

Europa Throttle Box Cable Installation for Trouble Free Operation

By Bud Yerly
Custom Flight Creations, Inc.

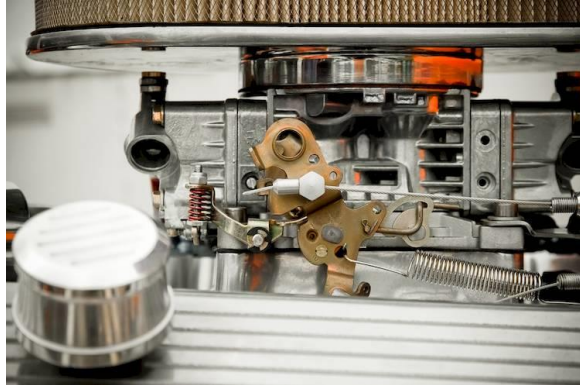
I have heard many builders bemoaning the Europa throttle box cables were completely crap. Not to hurt anyone's feelings but that is crap. It is all about the installation and attention to detail. I have installed many sets of throttle cables and I did find one cable out of some twenty sets that was binding, and that was fixed easily. Now to look why so many owners have difficulty.



Typical new Europa throttle box.

The first topic to analyze is the Rotax cable system itself. Motorcycles for a century have used cables to control the throttle. As have most of the cars I have owned since the 70s. So, if cables work in industry with simple non solid, braided cables, it can work in your Europa as well. Rotax does not call for a specific method of cable installation or operation. Our Austrian friends believe it is common knowledge on how to build a throttle cable operating system. The Bing carbs for the Rotax are built with a light duty spring to pull the throttles forward in the event of a throttle mechanism failure, which is "Aircraft Standard" as well as a common industry practice. So, a cockpit throttle system must also have built in friction to prevent the throttles from creeping forward due to the carb throttle spring.

Back in 2001, Europa Service Bulletin 7 required a check of the throttle cables for kinking. This was common as many failed to realize how a cable system was supposed to work. As a result, I saw screen door hinges added to the throttle arm on each carb to pull the throttle forward extra hard to make up for dragging cables due to kinks and tight bends. Folks who shortened their cables and failed to finish the cable end with a proper fitting or swaged end also had problems. Follow along and I'll attempt to describe the proper way to build a cable system, which doesn't require buying new solid cables, sheathed Teflon drive rods or other fixes requiring experimenting time and money.



Typical Holley Carburetor throttle cable that traverses 90 degrees of rotation in a hotrod.

So what is the problem? Mostly it is attention to subtle details in a cable installation. It is not difficult or time consuming to correct imprecise workmanship in the fabrication of the Europa throttle box. In the past the builder had to manufacture his own throttle box over foam, today Europa supplies a prebuilt throttle box which is very nicely done. However, the first step in any throttle installation is the firmness and accuracy of the alignment of the cables coming into the throttle box and the alignment of the elements. The cables must be mounted centered on the throttle arm, and dead parallel both in the horizontal and vertical. Just as with motor cycles, boats and cars, the Europa cables too must be installed with the cable sheath firmly and precisely aligned to the cockpit throttle arm mechanism to minimize cable bending or binding. If your throttle cables are bending, jamming, or dragging, just pull out the cable from the carb throttle and remove the sheaths and throttle box out of the aircraft. Lay the entire throttle box on the bench with the cable housings straight and get it aligned right.



Photo of a typically built throttle box.

Note the cable on the left of the throttle box above. The owner used exactly the parts called for and was careful to get his throttle cable sheaths aligned and spaced properly, however it is clear the throttle arm is aligned in the box, but the cable on the left is slightly out of alignment with the sheath and in need of a bit more spacing. The 10L washer on that side should be changed out for a nominal washer (1/16 vs 1/32 inch thickness) to align the cable perfectly. The cable sheaths should be aligned exactly with the cable attachment on the arm, however, the AN 4 washers used under the cable sheath nuts are actually too large by about 1mm or 1/16 inch. That small amount of misalignment caused by the washers must be corrected by grinding the washer edge just a bit to get precise alignment of the cable sheaths. Also, if the box was not made with the front face of the throttle box dead flat to accept the cable sheaths, with nuts and washers tight, there will be other alignment issues. Splayed sheaths or other alignment issues that prevent the sheaths from being square and parallel to the throttle arm, require remove of the cables from the sheaths and remove the cable sheaths from the throttle box. If your particular cable box is poorly aligned or rounded on the front or just plain wonky, pull the cables and fabricate a metal plate of .032 to .060 aluminum plate with precisely drilled holes and Redux it on to the front of the throttle box precisely square and vertical. A couple of layers of glass would be nice over the Reduxed plate to allow it to be secure forever. Keep in mind, the elevation of the cables must also be precise. Most build their box with the throttle at full forward, the cables are even with the sheath mounting and when the throttle is pulled aft the cables bend upward, and from idle to full. That bending will bind the cable slightly and eventually cause one or both cables to wear, jamb and flex in the cable box.

