the appropriate Insignia White markings. Squadron insignia for patrol plane squadrons normally were carried on the bow forward of the identification markings.



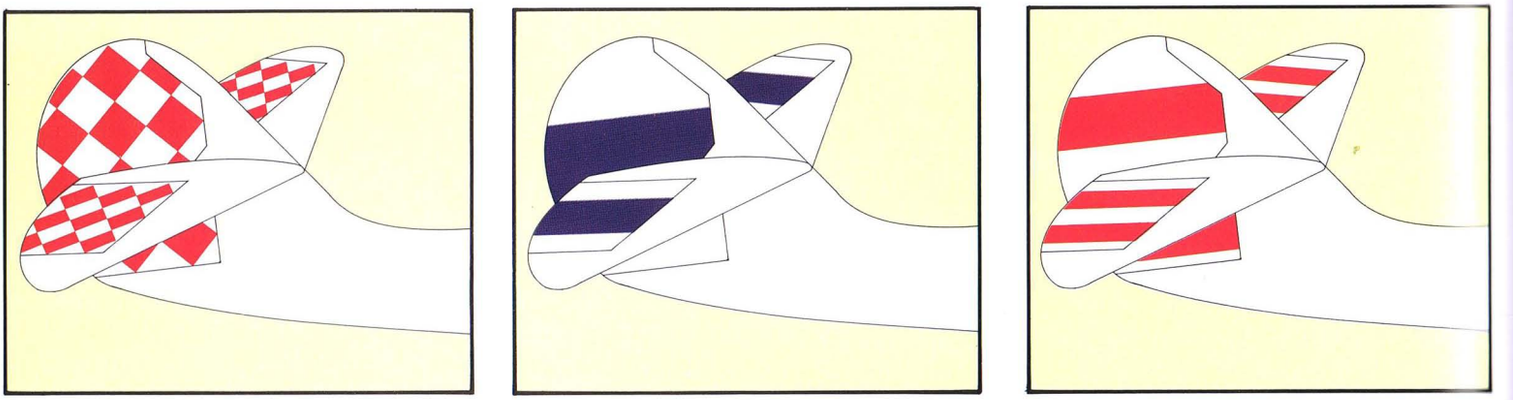


Top: A Curtiss SOC-1 from the light cruiser USS Raleigh is ashore on wheels. This is an unusual ship name and aircraft number configuration for this number 1 aircraft of a two-aircraft complement. The Raleigh was the flagship for Destroyers, Battle Force at this time so the aircraft were not part of any squadron. **Right:** This is the fifth section of VB-3. These Vought SB2U-1s show the colorful US Navy aircraft of this period. These aircraft are finished with Aluminum and Light Gray fuselage and underwing surface, Willow Green cowl and fuselage band and Chrome yellow upperwing surface. The tail of these are Insignia White showing that the squadron is based on the USS Saratoga. The diagonal stripes on the tail are an aide for the Landing Signal Officer (LSO) aboard the carrier. **Below:** On monoplanes the wing chevron had to be divided so that only a single stripe was painted on each wing as on this Douglas TBD-1 of Torpedo Squadron Three (VT-3). The half chevron stripe and lower half of the engine cowl are True Blue. Note the location of the aircraft number which was applied to both wings.





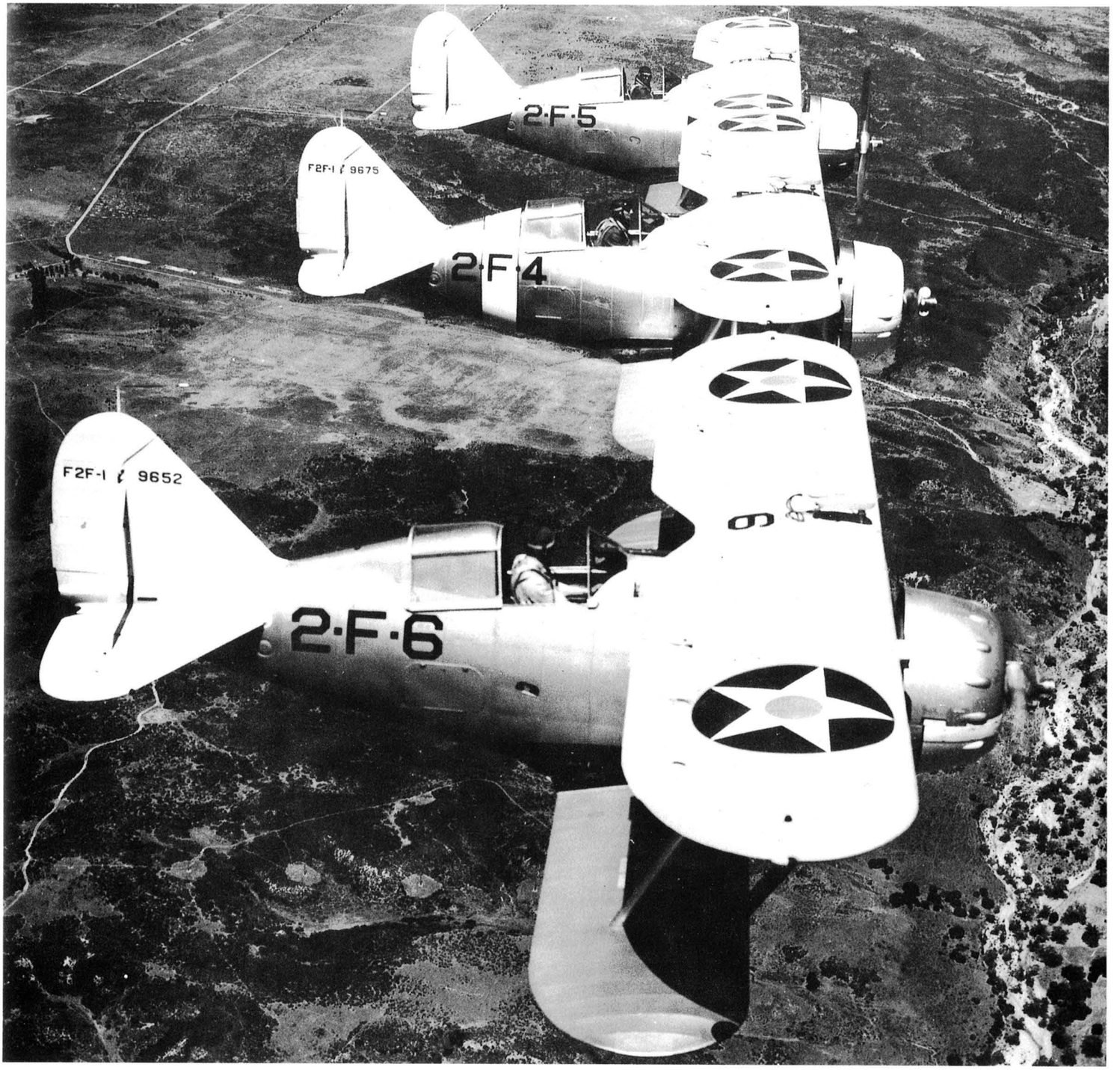
Left: A Consolidated PBY of VP-17 in Alaska can be identified as the third plane of the second section. The checkerboard tail marking is Insignia Red.



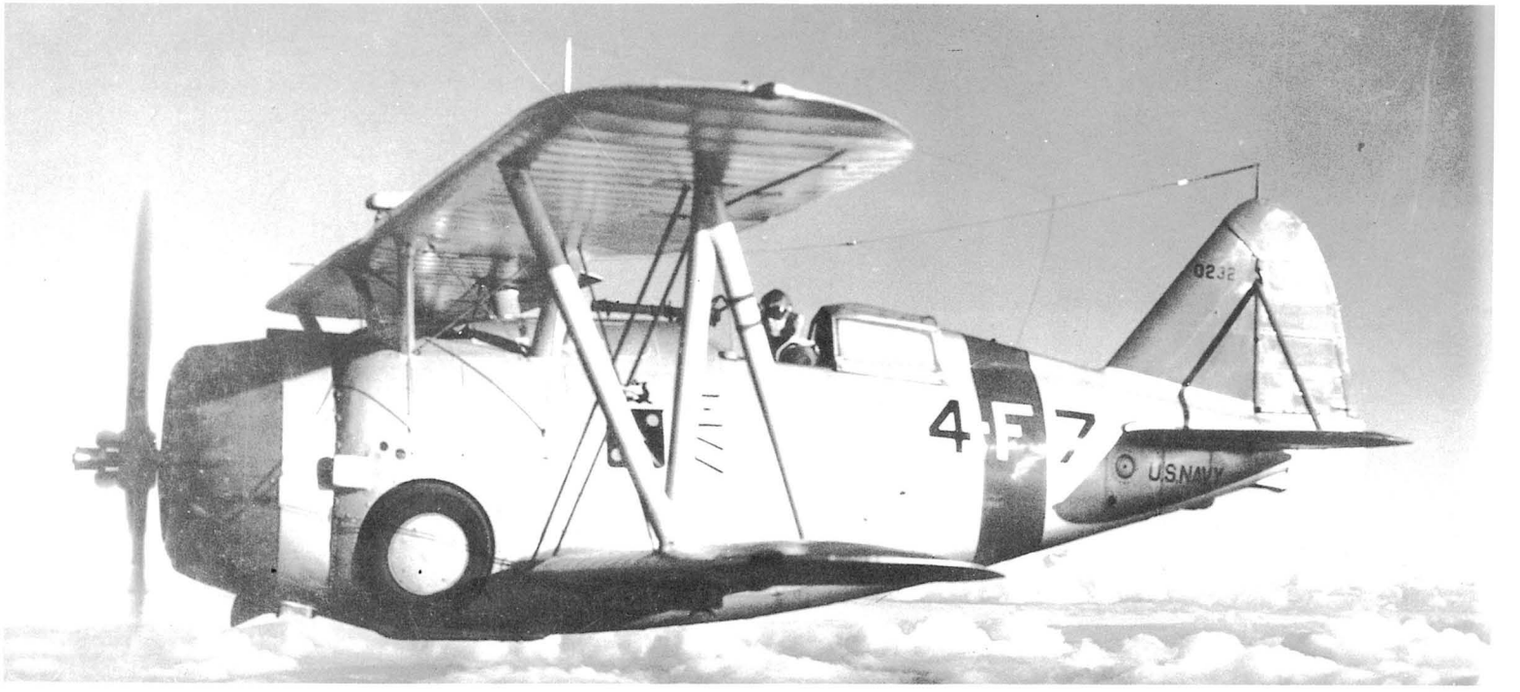
TYPICAL PATROL PLANE TAIL MARKINGS

Below: This Consolidated PBY-3 of Patrol Squadron Seven (VP-7) was photographed in April 1938 and is identified by the double True Blue fore and aft stripes on the rudder and elevators.

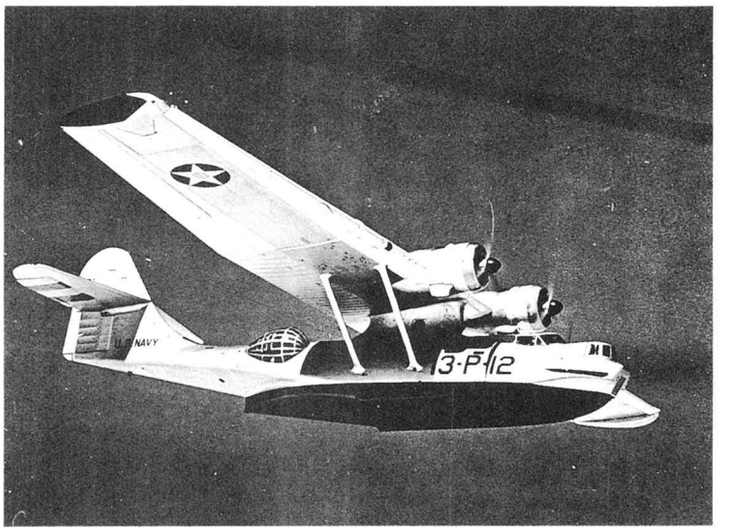
Right: In 1939 Aircraft Two, FMF, San Diego, California still used the red, white, and blue tail stripes on their aircraft as shown on the Curtiss R4C-1. Note the placement of the unit insignia on the tail and written-out designation on the nose. There was no short title for this senior unit, nor did it conform to the squadron letter designation system. The nonregulation lightning bolt down the fuselage is one of the first examples of colorful markings other than those displayed by the Marine Corps squadrons at Quantico, Virginia. **Below:** A beautiful formation of the second section of VF-2s showing all the specified recognition markings of the period.



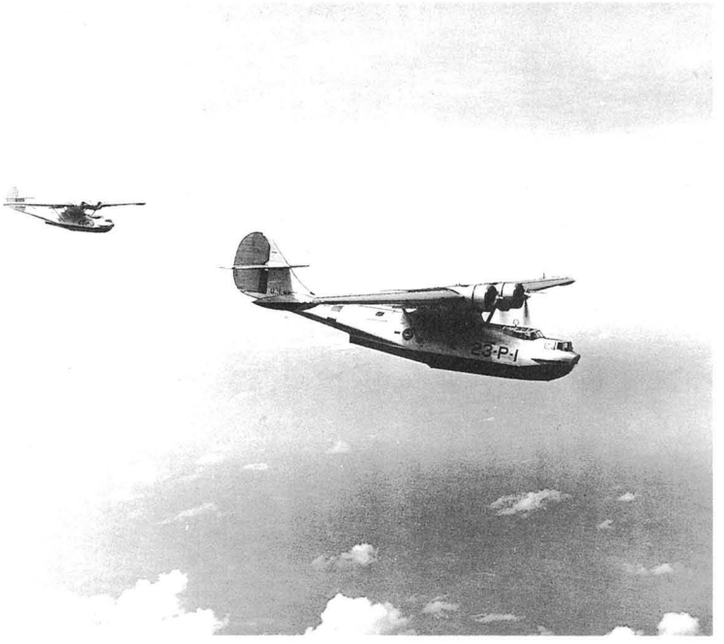
Left: The Black section leader stripe has been outlined in Insignia White to make it stand out from the Light Gray of the fuselage. The nonregulation "Shellback" turtle emblem shows the aircraft has flown over the equator and was applied to the fin or fuselage as desired by the pilot who made the flight.

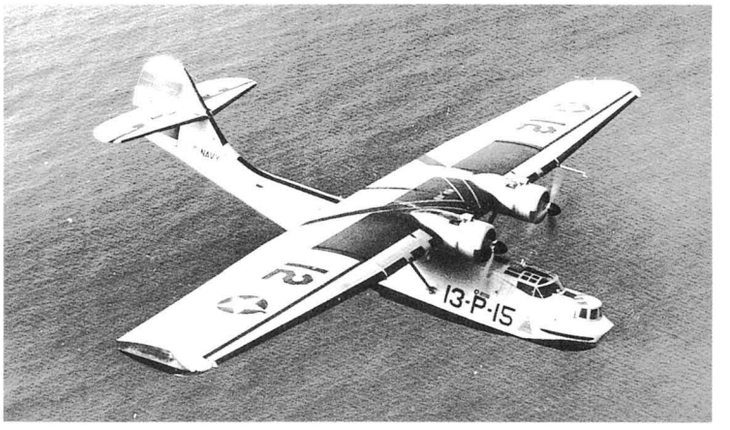


Above: This Grumman F3F-1 of Fighting Four (VF-4) was photographed on January 17, 1939, assigned to the USS Ranger with Willow Green tail. Note the two hashmarks under the NAVY "E" denoting three consecutive years by this pilot in all types of ordnance specified in the training syllabus. **Left:** The leader of the second section of VF-2 is brilliantly marked with an Insignia White cowl, wing chevron, and fuselage band. The Lemon Yellow identifies it as being assigned to the USS Lexington.

