Everything You May Need to Know About the Sting Sport's (Light-Sport Aircraft) Braking System (in USA)

by **Richard W. DeHaven**
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Preface & Background

In October 2010, after my first 20 hours of flight training in a 2005-model Sting Sport light-sport airplane (LSA) at Lodi, California, I knew I was "hooked" and decided to take the plunge. I purchased a lightly used 2007 Sting Sport (now called "Sting S3," or just "Sting"), a carbon-fiber aircraft product of TL Ultralight in the Czech Republic. I finished up my flight training in it, took my check-ride and earned a Sport-Pilot Certificate in June 2011. I've been flying her "pedal-to-the metal" ever since.

Recently, with the Hobbs meter hitting 2,600 hours after over 3,700 takeoffs and landings, a braking-system issue appeared: the brake fluid level in the plastic reservoir bottle on the firewall started slowly dropping. Closer inspection revealed that all four brake master cylinders were leaking at the ends of the pistons. And I already knew (from recently installing new brake pads) that one of the two pistons in each brake caliper was periodically "sticking," with the brakes relaxed. No problem, I thought, my brakes have served me flawlessly to this point; I'll just call TL's US distributor, Sportair USA, and either order rebuild kits for the troublesome master cylinders and calipers–or (depending upon cost) some brand new parts. But that's when I got the bad news: TL and Sportair were no longer "supporting" these AJP-type parts used on older-model Stings, such as mine.

At that point I decided to learn everything I could about my Sting's braking system, including: (1) exactly what components are used; (2) whether these components might be available from other retail sources; and (3) if not, whether and how, I should proceed in replacing my entire braking system using other TL-approved (Master Equipment List=MEL; dated 08/2018 and 31 Jan 2015) brake components. I eventually ended up either replacing or rebuilding my 2007 Sting's entire braking system. Everything of relevance that I learned in this endeavor is shared (in writing and photographs) with you here.

Disclaimers:
1. *This information pertains to a 2007 Sting (and similar year-models), with utility-trailer tires and AJP-type brake components–not the more traditional aircraft-type braking systems installed on later models of TL aircraft.*
2. *Nothing herein is meant as a recommendation or official procedure–by either me, Sportair, or TL. It's simply knowledge you can use in resolving any braking-system issues you encounter on a similar Sting S3.*
3. *Any action you take based on this document should also consider all other relevant* ***official*** *information, including the Sting Sport Maintenance Manual(s); MEL; Sting Owners' website; and direct contact with Sportair and/or TL, as appropriate.*

Braking System Based on AJP Motorcycle Parts

AJP was a European (Barcelona, Spain) manufacturer of brake components used on motorcycles, especially Ducatis, "trials" motorcycles, and various "enduro" models, beginning in the mid-1980s. TL Ultralight partnered with AJP, bringing AJP master cylinders (MCs) and brake calipers (BrCals) into use in early-model Sting braking systems (and brakes of other small aircraft). The AJP BrCals used are a two-piston model, commonly placed on front wheels of motorcycles, while the AJP MCs used are an 11mm-piston model, used with either front or rear motorcycle brakes.

Unfortunately, AJP-Spain closed its doors in the summer of 2011. This action, along with TL's desire to switch its lineup to traditional aircraft-type braking components, is likely why they (and hence, SportairUSA) stopped providing "support" for AJP parts. Nevertheless, there are still plenty of TL aircraft, other light aircraft, and older motorcycles around which need AJP parts support. And fortunately, another European company–Braktec–purchased AJPs tooling and stepped in to provide that support. Braktec products are currently imported into the US by AJPAmerica and sold through its three US dealers.

Sting Braking System Overview

Pilot's-Side Only Braking.–A pilot's-side-only braking system begins on the left firewall, with a 1/2-pint plastic brake fluid (DOT 4–if AJP parts) reservoir. This is the high-point of the system. From here, a plastic low-pressure line (LPL) passes down through the firewall to a 1/4" barbed nylon splitter, and hence two short LPLs supplying brake fluid to the IN ports of Left & Right (L/R) AJP MCs, for L/R brakes.

On my Sting, these 1/4" (ID) LPLs were yellowed, brittle and in obvious need of replacement. There were no identifying markings, but I replaced them with 1/4" ID Tygon 2375 clear brake fluid reservoir hose common on motorcycles. This line has a smooth inner core for enhanced flow and is resistant to Dot 4 fluid. (Note: Inexpensive vinyl line from a hardware store will quickly deteriorate with DOT 4 use and is thus *not* suitable for this application.)

One MC serves each toe-brake pedal on the pilot's side. MCs are fastened to the toe-brake/rudder pedal assembly in the horizontal position and operated (i.e., compressed & released) via adjustable-length aluminum push-rods. I could not locate any new (AJP) MCs in the US; however, rebuild kits (consisting of a new piston with seals, spring, piston keeper, and rubber end-grommet) *are* widely available in the US and Europe (*see* sources).

Nonetheless, if I should encounter any future (AJP) MC issues (on the pilot's side, at least), which cannot be resolved with a re-build kit, I will likely switch to Brembo motorcycle MCs. Brembos are nearly identical to AJPs (*see* photos & sources), including having the same piston size (11mm), bolt pattern and bolt size[1], and would thus appear to meet TL's definition of "AJP-type" MCs[1]. I also confirmed that the AJP aluminum reservoirs, which sit atop the pilot's-side MCs in a dual-braking system, *will* securely plug into the rubber IN grommet atop this Brembo MC (*See* photos). The only caveat is that this model of Brembo MC cannot be used in its present form, to replace AJP MCs on the co-pilot's side (in a dual-braking system), because it lacks a threaded IN connection for an AIGNEP red- or blue-tab fitting (discussed later).

