

MATCO mfg

Wheels & Brakes

MCMC-4 SERIES MASTER CYLINDERS



MC-4, MC-4A, MC-4D, MC-4E,
MC-4F(L), MC-4F(R), MC-4F(S),
MC-4G, MC-4GH, MC-4HV,
MC-4NGA, MC-4R, and MC-4X

Technical Service Bulletin

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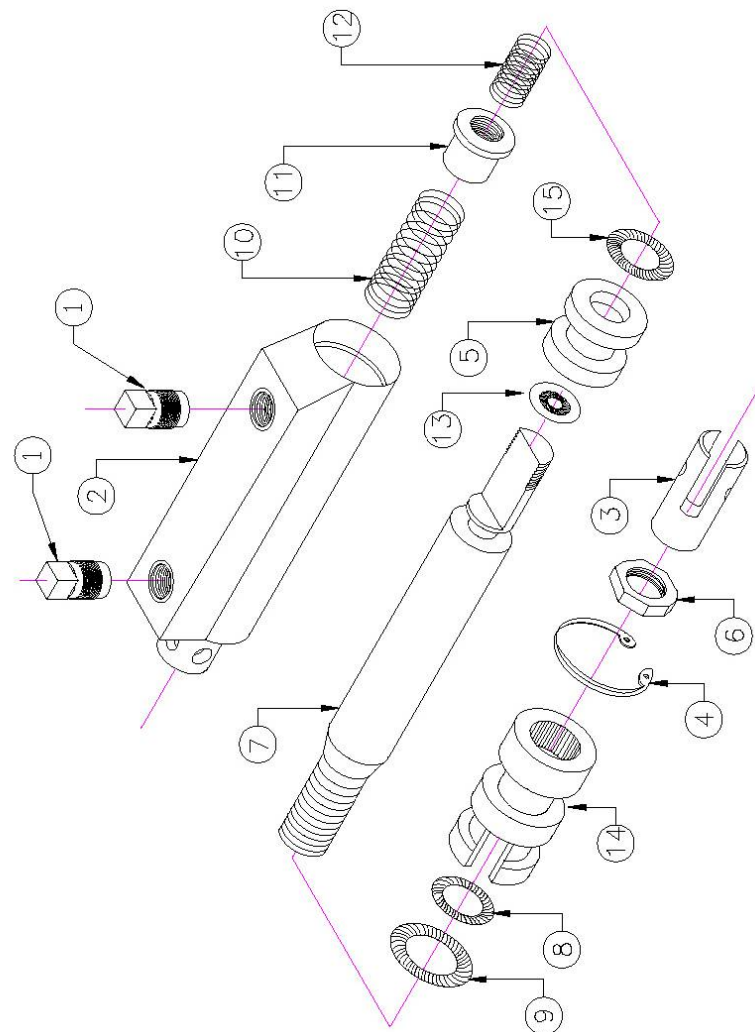
A. MC-4 SERIES MASTER CYLINDERS

The MC-4 Series Master Cylinder is a "series connected" type cylinder. It is gravity fed by a remote reservoir like the MATCO mfg R-100. The MC-4 is used primarily on toe and heel brake applications for single as well as dual brake systems. When placed under the copilot pedals and connected in series, no shuttle valve is needed in the system. MATCO mfg master cylinders feature Buna-N O-Rings to provide a leak proof seal. The MC-4 series use 1/8 NPT standard fittings and utilize long lasting industrial springs. Each shaft is ground and polished to provide smooth operating efficiency. The MC-4 master cylinder has evolved to include a series of high quality products that meet the needs of the sport aircraft community. Following is a list of available models and their specifications. in the MC-4 series of master cylinders.

