

SHOCK CORDS

Know when to change them

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Early on in the history of aviation it became clear that a landing gear with some “give” or shock absorption capabilities was desirable. The early Bleriot and other pioneer aircraft used thin tires set on wire-spoked wheels, and while they were great for clearing the humps and bumps of the local pasture, they didn’t soak up the bumps too well, so a second level of shock absorption was added—rubber shock cording.

For decades, woven fabric-covered shock cord (often called bungee cord) was the most common of all shock absorbers. In fact, it was so ubiquitous, used on so many different civilian and military aircraft, that it was even the subject of a mili-

A serviceable cord should have a smooth outer covering, with no bumps or disruptions to the woven cover. This one looks good, but age and repeated landing cycles have taken their toll.



No, it's not some new exotic pasta dish, or an undiscovered sea creature. The outer rubber strands show signs of environmental aging, as ozone and airborne contaminants (including engine exhaust chemicals) attack the rubber. You can see how the inner strands are less affected. Again, this shock cord didn't appear to be excessively worn when viewed from the outside; the damage was only obvious once the covering was cut away.





This same cord showed some signs of abrasion damage to the woven covering where the shock cord was in constant contact with the landing gear structure.



This cord shows obvious signs of damage to the outer covering and to the rubber strands inside. The bumps and breaks in the covering indicate many broken strands of rubber inside the shock cord. This cord must be replaced.



Most normal humans would not be able to pull on a 3/4-inch shock cord and be able to stretch it, but this cord had deteriorated to such an extent that it was possible for me to do so!

tary specification, MIL-C-5651D. It's still commonly used in the military and for civilian use. Double-covered shock cord is Type I; shock rings with a double-braided cover are Type II.

These cords are made with a core of rubber threads and a layer of woven cotton cording to protect the easily damaged rubber. Shock cord used in aviation applications has a pair of woven outer layers. The actual diameter of the rubber strip bundle is not the only factor that controls how much force is needed to stretch a cord. Made of heavy cotton thread, the woven cover serves another not-so-obvious function—it controls the level of force required to stretch the cord (the cord's "modulus"). The tighter the cover is woven over the rubber strip, the greater the force required to elongate the cord. Manufacturers can also vary the ratio of rubber strip and the cover yarn to control the modulus of the cord. That's why it's important to keep the cover intact; it not only protects the rubber strip from premature aging, but also is required to maintain the shock cord's strength.

The rubber itself is high-grade rubber strip, either natural latex rubber or synthetic rubber, similar to that used when golf balls were made with a wound rubber strip core, only wider. (There are no longer any manufacturers of wound rubber core golf balls in the United States!) While it exhibits great elasticity and durability, the rubber is susceptible to environmental damage. When exposed to air, ozone and other pollutants will quickly deteriorate it. So will exposure to engine oil and other chemicals, such as

MIL C-5651D
Shock Cord Dating System
The color code repeats on a five-year cycle.
First color stripe:
1997—Red
1998—Blue
1999—Yellow
2000—Black
2001—Green
2002—Red
2003—Blue
2004—Yellow
2005—Black
2006—Green
2007—Red
The second stripe indicates the quarter of manufacture:
January-March—Red
April-June—Blue
July-September—Green
October-December—Yellow
Some manufacturers add a third color stripe not required by MIL-C-5651D.



Some aircraft use multiple shock cords. This is the upper end of the landing gear of a Fokker Super Universal. A similar herringbone arrangement was used on the Ryan NYP, Spirit of St. Louis.

exhaust residue. Keeping the outer cover clean goes a long way toward keeping the rubber from deteriorating. That's why on a Cub or other similar landing gear systems, leather or vinyl "boots" are used to cover the shock cords.

If you've owned an airplane that is equipped with shock cords as part of the landing gear, you know how important it is to check the cords, to avoid a letdown feeling when one of the cords lets go with a sharp report. But what do you look for? How do you know it's time for a replacement? Do you use the calendar, the appearance of the cord, or the cord's date of manufacture?

The answer is all three! While a cord may look perfectly fine, if it's been sitting unprotected on the shelf in a hot hangar for years, odds are the rubber strip inside has deteriorated to such an extent that a few cycles of stretching will create a lumpy, useless mess. You've probably seen what can happen to a set of shock cords when an airplane has been left sitting out in the open for years. It doesn't seem to take very long for the landing gear to begin to splay outwards, and before you know it, the gear is near collapse.

Do your best to obtain fresh shock cords when it comes time to change out a cord. Each outer layer of the woven cord made to the exacting standards required for the mil spec will contain a pair (or sometimes a trio) of colored treads, which indicate the date of manufacture. The mil spec defines the meaning of the colored yarn. See the chart included in this article for details. The military requires a shock cord or ring be packaged and delivered no later than six months after manufacture; if stored properly, the cord can last for many years.

During an annual or other periodic inspection, check the shock cord first by standing back and looking at the airplane from the nose. Does it sit high up on its landing gear? Or have you noticed that the wing seems to be a bit lower than it used to be (sometimes evidenced by clonking your forehead when you go to enter the cockpit)? Is the inner portion of each of the tires wearing excessively?

When you rock the wings with your hands while on the ground, does the

landing gear seem excessively soft?

Even when the cords have been well protected, the interior of the shock cords will deteriorate over time and will need replacement. Evidence of that wear is most often seen in the form of surface irregularities in the covering.

Bumps, tears, or other disruptions in the smooth woven cover tell you something's amiss under that cotton wrap. Is there discoloration on the cover, indicating possible exposure to chemicals or oil, or is it dirt and grime from a lifetime of living on the belly of an airplane?

Take a look at the photos in this article. These shock cords had been in service for 14 years on an Aeronca Sedan. A pair of rings is used on each side, for a total of four shock cord rings. I'd noticed that the gear seemed rather soft when the wings were rocked up and down, and the gear seemed splayed out more than normal. Also knowing that the age of the cords was at least 14 years, I made plans to change the cords during the annual inspection. While one cord looked pretty good, the other, manufactured four years earlier (evidenced by different color-code cords in the woven covering) had obvious defects.

Once the decision has been made to replace the cords, caution must be exercised to prevent injury. These shock cords can recoil with tremendous force once stretched.

For the Piper Cub and its brethren, a few enterprising companies have made special tools for stretching and installing the cords. In other cases, a special tool is not needed, but do avoid the use of sharp or pointed tools to lever or pry the shock rings in place. Disrupting the covering not only exposes the rubber to the environment, but also can cause a change in the cord's modulus in a small area, weakening the cord and leading to premature failure.

Once the cords have been replaced, go out and enjoy that "new landing gear feeling." But be careful—you'll be amazed at how stiff the landing gear has become, and you may need to adjust your landing technique. But even if you "sproing" a few of those first landings, you'll have the peace of mind knowing your bungee cords are up to soaking up anything you can throw at them! 