

THE FIGHTER PILOT MUST

SEE TO FIGHT --

NOT

FIGHT TO SEE

In helping the fighter pilot accomplish his two objectivescomplete his assigned mission and return to his base intactaircraft designers and builders have used great skill in increasing speed, range, rate of climb, maneuverability, fire power and armor of American military aircraft.

To utilize those superior mechanical advantages, the pilot must be able to use his own physical equipment -- his eyes -- to the fullest possible extent....He must see to fight, not fight to see.

When enemy aircraft strike from the rear, the pilot cannot and must not look back. He must look ahead but see to the rear -- and see his enemy clearly in the split second allowed him by supersonic speed.

Rear vision can mean the difference between success or quick death. Inadequate rear vision can rob the pilot of every advantage the aircraft designers and builders have given him.

TWELVE "MUSTS" FOR THE IDEAL AIRCRAFT

REAR VISION MIRROR

Much has been learned from the failure of various devices used for rear vision early in World War II. These range from complicated periscopic instruments to automobile and truck mirrors.

An analysis of their faults helps to evaluate the progress that has since been made. Periscopic devices were unsatisfactory. Because they operate on the fixed focus principle the pilot's eye had to be positioned in a relatively small fixed area. The reflected image was too small and obscure.

Automobile and truck mirrors proved useless. When made from silver or gold their reflection was too high; reflection from lead sulfide mirrors was too low (see curves on page 6). Chemically deposited metallic mirrors deteriorated rapidly in service. Their reflective films were deposited on the second (back) surface. Result -- they reflected two images, one from reflecting film, one from the front surface of the glass itself. Dual images confused pilots, caused eye strain.

Finally, experience of Air Force and Navy experts, combat and test pilots, aircraft engineers crystallized into twelve indispensable qualities for the ideal aircraft rearview mirror:

1. SINGLE IMAGE

The combat pilot must see but **one** image in his rear view mirror. Time lost trying to resolve primary and secondary images into a single image may prove fatal. All mirrors with reflecting coatings on the back surface reflect two images, one from each surface. Even if both surfaces are optically ground and polished parallel, two images are seen when viewed from sharp angles.

Reflective film of all Liberty Aircraft Mirrors is on the first (front) surface. Pilot sees but one image.

2. WIDE FIELD OF VIEW

Pilot safety and accomplishment of mission can be threatened by approach of enemy aircraft from any angle. Therefore, the ideal rear view mirror must provide a wide field of view, both horizontally and vertically. Mirrors made from bent glass to give wide view are not satisfactory. It is difficult to bend glass to a sufficiently uniform spherical radius. Result -- confusion due to distorted and blurred images.

Liberty mirrors are not bent or pressed. They give a wide field of view without distortion because front surfaces are optically ground and polished to required radius of curvature.

3. UNIFORM IMAGE

Image must be uniform within the mirror regardless of area in which it appears. If radius of curvature is not constant, approaching plane will appear larger in one part of mirror than in another part. This misleads pilot on distance and speed of approaching aircraft.

Liberty mirrors reflect uniform images because curvature is optically ground and polished to constant spherical radius.

4. CORRECT REFLECTIVITY

Ideal mirror must have reflectivity to give best possible vision under various light and weather conditions -dawn, dusk, noontime, cloud formations, clear atmosphere -- must allow for absorption value of different types of pilot's goggle lenses. Many tests, trials and wide usage show that 50% total reflection is ideal. Reflectivity of gold and silver is too high; lead sulfide is too low.

Reflective film of Liberty mirrors is chromium with reflectivity of 50% plus or minus 3% of total light (see curves on page6).

5. REFLECTION IN NATURAL COLORS

Because friendly and enemy aircraft are recognized in part by color markings it is necessary that the rear view mirror reflect image in normal color.

