Technical Data
SIP Migmate - Replacing the Wire Liner

This page describes why the wire liner might need to be replaced and how to replace it. I bought a "torch service kit" for about £23 which includes some other bits and pieces, but wire liners are available by themselves for less than £10.

There are recognised weaknesses in the hobby SIP wire feed mechanisms (and those of some other hobby MIG welders).
The bottom of the page links to fixes developed by the forum.

The SIP Migmate shares it's wire feed system with the Topmig, and it's common from the 105 amp model up through the 150 and 170 amp welders. This one is a 130 Turbo built around 1998. All seem to have wire feed trouble

- Tricky to get a smooth weld at low amps
- End of wire isn't steady when welding - seems to move up and down
- Motor speed changes while welding
- The wire slips between the feed wheels

The wire feed motor (circled in red) is one source of the trouble. This is a low cost welder so they made the wire feed motor very small.

It seems to work well enough when new, but doesn't have much extra capacity to overcome problems with the wire feed system and liner as the welder gets older.

High friction

The wire seemed very stiff to pull through the liner.

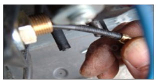
In the photo I've attached a 1kg (2.2lbs) bag of rice to the end of the wire, removed the tension on the wire feed rollers and the wire reel so the only resistance was in the wire liner and torch, and then tried to lift the rice bag up with the wire.

It took 3.3kg before the wire started to move through the liner. That's more than 3 bags of rice! After the liner was replaced the wire would feed with just 0.6kg weight (just over half a bag of rice).

Replacing the wire liner

Wire liners are available by themselves or as part of a torch service kit which includes a new swan neck, a swan neck liner, and a bunch of spare tips and shrouds.



The torch comes apart with 4 screws. Inside this one there is a brass block that switches the flow of shielding gas (many other welders have an electrical solenoid inside the machine to switch the gas).

I removed the gas pipe connector from the brass block for better access. It was a quick release type where the pipe comes out easily after pushing the sprung outside of the connector inwards towards the brass block.

The brass block was then easy to unscrew from the wire liner, and this also released the power cable.

The welder end is a little more fiddly The wire rollers can be moved away for access. The bottom is held on by 2 screws and the top one will move out of the way when the tensioning bolt is fully unscrewed and the tensioning spring pulled outwards from the welder.

In the photo the spanner is on the brass adaptor that holds the wire liner to the welder.

The brass ends will unscrew from the plastic liner and can be screwed onto a replacement liner. The thread pitch is good for steel liners as well as the original plastic type.

Use a steel liner!

Here's the real trick for rejuvenating an old SIP. The original liner was PVC (top of photo), but the alternative steel liners offer much less resistance to the wire.

The steel liner is stiffer than the plastic liner so helps keep the cord to the torch straight, again reducing friction for the wire.

The steel liners can be colour coded. Blue is for 0.6mm - 0.9mm wire and red for 1.0mm - 1.2mm. Steel liners might not be available for all hobby machines, and eurotorch liners won't fit.

The replacement liner pushes in from the torch end. They are often too long and need to be trimmed. An angle grinder can make a reasonably clean cut, but any sharp edges need to be cleaned off with a small file or drill bit. I'm told that side cutters might have been more sensible.

I cut mine to the same length as the old one, but a more sensible approach might have been to insert the liner, screw in in place at the torch end, pull the lead straight, then mark the correct length at the welder end. If the liner is too long it might put strain on the power lead connection (which isn't all that robust).

The gap between the end of the liner and the rollers should be as small as possible otherwise unsupported wire could birds nest (crumple up) before it makes it into the liner.

The power cable and cord cover are secured to the end of the wire feed mechanism with a wiring tie. I've routed the gas line around the wiring tie to prevent it from being squashed. I assume this is what SIP would have done originally, but my welder is old and messed around with so I can't be sure.

Swan neck







The swan neck won't normally need to be replaced unless the screw thread for the tip is damaged, but it's a quick and easy job. The neck is clamped into the brass block with a grub screw.