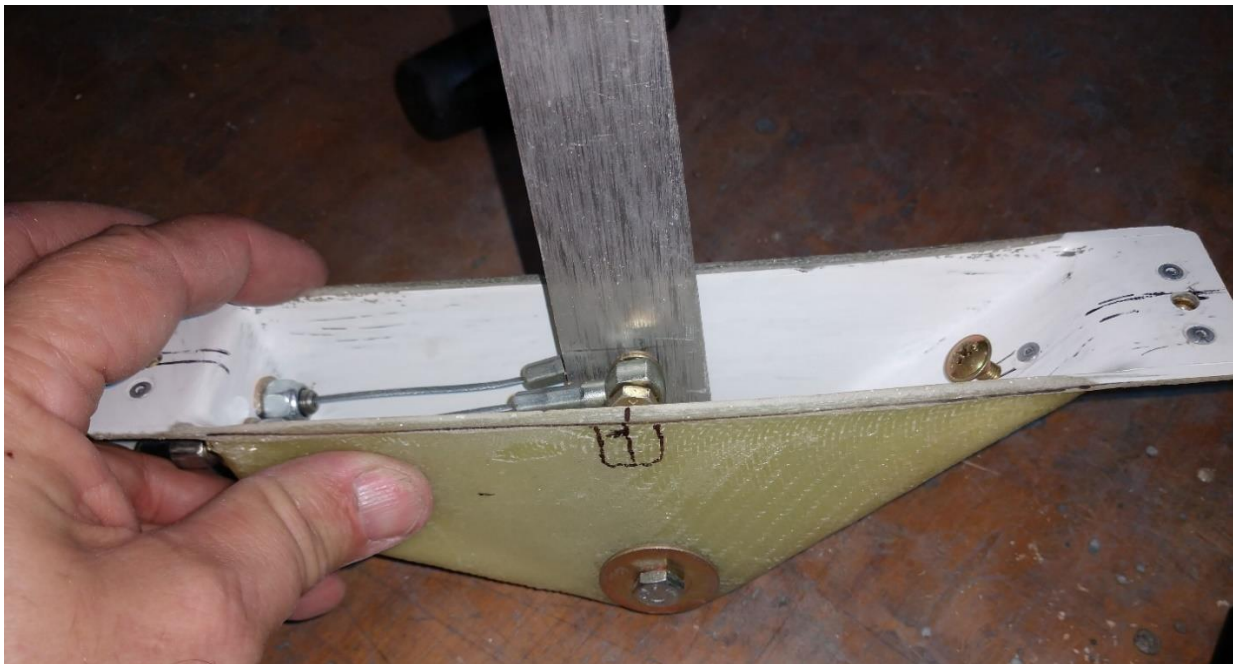


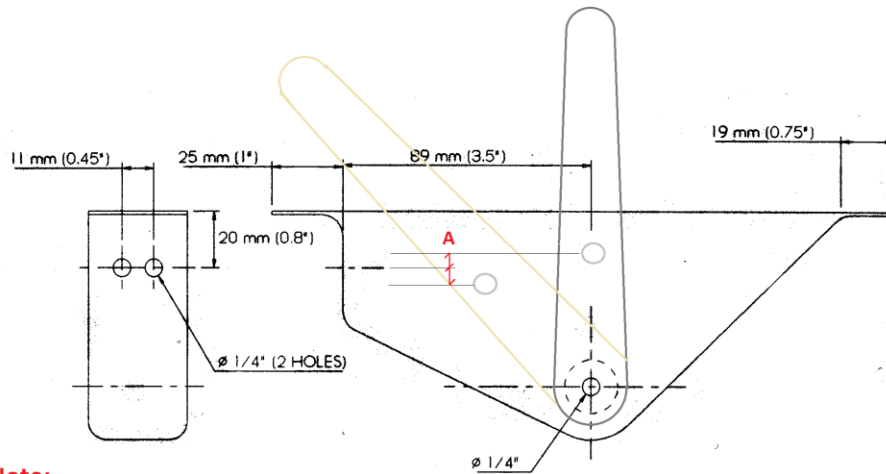
Photo of Bench cables at mid throttle. Note in the photo above the box is marked for cutting to get access to the bolt heads and nuts rather than pulling the handle out to repair.