When (AJP) MCs are compressed, small-diameter high-pressure line (HPL) delivers pressurized fluid from the OUT port of each MC to the respective L/R BrCal on each main wheel.

HPLs are Vales 4 x 2 (4mm [5/32"] OD/2mm [7/64"] ID) PA6 (L.150503) nylon line made in Italy. I did not find this line for sale in the US. However, I did acquire enough of it to replace all but one section of my aged HPLs ("nicks" along exposed portions running down the gear legs were the main issue) from Sportair for about $5/ft.

However, if I ever need to replace *all* of my HPLs again, I will likely switch to 1/8" OD (.079" ID) Type H Nylaflow nylon (i.e., 1/32" smaller OD than OEM, but with the same .079" ID). This line is inexpensive ($0.10-$0.25/ft) and widely available in the US[2]. It has adequate pressure ratings of 2,500 psi bursting pressure and 854 psi working pressure. It is also a type used in small-aircraft braking systems.

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[1]A Letter of Authorization (LOA) from the manufacturer *could* be required to switch to Brembo MCs.

[2]A Letter of Authorization (LOA) from the manufacturer *could* be required to switch to the 1/8"-in. OD line; also, 1/8" fittings *would* then be required (with possible LOA) in place of the OEM 5/32" fittings.

HPLs in the Sting S3 system are connected to BrCals and MCs with small, metal-and-plastic push-to-connect fittings. These fittings are described later.

But first, two noteworthy aspects of the Sting S3 (AJP) BrCals should be mentioned. First, the opposing calipers on L/R wheels are *not* mirror images of each other, but are instead the same, *identical* caliper (*see* photos). A unique three-bolt attachment pattern allows them to be bolted to either L or R wheels using a different *pair* of the three bolts. These two bolts affix calipers to a metal bracket welded at 90^0 to the axle assembly. Second, when removing or installing a BrCal, the entire axle assembly must first be removed from the strut to gain access to one otherwise inaccessible bolt of the two (*see* photos).

Each BrCal hydraulically presses a pair of motorcycle-type brake pads against a motorcycle-type brake disc (i.e., one pad presses against each side of the disc; *see* photos). Brake pads are GMA "F" pads for "F" calipers, which are widely available in the US (*see* sources).

Brake discs are bolted to the inside of each wheel, using three M10x1.0 bolts. Discs must be unbolted anytime the tire and wheel assembly is removed. I suspect the OEM brake disc is from a European motorcycle application, but I was unable to find it for sale in the US. Brake discs can be purchased from Sportair, however, for about $150/pair.

Dual Braking System.–When a Sting is fitted with dual brakes (i.e., L/R pedals for both pilot's and co-pilot's sides) several more components are needed. First, the L/R MCs on the pilot's-side are replaced with a similar pair of MCs having two small, aluminum fluid reservoirs atop their IN ports. Also, instead of carrying fluid directly to the BrCals, the pilot's-side MC OUT ports are connected instead to the respective L/R co-pilot's side MC IN ports. Then the co-pilot's side MC OUT ports

are connected to the respective L/R BrCals. These changes necessitate additional HPLs and fittings.

The fittings (eight total for dual brakes) used are unique to Stings and other TL aircraft. They are widely used in pneumatic systems, but are less common in hydraulic braking applications–at least in the US. TL's fittings are manufactured by AIGNEP SPA & Alpha Technologies, in Italy and Spain. TL's OEM fittings have a red, plastic push-to-connect tab; these red-tab fittings designate inch measurements (i.e., 5/32") and are sold only in Europe. They can be purchased through Sportair for about $35 each.

However, AIGNEP-Alpha Technologies also offers its product line in the US, through a facility in Tennessee. A blue-tab fitting, comparable to the OEM red-tab fitting, designating inch measurements (i.e., 5/32") and sold only in the US, is widely available here from numerous retail sources; these blue-tab fittings retail for about $6-7 each. I asked TL whether this blue-tab fitting was suitable for use[3] in my Sting and their emailed reply was: "It should be fine, provided adequate thread-grip is achieved." I have had no trouble with them, so far (100 hrs).

Inspecting the technical data for both the red-and blue-tab fittings reveals they utilize *rubber* seals generally *not* considered compatible (causing significant swelling) with DOT 4 brake fluid. However, these fittings appear to work well with good longevity (as evidenced by my lack of trouble until now), apparently because seals are in a tight, static (lack of seal movement) environment. Nevertheless, when any fitting which has been exposed to DOT 4 fluid is removed, it should be replaced with a new one, to prevent leaks or failure related to seal deformities. AIGNEP's torque value for these fittings is 3.7-5.2 Ft lbs.

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[3]A Letter of Authorization (LOA) from the manufacturer *could* be required to replace OEM red-tab fittings with US-sold blue-tab fittings.

Braking System Access for Maintenance & Repairs

With any major braking-system work, access is needed to both exterior and inside-the-cockpit components.

The Sting S3 and S4 Maintenance Manuals (MMs) provide three potential methods for lifting the airframe off the gear (for tire & wheel assembly removal), thus providing access to the aircraft's exterior braking components: (1) jacking (non-point) under the wings, (2) jacking under the aft, lowermost edges of struts, or (3) by lifting (and securing) the entire airframe off both struts and nose gear. Although I've used method #2 dozens of times, for replacing main-gear tires, I prefer method #3 for major braking-system work.

Lifting the whole airframe requires first constructing an inexpensive aircraft "engine stand," from 3/4" "black pipe," or other suitable material (*see* photos here, and in the Sting S3/S4 MMs). Then, the tail is pushed down and this stand is placed underneath, mating it to a pair of nipples on the L/R sides of the engine mounting frame next to the firewall. Next, using suitable padding and a wide strap (such as a 3-in-wide towing strap), the tail is lifted (taking weight off the main gear), then lowered back down onto a solid, padded support (e.g., a sturdy chair) of some kind. And lastly, padded sawhorses are placed underneath each wing, below spars, to prevent any side-to-side roll.