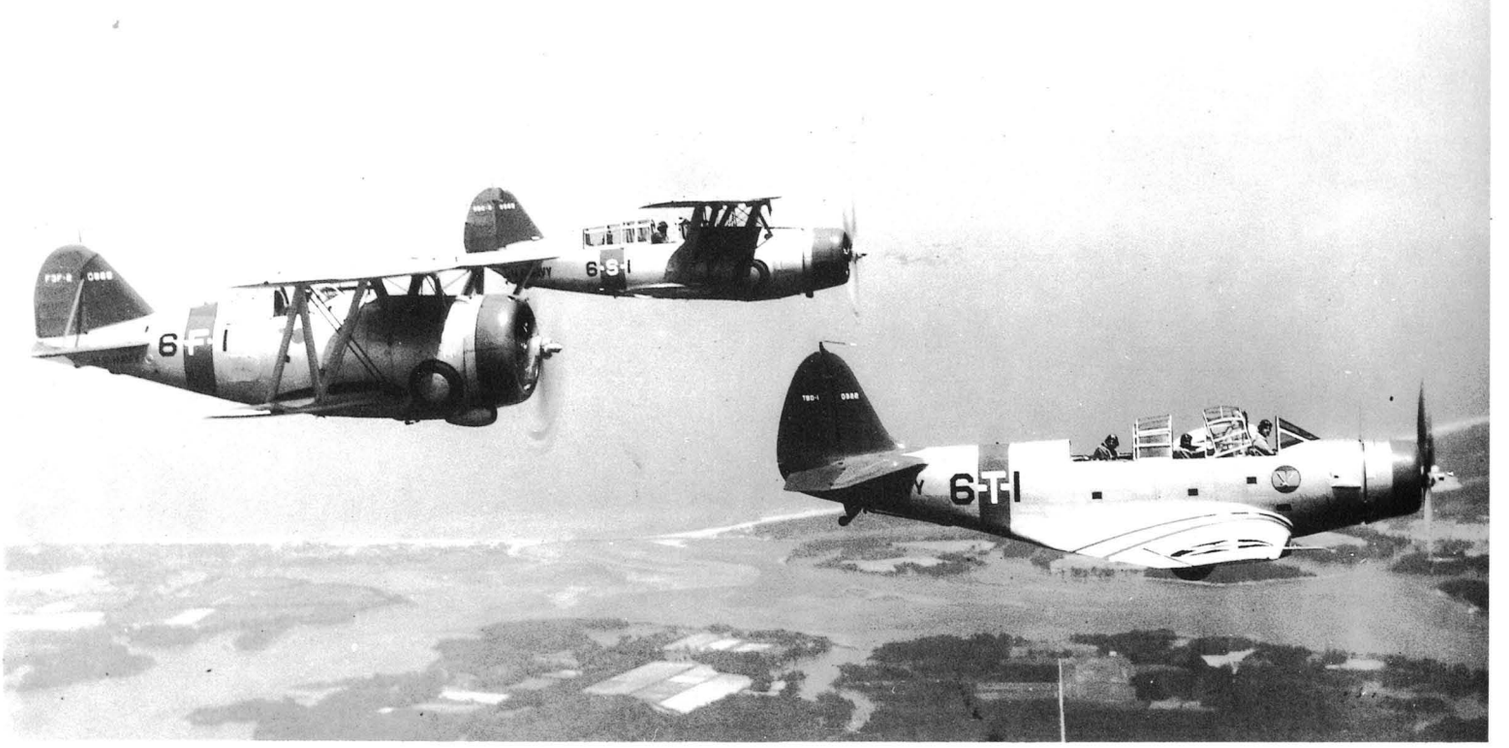


Right: A Consolidated PBY-4 of Patrol Squadron 13 (VP-13) clearly shows the Chrome Yellow of the upper wing surface carried around the leading edge and onto the undersurface for approximately five percent of the wing chord. The hull bottom is Black up to the chine.





Above and left: Did the painter in VP-13 goof and reverse the stencil when painting the wing, making a two in place of a five, or is this a case of an aircraft transfer where the hull number has been changed but not on the wing? Note the use of a white border on the wing chevron to make the black or green chevron stand out from the Black work area. **Below:** An interesting grouping shows the squadron leaders of Fighting Six (VF-6), Scouting Six (VS-6), and Torpedo Six (VT-6) from the USS Enterprise. Tail color for all is True Blue.



Photographed in May 1968 at Grumman's Calverton, Long Island, New York facility, this two seat Grumman was a duplicate, for company use, of the Gulfhawk III built for Al Williams. It was the last airworthy example of the famous fighter line first flown in March 1935. The unit designation on the side is meaningless as are the colorful markings, since no such unit ever existed in US naval aviation. The squadron insignia below the cockpit is a modification of the one used by VF-3S and others.

1ST AIR SQUADRON

AIRCRAFT ONE, FMF

VF-2

VMF-2

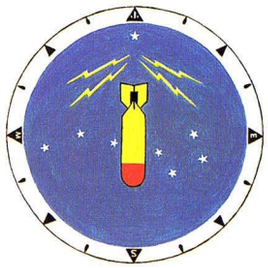
VP-4

VJ-7M
VMJ-2

VT-5A

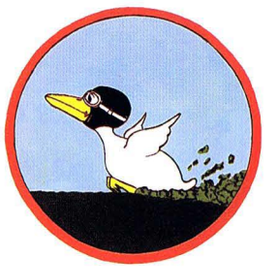
VF-6

VJ-2



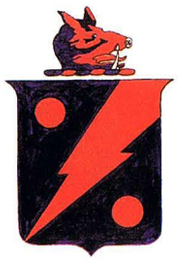
VP-10F

VF-1, VF-1B,
VB-2B, VB-3,
VB-4



NAS PENSACOLA

VS-11S



VF-5S
VF-1B
VF-5B

VP-6F, VP-6, VP-23

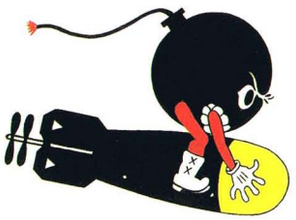
VB-2B
VF-6B
VF-3

VO-2B

VO-4B

VB-5

VB-6



VT-1B
VB-1B
VT-2

VB-5B, VB-2

VP-2S, VP-2F, VP-31

VP-1F, VP-21

VO-3B

VF-3S, VF-3B, VF-7B,
VF-5

VS-6B

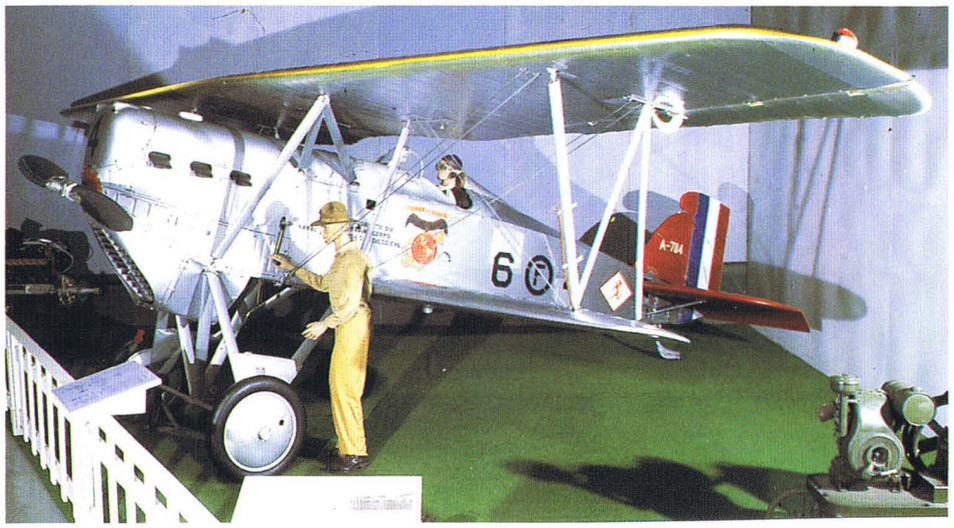
VP-8F, VP-24

VO-9M

VS-1B, VS-41

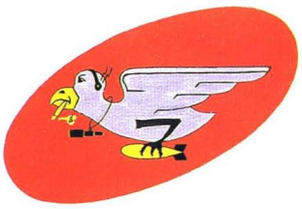
VD-5S

VS-10S



Right: Restored Boeing FB-5 on exhibit at Quantico, Virginia. This aircraft first flew on October 7, 1926, and was delivered for service in January 1927.

VF-3M, VF-10M,
VF-6M, VB-4M,
VMB-2



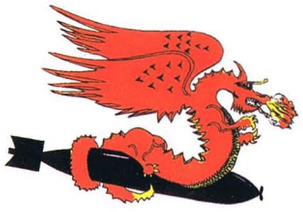
VS-4B
VS-42

VS-14S

USS SARATOGA

VP-19
VP-43

VP-4, VP-22



VT-2B, VT-3

VP-15F, VP-53

VS-12S

VB-3B, VB-4, VP-3

VT-6

VS-3B, VS-2

VO-6

VP-7

VJ-7M, AIRCRAFT TWO, FMF

VJ-1B

SECTION 4

MAINTENANCE SAFETY MARKINGS

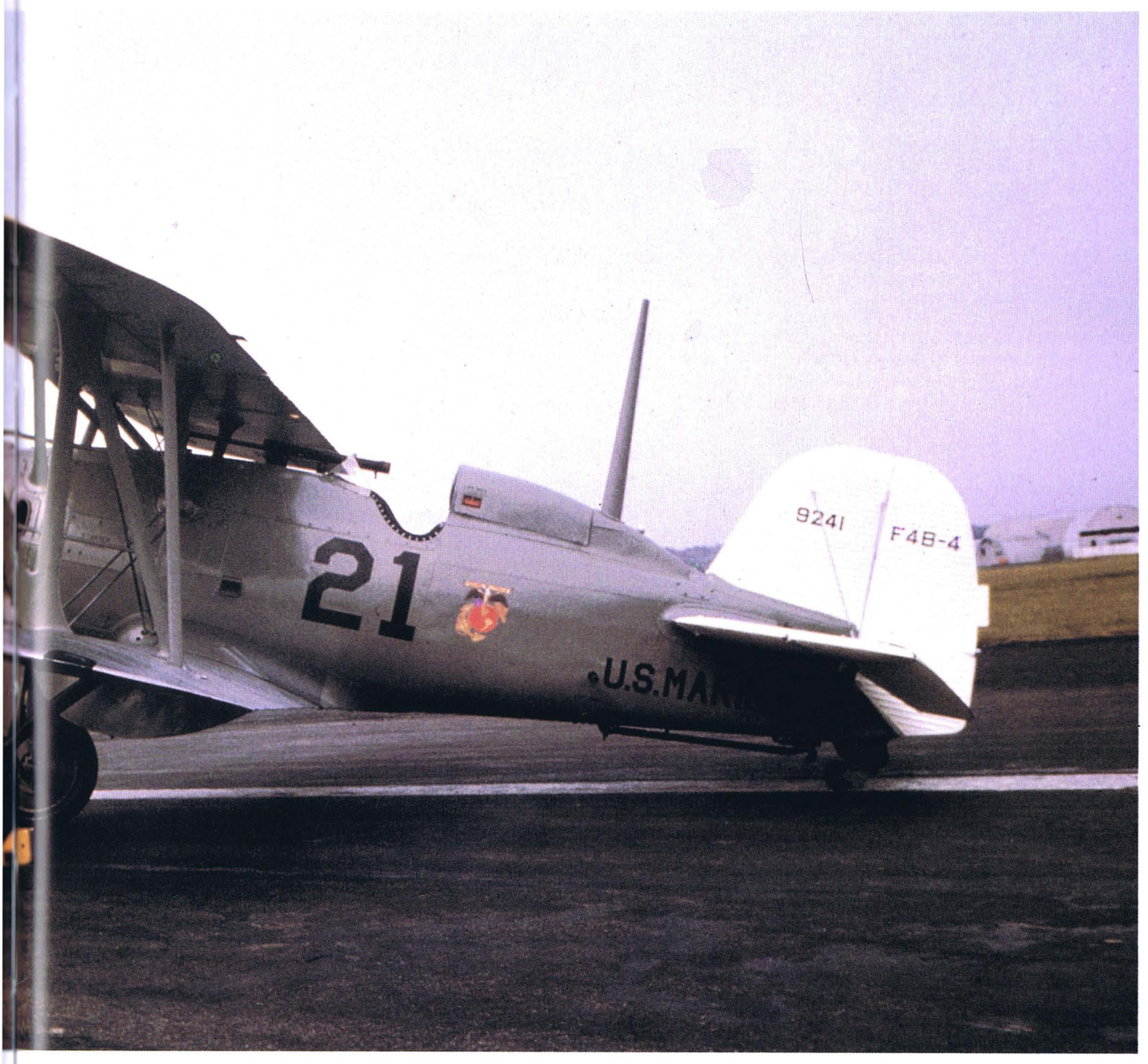
CHAPTER 10 1911–1919

In compiling data for this chapter a basic guideline has been to identify the technical markings of a general nature that would be found on most Naval aircraft. It is realized that there are many technical markings applied to Naval aircraft not included in detail and some may not even be mentioned in this chapter. It must be remembered that the listing of the technical-type marking can fill several pages for just one aircraft. Considering the number of different type aircraft operated by the Navy and Marine Corps, with their numerous versions and modifications, it becomes apparent that it would be impractical, if not impossible, to identify all technical markings applied in this volume. Here, then, is a compilation of the most frequently used markings of a technical nature rather than identification or recognition type as has been presented in Section 3.

Judged by the complex maze of hoses, tubes and pipes in the modern aircraft, the plumbing in the early aircraft was very basic. Yet the problem of proper identification was apparent from the beginning. Today's system still uses the basic ideas set forth by the Bureau of Steam Engineering in its letter of October 18, 1918, to the Inspector of Engineering Material (Aero) USN, at various aircraft manufacturing companies. In this letter the following colors were specified.

Fuel pipes	Red
Lubrication pipes	White
Air pipes	Blue
Water pipes	Yellow
Compressed air pipes	Black

Right: This is the only remaining Boeing F4B-4, restored and painted as originally flown by VF-9M at Quantico, Virginia. This aircraft is displayed at the National Air and Space Museum, Smithsonian Institution, Washington, DC. Here it is shown on display at Marine Corps Air Station Quantico, Virginia in 1962 for a reunion of the First Marine Aviation Force Veterans Association.


21
9241
F4B-4

A band was to be painted near each end of a pipe, and intermediate bands were not to be over 24 inches (60.96 cm) apart.

As Naval aviation expanded it became necessary to identify the multitude of bits and pieces as well as the major components of the various type and models of aircraft. Aeronautical Specification No. 93, *Marking of Finished Airplanes,* dated October 30, 1918, was the first directive of this type. Black letters 1 inch (2.54 cm) high were to be used for all such markings. Each wing panel, body and control was to carry the Bureau of Construction and Repair serial number. This was to be on the undersurface of airfoils and the side of fuselage.

Each airfoil also was to be marked with a combination of letters and numerals to designate the dope scheme employed in finishing it. For example: 1D4-3V2-5-28-18 indicates four coats of No. 1 dope and two coats of No. 3 varnish, with the work being finished May 28, 1918. If pigmented dope was applied, the letters PD were used in place of the D in the foregoing example. Should pigmented varnish be applied, the letters PV were similarly used. Each identification group was separated by a dash.

The proper location of struts was important in reassembling an aircraft. Therefore, a numbering system was devised which remained in use as long as Naval aircraft used wing struts. Numbers were to be placed on the struts, 1 inch (2.54 cm) from the bottom, with corresponding numbers on the lower wing panels close to the strut fitting. The front outermost strut on the right of the pilot was numbered one and the remaining front struts were marked in order from right to left with consecutive odd numbers. The rear outermost strut on the right of the pilot was numbered two and the remaining rear struts from right to left were marked with consecutive even numbers.

Aeronautical Specification No. 49, *Aircraft Insignia and Marking,* dated November 30, 1918, revised the letters signifying material in the doping code as follows:

AD	Acetate dope
ND	Nitrate dope
E	Naval Gray Enamel
V	Spar varnish
S	Shellac
W	Wood filler

To illustrate the new code AD2, ND3, E2 10-8-18 would mean two coats of acetate dope, three coats of nitrate dope, two coats of Naval Gray Enamel. The work was done October 8, 1918. Identification groups were to be separated by a comma and a space.