I prefer to set the cable sheath elevation and alignment as follows:

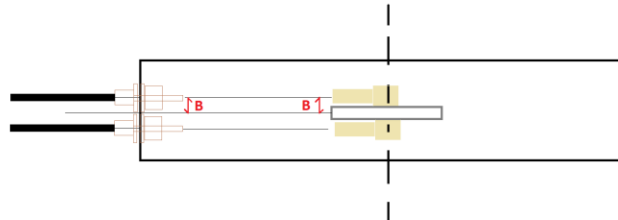
As the cockpit throttle arm moves in an arc, the throttle arm at its vertical position the cable pivot should be higher than the cable sheath end, and when the throttle arm is at idle and at full, it should be slightly lower. The cable sheath ends should split that difference in elevation to allow for the small amount of flex. The cable ends should be very free to rotate to allow this flex to happen without fail. To

measure the distance the cable moves up and down, install your throttle handle loosely and pull it full aft, make a mark through the hole, then full forward, and at ½ throttle or throttle arm fully vertical mark it again. Make a straight line from the idle and full marks and a horizontal line to that one for the ½ throttle mark. See the drawing below.

Throttle Cable Detail of Installation for Precise Nonbinding Operation



Note:
Distance A and B must be parallel !



Once assembled and aligned, I manipulate the throttle from idle to full on the bench and the cables will move without binding with nothing pulling on the cables, only the throttle movement alone. If binding is evident in the cable, investigate. I have found the cable sheath ferrule end can smash the cable and cause a tight entrance or exit hole. Remove the cable and using a properly sized bit (one must have a numbered bit set to build and aircraft) and relieve any tightness or binding in the nylon sheath.

Next is the cable sheath running etiquette. Cables are designed to be long and loopy. The ends of the cables must be well aligned with the arm connections as described and attached rigidly. Tight bends, as well as numerous bends will increase cable drag. In a properly run cable system when the cable is moved the sheath will move to flex with the cable movement. Also important is ensuring the cable end on both the throttle box and carb are dead straight for as long a distance as is practical. I do not cut the cables. It is not worth the time.



Photo of 12AY FWF with the cable end to carb throttle arm attachment. Note that the cables are as straight as practical prior to attachment at their fixation points. The choke cables loop over the opposite carb to the pull. Rotax would prefer the cable support tubes be running aft as the cable and choke arm bending are then in the same plane. In practice this is not necessary.

Running the cables to be free of kinks or binding inducing bends is a bit of a zen art. We know the cables are a bit long, but it was done for a reason. The length is long to assure large radius turns snaking through the firewall and for smooth alignment to the carbs. I run the cable straight out of the cockpit throttle box directly to the firewall, then make a gentle loop (over the gear frame of the trigear nose gear or through the metal firewall of the mono) then in a smooth curve down toward the water pump area near the opposite 1 inch coolant hose, then continue a smooth loop up to the appropriate carb side and aft to near the engine top mount and continue the circle to one carb. Then run the other cable as a mirror image. Do not fasten the cables with wire ties or Adel clamps. Let them be a sloppy loop. Keep the cable as straight as possible where it enters the carb ferrule support.

In a Mono, many have the throttle cables and fuel lines exiting the same hole through the metal firewall. I do the same. I make a hole near the center top of the metal firewall for the fuel lines, throttle and choke penetration. (To protect the fuel and throttle cables I make an edge shield to protect the lines from $\frac{1}{4}$ to $\frac{5}{16}$ fuel line split in half to fit over the deburred metal or window U channel seal and affix with high temp silicone sealant. Inside the wheel well, the fuel and throttle / choke lines should not be zip tied together tightly or bound tightly via an Adel clamp.) Once through the mono firewall, I run the port throttle cable in a smooth circle to right and around back to the carb. I run the starboard cable in

an opposite circle to the left to the carb. I check for operation without the cable hooked to the carb throttle arm and it nearly always works smoothly.