Liberty's chromium mirrors reflect all wave lengths in visible spectrum far more uniformly than do silver, gold or lead sulfide mirrors (see curves on page 6). Chromium is bonded to special black glass which absorbs light that penetrates reflective film. Result--Liberty mirrors give images with no visible color change.

6. DURABILITY

Ideal rear view mirror should be efficient for lifetime of aircraft. It must not be adversely affected by rapid temperature changes, salt air, condensation or actual wetting. Metallic mirror films made by chemical deposition deteriorate rapidly under these conditions.

Liberty mirrors are not made chemically. Chromium is applied to the black glass by thermal evaporation in a high vacuum. This process bonds chromium firmly to front surface of glass. Liberty mirrors are not affected by many hours of salt spray and wide temperature changes.

Liberty mirrors fully meet latest Air Force and Navy specifications as follows:

Army Air Force Specification No. 40956 for "Mirror, Rear View, Type A-1" Navy Aeronautical Specification M-608 for "Mirror-Rear Vision"

Several hundred thousand Liberty Aircraft Mirrors have served or are serving in all parts of the world. To our knowledge not one has failed in the field.

7. SHATTER RESISTANCE

Ideal rear view mirror should resist shattering on severe impact.

Liberty Aircraft Mirrors are designed to resist shattering. To roughened back surface of black glass is cemented a special, strong acetate fibre tape. If mirror should be broken by impact, glass particles tend to adhere to the acetate fibre tape, affording more protection against flying glass fragments.

8. UNIFORMITY BETWEEN DEVICES

When pilot sees image of approaching aircraft in rear view mirror he must judge its distance accurately and quickly. The apparent size of image affects his judgment. If he changes to another plane equipped with an identical mirror, image should be unchanged. Therefore, rear vision devices must be **uniform one** with another.

Liberty Aircraft Mirrors of same part number are all carefully fabricated to same size and optically ground and polished to same radius of curvature. Result --Liberty mirrors give uniformity of images between devices.

9. SIMPLICITY

Unless sealed and provided with desiccators, enclosed optical systems are subject to becoming nonfunctional due to condensation and dust particles. From standpoint of maintenance and use, the more simple, the better.

Liberty Aircraft Mirrors are the simplest possible device to use and maintain.

10. LIGHT WEIGHT

Like everything else that goes into a fighter plane the rear vision device must be as light in weight as possible.

Liberty mirrors are designed for low weight. They weigh approximately 2 to 8 ounces depending on the part number used.

11. APPROPRIATE SIZE AND SHAPE

Size and shape should be such as to give maximum field of view to the rear without blocking forward vision.

Liberty mirrors are made in wide variety of sizes and shapes to meet visual conditions of every type of fighter aircraft.

12. ADJUSTABILITY AND FREEDOM FROM VIBRATION

Usually vertical adjustment only is needed. Freedom from vibration within device is essential.

All Liberty mirrors have convenient vertical adjustment. Certain part numbers adjust in all directions. All types are free from vibration within the assembly.

PART NO. 619-NA-50 REAR VIEW MIRROR FOR AIRCRAFT



Front of Mirror



Back of mirror showing "U" type mounting bracket

PART NO. 619-NA-50

(Illustrated on facing page)

1½ to 1

Field of View:

Horizontal 535 feet, Vertical 180 feet

Demagnification Of Image:

7" wide x $2\frac{1}{2}$ " high

Case:

Size:

Metal enclosing case

Mounting:

Case fitted with special "U" type mounting bracket to provide vertical adjustment

Weight:

Approximately 8 ounces

Packaging:

Individually packed in a specially designed carton to insure delivery in good order

Liberty Drawing Number for Part No. 619-NA-50 is P-1091. Part No. 619-NA-50 is also made with a non-magnetic case, being known as Part No. 619-NA-50-NM. Weight of Part No. 619-NA-50-NM is approximately 5 ounces.

Liberty Drawing Number for Part No. 619-NA-50-NM is P-1088.

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