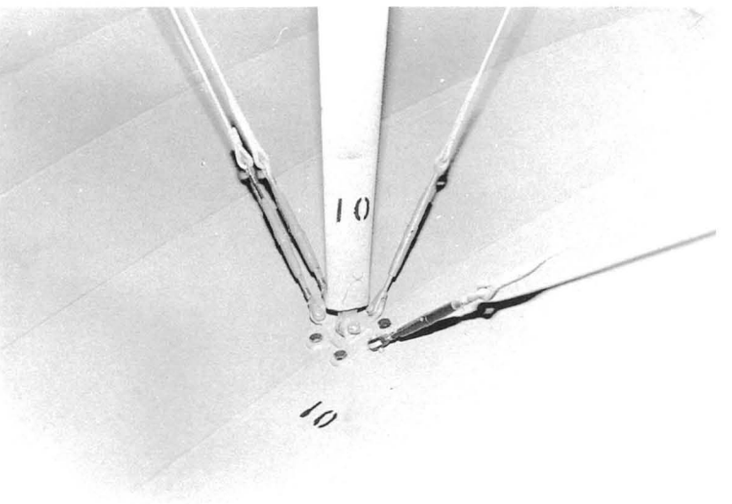
A new Aeronautical Specification No. 49, dated December 1919, required that a Manufacturer's Identification Plate be placed on the instrument panel of each aircraft. This identification could be a metal plate, transfer, or other convenient means not to exceed 3 inches (7.62 cm) by 6 inches (15.24 cm) bearing the following information.

1. Name, trademark and address of aircraft manufacturer.
2. Manufacturer's model and serial number.
3. Navy model, class and serial number.
4. Date of delivery (approximate).

The name or trademark of the aircraft manufacturer was not to appear in any conspicuous place on the aircraft other than that specified above. Any other had to be specifically approved in writing by the Bureau.

The use of aluminum wing enamel was recognized in this directive by the addition of the letter A to the doping code to designate this material.

All individual metallic fittings, except standard parts, such as bolts, nuts, washers, turnbuckles, swaged and streamline wire terminals and shackles, were required to be marked with the manufacturer's piece number. This number was to be in raised characters when possible and as large as practicable.



Right: Wing strut numbers have been applied to the restored Curtiss JN-4D at the US Naval Aviation Museum, Pensacola, Florida, in accordance with Aeronautical Specification No. 49. **Below:** Overall view of the same aircraft as shown in the close-up view.

CHAPTER 11 1920–1929

Aeronautical Specification No. 49 was replaced by a new directive Aero Process Specification No. 3, dated December 1, 1923. The title remained *Aircraft Insignia and Marking.* Insignia Blue was now specified for use in painting the numbers at the bottom of the struts and the corresponding numbers on the upper surface of the lower wing panels. The doping code also was to be Insignia Blue.

Sometime after Aeronautical Process Specification 3B was issued on December 15, 1924, a handwritten entry assigned the letter Y to the doping code to designate Navy Yellow Enamel. A corrected page to the Specification dated July 1, 1926, does not show a Y but has added the following four combinations.

AA ..... Aluminum pigmented acetate dope
AN ..... Aluminum pigmented nitrate dope
YA ..... Yellow pigmented acetate dope
YN ..... Yellow pigmented nitrate dope

A second corrected page, dated September 1, 1926, dropped the above four and substituted these two combinations.

PA ..... Pigmented acetate dope
PN ..... Pigmented nitrate dope

Bureau of Aeronautics Technical Order No. 252 dated April 6, 1929, directed the painting of propeller blade tips to minimize the danger to personnel from moving propellers. Each blade of all propellers in service was to be painted on both sides as follows:

From the tip to 4 inches (10.16 cm) from the tip—
Insignia Red
4 inches (10.16 cm) from the tip to 8 inches

Right: This G. Elias & Brother EM-1 (A-5906) is shown with the doping code F1,AD2,-ND3,-A2,-V1,-12-18-21 which translates: Finished with 2 coats acetate dope, 3 coats nitrate dope, 2 coats aluminum, 1 coat varnish, applied December 18, 1921.

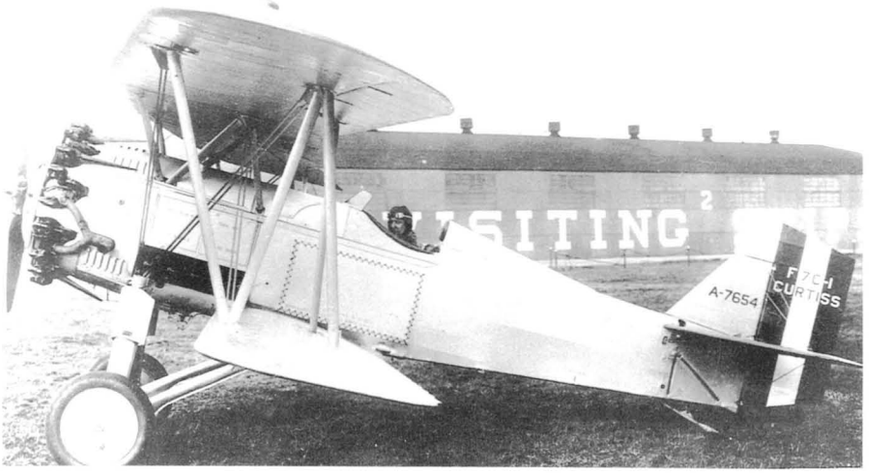

5906

(20.32 cm) from tip—Bright Yellow
8 inches (20.32 cm) from the tip to 12 inches (30.48 cm) from tip—Insignia Blue
12 inches (30.48 cm) from the tip to hub, the propeller was to be left unfinished.

This was a short lived directive which was superceded on May 20, 1929, by Technical Order No. 256. In addition to the safety marking requirements of T.O. No. 252, a limited portion of the propeller hub was to be painted either red or purple. Tests had indicated that the corona effect developed by a revolving colored hub and a bright finished blade root created a definite impression of action and called attention to the other markings.

As a means of preventing glare caused by reflection of the sun on rotating propellers, the rear surface of each blade could be painted with Insignia Blue. This was to be accomplished by extending the Insignia Blue band inboard an additional 24 inches (60.96 cm). This was an optional marking. In both of these instructions all the colors were to be glossy.

Right: This Curtiss F8C-5 shows the numerous maintenance-type markings found on the initial aircraft of a model. These were not always all applied to the production versions. **Below:** Close up of a Vought SU-4 shows some of the small technical information used in 1934. Note the doping code at the top of the fin and bottom of the rudder.



Right: This Curtiss F7C-1 is a good example of the type of technical markings applied to operational naval aircraft during the 1920s.

CHAPTER 12 1930–1939

Aeronautical Process Specification 3B was replaced by SR-2, *Specification for Aircraft Insignia and Marking*, dated June 1, 1931. After all these years mention of center section struts finally was made. They were to be included in the numbering sequence along with the interplane struts. The struts used on monoplane wings were to be numbered in the same manner as those used on biplanes.

The marking of piping systems was changed to:

Fuel System	Orange
Lubrication System	Yellow
Fire Extinguisher	Red.

These lines were to be identified with a 1/2 inch (1.27 cm) band near each end and such other intermediate bands as may be necessary to follow through a system.

Reflecting the changes in materials for painting aircraft, the doping code also was revised. It now consisted of letters to designate the following six materials.

AD	Acetate dope
ND	Nitrate dope
SPA	Semipigmented acetate dope
SPN	Semipigmented nitrate dope
PA	Pigmented acetate dope
PN	Pigmented nitrate dope

The doping code information was to be placed on the underside of the fuselage, wings and control panels in 1 inch (2.54 cm) Black characters.

In order to readily and accurately check the age of the covering it now was required that all refinished panels retain

Right: Because of the small size of the technical markings, few show on photos. However, the doping code on the rudder, LIFT HERE on the lower fuselage, TOOL BOX and STARTER CRANK on the forward fuselage are visible in the 1931 photo of a Marine Utility Squadron Seven (VJ-7M) Curtiss N2C-2 trainer.


703
U.S. MARINE CO
AVAL AIR STATION SA DIEGO

the original finish data. The new finish data carried the word REFINISHED immediately preceeding it. For example: ND2, PN2, 9-15-29 REFINISHED SPN4, 2-4-31.

The letters and numerals used for technical markings now were to be either Black or White just as were the recognition/identification type markings. The color used was determined by the background upon which the markings were applied and was to give the greatest contrast. White was to be used on Red or Blue and Black used on White, Gray, Aluminum, Green, and Yellow.

A Bureau of Aeronautics Memorandum dated October 21, 1931, stated that safety markings on hulls or pontoons in line with the propeller were not within the scope of SR-2. That Commanding Officers of squadrons can add marking for safety on any particular aircraft without reference to SR-2.

It can not be determined accurately at this time when the Navy adopted White as the identification color for water lines and Green for flotation gear. However, these colors were in effect on November 11, 1932, when the Chief, Bureau of Aeronautics wrote the Chief of the Material Division, Wright Field concerning a standardized Army-Navy system for the identification of aircraft piping systems.

SR-2a, dated February 1, 1933, reduced the size of letters and numerals in the doping code to 1/2 inch (1.27 cm). The characters were to be Black unless a different color was required for contrast. Semipigmented acetate dope was dropped from the list of approved materials.

Identification colors for piping systems was modified in accordance with the agreement between the Bureau of Aeronautics and the Army Air Corps for a standard Army-Navy system, and to correspond with shipboard markings. They were now as follows.

Fuel	Red
Oil	Yellow
Water	White
Prestone	White-Black-White
Fire Extinguisher	Brown
Flotation Equipment	Light Blue
Oxygen	Light Green

Lift points on all aircraft were to be indicated by the words LIFT HERE painted in letters 1 inch (2.54 cm) in height directly above the lift point.

The following instructions were to be painted at points where it is necessary to break electrical connections when folding back or removing wings, removing tail surfaces or struts: "Disconnect electrical wiring before removing (part)."

The identification colors for piping systems were further expanded by Bureau of Aeronautics letter Aer-E-252-SG, dated November 30, 1936, in accordance with a recent standardization with the US Air Corps. The colors now were as listed below.

Fuel	Red
Oil (Lubricating)	Yellow
Prestone	White-Black-White
Water	White
Fire Extinguisher	Brown
Flotation Equipment	Light Blue
Oxygen	Light Green
Airspeed	Black
Manifold Pressure	White-Light Blue
Vacuum	White-Light Green
Hydraulic Oil Pressure	Light Blue-Yellow-Light Blue
Air Pressure (Compressed)	Light Blue-Light Green
Steam	Light Blue-Black
Purging	Light Blue-Yellow
Exhaust Analyzer	Light Blue-Brown

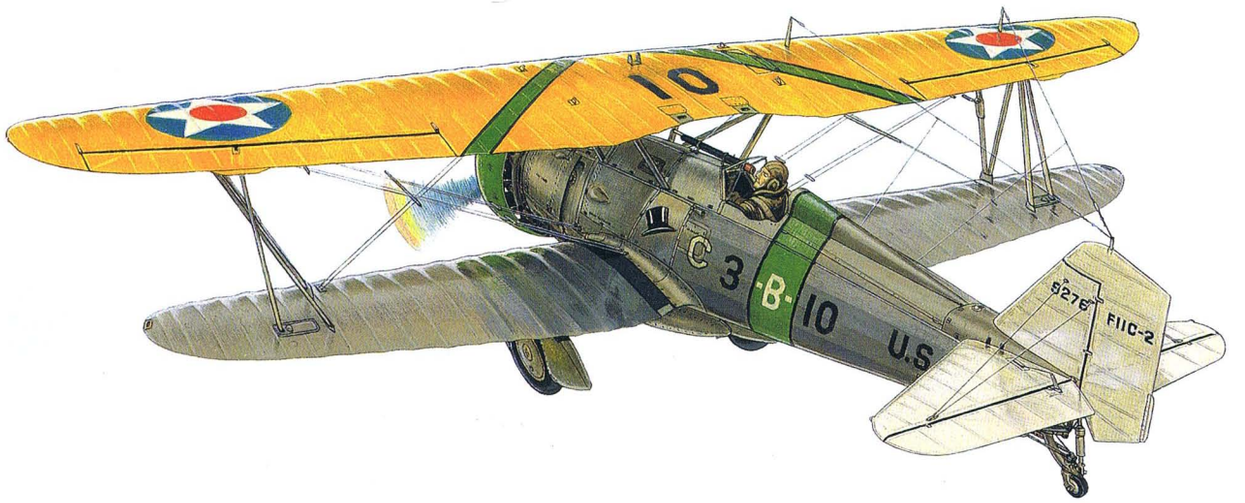
The standard Navy colors True Blue, Willow Green, and Orange Yellow were to be used where Light Blue, Light Green, and Yellow markings were specified.

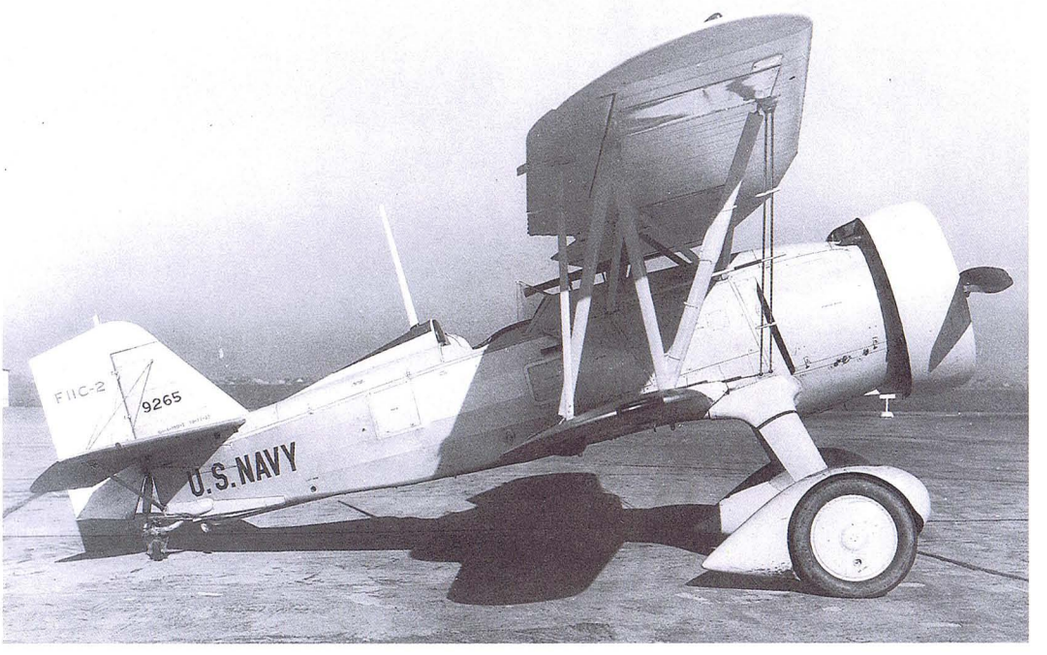
A Bureau of Aeronautics letter dated April 16, 1938, to Consolidated Aircraft San Diego, California, authorized the use of colored cellulose tape to identify piping systems. However, the tape had to be protected with a coat of varnish or lacquer.

SR-15c, *Naval Aeronautical Specification For The Protection of Naval Aircraft and Parts,* dated October 15, 1938, required hull bottoms finished in aluminum to have a Black waterline approximately 4 inches (10.16 cm) wide at the normal load waterline of the aircraft.

Amendment 1 to SR-15c, dated December 27, 1939, reduced the width of the black waterline to 2 inches (5.08 cm).

Right: This is a typical example of service markings as applied in 1930. It is interesting to see how roughly the U.S. NAVY has been painted freehand. **Below:** As a warning to personnel working around the aircraft when the propeller was turning, a red stripe in the arc of the propeller was usually painted on the main pontoon as shown on these VCS-6 Curtiss SOC-2s from the heavy cruiser USS Minneapolis.