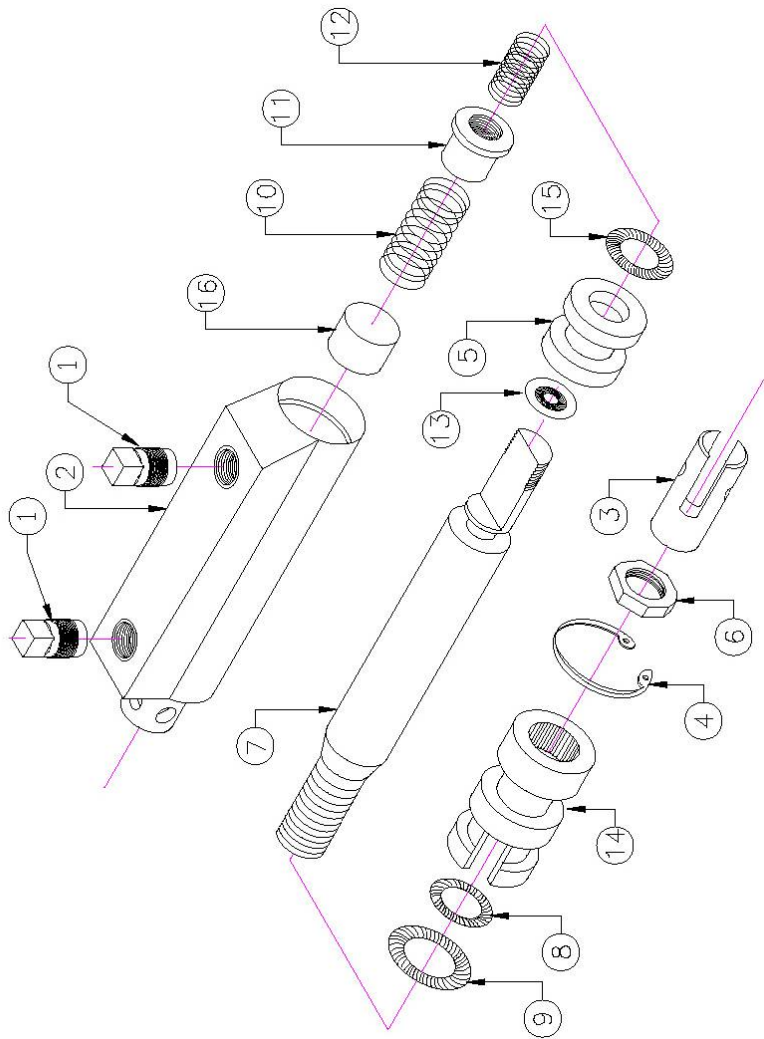
MASTER CYLINDER SPECIFICATIONS (IN)

MATCO PART #	PART DESCRIPTION	BORE (in) / DISPLACE (cu in)	INSTALL LENGTH	OVERALL LENGTH	STROKE	ANODIZE FINISH
MC-4	MASTER CYLINDER	0.625 / 0.43	7.7	8.25	1.388	GOLD
MC-4A	MASTER CYLINDER	0.625 / 0.37	7.2	7.7	1.19	GOLD
MC-4D	MASTER CYLINDER	0.625 / 0.37	6.5	7	1.19	GOLD
MC-4E	MC EXTRA	0.625 / 0.37	7	8	1.19	GOLD
MC-4F(L)	MC.62 (LEFT)	0.625 / 0.43	7	8	1.19	GOLD
MC-4F(R)	MC.62 (RIGHT)	0.625 / 0.43	7.875	8.05	1.388	GOLD
MC-4F(S)	MC.62 (SLOTTED)	0.625 / 0.43	7.875	8.05	1.388	GOLD
MC-4G	MASTER CYLINDER	0.625 / 0.37	7.875	8.05	1.388	GOLD
MC-4GH	MASTER CYLINDER	0.625 / 0.18	5	5.4	0.6	SILVER
MC-4HV	MC HIGH VOLUME	0.688 / 0.52	11.66	11.91	1.388	GREEN
MC-4NGA	MC NEW GLASSAIR	0.625 / 0.43	8.2	8.75	1.388	GOLD
MC-4R	MC REDLINE	0.688 / 0.52	11.66	11.91	1.388	BLACK
MC-4X	MASTER CYLINDER	0.625 / 0.18	5	5.4	0.6	SILVER