Access to braking components inside the leg-rest areas of the cockpit, fore of the seats, is another matter and can be problematic (*see* photos). In particular, large individuals (in stature and/or weight), soon discover that getting shoulders and both arms into these small areas is almost impossible. Moreover, as my mechanic (a large guy) can attest, if you do, you may get "stuck" and have to be pulled back out by the belt!

As a result, I invest extra time to improve access by: unbolting (two bolts each, plus any auto-pilot servo) both sticks; laying them flat on the floor or next to the spars (PTT system remains in place); and removing and covering the seat-bottom areas with pieces of plywood (which are then padded; *see* photos). I also remove the seat-backs, seat-back-support and luggage boxes, to ensure adequate leg room when squirming forward, head-first, into either of the leg-rest areas.

Filling and Bleeding the Sting Brake System

I'll preface this topic by describing what I did during overhaul of my Sting's aging (2,600-hr) braking system. First, I removed the brake fluid, by disconnecting both HPLs at the fittings on the L/R BrCals, and letting them drain overnight into glass jars. Next, I removed and rebuilt the four MCs. I also replaced, with new parts, the following: LPLs, HPLs (except one short section), fittings, brake pads, brake discs and BrCals. I then took my time filling (new DOT 4 fluid), bleeding and testing the new braking system (including re-draining it twice and starting over, just for the experience!) over a few days, to *learn* as much as possible and ensure I wouldn't just be "blowing smoke" here.

I was surprised to find that the Sting S3 MM provides no guidance at all regarding the filling and bleeding process. TL did address these issues later, in the Sting S4 MM, but the S4 braking system is markedly different, with the addition of a parking brake, the use of aircraft-type components, and MCs mounted vertically instead of horizontally. In addition, TL's vague S4 instructions, which include "trying to remove air bubbles" (without defining "success," by the way) by unbolting MCs and BrCals and "tilting them," or "tilting the aircraft," to remove such air, sounded to me like a recipe for frustration (at best) or failure (at worst). Thus, I made no attempt to adapt TL's S4 'filling and bleeding' guidance to my S3 Sting.

One significant issue with the Sting S3 is that the horizontally-mounted (AJP) MCs (with mid-cylinder IN ports and end-of-cylinder OUT ports), tend to be air-bubble traps. Nevertheless, as with most small-aircraft braking systems, entrained air can usually be removed by filling and bleeding the system from bottom (bleeder screws on the BrCals) up (to plastic reservoir bottle). Bottom-up bleeding is done under pressure, using either a modified finger-pump-oiler or some sort of pressurized tank, to push fluid upwards through the system. Best results generally occur with a "good flow" of fluid, which pushes relatively quickly through the system and dislodges entrained air.

What follows is how I accomplished bottom-up filling and bleeding on my Sting S3, working alone. To speed up the process–and lower risk of brake fluid being spilled on your airplane and hangar floor–it may be prudent to enlist an extra individual (or two) for assistance.

Although I *have* successfully used an 'oiler' to bottom-up bleed my S3 brakes once before (when a friend inadvertently opened the system, while helping me install new brake pads) I now prefer a pressurized tank.[4] There are many such pressure-bleeders available from retailers, including aircraft parts-supply companies. Or one can easily be made. I made mine from a 1/2-gal pesticide sprayer purchased from ACE Hardware for about $11, plus a few dollars worth of fittings and line (*see* photos)[5].

First, I inserted several inches of clear plastic line (*see* photos) into the output line of the pressure-tank. Clear line allows you to see air bubbles (and fluid) moving up and out of the line, during pressurization. Inexpensive 3/16" ID vinyl line from a hardware is suitable for this limited exposure to brake fluid. An on/off valve is needed ahead of the

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[4]There are many ways of doing this. Don't hesitate to modify my method as you see fit–to make it better!

[5]I thank Roger Lee, an LSA mechanic in Arizona, for this invaluable tip!

clear line. I also added about 1.5" of 3/16" ID Polyethylene (PE) line (also from a hardware store) to the end of the clear output line. PE line, which is rigid, is for the connection to the BrCal bleeder nipple.

All connections are then tightly secured with clamps. I use brass (3/16") rather than nylon barbed connectors, as they seem to withstand hard clamping better, are less likely to leak, and survive multiple uses.

Next, I heat the bleeder nipple on the BrCal and also the end of the PE line slightly with a heat-gun, then quickly slide the PE tube over the bleeder nipple and let it cool[6]. This gives a solid, tight fit. But just to be sure (to prevent an "unhappy ending" as I had once, when it popped off!), I also clamp it.

Lastly, I drill a tiny hole in the top of the PE line (which is now firmly secured to the bleeder nipple) right next to the bleeder nipple. Then I insert the tiniest sheet metal screw I can find at the hardware store a couple turns into this hole. Now I have a "bleeder" for the pressure-bleeder input line. This is insurance against inadvertently *adding* any air to my braking system during bottom-up filling and bleeding.

I then put about 1.5 quarts of DOT 4 fluid in the tank and pressurize it. The little ACE sprayer accepts a maximum of about 40-50 pumps. I then remove the bleeder screw I've placed next to the bleeder nipple and slowly open the bleeder-tank output line. Air bubbles and DOT 4 are seen moving towards the end of the line (and bleeder nipple). Once all the air is expelled out the bleeder hole I've drilled, I turn the control valve off and "cap" the line with the bleeder screw.

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[6]To improve access to the work area, I prefer to remove the tire and wheel assembly, first.

Now I conduct a final, full-pressure test. With the bleeder nipple on the BrCal still closed, I fully pressurize the output line from the pressure tank. If any leaks occur, I eliminate them, then re-bleed the output line.

