DIVES

In all high speed aircraft, particularly the P-38, you encounter a serious acceleration problem.

Previously you have flown airplanes that had a comparatively low terminal velocity and did not accelerate above a certain speed.

This is our problem: In high speed dives, the lack of resistance, due to the clean lines of the airplane, causes a tremendous acceleration if gravity is allowed to exert its full influence. As you approach the critical airspeed, the airplane becomes noseheavy and starts to buffet as if you were about to stall. Therefore, it is very foolhardy to point the P-38 straight down for any length of time. Adding to this problem of acceleration is the problem of time required and space necessary to pull out of the dive and regain straight and level flight.

In your flying experience you have become aware of the futility of trying to recover from a stall by holding the stick back. The same situation exists here. In a high speed dive, only a few G's cause the airplane to buffet.

When it is necessary to point down, reduce power and enter the dive at a low airspeed.

CAUTION

Manifold pressure must be kept at or above 20" Hg during extended shallow dives in order to prevent the engines from misfiring when you advance the throttles after the pullout from the dive.

Normal Dive Recovery

If you have allowed yourself to build up excessive airspeed in a dive, follow this recommended procedure for recovery:

1. Pull back the throttles (if you haven't already done so).
2. Apply sufficient back pressure until you feel a slight nibble in the wheel. Any further pressure causes the airplane to buffet and defeats your purpose of trying to pull out.
3. Use only a few degrees of elevator trim tab to help you.

Caution: **USE THE ELEVATOR TAB WITH EXTREME CARE.**

TOO MUCH TRIM CAUSES A TAIL-HEAVY CONDITION.

Relationship of Airspeed and Altitude

The maximum safe airspeeds for the P-38 at different altitudes are given in the accompanying chart. Notice in the chart that the airspeeds are given in terms of IAS (indicated airspeed) and TAS (true airspeed). Notice also how greatly these two figures differ. At 30,000 feet, for example, 300 mph IAS means you are actually traveling 480 mph TAS. A good rule of thumb to remember in making this airspeed correction is:

Increase IAS 2% per 1000 feet. This is the way it works out in the above example: 2% for each 1000 feet in 30,000 feet is 60%; 60% of 300 IAS is 180 mph; add 300 and 180 mph and you have 480 mph TAS.

The red line on the airspeed indicator of the P-38 is placed at 420 mph. That does not mean 420 mph IAS at any altitude. That is simply the speed at which the load on the wings and other structural parts reaches the maximum they are designed to carry.

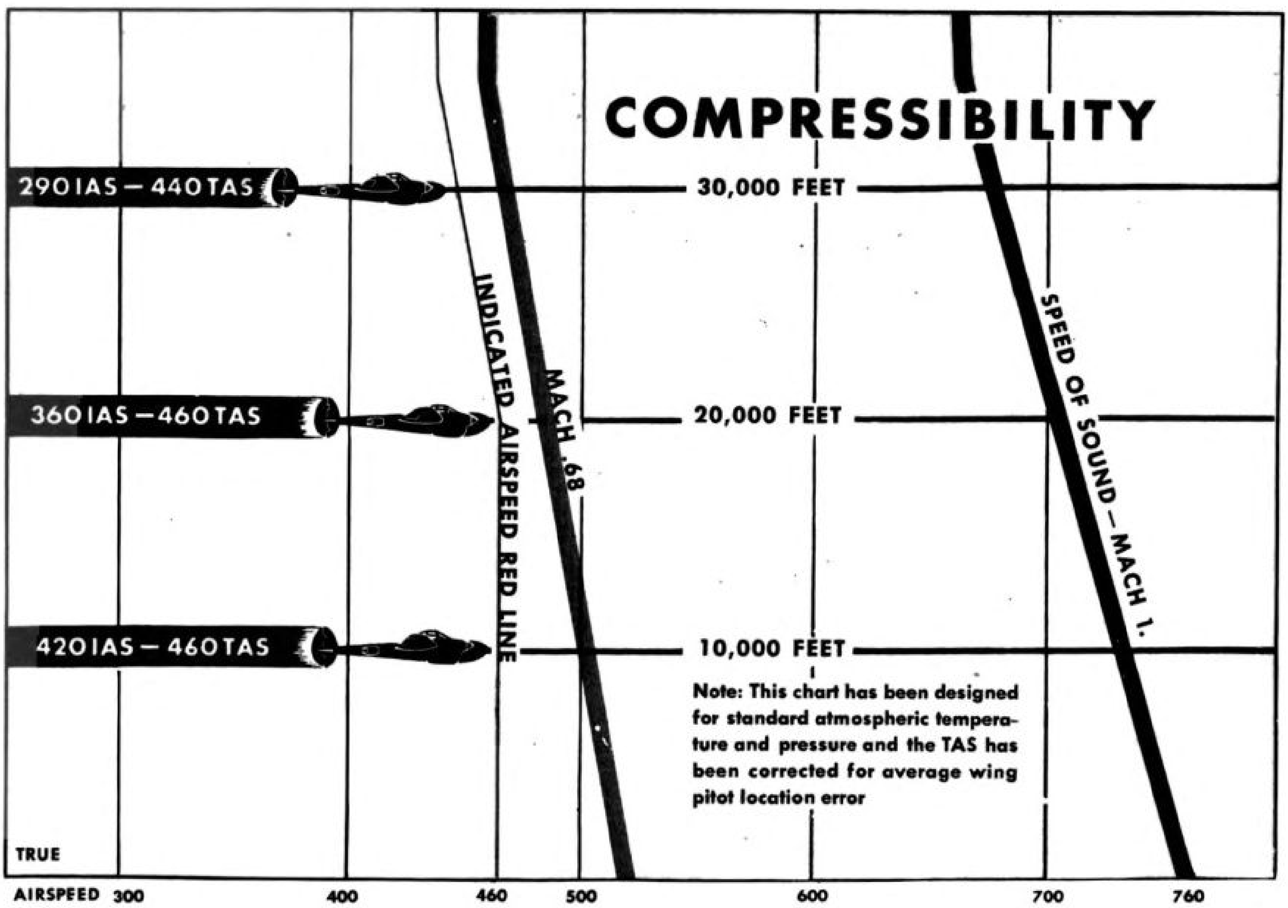
Notice in the chart that above 10,000 feet the indicated red line is less than 420 mph IAS and continues to decrease with an increase of altitude. At 30,000 feet, your safe maximum IAS is 290 mph.