B. MC-4 ASSEMBLY DRAWING



C. MC-4A ASSEMBLY DRAWNG



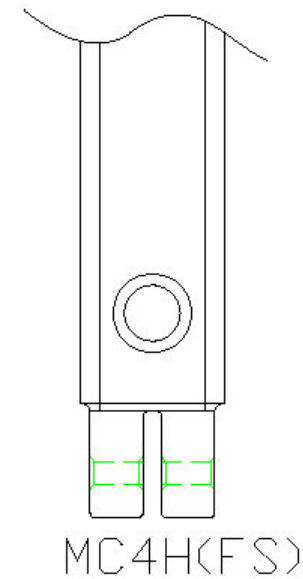
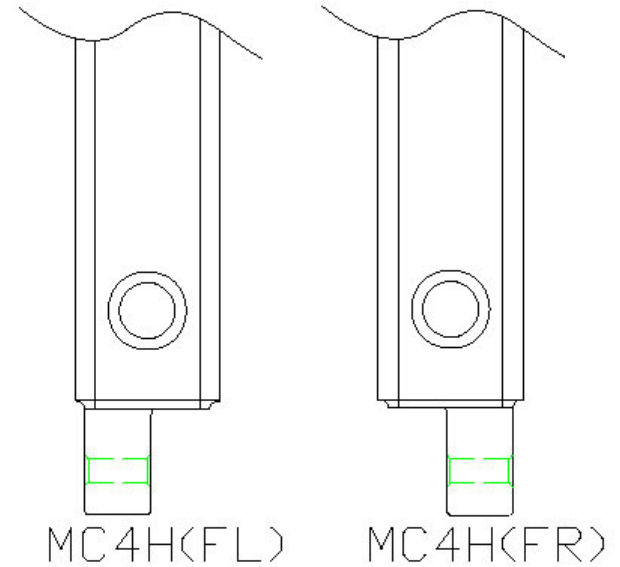
D. MC-4 SERIES PARTS LIST # 1

MCMC-4 PARTS LIST # 1									
DWG #	MATCO mfg		MODEL NUMBER / MC-						
	PART NUMBER	DESCRIPTION	4	4A	4D	4E	4F(L)	4F(R)	4F(S)
2	MCMC4H(A)	HOUSING MC-4	1	1	1				
2	MCMC4H(E)	HOUSING, EXTRA				1			
2	MCMC4H(F)L	HOUSING, LEFT					1		
2	MCMC4H(F)R	HOUSING, RIGHT						1	
2	MCMC4H(F)S	HSING, SLOTTED							1
11	MCMC-16	SPRING GUIDE	1	1	1	1	1	1	1
3	MCMC-17	CLEVIS	1	1					
3	MCMC-17S	CLEVIS, SHORT			1				
16	MCMC-18	PEDESTAL		1	1	1			
14	MCMC4-2	END GLAND	1	1	1	1	1	1	1
7	MCMC4-1	SHAFT MC-4	1						
7	MCMC4A-1	SHAFT MC-4A		1	1				
7	MCMC4D-1	SHAFT MC-4D			1				
7	MCMC4E-1	SHAFT, MC4E				1			
7	MCMC4F-1	SHAFT, MC-4F					1	1	1
5	MCMCP.625(B)	PISTON .625	1	1	1	1	1	1	1
6	MSC.31-24JAMNUT	JAM NUT	1	1					
8	MSC2-012	O-RING	1	1	1	1	1	1	1
15	MSC2-111	O-RING	1	1	1	1	1	1	1
9	MSC2-112	O-RING	1	1	1	1	1	1	1
4	MSC3000-X68	SNAP RING	1	1	1	1	1	1	1
13	MSC600-0101-10	STAT-O SEAL	1	1	1	1	1	1	1
12	MSCC0300-026-0440M	SPRING, VALVE	1	1	1	1	1	1	1
10	MSCC0480-055-2500M	SPRING		1	1				
10	MSCC0480-055-3000M	SPRING	1			1	1	1	1
N/A	MSLABELMATCO-4	LABEL, MC-4	1						
N/A	MSLABELMATCO-4A	LABEL, MC-4A			1				
N/A	MSLABELMATCO-5	LABEL, SILVER			1	1	1	1	1
1	MSCP-18	THREADED PLUG	2	2	2		2	2	2