The thing that does need to be replaced on this welder is the swan neck liner (in the photo the replacement is being pushed through the swan neck). It's always worth fitting a contact tip to check the length of this liner before screwing everything back together. Mine was a bit long and needed to be trimmed.

Here's a blurry photo of the end of the old swan neck liner. It's full of bits of plastic pulled out of the old PVC wire liner. I guess the bits of plastic worn off the liner make it as far as the tip, get hot, then melt together. Can't be the best thing for a smooth wire feed.

Setting the tensioners

First the wire roller with the grove needed to be cleaned out - the groove was full of black gunk. From there I set the wire reel on a reasonably loose tension (the reel tensioner on this welder doesn't seem to make much difference anyway).

The roller tension adjuster worked well screwed 3/4 of the way in. Much better than the original setting where it needed to be screwed in all the way and then a bit more. I set it so that it would push against a reasonable resistance but slip if the wire became jammed in the tip. I'm running a partly used 5kg reel of wire. A smaller reel would put less strain on the wire feed mechanism.

For more detail see setting up the wire feed

The verdict

With everything back together the welder was transformed. The end of the wire is now much more stable when welding, hence the arc is less stuttery and the welder is easier to fine tune.

It is still a tricky welder to set up and use. The wire speed control is sensitive and unforgiving if the speed is slightly out. I did find neat welds more difficult to achieve then with more expensive welders, but for occasional work the welder is now usable.

The test welds on the picture are continuous welds on 0.8mm sheet on minimum power and using Argon/CO2 mix gas and 0.6mm wire. The welds aren't perfect, but welding at this thickness was almost unachievable before the liner was replaced.

How often should the liner be replaced?

The professionals on the forum tend to replace their wire liners after running through 30kg of wire. At their rate of use that can be once a month. A hobby welder might not get through 30kg of wire in it's lifetime. For hobby welders the main cause of liner wear is wire that has a light coating of rust due to infrequent use. Rust is an abrasive, and the liner might need to be replaced after just a few minutes of welding with rusty wire. (Rusty wire should really be unwound and cut from the reel before welding).

Steel vs plastic liners

The plastic liner originally fitted to this SIP welder had recently been replaced but was still causing wire feed problems. The wire feed system on this welder seems to be very marginal, and the plastic liner pushes it over the edge. The steel liner offers only 20% of the resistance of the old plastic liner and the welder works much more predictably with the new steel liner.

Still not working? - Align the rollers

The pivot for the top roller is mounted only on one side. The pivot can flex causing the top roller to contact the bottom on one edge rather than gripping the wire. An excellent solution suggested on the forum is to add a second support for the top roller to prevent twisting. See the SIP / Cosmo Wire Feed Solution thread for details.

Wire speed Reference

The 0.6mm wire size figures have been tested to 2mm and the figures are extrapolated. The 0.8mm figures have been extrapolated from the 0.6mm results so will be less reliable, but they are at least a starting point. Where the figures are against a grey background the wire size isn't really suitable for the material thickness.

The markings on welder wire feed controls do not represent speed in metres per minute. Measure the speed using a stopwatch and tape measure. It might be useful to mark positions around the wire feed knob for future use.

Steel Thickness (mm)	Wire Speed (metres per minute)	
	0.6mm wire	**0.8mm wire**
0.8	2.5	1.6
1	3	1.9
1.2	3.6	2.2
1.5	4.3	2.6
2.0	5.6	3.5
3.0	7.9	4.9
4.0	9.8	6.1
5.0	12.5	7.7

Torch Position and Laying Welds

It pays to practice on scrap sheet until you have a good technique before trying any project welding. Welding fabricators are often happy to sell off-cuts from their scrap bins for cash. Select a few different thicknesses. A good thickness for a first practice session is 1.5mm.

That's thick enough to stop blowing holes being a big issue, and is a handy thickness for experimenting with power settings.