Then I focus on getting MCs ready for the "rock-n-roll" they'll need to move entrained air along, sending it upwards to the brake fluid reservoir bottle on the firewall (be sure the lid is removed)–and ultimately out into the atmosphere.

For this, I gather four 2.0-2.5-ft-long wooden sticks (3/4"-diameter wooden dowels work well) or pieces of PVC pipe and some Gorilla tape. I tape one end of each stick to the top of a different toe-brake pedal. I then arrange the free ends of sticks (what I'll use for some serious "jiggling") so I can reach the two (pilot & co-pilot) left-pedal ones, while standing just outside the aircraft in front of the left wing. And I similarly arrange the two right-pedal sticks, so I can reach them both while standing at the right front edge of the fuselage.

Now, the brake fluid can finally flow. I fill and bleed the left (longest in a dual system) brake first. With pressure already applied from the tank, I open the bleeder nipple (the clear vinyl line twists slightly as the nipple is rotated) on the BrCal about 1/4 turn[7]. Then I go quickly to the left, outside position, grab the two left sticks (one in each hand) and begin (simultaneous L/R) jiggling[8]. Within a few seconds, I usually see fluid rising into the bottom of the reservoir bottle. Air bubbles are quickly detected, too. From my strategic position I can watch the show, while continuing the L/R MC jiggling.

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[7]A significant, moderately fast flow is the goal–one which moves entrained air along, without fluid leaking excessively from the bleeder-nipple threads, which may lower pressures and introduce air. The 1/4-turn I settled on is specific to my *new* AJP BrCals; a different setting may be needed for other calipers & the OEM AJP BrCals.

[8]The goal is to vigorously shake the MCs and mounting brackets, but *not* to depress the MC pistons.

As fluid nears the top in the bottle, I stop jiggling briefly to remove it, using a turkey baster. Then I resume jiggling. I keep this routine up until either bubbles are no longer seen rising in the bottle, or I've removed 1-2 pints of fluid. Then I'm done with this BrCal and move to the right BrCal and repeat the process. A strategically-placed mirror facilitates monitoring the reservoir bottle from the right side.

With L/R sides done, I then perform 10-20 quick "pumps" of each of the four brake pedals[9]. If they get hard, and stay that way, the job is done. If any pedal exhibits sponginess (especially after being idle for a while), I re-bleed that particular side again, using the same process. It may take one or two re-bleeds before all pedals remain uniformly hard, indicating all (or most) air has been expelled.

If up-pumping with the pressure tank through either BrCal fails to quickly (<30 seconds) send brake fluid to the reservoir bottle, six remedial actions can be tried (in order): (1) ensure all four brake push-rods are properly adjusted, so as not to cause *any* piston displacement in MCs, with brake pedals at "rest;" (2) slowly pump the brake pedals for the side being filled/bled; (3) increase bleeder-tank pressure; (4) adjust the bleeder-nipple opening slightly (i.e., either larger or smaller opening); (5) alternately pressurize, then un-pressurize the system, to dislodge stuck air bubbles; or (6) halt the filling and bleeding process, drain all fluid out (at bottom), and start over.

If forced to start over, first rule out possible air entrainment where HPLs follow highly irregular up-and-down contours. Also check that LPLs between the reservoir bottle and the two MC reservoirs atop the pilot's side MCs (in a dual-braking system) slope *uniformly* downward. In my Sting, they had "humps," which trapped large, system-blocking air bubbles (an issue corrected when I replaced my LPLs).

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[9]Reinstall the tire and wheel assembly, first, if you've removed it, as I do.

When finished, check two more things. First, ensure there are no leaks anywhere–including lines, fittings, MCs, and BrCals. Second, examine carefully ("back-lighting" with a flashlight in low light works well) to ensure no entrained air has been pushed down into the lowermost two HPLs, between the fuselage and BrCals (i.e., along the struts).

In my case, after using my new brakes for a few weeks, I noticed some air in the HPL along the left strut (although both brakes were still working fine). To remove this pesky air (which may have worked *down* from a MC) I engaged a top-down, automotive-type bleeding procedure, involving cracking open (then closing quickly) the bleeder valve, as the pedal was pushed down (after several quick pumps) and held, by someone inside the airplane. Several pump-and-bleeds in this manner may be needed to clear out the last vestiges of air.

Troubleshooting Other Common Braking-System Issues

1. ***Brake Pads Wearing Unevenly***.–There are two common causes for this. First, unusually hard braking can bend the BrCal mounting bracket. To determine if this is the trouble, remove the axle from the lower strut, then remove the BrCal from the mounting bracket. (*Do not* disconnect the HPL to the BrCal, just set the BrCal aside, with support of some kind to keep the HPL from pulling out of the fitting.) Then check whether the bracket is 90^0 square to the axle. If not, square it up (using a large vise, while twisting the axle) and reinstall. Then, try to avoid any severe, hard braking in the future. If the bracket does bend again, a metal gusset may need to be welded onto it, for added strength (*see* photo).

Another potential problem involves the M8 bolt which assists in holding the axle/mounting bracket assembly to the strut. If this bolt is over-torqued, it crushes the underlying, relatively soft strut, thus pulling the BrCal out of proper alignment with the brake disc. One solution to this problem is a shim (e.g., thin fender washer) of suitable thickness over

the damaged area of the strut, between the mounting bracket and strut, to realign the BrCal and disc.

2. ***Rhythmic Brake "Dragging" Noise During Taxiing.***–This is usually a symptom of a miss-aligned BrCal and brake disc. Refer to the problem and solutions given above in #1.