E. MC-4 SERIES PARTS LIST # 2

MCMC-4 PARTS LIST # 2								
DWG #	MATCO mfg		MODEL NUMBER / MC-					
	PART NUMBER	DESCRIPTION	4G	4GH	4HV	4NGA	4R	4X
2	MCMC4H(A)	HOUSING MC-4	1			1		
2	MCMC4H(GH)	HOUSING, EXTRA		1				1
2	MCMC4H(R)	HOUSING, REDLINE					1	
11	MCMC-16	SPRING GUIDE	1	1	1	1	1	1
3	MCMC-17	CLEVIS	1		1			
3	MCMC-17S	CLEVIS, SHORT		1				
3	MCMC-17L	CLEVIS, LONG				1		
3	MCMC-17M	CLEVIS, METRIC						1
16	MCMC-18	PEDESTAL	1					
14	MCMC4-2	END GLAND	1	1	1	1	1	1
7	MCMC4-1	SHAFT MC-4			1	1		
7	MCMC4G-1	SHAFT MC-4G	1					
7	MCMC4-1GH	SHAFT MC-4GH		1				1
7	MCMC4R-1	SHAFT MC-4®					1	
5	MCMCP.625(B)	PISTON .625	1	1		1		1
5	MCMCP.688(B)	PISTON, REDLINE					1	
6	MSC.31-24JAMNUT	JAM NUT		1	1	1		1
8	MSC2-012	O-RING	1	1	1	1	1	1
15	MSC2-111	O-RING	1	1		1		1
9	MSC2-112	O-RING	1	1	2	1	1	1
4	MSC3000-X68	SNAP RING	1	1	2	1	1	1
13	MSC600-0101-10	STAT-0 SEAL	1	1	1	1	1	1
12	MSCC0300-026-0440M	SPRING, VALVE	1	1	1	1	1	1
10	MSCC0480-055-2250M	SPRING MC-4GH		1				1
10	MSCC0480-055-2500M	SPRING	1					
10	MSCC0480-055-3000M	SPRING			1	1	1	

F. MC-4F LEFT, RIGHT, AND SLOTTED



G. MC-4 SERIES MASTER CYLINDER ASSEMBLY

NOTE: The following assembly instructions are intended as a general guideline for the assembly of all MC-4 master cylinder models. The parts list will vary slightly with each model, but the sequence for assembly is the same.

SHAFT ASSEMBLY

1. Place the stat o-seal, part number (**13**), onto the o-ring groove of the MC4-1 shaft, PN (**7**), making sure that the o-ring is not damaged and is fully seated in the groove.
2. Using Buna o-ring, PN (**15**), install it on to the o-ring groove of the piston, PN (**5**). Make sure that the o-ring is not damaged and is fully seated in the groove.
3. Place the Piston, PN (**5**), on the shaft with the flat side of the piston resting against the stat-o-seal, PN (**13**),
4. Install the valve spring, PN (**12**), into the counter bore of the piston, PN (**5**).
5. Using Loctite Black Max adhesive, apply a light coat of adhesive sparingly to the half thread portion of the MC4-1 shaft, PN (**7**), (10-32nd thread). Thread the spring guide, PN (**12**), (flange end first) firmly onto the shaft until the end of the shaft is flush with the outside end of the spring guide. Using Loctite solvent, remove any excess adhesive.

END GLAND ASSEMBLY

1. Install o-ring 2-012, PN (**8**), into the interior o-ring groove of the end gland, PN (**14**), making sure that it is seated properly.
2. Install o-ring 2-112, PN (**9**), onto the outer o-ring groove of the end gland, PN (**14**), making sure that it is seated properly.
3. Using caution, slide the end gland assembly over the threaded portion of the shaft, slotted end first. Continue to slide the end gland on to the shaft until it is seated firmly against the piston.
4. Allow shaft assembly to dry for 24 hours.

FINAL ASSEMBLY

1. Inspect the housing bore, PN (**2**), using adequate lighting to insure that no burrs, chips or foreign materials are present, and that no damage has occurred to the bore. Housing bore may be polished with a Scotch Brite pad (green # 96).

NOTE: Master Cylinders MC-4A, MC-4D, MC-4E & MC-4G Require a Pedestal PN (**16**) on the MC-4A drawing. The pedestal is inserted into the bore of the housing at this point in the assembly. The machined end of the pedestal facing up, and the flat end resting against the bottom of the bore.