Preparing the metal

Metal needs to be completely clean of rust or paint before welding. Not just because it is difficult to arc against a dirty surface, but because any contaminants will tend to find their way into the weld and reduce it's strength. An area should be cleaned for the earth clamp mounting too.

Light use of an angle grinder or flap wheel will quickly remove surface rust and paint, and for more inaccessible areas an air grinder or dremmel can be effective.

Holding the torch

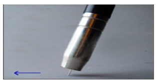
MIG can be used one handed, but it's much easier when you can use both hands to steady the torch. Throw away the hand held mask that came with the welder and buy a full face mask. Welding control will be further improved if you can rest an arm against something solid.

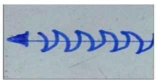
In the photo the left arm is resting on the chassis and supporting the neck of the torch. The back of the fingers are too close to the weld will get hot quickly, but this position should be fine for a short period of welding.

The head is angled to one side to make the weld pool visible (the gas shroud gets in the way).

Positioning the tip

I tend to angle the torch at maybe 20 degrees from vertical with the shroud angled forward.





The contact tip should be about 6mm to 10mm from the metal to be welded, so cutting the wire about 10mm long and holding the torch so the wire touches the sheet is a good way to position a MIG welder.

Welder movement

There are a variety of torch movements used in MIG welding. Generally some form of zig-zag or weaving motion is used to ensure the arc acts against both sheets to be welded.

For thinner metal I prefer a curved zig-zag as illustrated in the photo.

Video

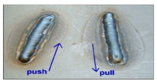
It's much easier to lay weld onto a sheet of steel than to do a join, so it's best to practice technique that way.

After a couple of seconds welding a liquid weld pool should develop.

If the weld pool becomes too large (welding too slowly or too high power settings) it might create a hole in the metal. Weld too quickly and the weld will not penetrate through the metal.

600Kb Flash video preloads before playing and includes sound.

Welding direction



This page describes welding in the "push" direction. Pushing the torch rather than pulling is a good habit to get into as it improves coverage of shielding gas.

For thin mild steel welded horizontally the direction of welding doesn't make a great deal of difference to the weld, so if visibility is better with the pull technique then that can be used.

Practice laying welds until the welds start looking neat. It should only take a couple of hours practice to get a feel for MIG welding.

The welds in the photo were mostly made by a first time MIG welder using initial settings for wire speed and power setting from the calculator.

Spend a little time laying welds on sheet to get a feel for welding on different power settings before trying to join two pieces of metal. And keep working through the tutorial for more tips.

What mistakes are you going to make?

I've taught a few people to weld and the same mistakes happen every time. Here are some trouble-shooting tips for when the same thing happens to you:

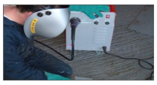
- **You'll hold the torch too far from the metal.** If you don't bang the shroud against the metal you are welding every now and again you'll probably be holding the torch too far away. Some DIY welders suggest touching the shroud against the metal to help hold position, but that's just a little a too close and you'll overheat the contact tip which makes the wire stick. I bang the shroud against the metal often even after 15 years of DIY welding.
- **You'll move the torch too fast.** You'll end up with a tall thin weld doing it that way, and you'll have real trouble joining two bits of metal together later on in this tutorial. Use some sort of regular side to side movement as you go along. That'll make the weld wider and less tall, and will help control your speed of travel. If you blow holes then turn down the power and wire speed. If you still blow holes then practice on something a bit thicker until you get the hang of it.

Wire speed is probably the most important setting on a MIG welder. This page is intended to help you fine tune your wire speed and includes a video to demonstrate what the different speeds sound like.

Many wire speed adjustment problems are due to wire feed set up issues, so it's worth checking that page if this one doesn't help.

Technique

It's possible to weld neatly at the wrong power setting - penetration might be too little or too much, but the welds can still be neat. Get the wire speed wrong and it can become very difficult to weld at all. The trick to finding the right wire speed is to experiment.



Adjusting wire speed on the fly while welding a scrap piece of steel is a quick way to test. Set the welder to approximately the right power setting for the thickness of metal, start welding, and while welding alter the wire speed knob until you get somewhere near.