Once through the firewall and to the carbs, I avoid pulling the cables tightly to the firewall face or anything else rigid and secured with a tight fitting fastener such as a #3 Adel. In some installations, a loop can be conveniently mounted to the firewall or to each other and if the loop is setting against the firewall, that would be a convenient fixation point if necessary to allow clear access to other engine or other firewall systems. The XS firewall forward has more room than the Classic for long loopy carb and choke lines. Space is at a premium in the Classic.



Photo of a Classic throttle cable installation showing how it was secured at a convenient nonbinding point. The cables of the throttle are very neat, but the choke cables were cut by the owner and installed to the instrument panel face and were run separately. Alignment to the choke tubes was experimented with and the loops were experimented with until operation was adequate. Lesson learned, don't cut the cables. Leave them long and loopy.

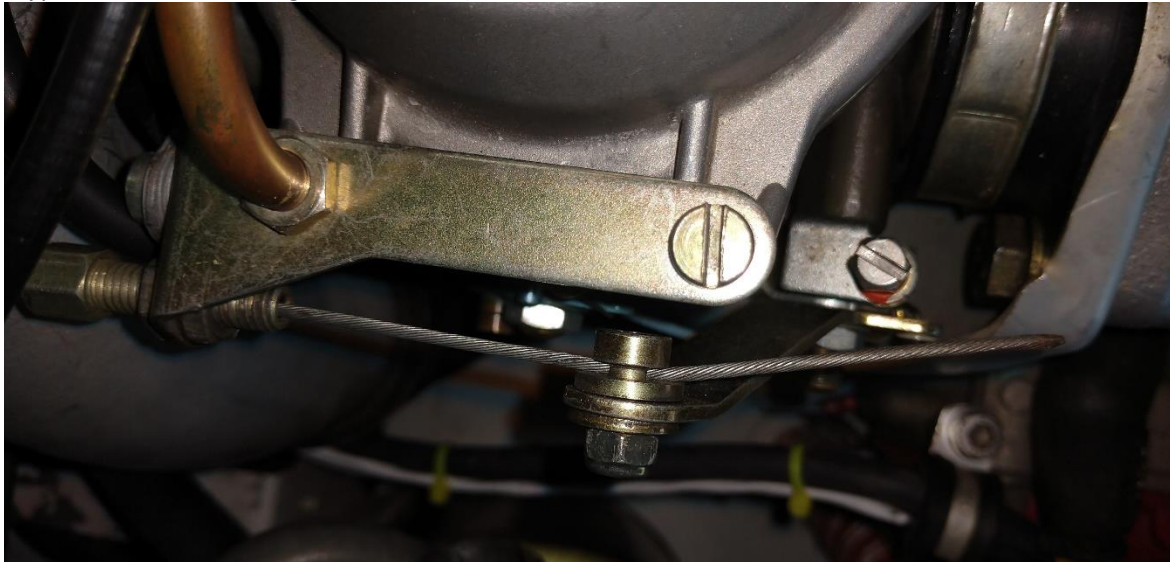
Note in the photo above, the larger Adel type clamps holding this Classic throttle cable loop are oversized to be loose and allow the cables to slide back and forth in operation. Without this loose attachment the cables did bind. This took a couple of tries to get the cable bends just right as the attachment of the cables to the firewall was necessary for the Classic cold air plenum and accessory clearance issues specific to the Classic aircraft. Again, do not apply any extra force on the cable sheath to secure it such as a tight zip tie. Only light holding is allowable. In all my XS trigear aircraft, I do not secure the throttle cables to anything.

Once installed, the cockpit throttle should only require the slightest effort to operate the cable. Once the throttle box is properly assembled and the cables are run smoothly, attach the cables to the carb throttle arms.

Caution: many installations are ruined as the cables are mashed and frayed by the installer when attaching the cable to the carb throttle arms.