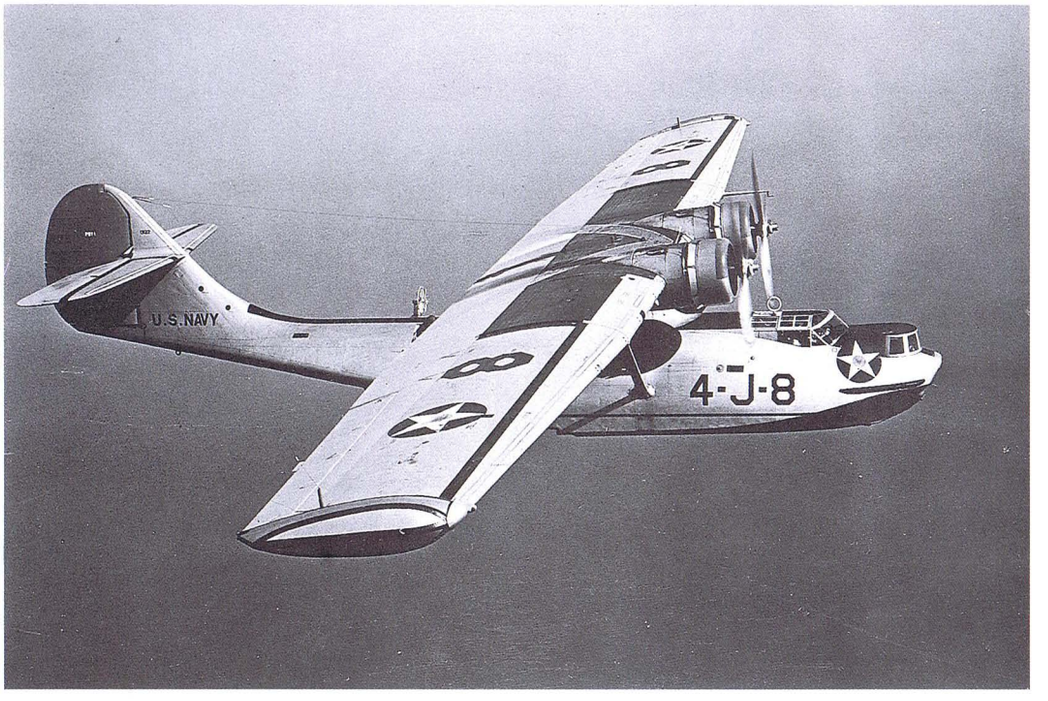


Illustration above: One of the best looking US Navy aircraft of the '30s, the Curtiss Goshhawk was used both as a fighter and a light bomber. Shown here the number ten airplane of VB-3 proudly displays the little known communication C award along with its famous High Hat insignia. **Left:** A Curtiss F11C-2 awaiting a squadron assignment shows many of the technical markings applied to aircraft in the '30s. **Below left:** This Consolidated PBY-1 of VJ-4 clearly shows the black water line on the side of the hull and wing-tip floats. Of interest is the wind-driven propeller on the aft fuselage to power the tow target reel and the fact that a utility squadron was also engaged in the neutrality patrol as indicated by the national aircraft insignia on the bow of the hull.

Right: Even though the propellers on these Sikorsky JRS-1s posed no threat to personnel they had the blade tips painted red, yellow, and blue. Note that the Chrome Yellow of the upper wing surface still terminates at the leading edge of the wing. **Below:** A Consolidated PBY-3, based at NAS San Diego, California, circa 1938. The areas around the rear of the engine nacelles, stripes on wing and aft on top of the hull are Black to designate hard areas where it is safe to walk. Note how the wing chevron blends into the work area.

SECTION 5

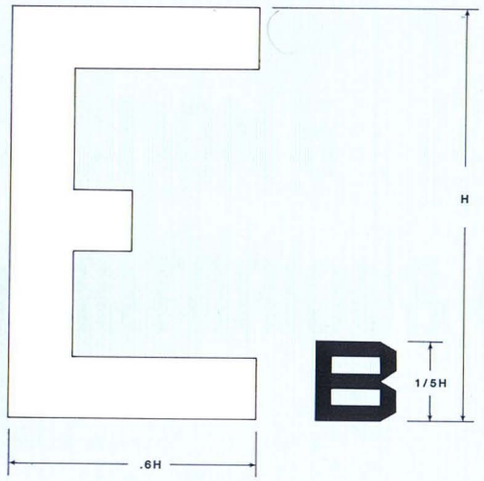
MERITORIOUS MARKINGS

CHAPTER 13 1911–1919

The practice of awarding suitable visible recognition for deeds well done has been a part of the military from the beginning. Since the primary use for military aircraft is as combat weapons, it is not surprising that those operating this new weapon should soon desire recognition. This recognition was to be separate from awards of valor and specifically to show skill in their form of endeavor. It is interesting to note that the custom of paying prize money for excellence in gunnery was inaugurated in the United States Navy in 1903 when President Theodore Roosevelt authorized gunnery competition within units of the Fleet.

Naval aviation prior to World War I consisted of aircraft suitable only for short range observation flights. In the press of World War I expansion there were far too many problems to worry about which unit was making the highest gunnery score. However, with the advent of peace and the training program necessitated by the reduction in force, an award of this type had its appeal.

Right: The Curtiss F-5L and crew of VS-1 were the first to be awarded the Navy "E" in 1923. Note the diagonal recognition stripes on the hull.



NAVY "E" FOR BOMBING

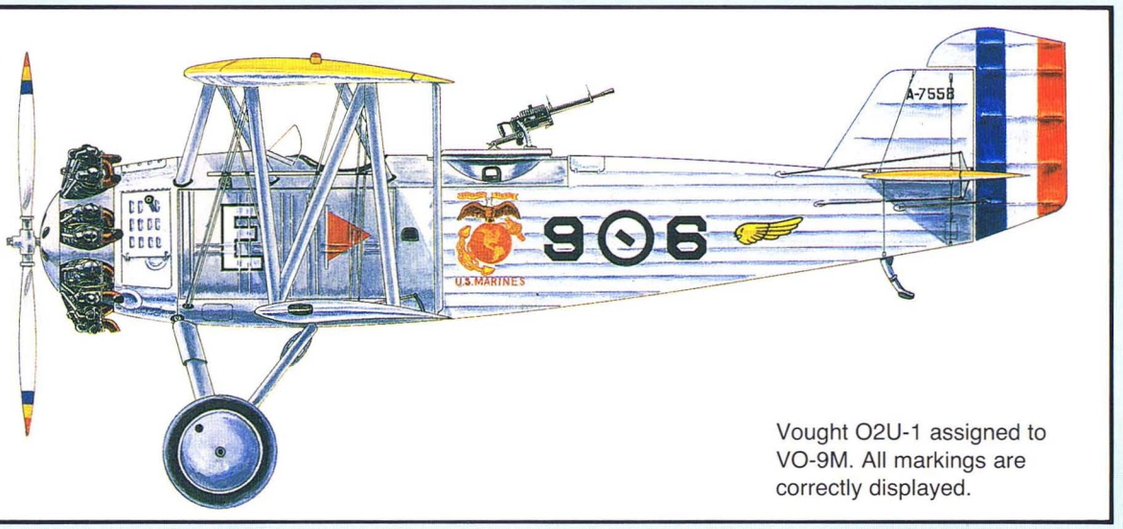
CHAPTER 14 1920–1929

The first known reference to an "E" for use on aircraft is in a letter from the Commanding Officer, United States Naval Air Station, Rockaway Beach, L.I., dated February 11, 1920. In this letter he recommended various maneuvers to be conducted in bombing and gunnery (rear seat free gunnery only) for Preliminary and Record Target Practice. It was recommended that the air station making the highest final score be permitted to fly a pennant designated by the Department, and that all planes from that station have an E painted on both sides signifying excellence and corresponding to the Es painted on ship's turrets.

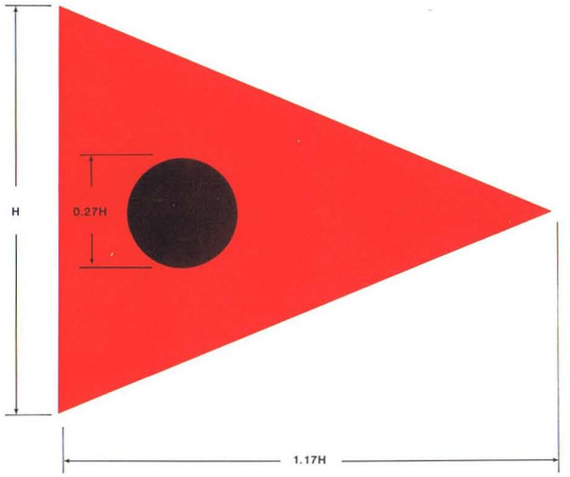
The recommendation must have been well received by the Navy Department, for it was incorporated in the next issue of *Orders for Gunnery Exercises, All Classes of Vessels, 1922-1923*. Chapter 36 on Gunnery Trophies specifies the following data which has been the basis for the E and trophy pennant ever since.

A pennant was to be "Awarded to the airsquadron obtaining the highest merit for the gunnery year of all air squadrons required to hold gunnery exercises, provided that there are two or more squadrons competing, and further provided that the gunnery merit obtained is considered creditable. The pennant shall be red with a circular black center; the fly shall be 1.17 of the hoist, and the black center shall have a diameter of 0.27 of the hoist. It shall be displayed by all aircraft of the squadron to which the pennant is awarded. The pennant shall be painted on the body, car, or fuselage in a position and of a size as designated for the Navy 'E.' The hoist of the pennant shall always be forward. Aircraft displaying both the Navy 'E' and the gunnery excellence pennant shall display the pennant abaft the Navy 'E.'

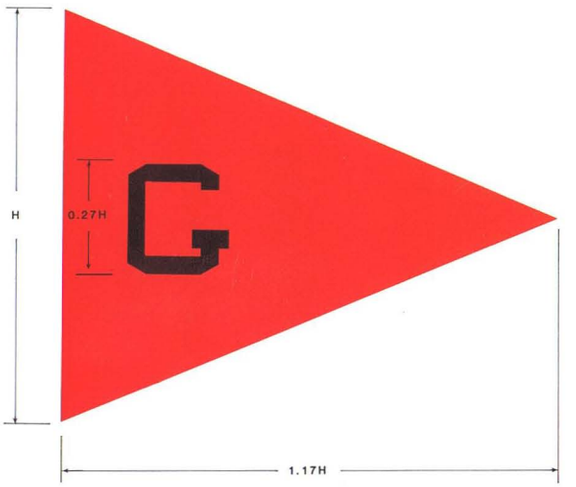
Right: A Naval Aircraft Factory TS-1 of VF-1 is depicted in October 1924 showing the first US Navy fighter aircraft to carry the Gunnery Trophy pennant and the Navy "E."



Vought O2U-1 assigned to VO-9M. All markings are correctly displayed.



BATTLE EFFICIENCY PENNANT



GUNNERY TROPHY PENNANT

"The Navy 'E' is awarded to turrets, guns, torpedo batteries, aircraft units and mine tracks which attain particularly high merits on certain practices . . .

"(f) . . . The standard gunnery merit will be established by the Department upon the results of the practice.

"All turret, gun, torpedo battery, mine track and aircraft 'E's' will be white rectangular block letters of the following dimensions.

". . .(d) For aircraft 10 inches [25.40 cm] in height for smaller aircraft up to 20 inches [50.80 cm] in height for larger aircraft. The width shall be six-tenths of the height.

". . .(e) 'E's' for aircraft shall be located on both sides of the body, car, or fuselage of the aircraft as near the pilot's cockpit as possible without obstruction from view by the wings or other appendages of the aircraft."

Members of the crew of aircraft units which attained a gunnery merit equal to or greater than the standard gunnery merit were entitled to wear a small block letter E on the sleeve of their uniforms in the position prescribed by uniform regulations.

A drawing *"Sketch (SL-9) Location of Gunnery Efficiency Insignia"* by Bureau of Aeronautics and dated January 19, 1922, shows both a white E for efficiency and a red E for engineering. To date, no record has been located indicating that a red E for engineering was ever authorized or issued to aviation units. It is believed that this sketch was copied from the normal shipboard E which did provide for both a red and a white E.

The Chief of Naval Operations, on September 12, 1923, awarded the gunnery trophy to Scouting Plane Squadron One. This was the first issue of the award. The following year it was awarded to Fighting Plane Squadron One with VO Squadron Three (Marine Corps) in second place.

In answer to a request from the Commander Aircraft Squadrons, Battle Fleet, concerning when the gunnery trophy would be presented to Fighting Plane Squadron One, the Chief of Naval Operations quoted in part Article 3302 of Orders for Gunnery Exercises, 1923–1924. "In view of the fact that in the case of aircraft this award is made to the squadron as a whole, the award will consist of the privilege of all aircraft of this squadron painting on each side of the body, fuselage, or boat a red pennant similar to the battle efficiency pennant, except that the black center will be replaced by a black letter 'G' of the same proportional size. This pennant will be painted, the hoist being 15 inches [38.10 cm] in height and the other dimensions in the same proportion as the prescribed dimensions of the battle efficiency pennant as nearly as practicable abreast of the Pilot's cockpit with the hoist forward."

It was the desire and intent of the CNO to have a suitable trophy made for aircraft. This was dependent upon sufficient funds and it has not been possible to determine if such a trophy were ever produced. All indications are that it was not. Some photographs show what appears to be the red pennant without either the black circle or the letter "G." However, this may be only the result of the film used and not that the marking was incorrectly applied.

Aeronautical Process Specification No. 3B, *Aircraft Insignia and Marking,* dated December 15, 1924, was the first time that Bureau of Aeronautics specified the "E" or gunnery pennant in its marking directives. At this time it specified that the gunnery pennant be placed on the side of the fuselage between the leading and trailing edges of the wings. The "E" was to be placed on the side of the fuselage, approximately under the trailing edge of the wing. This is in direct conflict with the Orders for Gunnery Exercises which specified the pennant to be aft of the "E."

Orders for Gunnery Exercises 1927–1928 has the following explanation for the awarding of a Navy "E" in individual battle practice (IBP) in aircraft. "The Navy "E" will be awarded to individual aircraft attaining a merit for individual battle practice equal to or greater than the merit of 100 (a computed figure, not a score) for any form of practice (weapon used). Where more than one form of practice is required to be fired and the above merit is attained in all forms, a plain E will be painted abreast the pilot's cockpit on each side of the body, boat or fuselage. When the above merit is attained on one or more forms, but less than the total forms required to be fired, the E will be followed by a small B, M, or T 1/5, the dimension of the E to indicate the form of practice (bombs, machine guns, torpedoes) on which the above merit was attained. Thus the following combinations will be had: E, E_{BM}, E_{BT}, E_{MT}, E_{B}, E_{M}, E_{T}.

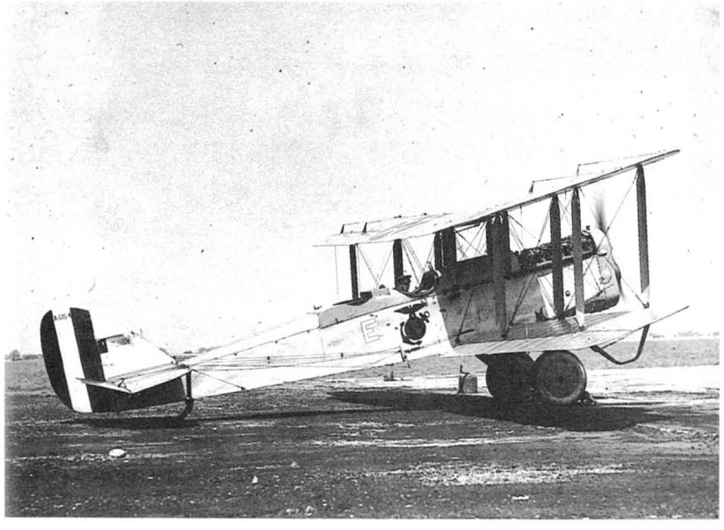
"In the case of aircraft the gunnery trophy award is made to the squadron as a whole. All aircraft of the squadron will paint abreast the cockpit on each side of the body, fuselage, or boat, a red pennant similar to the battle efficiency pennant,

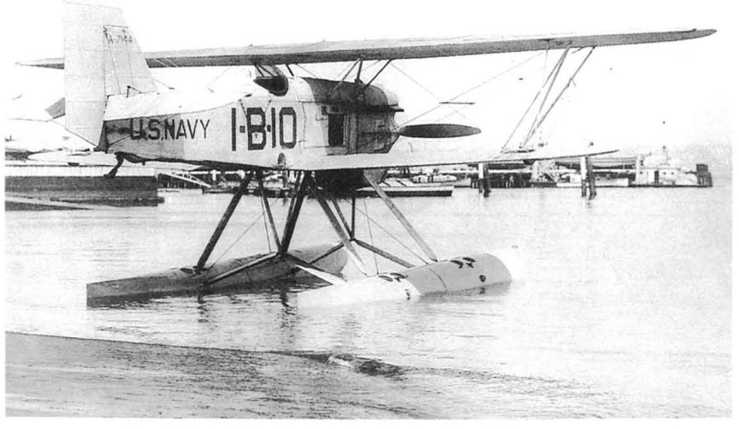
Right: A Curtiss OC-1 of VO-8M shows a shadow outline to make the Insignia White Navy "E" more prominent against the Aluminum background. The engine cowl, with only the top half painted the section color, obviously has been borrowed from the number 2 aircraft. The squadron insignia occupies the location for branch of service designation, while the Marine Corps emblem is where the squadron insignia should be. This reversal of designations was quite common in Marine Corps aviation units.
Middle below: A De Havilland DH-4 shows early application of the Navy "E" aft of the Marine Corps emblem which occupies the location prescribed for the "E". The designation FIRST AVIATION GROUP, U.S. MARINE CORPS, QUANNTICO, VA. on the fin is unusual. At this time all aircraft were just assigned to the base with no distinction of a specific squadron.