2. Place spring, PN (**10**), into the bore of the housing and make sure that the spring is fully seated.
3. Generously lubricate the piston o-ring, PN (**15**), and the end gland exterior o-ring, PN (**9**), with petroleum jelly. Insert shaft assembly, (piston end first), into the bore of the housing, PN (**2**), making sure that the piston o-ring is not damaged as it passes over the snap ring groove.
4. With the shaft assembly securely seated in the bore, firmly press the end gland, PN (**14**), below the snap ring groove, and using a pair of snap ring pliers, install the snap ring, PN (**4**), into place. Make sure that the flat side of the snap ring faces away from the end gland assembly.
5. Fill assembly with MIL-H-5606 brake fluid. **Do Not use automotive glycol based brake fluids such as DOT 3, DOT 4, and DOT 5.1**

MATCO mfg. strongly recommends MIL-H-5606.

H. HYDRAULIC PRESSURE TEST

1. Plug outlet hole with a 1/8 in NPT plug.
2. Fill bore of assembly with Mil-H-5606 red aircraft fluid and make sure that no air bubbles remain in the assembly.
3. Using a hydraulic press, or suitable tool, pressurize the assembly to between 800 and 1000 PSI. The assembly should start to pressurize after a stroke of no more than .25 inches (1/4 of an inch).
4. Apply a minimum side load pressure of 20 pounds to ensure that the assembly maintains its pressure.

I. CLEVIS ATTACHMENT

1. Thread the jamnut, PN (6), on to the shaft of the master cylinder.
2. Thread the clevis, PN (3), onto the shaft of the master cylinder until it is flush with the 1/4 inch milled cut out. Tighten the jamnut firmly against the bottom of the clevis.

J. OPTIONAL INTENSIFIER

MATCO mfg. offers an intensifier kit, part number MC-4I, that will provide a 50 percent increase in pressure through the use of a (1/2") .50 inch piston. This kit can be installed at the factory or in the field.

NOTE All o-rings in the brake and master cylinder, are Buna Nitrile and are **NOT compatible with automotive glycol based brake fluids** such as DOT 3, DOT 4, and DOT 5.1.

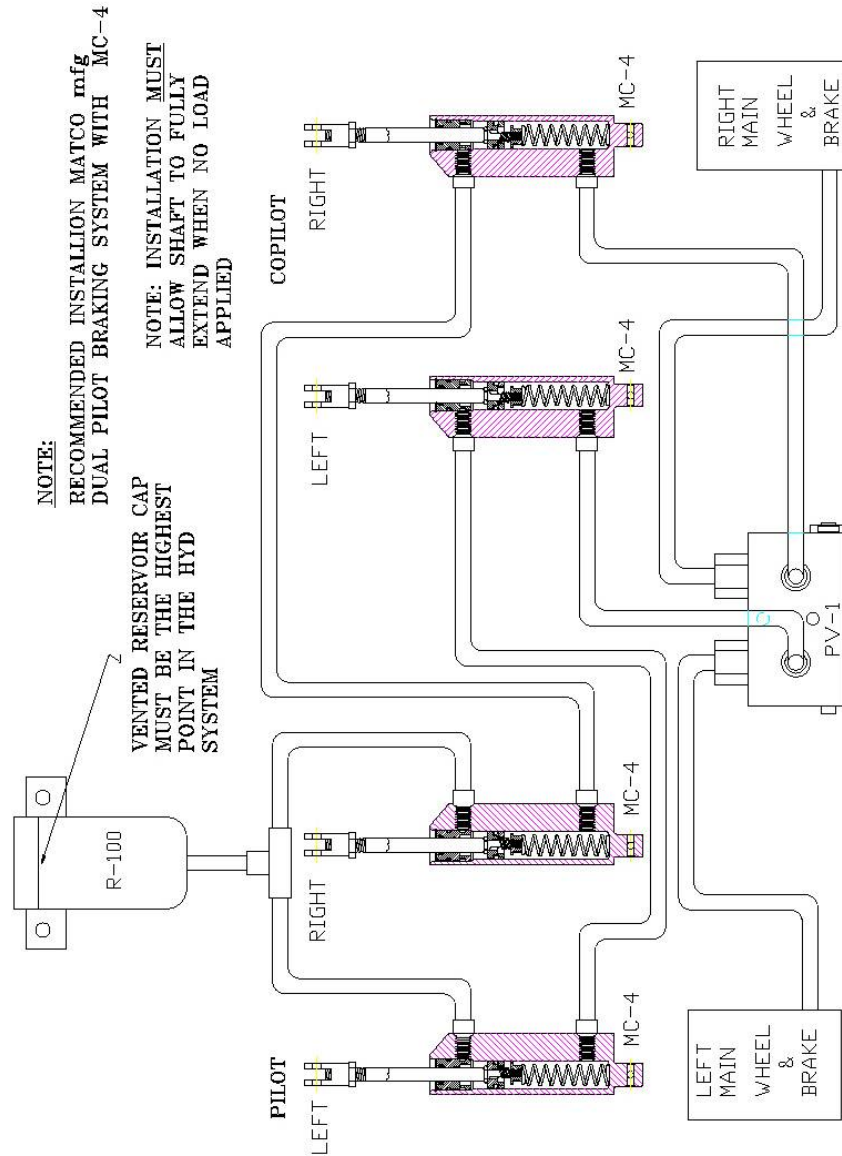
MATCO mfg. strongly recommends MIL-H-5606.