3. ***Leaking Brake Fitting.***–For a leak around the seating threads of a push-to-connect fitting, check the torque first, which should be 3.7-5.2 Ft lbs. Otherwise, a leak anywhere except where the HPL enters the fitting, indicates a bad fitting. Just replace it. However, for a leak where the HPL enters the push-tab, remove the line (depress tab/pull line), make a new, clean-and-square cut a few mm back from the end, and reinsert the line. If it still leaks, install a new fitting.

4. ***Soft or "Spongy" Brake Pedal(s).***–This indicates that air is still entrained somewhere in the brake hydraulic system. It must be bled out, using the procedures described above. Whenever the pressurized part of the hydraulic system is opened–regardless of how much, where, or for how long–it requires such bleeding.

5. ***Installing New HPLs Through the Hull.***–Be sure and read TL's instructions for this, found on-line in the "How To's" for "Co-pilot's Side Brake Installation" instructions. We also found it easy to just "butt" old and new ends of OEM Vales line together, wrap the joint with a small piece of Gorilla tape, and then pull the old line out and the new line into place. This should be a two-person job, however, with one person pulling and one feeding the line through, to prevent the taped joint from failing.

6. ***Stripped Brake-Disc Bolt.***–It doesn't take much to over-torque one of the three M10 attachment bolts and pull threads out of a wheel–and I did!

Such damage can be repaired by drilling out the damaged threads and replacing them using Heli-coil or Timesert (my preference) thread inserts.

Sources of Parts

For repair kits or new AJP parts, begin by Googling "AJP brakes," then click on the "AJPAmerica" website (usually at the top of page). Note that AJPAmerica, a US importer of (replacement) AJP parts, does not quote any prices or sell direct to the public; all pricing and purchasing is done through one of their three listed US dealers–located in CA, AZ, and IN.

1. ***AJP BrCals.***–I purchased two new brake calipers (PN: BT27722000; formerly R230001) through AJPAmerica's AZ dealer (602-370-7546) for $375, including shipping. Delivery was prompt. The two calipers in a pair are identical; bolt-up to L/R wheels depends on which *pair* of the three attachment bolts is used. These appear to be high-quality calipers, identical (as far as I can tell) to OEM, except they lack the AJP emblem on one side and have 8mm instead of 10mm bleeder screws. A re-build kit (PN: R260001) is also available; however, I did not price, purchase or otherwise evaluate one.

2. ***AJP MCs.***–New, replacement AJP master cylinders are no longer available, possibly because there were too many models for the take-over company to economically reproduce. However, rebuild kits are available and I purchased six of them (PN: 152.00.011C; AJP RP KT BT31 for AJP MC#15304) for $35 each, through the CA dealer (209-785-6878). Delivery was prompt, but I did have to resolve a billing dispute with the seller. The parts in the rebuild kits fit my OEM MCs perfectly, and I haven't had any further leaks since (100 hrs) the rebuilds.

3. ***Brake Pads–GMA "F" pad for "F" calipers.***–These pads (one set of four pads replace all) are widely available in the US on Ebay, Amazon

and from other retailers for $43-65/set. However, I always purchase mine from the nearest Harley Davidson dealer. Ask for PN:1720-0077.

4. ***Brembo MCs.***–Brembo brake components are manufactured in Bergano, Italy. Brembo (motorcycle) rear brake MCs, with 11mm pistons (top entry), gold color (PN: 10.4776.51-H-6.2) are near-identical to OEM *pilot's-side* AJP MCs on my airplane. I purchased four Brembos from Motowheels in Rancho Cordova, CA (916-369-2509) for $52.65 each. I disassembled one to compare it (piston size, length etc.) to my AJP MCs; however, none of these MCs have yet been used on my Sting. I did confirm, however, that the OEM AJP aluminum reservoirs, which sit atop pilot's-side MCs in a dual-braking system, *do* plug snugly into the top-entry port of these Brembo MCs. Just be aware that this Brembo MC is not suitable (as configured) for replacing the co-pilot's side AJP MCs in a dual-braking system. It lacks a threaded IN connection for attaching a red-or blue-tab AIGNEP HPL fitting (*see* #5-6, below).

5. ***AIGNEP (Red Tab) 5/32" Metal Swivel Elbow, 90^0 Fittings.***–These OEM fittings cannot be purchased directly in the US, but are available through TL's US distributor–SportairUSA–for about $30-$35 each.

6. ***AIGNEP (Blue Tab) 5/32" Metal Swivel Elbow, 90^0 Fittings.***–These US fittings (Mfr #87110-53-02), which TL says are suitable matches to OEM fittings, are widely available in the US for about $6-7 each. I purchased 10 (8 needed in rebuilding my braking system) from Grainger Industrial Supply (PN:5UPP0; *see* their website). Grainger has retail outlets throughout the US and sells packages of five for $34.50. The US has numerous other retailers with similar pricing.

7. ***O-Ring for Aluminum Reservoir Lid, Pilot's Side MCs.***–This O-ring has a 28mm ID and 32mm OD. Grainger retails them in packages of 10

(PN:41KW23) for $1.18. Two are needed, when you remove the two reservoir lids for cleaning the aluminum reservoirs.

8. ***LPL-Tygon 2375 Clear Brake Fluid Reservoir Hose 1/4"ID.***–This low-pressure brake fluid line, for the fluid-bottle-to-pilot's-side-MCs connection, is widely available in the US. I purchased three 1-ft pieces (more than enough to replace my aging LPLs) on Amazon for $7/ft, but other on-line sources offer pricing of $2-$5/ft for longer lengths.

9. ***HPL-OEM-Vales 4 x 2 (4mm [5/32"] OD/2mm [7/64"] ID) PA6 (L.150503) nylon line.***–This OEM high-pressure brake line used on the Sting is manufactured in Italy. I was unable to find it for sale on-line in the US. However, it is available for about $5-7/ft from SportairUSA, TL's US aircraft distributor.