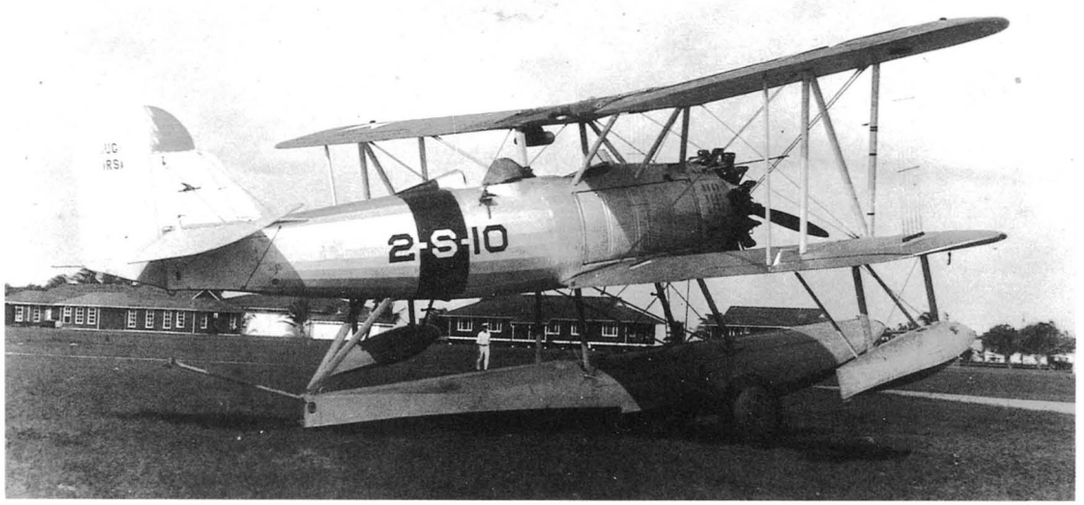
except that the black center will be replaced by a black letter G of the same proportional size. The hoist, which will be forward, will be 15 inches [38.10 cm] in height and the other dimensions will be in the same proportion as those prescribed for the battle efficiency pennant. Aircraft displaying both the Navy 'E' and the gunnery excellence pennant shall display the pennant abaft the Navy 'E.' "

The dimensions for the E on aircraft were specified to be: height of letter, 15 inches (38.10 cm); width of letter, 12 inches (30.48 cm); length of middle portion of letter, 6 inches (15.24 cm); width of all portions of letter, 3 inches (7.62 cm).

A specific date has not been established for the first use of the "Winged Turtle" on aircraft as this was not an authorized marking and was never included in painting instructions. It appears that it was generally applied wherever the recipient desired. This marking designated aircraft that had flown across the equator in the same manner as the document issued to personnel who had sailed across the equator and became a "Shellback." The earliest known photo showing this marking is dated June 1, 1929, and shows a VS-2B O2U-2 at Coco Solo, Canal Zone.







Right: This shellback turtle on the vertical fin is the earliest known use of this marking. There is no explanation for the rudder stripes being blocked out on this Vought 02U-2 in 1929 while on maneuvers at Coco Solo, Canal Zone. VS-2B was based aboard the USS Saratoga at this time making the amphibian-type landing gear unusual.
Middle right: The "Red Rippers" of Bombing One (VB-1B) operated their Curtiss F6C-3s on twin floats during 1928. The Navy "E," which appears to have been for bombing, must have been won prior to this float period.

CHAPTER 15 1930–1939

The Bureau of Aeronautics, on December 10, 1930, sent a letter directive to all major aviation commands concerning aircraft insignia and markings. In this letter the location of the gunnery E was to be forward of the designating marking, between it and the squadron insignia. This terminology is rather strange in that it ignores the bombing and torpedo awards.

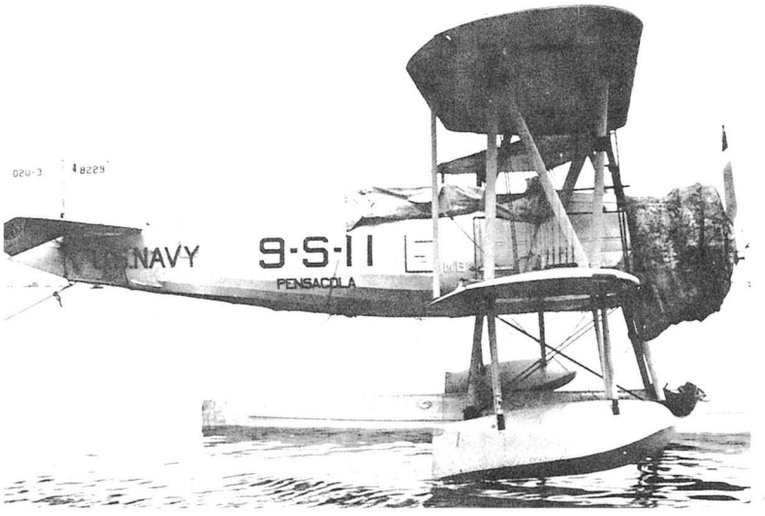
The dimensions and colors specified in Orders for Gunnery Exercises and the Bureau of Aeronautics directives on the marking of aircraft had been in conflict for years. This was finally resolved with the issue of *Orders for Gunnery Exercises 1931-1932.* This directive clarified that the dimensions for the E on aircraft were to conform with those of standard fuselage-designating markings then in effect. The paragraph on the gunnery pennant was changed to read, "The hoist of the pennant which will be forward will be of such height to conform with the standard fuselage designating marking now prescribed by the Bureau of Aeronautics and the other dimensions of the pennant shall be in the same proportion as those prescribed for the battle efficiency pennant."

In order to make the competition as fair as possible, the various types of squadrons were grouped together in the *Orders for Gunnery Exercises 1932-1933.* These groupings were:

1. Fighting and Dive Bombing squadrons (VF—VB) except shore-based Marine Corps VS squadrons.
2. Scouting squadrons (VS) except those attached to heavy and light cruisers.
3. Torpedo, Bombing, and Patrol squadrons (VT—VP).
4. Shore-based Marine Corps Fighting and Observation squadrons (VF—VO).

Right: An "E" in bombing and machine guns is displayed on this Vought SU-2 of VO-8M. Such an award was difficult to win in the multiplace aircraft as each member of the crew had to qualify in his specialty. In this case both the pilot with his fixed guns and the man in the rear seat with his flexible gun had to qualify for the "E" in machine guns.


8-0-2



Left: A Vought 03U-3 pf VS-9S from the heavy cruiser USS Pensacola is shown in 1933. The M and B beside the Navy "E" shows that the crew of this aircraft was awarded the "E" for efficiency in both machine gun and bombing. These additional letters were not required since they had achieved excellence in all phases required for their category which would have been apparent with just the "E." The horizontal tail stripe is Insignia White.

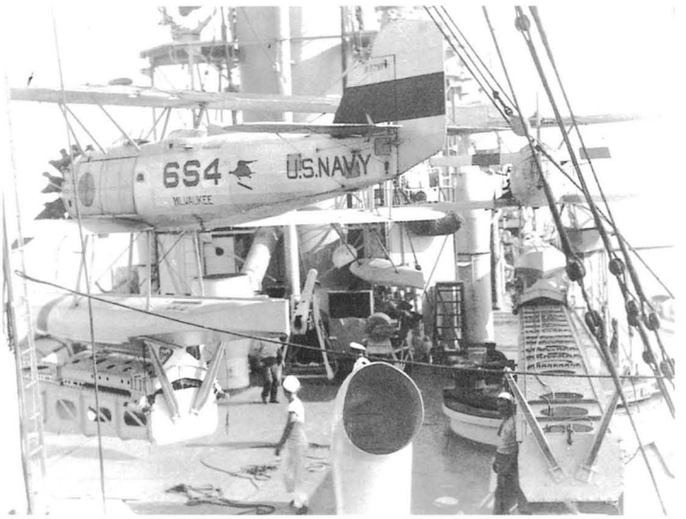
Training squadrons, Utility squadrons and those specifically excused by the Bureau did not have to conduct these exercises. If there were fewer than five aircraft squadrons in the competition, or if the highest merit was not considered creditable, no award would be made. As can be seen from this the two carrier-based Marine Corps squadrons competed against the Navy carrier-based scouting squadrons and not against the shore-based Marine Corps squadrons. The VO—VS squadrons aboard battleships, heavy cruisers and light cruisers competed under different regulations as part of the ship complement for the overall ship's battle efficiency and not as squadrons. With this grouping a squadron was competing with other squadrons operating basically the same equipment and with the same problems of tactics and personnel.

It should be remembered that the Gunnery Trophy (and its pennant) was a squadron award. The Navy "E" was an individual award for the aircraft and its assigned crew. This presented problems in the multiplace aircraft which had to qualify several people rather than just the pilot as in a single seat fighter.

There was a C awarded for proficiency in communications during this period. The documents specifying the requirements for this award have not been located. However, it is believed to have originated during the Fleet communication competition of 1935-1936. The award of the C followed the procedures established for competition between vessels. A white C was awarded to the winning squadron, while second place was indicated by a red C. This award was not covered in any of the aircraft painting instructions. Its size and location seems to have been left to the discretion of the squadron commander. The communication competition, in aviation, was discontinued during WW II and was not reinstated after the war.

Left: Squadron missions changed frequently and the "Red Rippers" are once again a fighting squadron in 1932 flying Boeing F4B-2s. The Navy "E" has a shadow outline to make it more prominent against the Light Gray of the forward fuselage. Flying from the USS Lexington the tail color is True Blue.

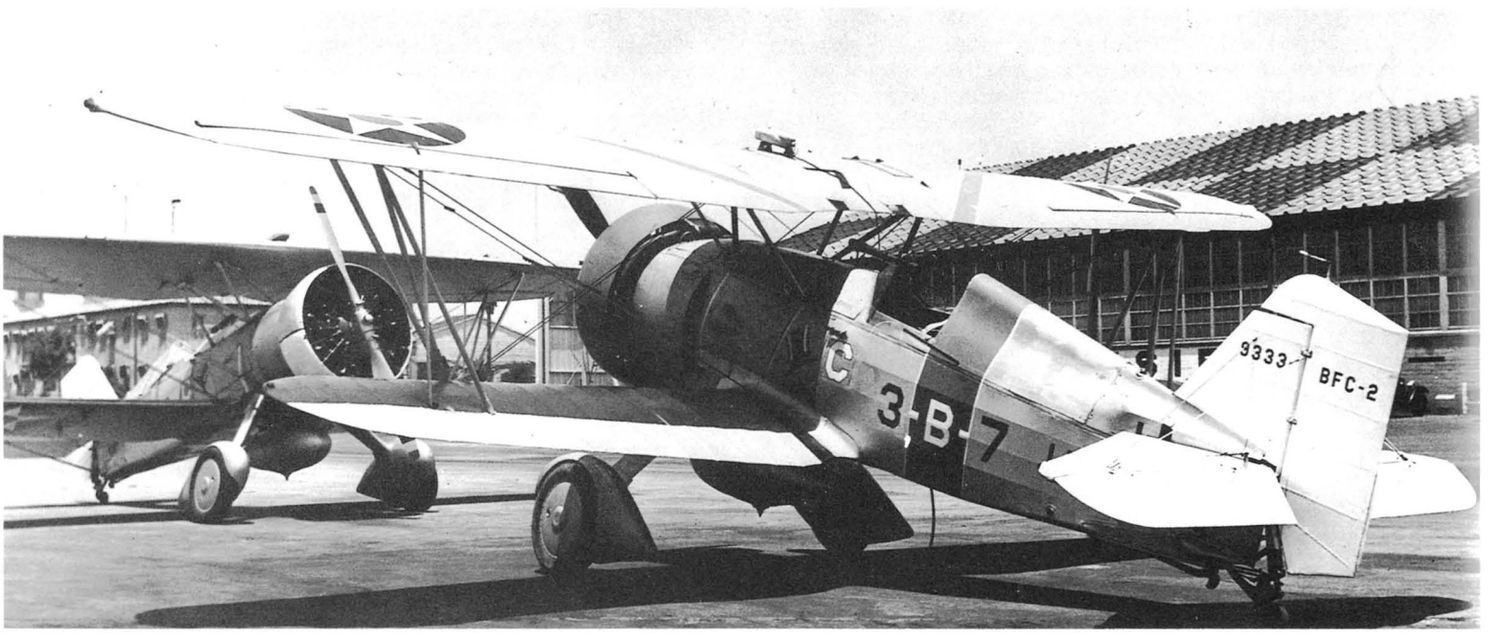
Top: This is an unusual photo which shows so many special markings for all aircraft of the USS West Virginia. The EM with three hash marks indicated that VO-4B achieved a high merit in machine guns for four consecutive years. The battle efficiency pennant was awarded to battleships, cruisers, destroyers, etc., during each competition year. The battle efficiency pennant painted on these aircraft should not be confused with the gunnery trophy pennant which was the same design except that the Black center was replaced with a Black block letter G. VO-VS aircraft operating from battleships or cruisers did not compete as squadrons for an aircraft gunnery trophy. The ship aviation units competed in the overall gunnery efficiency of the ship to which attached. **Above:** A good view of a Berliner-Joyce OJ-2 of VS-5B in 1933 shows a True Blue tail stripe. Both the "E" and "M" have a heavy shadow outline for added visibility. This shadow outline was not a specified marking but was used frequently on aircraft just as it was aboard ship. **Below left:** A large aircraft number has been applied to the under surface of the lower wing of this Douglas PD-1 in January 1931, but no national aircraft insignia. The squadron insignia should be on the bow forward of the gunnery pennant. Note the change in design of the pennant when placed on the right side of the hull or fuselage so that the hoist is forward and the pennant appears as it would if flying from a pole. **Below right:** The small letter "B" beside the Navy "E" denotes excellence in bombing for the crew of this Douglas PD-1 in April 1931. The gunnery pennant is an award to the entire squadron. Compare this with the previous VP-7 photo.



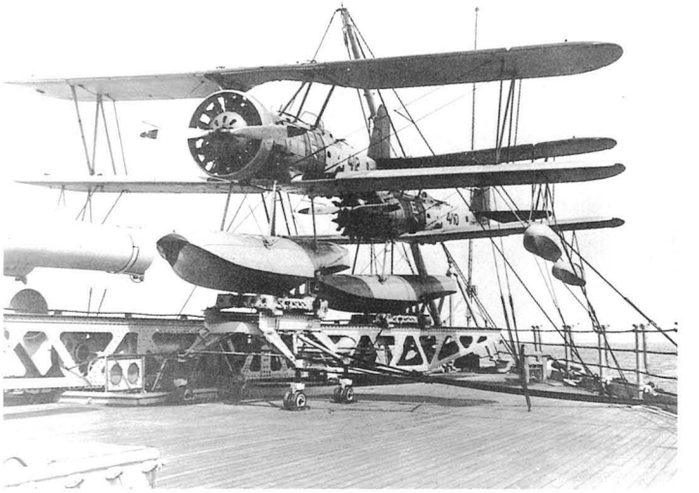
Left: A Vought O2U-1 of VS-6B is shown aboard the light cruiser USS Milwaukee, circa 1934/35. Note the absence of dashes between the designators and that the aircraft has crossed the equator twice as depicted by the hashmark under the winged turtle. The tail stripe is Insignia Red.