Video

In the video the wire speed has been gradually increased from very slow to very fast. The captions at the top show where I think the wire speed is too slow, good, and too fast.

Be sure to turn your sound on - the sound of the weld reveals what is happening more than the images. There's a control at the bottom of the video you can move to listen again to each segment.

1.3Mb Flash video preloads before playing and includes sound.

Guide to video

off
The wire feed starts at zero. It takes a little turning to get it going at all.
Far too slow
The wire is making occasional contact with the metal, but as soon as contact is made the wire burns back (forms a ball and melts back to the contact tip).
Too slow
The wire is still burning back after contacting the metal, but the process is repeating more quickly.
Good
The wire is going fast enough to give a constant arc to the metal, and there is a nice consistent sizzle sound to the weld. (said to sound like bacon frying, though I fail to replicate the sound with my cooking. Maybe a more expert hand holding the frying pan might get closer.)
Too fast
The weld is still consistent but but the crackle is starting to sound fierce and the penetration is increased. Cheaper welders might start making a machine gun like noise at this point.

Wire speed actually controls welding current (the power knob on the welder only sets the voltage). Increasing the wire speed past the point where you achieve a nice consistent weld will only increase the current and can cause blow through on thinner steel.
Far too fast
Here the wire is moving so quickly that it bends as it hits the metal. The torch feels like it is being

pushed away from the metal, and there is a lot of spatter.
Wire speed tips and tricks

- Generally for thinner metal the wire speed is set at the lowest speed that welding can take place smoothly. This is because the current actually reduces as the wire speed is reduced so thin metal can be welded more slowly and controllably.
- It's possible to reduce wire speed further by reducing the distance between the contact tip and the work piece. This can cause the tip to overheat, grip and stop the wire, and ruin the tip, but it can be a useful technique for delicate welding such as end on to an edge especially if an oversized tip is used or when welding for short periods.
- For welding into a corner increase the wire speed. This reduces the length of the arc and makes it easier to weld directly into the corner rather than arcing against the sides.
- Wire speed will need to be increased slightly when welding on a vertical surface vertically or to the underneath of a horizontal surface.

Wire speed control and different welders

Wire speed will need to be increased as the welder power setting is increased.

For DIY MIG welders the wire feed is usually independent from the power setting. On these welders the wire speed will have to be manually increased as the power is increased. For my Clarke welder running 0.8mm wire a speed setting of 2.3 was good for the lowest power setting, and 5 worked well on the highest setting.

More expensive welders normally have automatic adjustment of wire speed - the speed is changed by the welder when the power setting is altered. On my Portamig 181 a setting of 5.5 is good for both low and higher power settings, and the wire speed knob is only there to allow tweaking.

The page covers the effects of setting a machine to suit a metal thickness. Note other factors also come into play:

- The speed of welding will affect the weld appearance and penetration. Decreasing the speed of torch travel will increase penetration.
- The weave pattern of the torch also influences weld penetration.
- Preparing the joint in to a "V" shape or leaving a root gap can dramatically reduce the power required for a given metal thickness. These techniques are touched upon in the 90amp 4mm challenge.

Power controls, amps and voltage

The power controls on a MIG welder adjust the voltage rather than the amps, though to some extent that's academic as increasing the voltage will also increase the amps.

It's worth knowing that the wire speed also controls the amps.

Comparing the different settings

The calculator provides a rough starting point for power settings. The easiest way to fine tune the setting is to practice on scrap steel of the same thickness as the steel you want to weld.

Here a series of welds have been laid on 1.2mm sheet using increasing power settings from left to right. Welds made on the lower settings are quite narrow and tall, and welds on the higher settings are wide and flat.

Weld penetration

Looking at the reverse side of the weld is more informative. The two welds on the left side haven't penetrated all the way through the sheet, but the three welds on the right have penetrated a little too far.

The aim when welding two pieces together edge-to-edge is to end up with the edges of the metal melted into the weld on both sides of the joint, but not to have excessive penetration.