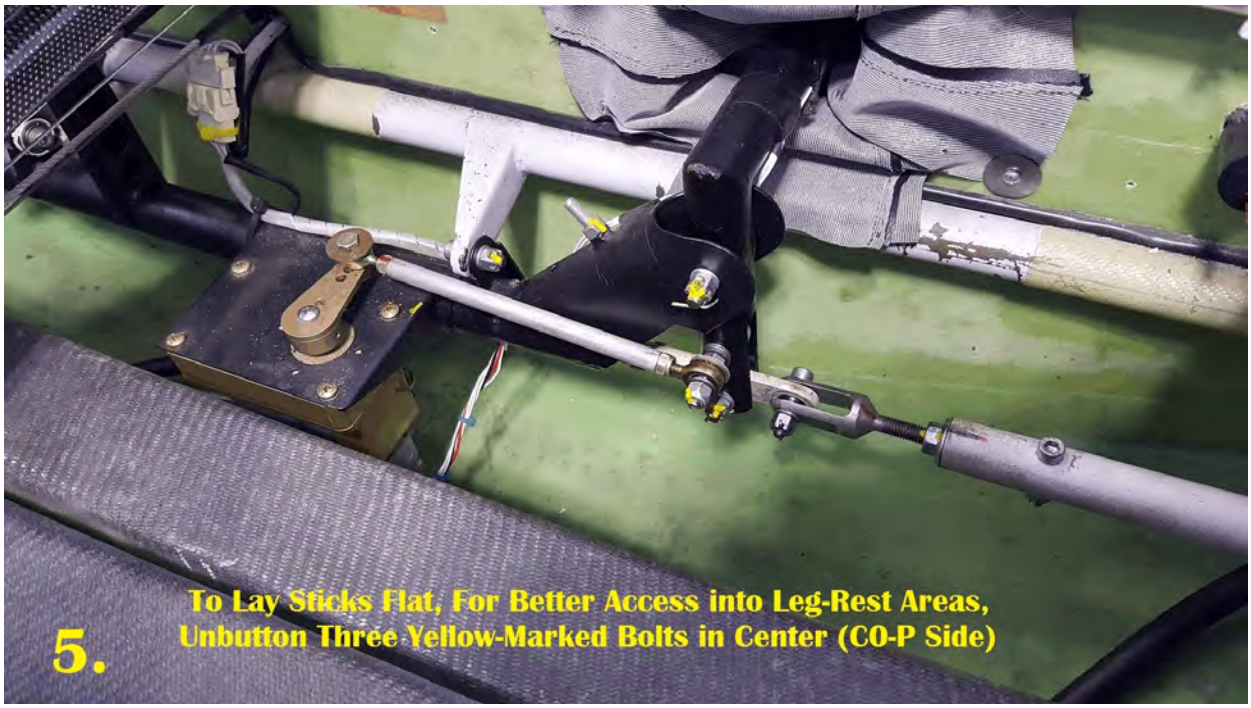
10. ***HPL-(Potential Replacement for Vales OEM)=1/8" OD (7/64" ID) Nylaflow Type H Tubing.***–This inexpensive ($0.10-$0.25/ft) line, widely available in the US, is just 1/32" smaller OD than the Vales line; however, its ID (7/64") is the same as Vales. Nevertheless, its pressure ratings (2,500 psi bursting pressure/854 psi working pressure) are adequate for small hydraulic systems, including light-aircraft braking systems, where it finds use today. However, if this 1/8" line is used, OEM red-or blue-tab 5/32" fittings would need to be replaced with 1/8" fittings. A suitable AIGNEP fitting (Mfr #87110-02-02) retails for $29.83 (pkg 5; PN:5UPL5) from Grainger. Both 1/8" Nylaflow Type H line and 1/8" AIGNEP fittings are available from numerous retailers in the US.

RWD; May 22, 2019.

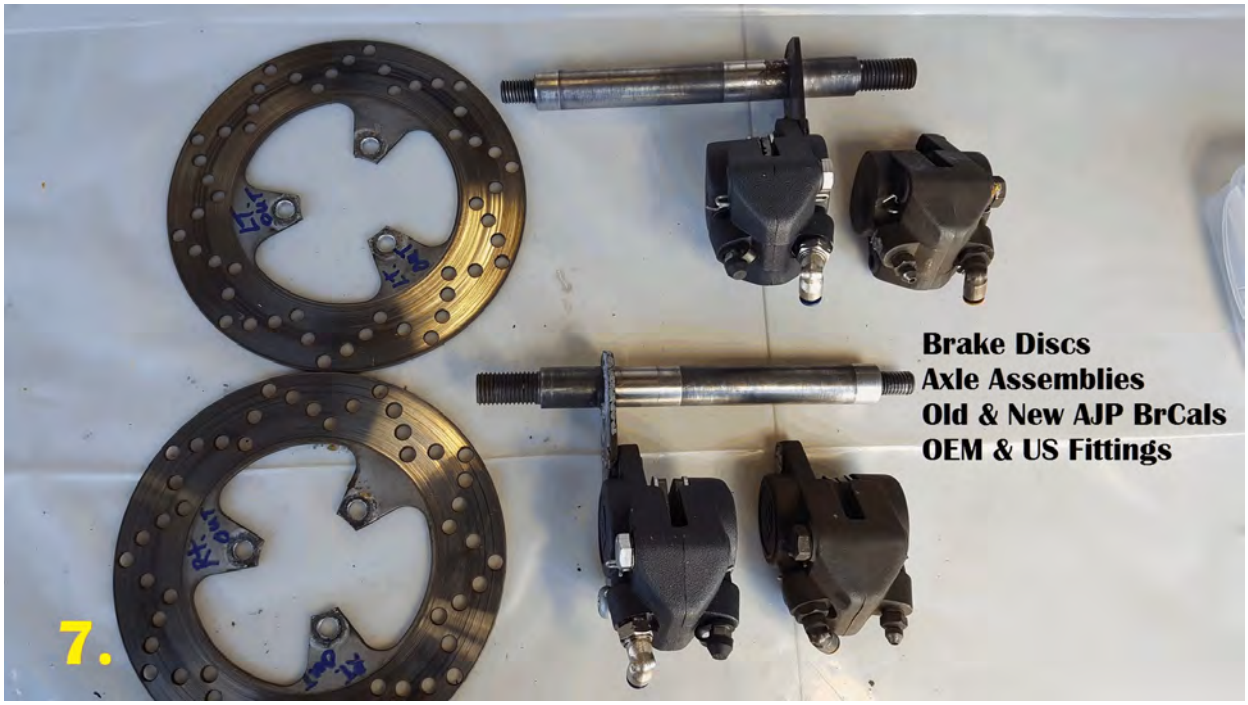
Photos Illustrating Key Points in the Text.