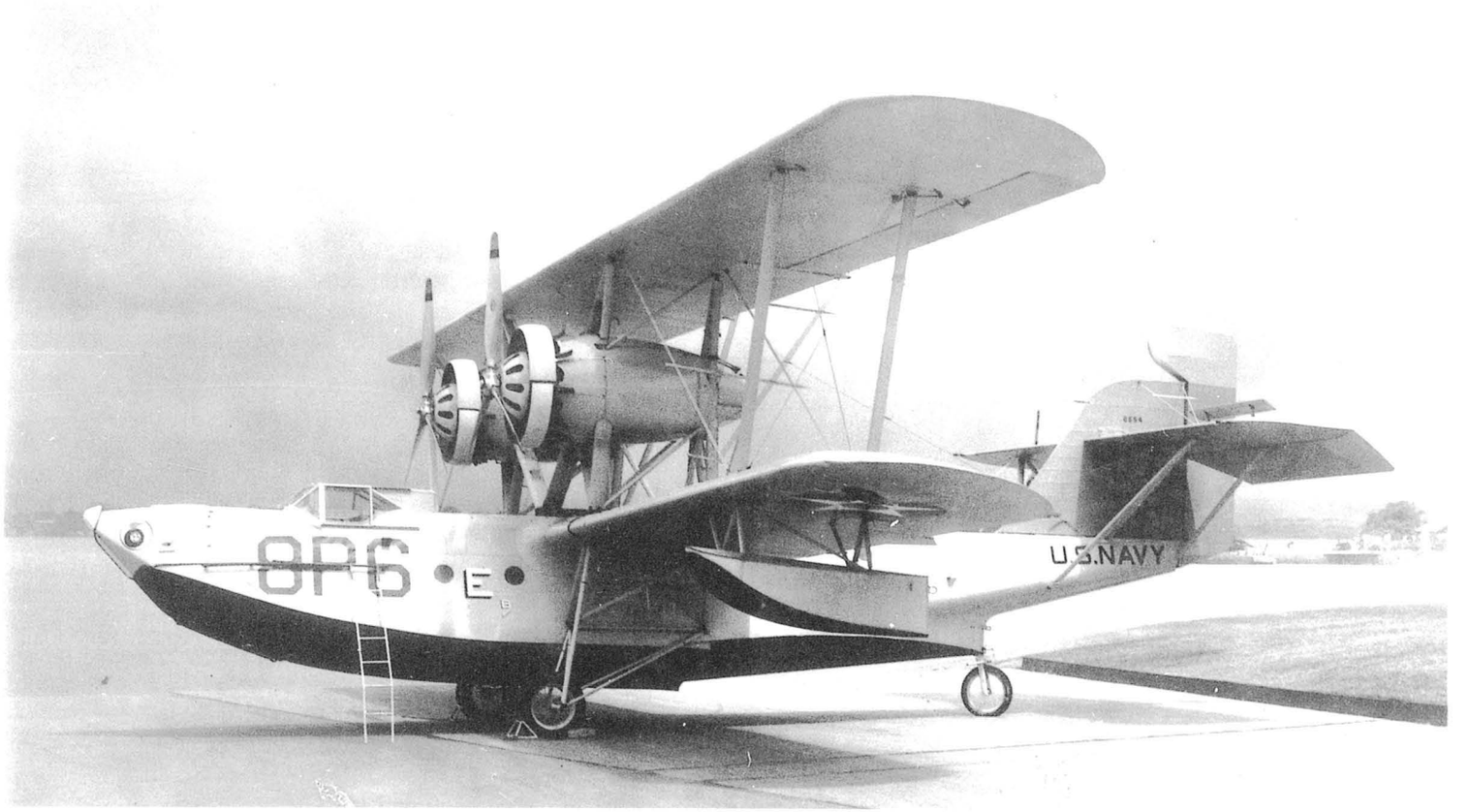
Above: Number 2 Boeing F4B-4 of VF-10M at NAS San Diego, California, in 1933, shows an "E" in bombing. The lack of a shadow outline on the M shows the poor contrast against the Light Gray background. Once again, the Marine Corps squadrons did not apply markings in the prescribed locations. This is the same aircraft shown on page 115 and is now displayed in the National Air and Space Museum, Smithsonian Institution, Washington, DC as number 21 of VO-9M. **Above right:** Outstanding proficiency is shown in this 1933 photo of the squadron leader's aircraft of VS-1B. The two Ms show it was awarded to both the pilot and the rear seat gunner, to whom it was awarded for three consecutive years. Tail color is Willow Green.

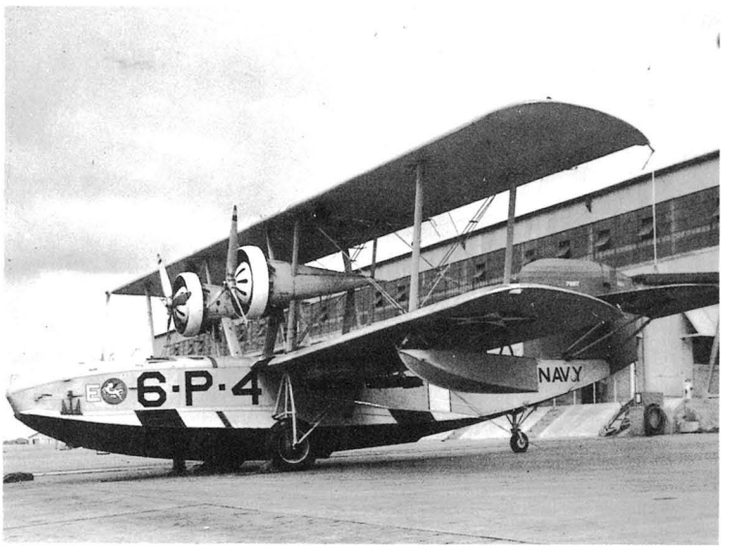
Below: The little-used and seldom-seen communication "C" is displayed here on the Curtiss BFC-2 of VB-3B. Two-way communication in fighter aircraft was in its infancy at this time.



Right: Vought O2U-1s of VO-4B are shown on the stern of a battleship. The Navy "E" carried by these aircraft show excellence by the entire ship Gunnery Department, not just the attached aviation unit. **Below:** This is a good example of how structural members can distort markings when viewed from certain angles. The B with a hash mark, in this July 1933 photo, denotes two consecutive years that the crew of this VP-8F Hall PH-1 had been awarded an "E" for bombing. **Bottom right:** This number 4 Douglas PD-1 of VP-6F in April 1936 was awarded an "E" in machine guns and bombing. Both the fuselage band and "E" are outlined in Black to make the Insignia White stand out against the Light Gray background. The tail is solid True Blue. Note the Insignia Red propeller-warning stripe, below the propeller, on top of the hull and sponson. **Botton left:** In April 1935 this Vought O3U-3 was the number 3 utility aircraft attached to the USS Ranger. The winged turtle "Shellback" insignia shows that the aircraft has flown across the equator. Not being a directed marking, it varied in its location. The design varied according to the skill of the squadron painter.





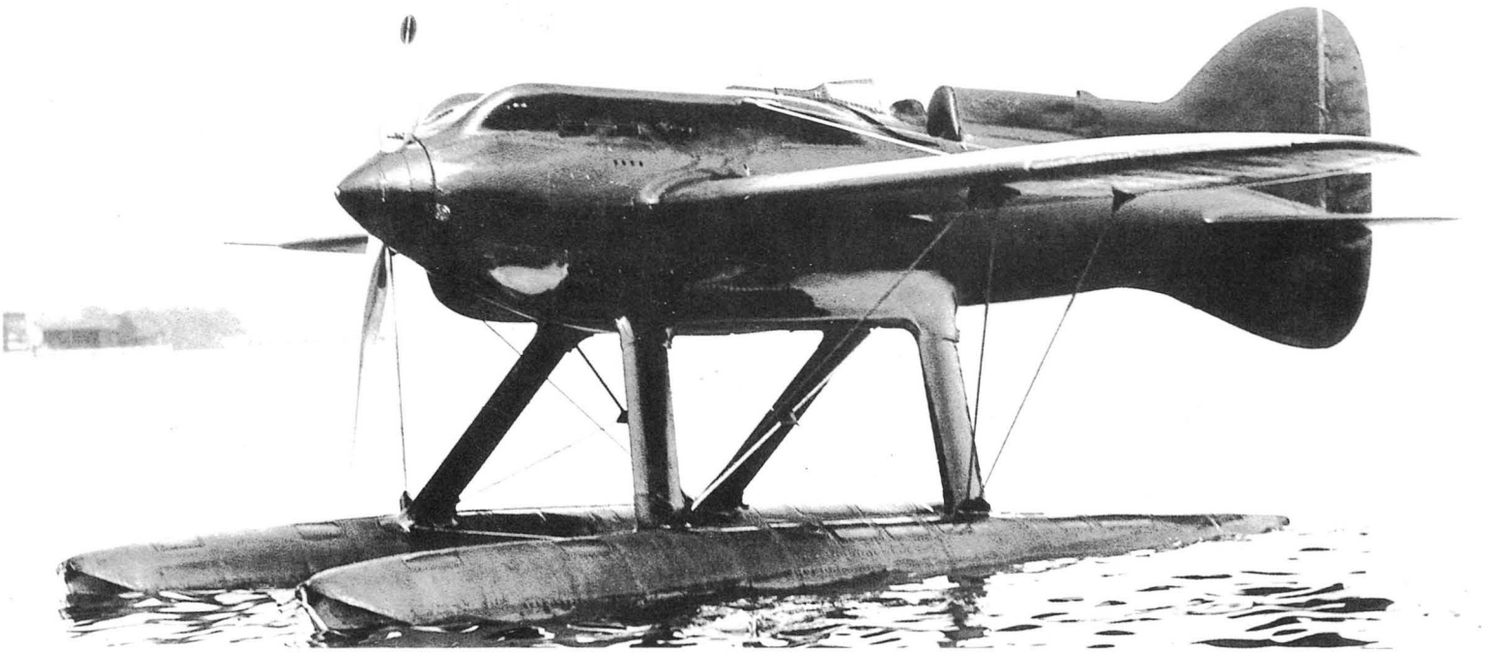


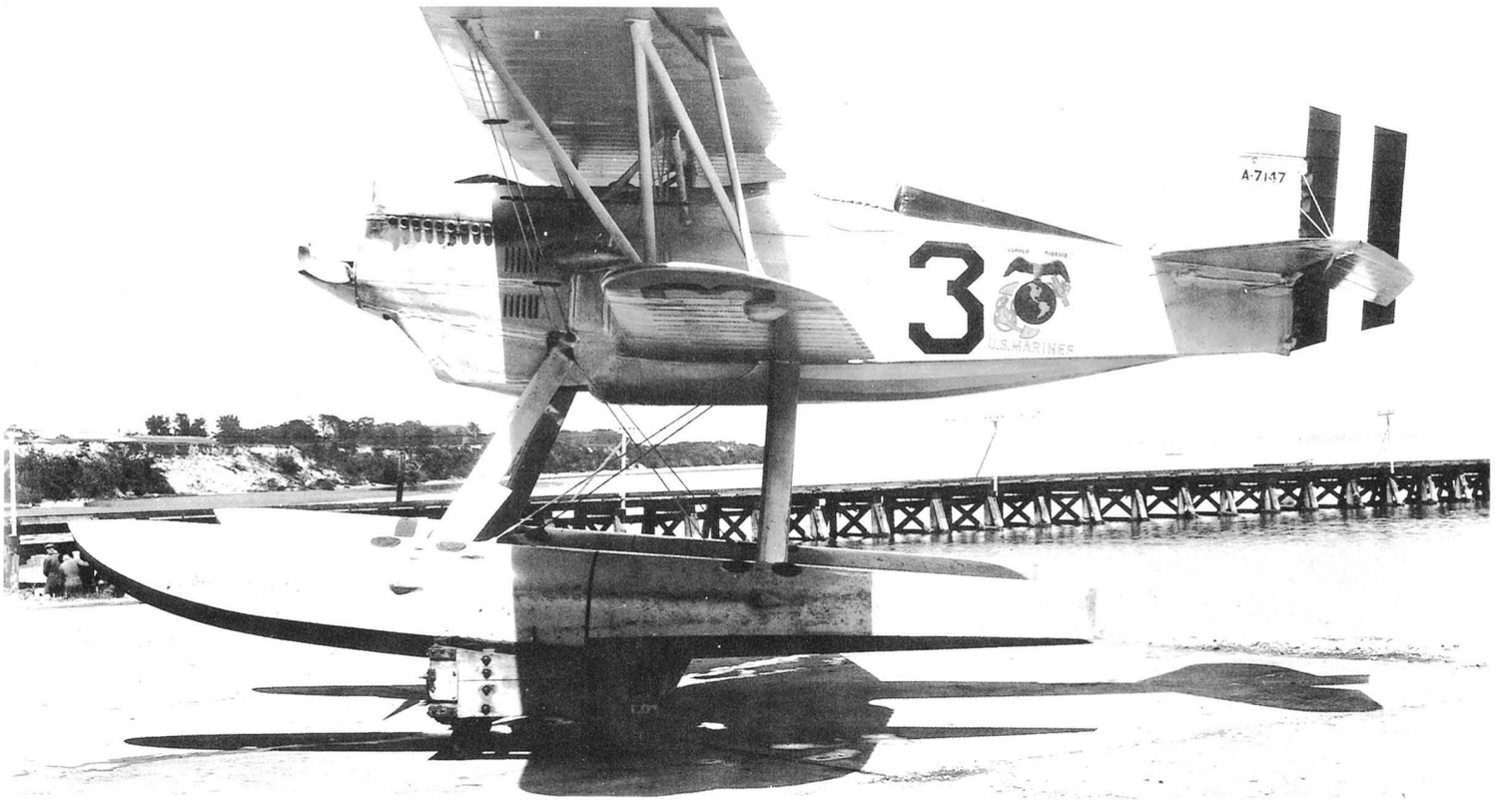
APPENDIX A
US NAVAL RACING AIRCRAFT

Due to a lack of official directives, one phase of naval aviation in the 1920s and '30s has not been covered in the body of the text. This is the series of aircraft procured by the Bureau of Aeronautics strictly for racing purposes. While some service types were modified for racing, many were built specifically for this purpose. However they were obtained, they provided valuable information on powerplants, aerodynamics and aircraft construction during a time when there was very little money available for aircraft development. These planes resulted in significantly advancing the development of fighter aircraft.

An exhaustive effort has been made to document the unique markings and colors that were applied to the specially designed navy racers which competed in premiere racing events of the Pulitzer and Schneider Trophy contests. Some of the modified Navy and Marine Corps service aircraft that participated in the Curtiss Marine Trophy races and the National Air Races of the period also have been documented. Full coverage of these events, however, is made difficult since on numerous occasions a considerable number of service aircraft participated, sometimes entire squadrons.

Regulations issued by the **Federal Aeronautique Internationale** through the National Aeronautics Association and the Royal Aero Club specified the colors, location and general manner in which race numbers were to be applied. References to the special (nonregulation) colors which were applied to many of the racers have been obtained from maga-





zines and newspaper articles of the period. Such information, in concert with the scarce black and white photographs presented, remain one of the best records of the paint schemes and markings applied to these colorful aircraft.

Although flown under the auspices of the Curtiss Aeroplane and Motor Company after the official withdrawal of military participation in the 1921 Pulitzer Trophy race, the Curtiss CR-1 aircraft was, nevertheless, billed and usually referred to as the "Curtiss Navy" racer. Several contemporary newspaper articles covering the race also refer to this aircraft as the "gray racer." It appears that a medium gray, most likely Naval Gray Enamel, was applied to the fuselage, engine cowling, interplane struts and landing gear chassis. Both surfaces of the upper and lower wings, and the cabane pylon, fin, stabilizers, elevators, and wheel covers appear to have been finished with Aluminum Wing Enamel.

Opposite top: This Curtiss CR-1 (A-6081) was flown to victory by test pilot Bert Acosta in the second annual Pulitzer Trophy race held at Omaha, Nebraska, on November 3, 1921.