The raw cable ends on the stainless cables from nearly all manufacturers have a tinned or leaded tips. This leaded end will keep for years unless abused and allow the cable to slide into its securing fixture without fraying. It is not necessary to crimp the cable end with some sort of cable stop. If your cable ends are long, simply bend them by hand to clear your carb heat, oil or fuel lines. Cable security is the biggest issue on the carbs. Many installers ruin their cables by overtightening the throttle cable attachment.

Here is the best way to install the cable to the Bing carb throttle arm from my friends at Lockwood Aviation. *“With the #10 nuts on the throttle cable support bracket slightly loose for setting, loosen the Allen and nut on the throttle arm (a 4mm Allen and 8 mm wrench) to allow the hole in the fitting to be completely open for cable insertion. Do not remove the nut and pivot from the throttle arm. Simply bend the cable upward sufficiently to thread the cable tip carefully into the hole. (See the photo below of a typical throttle cable tightened down.)*



*Once in the hole, set the cockpit throttle to full forward, and pull through the cables one at a time forward with your fingers tight and just turn the nut snug holding the cable alone. **Then using the Allen wrench tighten the cable until you observe the cable just begin to bend.** Repeat on the other side. Snug up the nuts on the throttle cable sheath supports with a 10mm wrench just snug. No lock washer is necessary, but some have used Nyloc type nuts although Loctite is just as effective. If the carbs are well tuned (which they are from the factory) pull the cockpit throttle to idle until resistance is felt. Check that each carb throttle lever is at the idle stop or very near it. Set the cockpit idle stop for now to prevent the stops on the throttle from bending. Under no circumstances use the throttle stop on the carb as your final cockpit throttle stop. The cockpit throttle must have a stop that sets the idle RPM, not the carb stop. The engine will start and run in this condition and is ready for a carb balance and final idle setting.”*

I have found this is the case on new engines and after a carb rebuild where the previous idle stops were not changed. After about 3 carb rebuilds over 500 hours, my cables are still smooth and easily enter and exit the cable set on the carb throttle arm.

On engines in service I carefully check the carb mechanical stops as often times the cockpit idle stop is not set (or even installed) and the carb stops are used as the idle stop. This is a guarantee to have a bent carb stop and poor balance at idle. Consult with your Rotax mechanic on the condition of your carb idle stops or replace them and do an initial mechanical stop setting per the Rotax maintenance manual.

Once the carbs are balanced pneumatically, set your idle stop in the cockpit at the throttle handle. I do not reset the cables. If the idle is say 1800 RPM and smooth, with the carb stops on each carb are in contact with the stop, I differ from Rotax manual for idle carb settings slightly. My preference on a clean aircraft like the Europa is to set the idle a bit lower than the 1800 RPM standard which is recommended using the carb throttle stop set screws. If all is stable on the carb stops at 1600 RPM I leave the stops alone. Then I advance the throttle in the cockpit to 1650-1800 RPM and set the cockpit throttle stop to achieve my idle.

Notes on my personal idle setting:

Although 1400 RPM is the minimum idle, that setting may be too low of an idle setting and the gearbox noticeably chatters, so I set it no lower than 1600 RPM to 1650 RPM to avoid gearbox chatter, achieve a smoother idle and in no case do I set the idle above 1800 RPM max ground static idle. During operations, a hot idle setting is preferred. With well synchronized carbs, and a mechanically sound engine, the current 912, 912S and 914 can achieve 1600 RPM and a smooth idle with no gearbox chatter or funny noises from the airframe and engine. (Early 2000-2004 912ULS engines had problems at the low end idle with chatter and rough idle (especially cold), so pay attention to the smoothness of the idle and adjust the idle slightly higher as needed on a hot idle.) To continue, after a carb rebuild, if the carbs are on their stops at 1800 RPM hot idle with the crossover tube connected after a pneumatic balance, I personally back the carb idle stop screw back 1/8-1/4 turn on each carb then back the cockpit idle stop off a bit to allow the cables to tighten up and evenly reduce the idle to my desired RPM. Recheck your idle is smooth by observing the ignition boxes (which are on rubber mounts) are smooth or nearly motionless. (The idle speed can be set by 1/4 turn increments on the carburetors back until a satisfactory idle is achieved normally without a pneumatic re-balance.) Finally, I set the cockpit idle stop to prevent bending the stop tabs on the carbs. If in winter and poor idle conditions are occurring, set the idle a bit higher by inserting a screw driver in the throttle slit and turning anti-clockwise a half turn for a smooth idle and then in summer, crank it back a turn. Cold idle is slighted by the Rotax manual. In your operations, after the engine starts, advance the throttle to achieve 2000-2500 RPM until the engine is warmed up (oil temperature above 100 F) then you should be able to sustain a smooth idle below 1800.