3. Nose and Tail Raised
3.

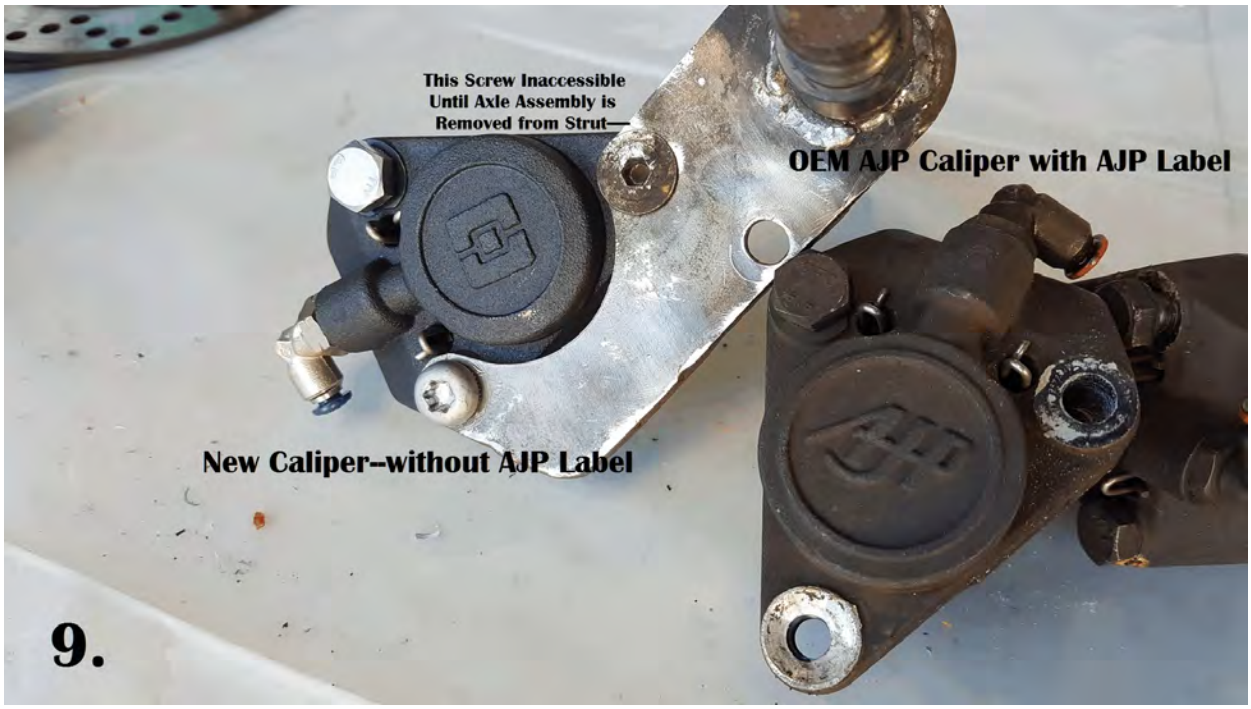

4.
4. Wings Supported with Padded Sawhorses


5.
To Lay Sticks Flat, For Better Access into Leg-Rest Areas,
Unbutton Three Yellow-Marked Bolts in Center (CO-P Side)


N161MZ
6.
Now, If You're Not TOO BIG, You Can Slide in There!


Brake Discs
Axle Assemblies
Old & New AJP BrCals
OEM & US Fittings
7.