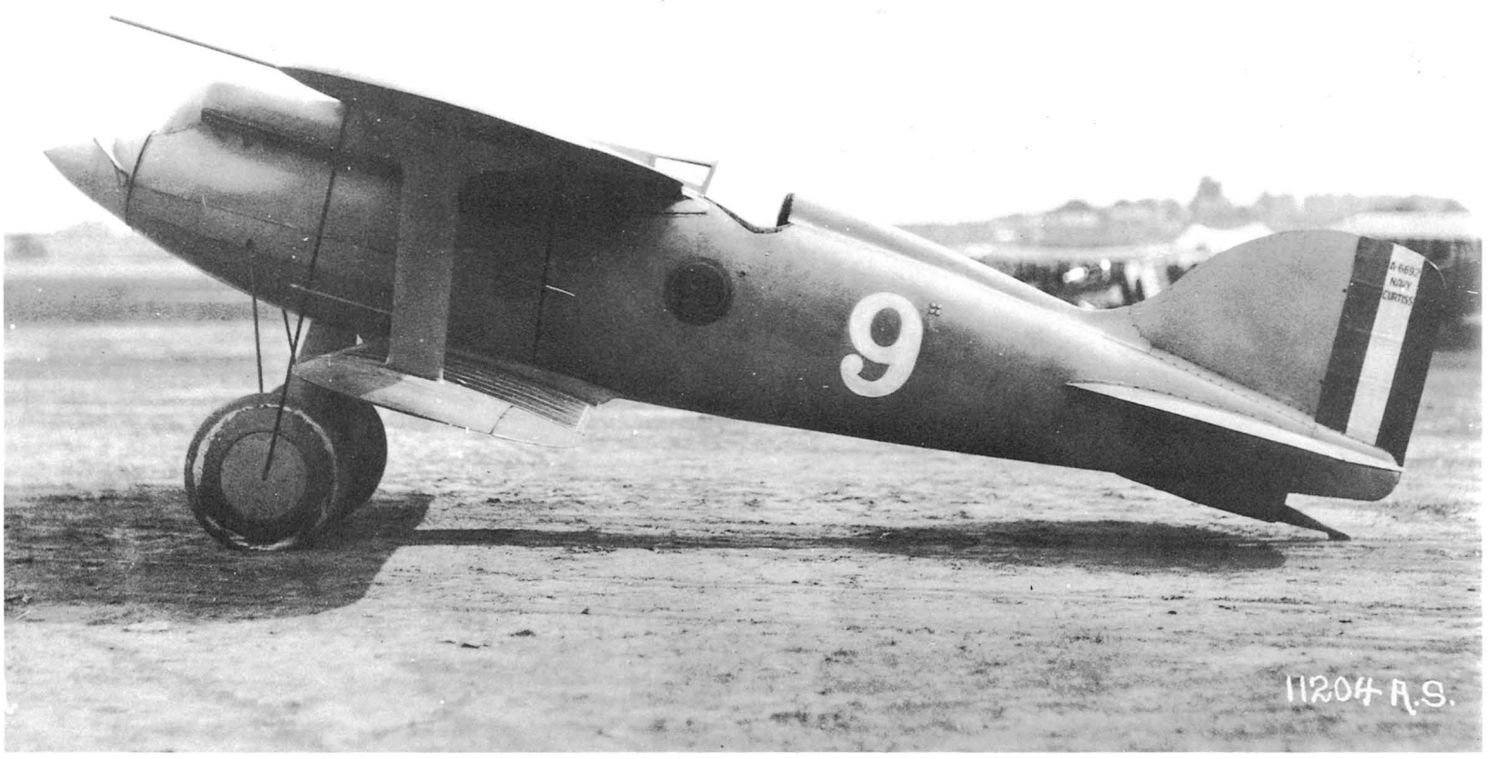
Opposite bottom: The experimental Mercury Racer is shown in July 1929, painted overall in Insignia Blue with yellow wings and horizontal tail surfaces. The wing radiators were natural metal. **Above:** This Curtiss F6C-1 was modified for participation in the Curtiss Marine Trophy Race 1930. This was a standard fighter plane assigned to VF-4M squadron at Quantico, Virginia. The large number 3 on the fuselage and lower wing and MARINES on the lower wing were for the race. **Below:** The same aircraft was extensively modified for the Thompson Trophy Race 1930.

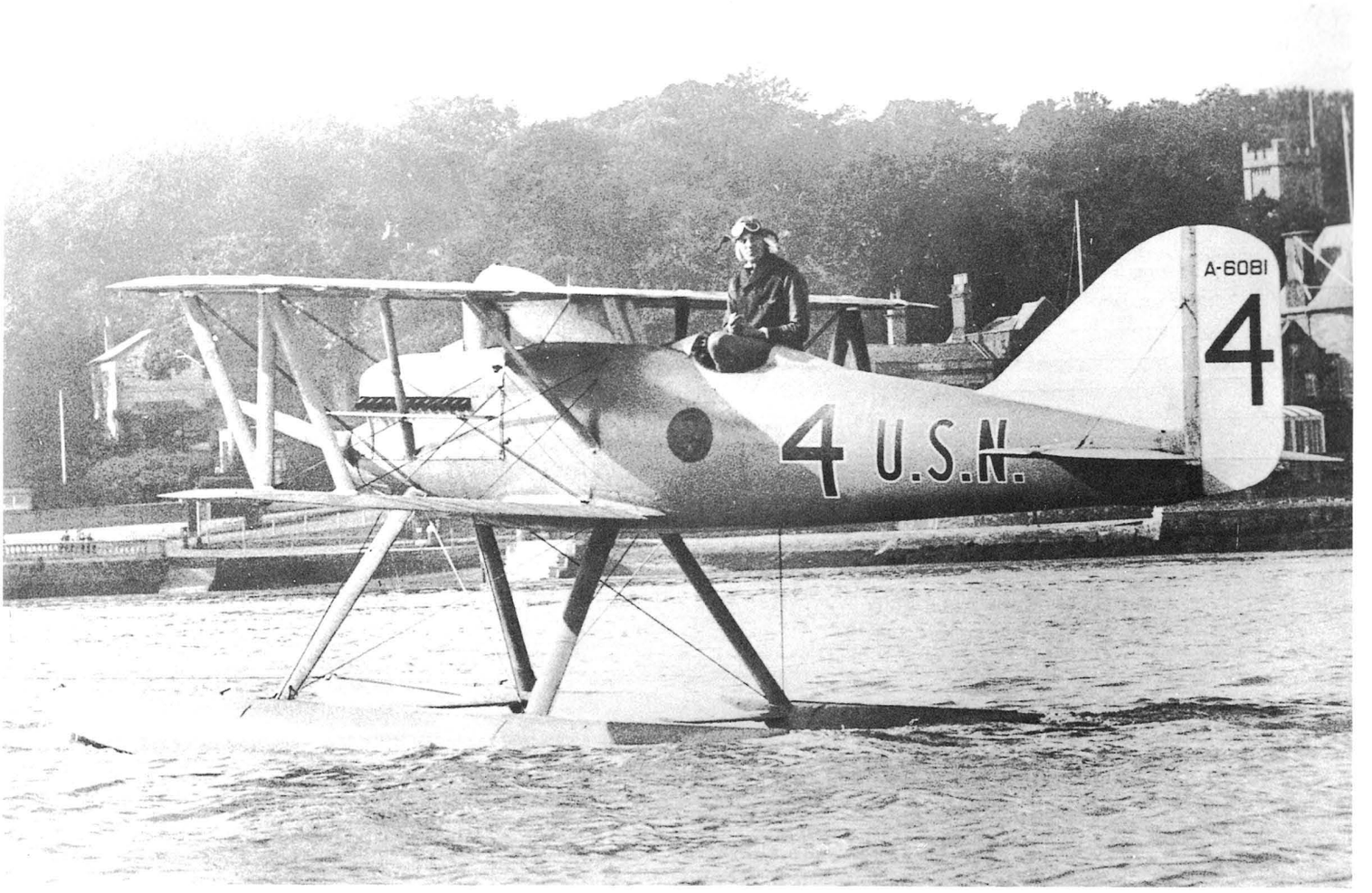
Contest regulations issued by the National Aeronautic Association stipulated that each airplane was to have its number "...painted on the bottom surface of lower wings and on each side of the fuselage, clear of the wing, in characters as large as possible." The insert of Bert Acosta banking the aircraft through one of the turns reveals that the race numbers applied under the lower wings were centered within dark colored roundels, possibly black enamel. As the size and location of these roundels approximates the size and location of the national aircraft insignia, this was probably done to conceal the original markings in line with that part of the contest regulations which stipulated that it "...shall not have other numbering or lettering over 12 inches [30.48 cm] in height." Since the regulations issued for this event do not clearly specify colors for the numbers, we can only guess what they might have been. However, it seems probable that they were applied with black enamel on the fuselage and white enamel on the lower wings.

The national aircraft insignia on the upper wing and the rudder stripes should have been applied in accordance with Aeronautical Specification No. 49. The lettering "CURTISS" and "NAVY" on the fin is not in conformance with the current directives. The aluminum spinner cap fitted to the propeller appears not to have been painted, while the two aluminum Lamblin radiators were nickel plated.

Above left: Only known photograph to exist showing underwing markings of the Curtiss CR-1 being flown by Bert Acosta. A ground view of this aircraft is shown at the top of page 184.

Below: This is Curtiss R2C-1 (A-6692) in which Lt. Alford J. Williams, USN captured the fourth annual Pulitzer Trophy race for high-speed planes which was held during the International Air Races at Lambert Field, St. Louis, Missouri, on October 6, 1923.





Above: This is the Curtiss CR-3 (A-6081) in which Lt. David Rittenhouse, USN won the Schneider International Seaplane Race at Cowes, Isle of Wight, England, on September 28, 1923.

The CR-3 flown in the Schneider International Seaplane Race was described colorfully in the October 3, 1923, issue of the British aeronautical publication, *The Aeroplane*, as "...the lean gray form of the Curtiss racer." It would appear that the fuselage, engine cowling, propeller spinner, interplane struts, cabane struts, float struts, spreader bars and floats were finished in the standard Naval Gray Enamel. The metal fairing which surrounded the return water pipes connected to the rear of the cabane pylon also appears to have been finished in Naval Gray Enamel. The Brass oil cooler positioned in front of the cabane pylon between the upper wing and engine cowling does not appear to have been painted.

While both surfaces of the upper wing were extensively fitted with a network of brass wing radiators, it is believed that the stripes of paneling between each section of radiator, as well as the wing tips, expansion tank and cabane pylon were finished with Aluminum Wing Enamel. It is only logical that the lower wings, ailerons, fin, stabilizers and elevators also were finished with Aluminum Wing Enamel. In an attempt to improve controllability, narrow strips of sheet rubber (most likely a reddish brown color) were used to cover the gaps between the fin and rudder, and the stabilizers and elevators.

The regulations for the contest issued by the Royal Aero Club stipulated that each aircraft would be "...allotted a number, which must be painted in black on a white surface on each side of the Rudder." To comply with this part of the regulations it appears that the rudder was painted entirely white, while the race number and aircraft designation number were applied in black as directed. A thin border of white was used to outline the black race number and lettering U.S.N. on each side of the fuselage. While the regulations stipulated that the registration marks (race numbers) also must be displayed on "...the lower surface of the lower mainplanes, and on the upper surface of the top mainplanes," it is not known if this was done.

The national aircraft insignia was applied to the lower wings, but not the upper wing. The Bureau of Aeronautics seal applied to either side of the fuselage most likely would have been a decalcomania in the full colors of the official seal. The artwork of this seal which has been rendered on page 26 can be consulted for further details.

A feature article on the Pulitzer Trophy Race appearing in the October 15, 1923, issue of the aeronautical publication *Aviation* makes reference to the Curtiss R2C-1 as the "...blue Navy-Curtiss racer No. 9." In comparing the density of the blue in the tail stripes (the band nearest the rudder post) to that of the aircraft, it would appear that the color applied to the fuselage, engine cowling, propeller spinner, interplane struts, fin, stabilizers, landing gear chassis and the metal plates that were fitted to either side of the wheel hubs was a medium blue enamel.

A gold-colored dope appears to have been used to finish the wing panels and ailerons outboard of the brass wing radiators, as well as the elevators and the linen streamline covers which faired the tire and wheel hub assemblies. Photographs reveal that as the aircraft saw continued service during the event, the gold dope applied to the wheel covers became worn about the tires, exposing the fabric underneath which probably had been painted with aluminum dope as a base coat.

The Bureau of Aeronautics seal applied to each side of the fuselage, most likely would have been a decalcomania.

Contest regulations issued for the event by the National Aeronautic Association stipulated that the numbers assigned to each aircraft "...shall be painted on the bottom surface of the lower wing and on each side of the fuselage, clear of the wing, in characters as large and clear as possible. It shall have no other numbering or lettering over twelve inches [30.48 cm] in height." While the national aircraft insignia that were applied to the panels on the underside of the lower wings, outboard of the radiators, are evident in photographs taken at the time of the race, it appears that the required race numbers never were applied under the lower wing as instructed. The published regulations do not specify what colors the race numbers were to be, but it is reasonable to assume that the numbers applied to the fuselage of each R2C-1 were in white enamel.

For extensive assistance rendered by the National Air and Space Museum in researching a significant portion of this appendix, we are deeply indebted to the efforts of Commander Paul E. Garber, USNR(Ret), Historian Emeritus and Ramsey Fellow, Admiral Dewitt C. Ramsey Fund, Department of Aeronautics, NASM.

APPENDIX B
AIRCRAFT MODEL DESIGNATION SYSTEM

The systems used to designate Naval aircraft have been covered in detail in numerous readily available publications and are really beyond the scope of this book. The tables contained in this appendix are designed to provide those letters necessary to construct aircraft designations for aircraft utilized by Naval aviation up to 1939. The majority of Type/Class designations used from May 19, 1917, up to December 31, 1939, are shown in Table I.

In order to properly mark Naval aircraft, the letters assigned to manufacturers must be known. The list of manufacturers in Table II covers most of those who built aircraft operated by the Navy/Marine Corps while the Navy system of designating aircraft was in effect. There are a few companies not included such as Thomas-Morse Aircraft Company whose only models used in Naval aviation were always known by their Air Service designation as S-5 and MB-3. Similarly, the Dayton-Wright aircraft was known by its Air Service designation as a TW-3. Yet both of these companies had been assigned letter designations by the Bureau of Aeronautics. The dates shown in Table II are the dates in which the letter was assigned to the manufacturer. Those designations in Tables I and II that do not have a second date shown in the period column were continued in use after 1939.

The four major elements in this system are as follows.

1. Aircraft Type/Class
2. Manufacturer Type Sequence
3. Manufacturer
4. Modification

Using the JF-1 as an example, it can be seen that this is a Utility aircraft built by Grumman and is the 1st example (NOT the 1st modification). However, the designation F4B-3 shows that this is the 4th Fighter model built by Boeing and is the 2nd modification of the basic aircraft. This can be expanded to show additional characteristics as seen below.

Experimental Aircraft	X
Type/Class	F
Manufacturer Type Sequence	3
Manufacturer	F
Aircraft Modification Sequence	-
	2

In some cases two or more letters are utilized to show the Type/Class of the aircraft such as SB for Scout Bombing as in SBC-2, and TB for Torpedo Bombing as in TBD-1.

Special purpose suffixes have been used almost from the beginning to designate various changes in the configuration, mission, or equipment carried. For example, the DH-4B denoted that the front cockpit and internal fuel tank had switched locations, from those used in the DH-4, so that the pilot sat behind the fuel tank and closer to the rear-seat gunner. HS-2L denotes the HS-2 aircraft equipped with a Liberty engine, while VE-7SF designated a single-seat fighter version of the basic two-seat VE-7. As the number of aircraft and their missions increased so did the requirements for special suffixes.

APPENDIX C
COLORS FOR US MILITARY AIRCRAFT

The following chart illustrates the relationship of colors used on US Naval aircraft as the various standards have evolved through the years. Each of the superseding directives contained a cross reference chart to show the user where the new color numbers were derived. These charts have been the basis for this compilation.

The first directive for a series of paint colors applicable to aircraft was War Department Specification No. 3-1 issued November 18, 1919. This two-digit system was adopted by the Air Service on July 19, 1922. No date has been located for adoption by the Navy. The Navy developed a color master known as the Navy Standard Aircraft Color Card in 1933 to replace the wet master samples used previously. During the '20s and '30s a concerted effort was made by the military to standardize wherever possible. One of the areas in which this was done was colors. A series of porcelain enamel on steel plates was developed and issued as Army-Navy Aircraft Color Standard covering all the glossy colors then in use. This was expanded with the issue of the Army/Navy Aeronautical (ANA) Bulletins which were first issued in 1943 and

included both glossy and matte colors. Numerous colors in both these series were duplicates of those already in 3-1. Both 3-1 and the ANA series were expanded during WW II to accommodate the additional colors required by wartime operations including those colors being applied to US aircraft provided to the allies under Lend-Lease. This resulted in a revised 3-1 Color Card being issued April 21, 1943, which now utilized a three-digit system as the ANA series had always employed. In all the systems which have utilized three, four, and five digits the colors are broken down into Gloss, Semigloss and Flat (camouflage). The first digit of the color number designated the category in which the color was to be found.

On January 12, 1950, TT-C-595 was issued as a Federal Specification to consolidate the numerous color listings used by various government agencies into one Federal Specification. TT-C-595 subsequently was replaced by Federal Standard 595, and in turn by 595a with several modifications.