In other words, the red line is not a fixed figure, but a **variable** figure—variable with altitude. The higher you go, the lower the maximum allowable IAS.

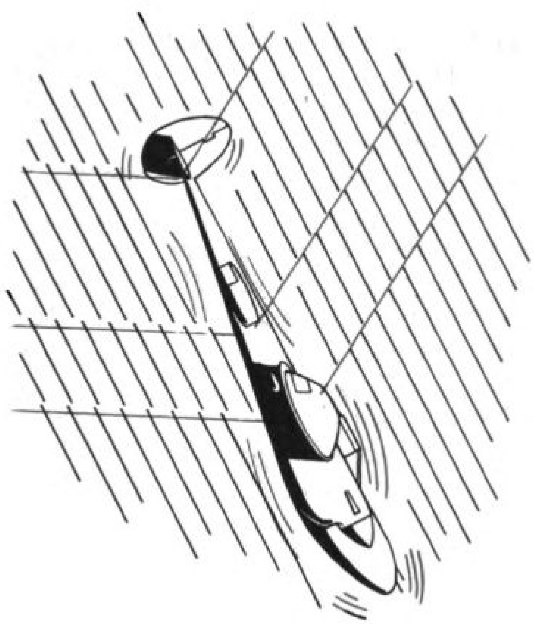
Many pilots fail to realize this great difference between IAS and TAS at high altitudes. Don't be fooled. Study these figures carefully. **Never exceed these airspeeds.**

In the case of high speed fighter planes, a new factor enters the picture which makes diving unsafe at high altitudes long before the usual red line is reached. This new factor is compressibility. It is the reason for the variable red-line speed as given in the chart.

Another rule of thumb in correcting IAS to TAS is: Add 5 mph per 1000 feet to IAS to get TAS.



COMPRESSIBILITY



Since extremely high airplane speeds have been developed only in recent years, the phenomenon of compressibility is still pretty much of a mystery. Scientists and engineers know comparatively little about it and dive tests are still being run to prove or disprove the many theories about it. Here we attempt to give you a pilot's explanation about compressibility in a P-38; one that will help you understand this phenomenon and impress upon you the importance of avoiding it.

About all that is known for certain is this. When an airplane approaches the speed of sound, it loses its efficiency. Compression waves or shock waves develop on the wings and other surfaces of the airplane.

Although there is a great deal of disagreement as to **what** happens when compressibility is reached, and **why**, there is no question as to the **result**, so far as the pilot is concerned.

The lift characteristics of the airplane are greatly reduced and the stability, control, and trim are affected.

Each type high speed fighter plane has its own individual compressibility characteristics. In your P-38, the first effect as you approach compressibility is that the airplane becomes noseheavy. The control wheel moves forward and becomes increasingly difficult to pull back. At this stage, an uncontrollable buffeting and vibrating develops. If the speed of the airplane isn't checked and control regained, it is possible that the terrific vibrations of the shock waves may cause structural failure, or the airplane may crash while still in the compressibility dive.

Relationship of Compressibility to the Speed of Sound

Under standard temperature and atmospheric conditions, the speed of sound at sea level is 760 mph. An airplane goes into compressibility before actually reaching the speed of sound. This speed varies in different airplanes depending upon the individual design of the airplane.

The speed at which an airplane enters compressibility, in ratio to the speed of sound, is technically known as its **Mach number** (pronounced Mock and named after the man who did considerable research in this field).

One of the most important things to remember about compressibility is that the speed of sound varies with altitude. Note these approximate figures:

At sea level, sound travels 760 mph.

At 35,000 feet, sound travels 670 mph.

35,000 feet → *670 mph*

Sea Level ——→ *760 mph*

THE SPEED OF SOUND DECREASES WITH AN INCREASE OF ALTITUDE

Therefore, the higher you go, the sooner you reach the speed of sound, and the lower your safe IAS will be.

In a high speed dive from altitude, you get into compressibility before you reach the 420 mph IAS red line on the airspeed indicator.

COMPRESSIBILITY DIVE

It is possible to come out of compressibility if you don't go too far. This all depends on the circumstances of the dive; the angle, starting altitude, airspeed, and the point at which compressibility was reached.

Then there is this to consider; while in compressibility you have no control over the airplane. Also it is possible to aggravate your situation and make it a lot worse. All that you can do is pull back the throttles (if they aren't already back), hold the stick as steady as possible with some back pressure, and then ride it through until you decelerate enough, at a lower altitude, to reduce your speed below the red line speed given in the chart. This usually means an uncontrolled dive of between 10,000 feet and 15,000 feet, depending upon circumstances.

The exact altitude you drop and the length of time you are in compressibility depends to a great extent upon the angle of dive in which you encountered compressibility.

Only after you have lost enough speed and altitude will you come out of compressibility and regain control of your airplane. At that point, with the airplane again under control, you can **begin** to come out of your dive.

Note that last sentence carefully. You can then **begin** to come out of your dive—that's after losing 10,000 feet to 15,000 feet. If at that point you still have sufficient altitude for a controlled dive recovery, you're okay. If you don't . . . ?