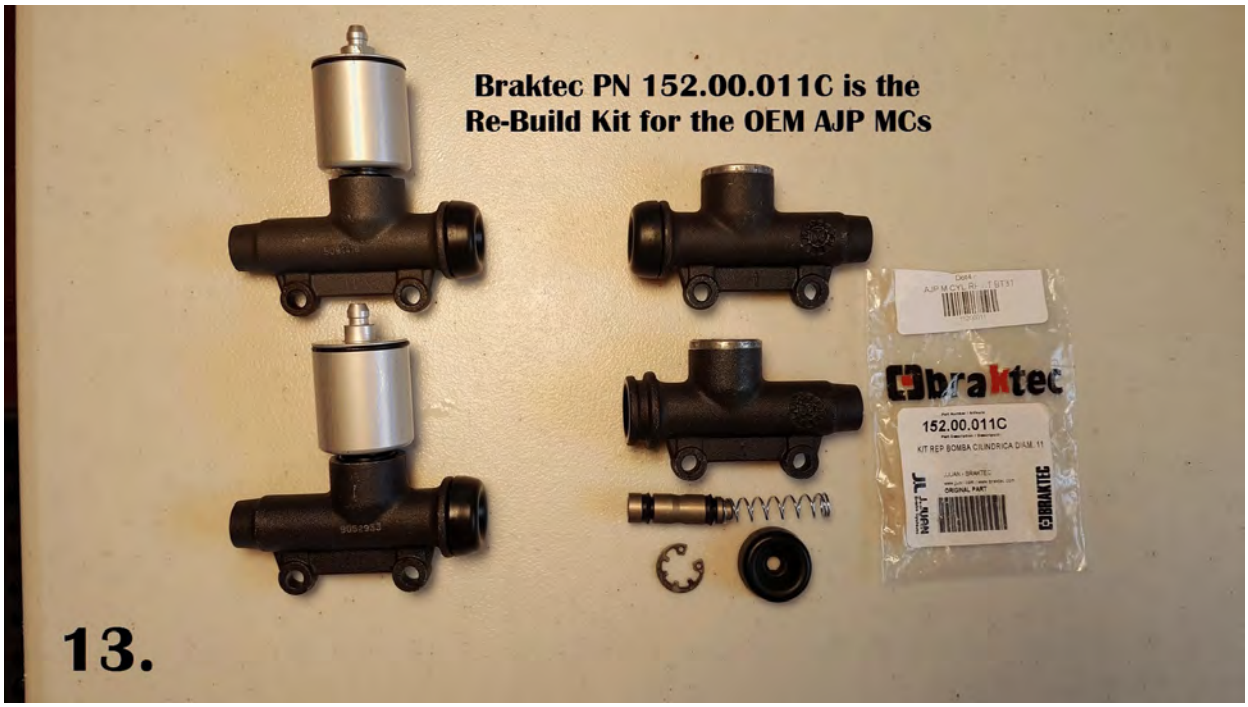

Gusset Welded to BrCal
Mounting Bracket for
Strengthening/Resisting
Bending
8.

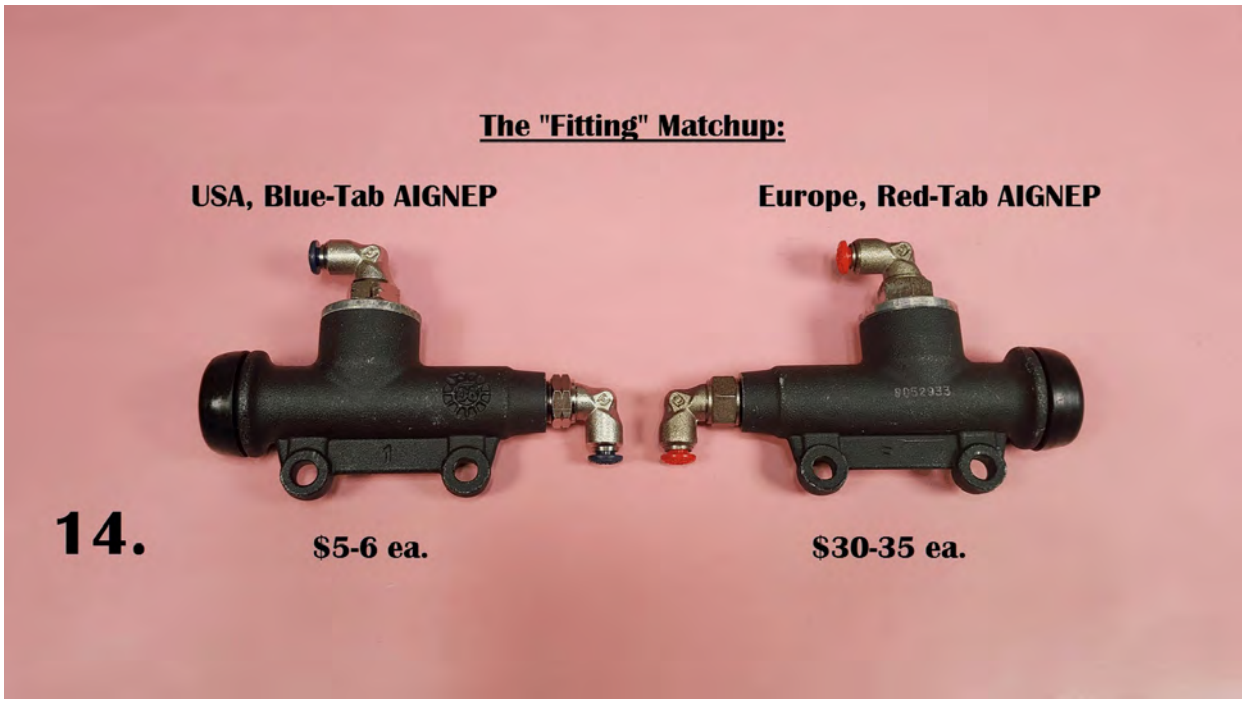

This Screw Inaccessible
Until Axle Assembly is
Removed from Strut—
OEM AJP Caliper with AJP Label
New Caliper--without AJP Label
9.


AJP-OEM
MC Parts
Cleaned and
Ready for
Re-build Assembly
10.


Pilot's (L) and Co-Pilot's (R)
Side OEM AJP MCs
And Comparable
Gold
Brembo MC
11.


inch/mm
OFF ON ZERO
CEN-TECH
The AJP Reservoir Fits Snugly into
the Brembo "Gold" Master Cylinder
Rubber
"IN" Grommet
12.


Braktec PN 152.00.011C is the
Re-Build Kit for the OEM AJP MCs
braktec
152.00.011C
13.


The "Fitting" Matchup:
USA, Blue-Tab AIGNEP
Europe, Red-Tab AIGNEP
14.
$5-6 ea.
$30-35 ea.


DOT 4
BRAKE FLUID
Home & Garden
ACE
Inexpensive Ace
Sprayer
All Connections, Yet
to be Clamped
15.


PE "Bleeder" on BrCal
Bleeder Nipple
Use Brass, Not Nylon "Joints," as Here
16.