Note: In practice, starting can be more difficult if the idle is set above 1800 RPM or you have a course pitch prop setting at idle. If you have a very course pitch on your ground adjustable prop for high cruise RPM, your idle throttle stop may need to be higher due to the extra effort to swing the course prop to maintain a 1600-1800 idle RPM. This will require the carb throttle butterfly to be opened farther on the throttle idle stop as the course prop requires more power at idle. The choke fuel air flow will be hampered by the opened butterfly on start causing less air to be drawn through the enriching circuit leading to too lean of a starting mixture. This is common with the ground adjustable pitched props set course or some constant speed props such as the Woodcomp SR2000 and the Airmaster AP420 with Sensenich blades which have a very course pitch on the fine setting. Remember, after a cold start with a course pitch prop, advance your throttle immediately after start to 2000 to 2500 RPM after start until the engine is warm to prevent cold running chatter and stumbling.

With the above throttle cable running etiquette and carb idle set, you should get trouble free throttle operation. I rarely lube my cables except on a 5 year hose replacement. I use a light oil then wipe clean as the liner is a nylon and the cable is stainless so corrosion is not an issue. I do oil my carb cable set nut on the carb throttle every oil change or 25 hours minimum to keep it rotating nicely and free of corrosion. Although anodized steel, the coating will wear with time so a drop of oil from the dip stick is all it takes.

The choke on the other hand is a pain, a T handle is very nice to have as the round Europa supplied knob tends to pull off the brass insert in a hot climate where a great deal of force is needed to pull the cold choke cable on start. The knob issue I fix by scuffing and regluing the knob on with Redux. I also have unscrewed the knob and cross drilled the knob with brass insert. Then tap and install two short 6/32 set screws to keep the plastic knob fixed to the threaded brass insert and lock the knob to the choke rod. It works. However, if the choke knob pull is excessively hard, pull the cables and start looking as you probably have a kink somewhere or excessive drag in the brass choke tubes. If the cables move easily on the bench or disconnected from the carb choke lever, clean up your brass tubes and lube them lightly.



90 degree Brass choke tube.

The choke is always a tough pull on the current Rotax Bing Carburetor equipped with the 90 degree brass tube. This system binds the cable on the pull. Use an old cable and some valve lapping compound or similar and smooth the inside of the brass tube if it is burred. Inspect your cable ends for burrs or smashed ends as the choke cable has a 5mm cap crimped on. If that cap was over crimped, binding will occur. Lube the brass tube with graphite and install the cable. Once again, I run the left carb choke cable in a loose loop from the firewall to the top of the right carb, then over to the left carb 90 degree tube and vice versa as shown in the photo below. I safety wire the choke end to the brass tube, and do zip tie the now parallel choke cables running between the carbs for neatness and alignment. There are other after market ways to change the mechanism for choke operation, but I do the above as this works and reduces the normally tough pull on the choke.



Photo of 12AY showing choke cable runs.

Years ago in a Kitfox FWF I helped the client get the bugs out his throttle and choke cables. We removed the bent tube and installed a vertical fitting off the throttle support bracket and ran it vertical some 4 inches then began a bend back to the firewall. It worked great on a radial engine type cowl (that was very large and draggy), but it won't work in a sleek tight cowl where vertical room over the engine is at a premium. Hence the bent choke tubes.



Modified straight choke cable adapter for the Bing 64 on a Kitfox.

In summary, pay attention to alignment in your throttle box, run the cables loopy and loose, don't cut them without the right parts and crimping tools, lube to clean your cables with light machine oil every 5 years and pay attention to your idle stops. The choke cable is a tough pull, but through a bit of smoothing of the cable guides and fixing the knob firmly so the plastic doesn't pull off, it too will give years of service. I have had my cables in for over 10 years and never had a problem. However, I did install a throttle friction for ease of use. That is another story.