In using this chart it must be remembered that these are not new numbers for exactly the same shade as shown in the previous directives. Rather, they are the nearest equivalent and in many cases are a compromise. Several colors in the chart have a 595a number in parentheses above the given number. This indicates a standard color that is thought, by some, to be a better match than the one officially designated. In each such case these numbers have been determined visually using one example of each color. There is no way to determine if the specific sample viewed was in reality the correct color as originally issued. However, they are included as a possible aid in assisting the user in determining what he feels is the correct color.

All Munsell numbers have been derived at either the National Bureau of Standards or the Munsell Color Company, Inc. Those shown for Federal Standard 595a were developed for use in Volume II which was never published but are included here for reference. Since that time there has been a gradual shift in some colors. A revised edition of Federal Standard 595a is under preparation at the time of writing, and the adjusted Munsell numbers will be shown in later volumes.

TABLE I

TYPE/CLASS DESIGNATION

TYPE/CLASS	MEANING	PERIOD	TYPE/CLASS	MEANING	PERIOD
B	Bomber	1931-	P	Pursuit	1923-Only
BF	Bomber Fighter	1934-1937	PB	Patrol Bomber	1935-
F	Fighter	1922-	PT	Patrol Torpedo	1922-Only
G	Transport, single engine	1939-	PT	Patrol Torpedo Bomber	1937-1938
H	Hospital	1929-1931	R	Transport	1931-
J	Transport (to R)	1928-1931	R	Racer	1923-1928
J	Utility	1931-	S	Scout	1922-
JR	Utility Transport	1935-	SB	Scout Bomber	1934-
M	Marine Expeditionary	1922-1925	SN	Scout Trainer	1939-
N	Trainer	1922-	SO	Scout Observation	1934-
O	Observation	1922-	T	Torpedo	1922-1935
OS	Observation Scout	1935-	T	Transport	1927-1930
P	Patrol	1922-	TB	Torpedo Bomber	1935-

TABLE II

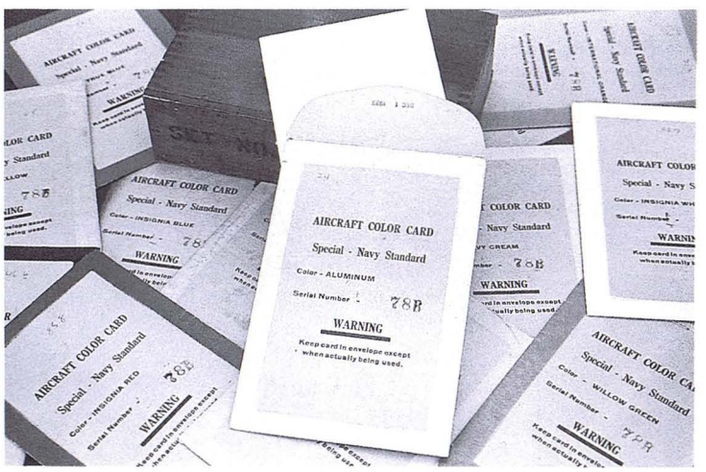
MANUFACTURER'S DESIGNATION

LETTERS	MANUFACTURER	YEARS	LETTERS	MANUFACTURER	YEARS
A	Aeromarine Plane and Motor Co.	1922-Only	K	Keystone	1927-1930
A	Atlantic Aircraft Corp. (American Fokker)	1927-1930	K	Kinner Airplace & Motor Corp.	1935-1936
A	Brewster Aeronautical Corp.	1935-	L	Bell Aircraft Corp.	1939-
A	General Aviation Corp. (ex Atlantic)	1930-1932	L	Grover Loening, Inc.	1932-1933
B	Beach Aircraft Co.	1937-	L	Loening Aeronautical Engineering Corp.	1922-1932
B	Boeing Aircraft Co.	1923-	M	Glenn L. Martin Co.	1922-
C	Curtiss Aeroplane & Motor Co.	1922-	N	Naval Aircraft Factory	1922-
D	Douglas Aircraft Corp.	1922-	O	Lockheed Aircraft Corp. (Plant B)	1931-
DH	De Havilland Aircraft Co., Ltd. (England)	1927-1931	P	Pitcairn Autogyro Co.	1931-1932
DW	Dayton-Wright Airplane Co.	1923-Only	Q	Fairchild Engine & Airplane Co.	1928-
E	Bellanca Aircraft Corp.	1931-1937	Q	Stinson Aircraft Corp.	1934-1936
E	G. Elias & Brothers	1922-1924	R	Ford Motor Co.	1927-1932
F	Grumman Aircraft Engineering Corp.	1931-	S	Sikorsky Aviation Corp.	1928-
G	Gallaudet Aircraft Corp.	1922-	S	Stearman Aircraft Co.	1934-
G	Great Lakes Aircraft Corp.	1929-1935	T	New Standard Aircraft Corp.	1930-1934
H	Hall-Aluminum Aircraft Corp. (into Consolidated)	1928-	T	The Northrop Corp. (later Douglas El Segundo)	1933-1937
H	Huff, Daland & Co. (became Keystone 1927)	1922-1927	U	Lewis & Vought; Chance Vought	1922-
H	Stearman-Hammond Aircraft Corp.	1937-1938	W	Waco Aircraft Corp.	1934-
J	Berliner-Joyce Aircraft Corp.	1929-1935	W	Wright Aeronautical Corp.	1922-1926
J	General Aviation Corp. (ex Atlantic)	1935-Only	X	Cox-Klemin Aircraft Corp.	1922-1924
J	North American Aviation (successor to General Aviation)	1937-	Y	Consolidated Aircraft Corp.	1926-
K	Fairchild Aircraft Corp.	1937-	Z	Pennsylvania Aircraft Syndicate	1933-1934

TABLE III

SPECIAL PURPOSE SUFFIX	
SUFFIX LETTER	MEANING
C	Modified for catapult
G	Guns added
H	Hispano Suiza engine
L	Liberty engine
SF	Single-seat fighter

NOTES:



Above: Such items as this arrangement of the original Navy Color Cards within the author's collection, make possible the matching of the color chips found on page 193 of this volume.

Fed Spec 595a	Munsell (595a Series)	Color Name
11136	5.6R 3.9/10.1	Insignia Red
12197	8.6R 5.0/12.8	International Orange
15044	6.0PB 2.6/1.6	Insignia Blue
15102	4.3PB 4.0/7.3	True Blue
16081	1.2BG 3.8/0.2	Engine Gray
16473	8.8BG 6.9/0.6	Aircraft Gray
13538	9.6YR 7.7/13.3	Orange Yellow
13594	2.2Y 8.0/5.2	Navy Cream
13655	2.8Y 8.2/12.8	Lemon Yellow
14087	6.0Y 3.0/0.9	Olive Drab
14187	8.3GY 5.0/7.1	Willow Green
17038	3.8Y 2.4/0.1	Gloss Black
17875	2.0BG 9.3/0.3	Insignia White
		Curtis English Khaki Gray
17178	5B 7.58/0.3	Aluminum
27040	1.5PB 1.75/0.4	Instrument Black

COLORS FOR U. S. NAVAL AIRCRAFT
1911 to 1939

Fed Spec TT-C-595	ANA Bulletin 166	Munsell (1) Navy Standard	3-1 Old	Munsell
1105	509	7.5R 3.23/11.7	(11105) 15 & 16	Old Glory Red 5.6R 3.50/11.95 (2)
1205	508	9.3R 4.87/12.5	5	
1510	502	5.8PB 1.16/3.9	(15045) 24	Old Glory Blue 7.85PB 2.25/6.0 (2)
1520	501	4.6PB 3.60/9.2		
1610	513	7.6B 3.14/0.5	13	
1645	512	0.4PB 6.82/0.9	12	
1310/1315	506	1.4Y 7.72/15.05	(13432) 4	
1745	507	2.7Y 7.59/5.0	1 & 2	
1320	505	4.4Y 8.17/13.5		
1405	504		8 & 22	2.5Y 3/4 (3)
1460	503	2.5GY 5.20/4.7	25	
1770/1775	515	2.0PB 0.68/0.6		
1755	511	4.5GY 9.34/0.5		
				3.4Y 5.77/4.5 (4)

1. Special Navy Standard Aircraft Color Card Set, Serial No. 78-B Dated December 1, 1933
2. The Color Association of the United States fabric sample
3. NASM DH-4 original fabric
4. Valspar Corporation Archives sample

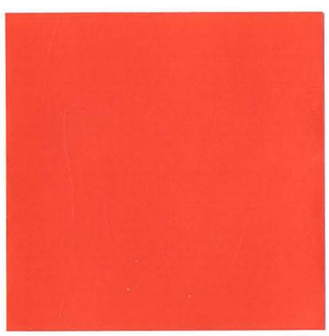
AIRCRAFT INDEX

PHOTOGRAPH CREDITS

Blackwell, H 85B
Curtiss Aircraft 109B
Dickson, Robert L 104B
Elmblade, Ralph 121B
Gill, Rolland 77, 98T, 110, 112MR, 130, 142B, 180T, 180B
Heaton, A.L. 127M
Hitchcock, Thomas H. 4, 6, 20, 21, 131B, 154
Larkins, William T 23, 28, 35B, 39, 69, 81B, 83, 84, 94T, 95MR, 97T, 98ML, 98MR, 98BL, 98BR, 99MR, 100T, 100BL, 102B, 103T, 103M, 127B, 129MR, 132M, 132B, 141M, 141B, 145T, 145MR, 152T, 165T, 165B, 181M, 182B, 183T
Lawson, Robert 117
Mitchell, John C. 177T
National Archives 17B, 21, 25, 27, 31B, 32T, 32B, 35T, 37T, 38T, 38B, 50T, 50B, 51T, 53T, 53B, 54T, 54BL, 54BR, 55T, 55B, 56ML, 56MR, 57T, 57M, 59, 60T, 61, 62, 63T, 63B, 64T, 65T, 66, 68, 74, 75, 78T, 78M, 78B, 85T, 86B, 87, 91T, 91BL, 93T, 93M, 93B, 94BL, 94BR, 95T, 95ML, 95B, 96T, 99T, 99ML, 100ML, 100MR, 100BR, 101T, 101M, 101BL, 101BR, 102T, 102ML, 102MR, 103B, 104T, 105T, 105B, 107, 109ML, 109MR, 111T, 111ML, 111B, 112ML, 113T, 113MR, 114B, 118, 119M, 119B, 122, 123, 124ML, 127T, 128B, 129T, 129ML, 134, 137, 138M, 138B, 139M, 139B, 142T, 142ML, 144T, 144ML, 144MR, 144B, 145ML, 147M, 147B, 148ML, 148MR, 149B, 150T, 150B, 151B, 152M, 152B, 153ML, 153MR, 153B, 163, 169T, 169B, 170M, 171M, 177ML, 177MR, 177B, 179, 181BL, 181BR, 182ML, 182MR, 183M, 183BR, 183BL, 184B
Naval Weapons Laboratory Dahlgren 89T
Pritchard, J.R. 121T, 149T
Scarborough, William E. 171B
Smithsonian Institution 15, 45, 48, 64B, 67, 73, 91BR, 125, 129B, 140, 145B, 146T, 146ML, 146MR, 146BL, 146BR, 173, 184T, 186T, 186B, 187
Swisher, William L. 159
US Marine Corps 16T, 20T, 56B, 57B, 63M, 65B, 81T, 81M, 88, 89ML, 89B, 90, 94M, 96M, 96B, 97M, 97B, 108, 111MR, 113M, 113ML, 115T, 115B, 116, 120, 121M, 126, 148T, 167, 185T, 185B
US Navy 3, 22T, 36M, 36B, 37B, 40, 47, 52T, 79, 80, 86T, 86M, 89MR, 99M, 109T, 112B, 114T, 131T, 131M, 133, 142MR, 148B, 149M, 153T, 161T, 161B, 164, 170B, 175, 181T, 182T
Williams, Gordon S. 42, 128T
Withers, J. 71

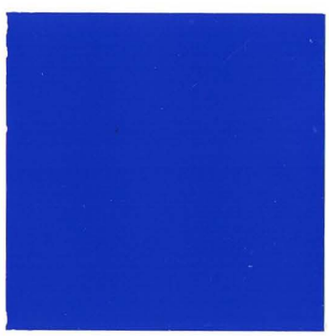
Fifteen of the color chips shown below are precise duplications of original U.S. Navy standards. Both hue and surface finish follow the original standards issued on June 27, 1932, by the Navy Yard, Naval Aircraft Factory, Philadelphia, Pennsylvania. The 16th chip, Curtiss English Khaki Gray, was duplicated from the original formula held in the archives of the Valentine Paint and Varnish Co. The application and general usage of all these colors is described in THE OFFICIAL MONOGRAM U.S. NAVY & MARINE CORPS AIRCRAFT COLOR GUIDE, VOLUME 1, 1911-1939. The application and general usage of many of the colors is also relevant to subsequent volumes in this series.

INSIGNIA RED

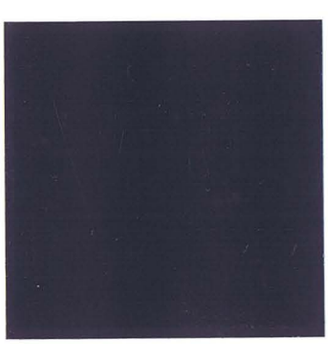


INTERNATIONAL ORANGE

INSIGNIA BLUE



TRUE BLUE

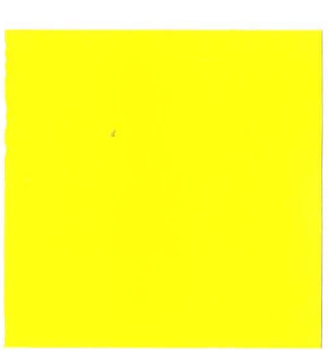


ENGINE GRAY

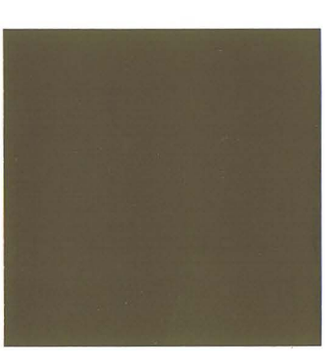
AIRCRAFT GRAY

ORANGE YELLOW

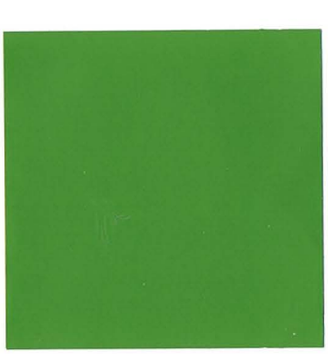
NAVY CREAM



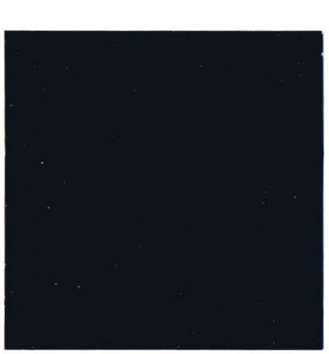
LEMON YELLOW



OLIVE DRAB

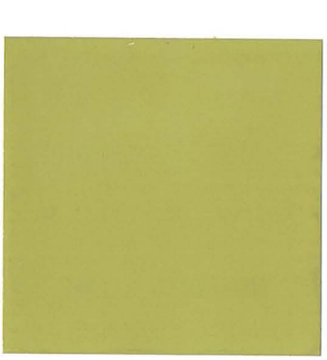


WILLOW GREEN

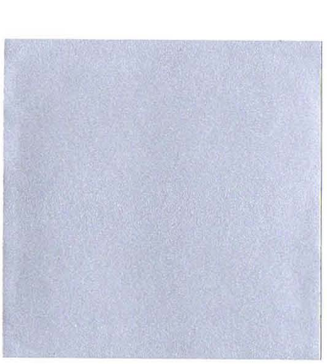


GLOSS BLACK

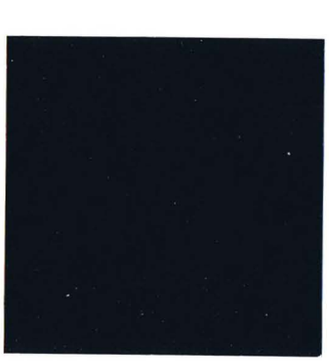
INSIGNIA WHITE



CURTISS ENGLISH KHAKI GRAY



ALUMINUM



INSTRUMENT BLACK

ISBN 0-914144-31-6