K. MC-4 REBUILD KITS

MATCO mfg rebuild kits are available for all models of master cylinders. By following the general MC-4 assembly instructions in this manual, your master cylinder can be rebuilt in a short period time. A pair of snap ring pliers is recommended for the job, and can be purchased through one of several aviation catalog suppliers.

MC-4 REBUILD KITS		
PART #	DESCRIPTION	REBUILD KIT PART #
MC-4	MASTER CYLINDER	MCMCRBD4
MC-4A	MASTER CYLINDER	MCMCRBD4A
MC-4D	MASTER CYLINDER	MCMCRBD4A
MC-4E	MC EXTRA	MCMCRBD4A
MC-4F(L)	MC.62-LEFT	MCMCRBD4
MC-4F®	MC.62-RIGHT	MCMCRBD4
MC-4F(S)	MC.62-SLOTTED	MCMCRBD4
MC-4G	MASTER CYLINDER	MCMCRBD4A
MC-4GH	MASTER CYLINDER	MCMCRBD4X
MC-4HV	MC HIGH VOLUME	MCMCRBD4R
MC-4NGA	MASTER CYLINDER	MCMCRBD4
MC-4R	MC REDLINE	MCMCRBD4R
MC-4X	MASTER CYLINDER	MCMCRBD4X

L. HYDRAULIC INSTALLATION



M. PEDAL GEOMETRY

The importance of good pedal geometry can make the difference between a marginal performing brake system, and one that gives maximum braking performance to the wheels.

It is important that the calipers are properly mounted so that the pads make contact on both sides of the disc (both new and worn) and are maintained so that the calipers float freely.

With that said, the most common reason for under performance in a brake system, is low pressure. **MATCO mfg. brakes require 450 pounds per square inch of hydraulic pressure** to achieve their rated torque. Additional calipers can be added to get higher torque at lower pressures, but is often more weight efficient to modify the hydraulic system pedal geometry to generate higher pressures. As a minimum, systems using hand or foot operated master cylinders such as the MC-4, MC-5 or MC-7 series, require a 2.5 to 1 mechanical advantage. The MC-4 & MC-5 have a .625 inch diameter pistons. (*Systems using MC-4 or MC-5 with intensifiers have .500-inch pistons and require a 1.6 to 1 mechanical advantage*). Mechanical advantage, MA, is the ratio of the force applied to the master cylinder shaft divided by the force applied by the hand or foot. **Dia.1** shows two examples of pedal geometry. The first has an MA of 1 to 1 since the distance from the applied load to the pivot point is the same as the distance to the MC and is undesirable. The second shows a more favorable configuration that will easily provide the required pressure to the brakes with moderate toe force. It is often necessary to keep the foot pedal shorter than that shown in **Dia.1**. An alternate geometry is shown in **Dia.2**. This design would utilize a fork arrangement on the MC connection to allow clearance of the MC body and then a short linkage to the MC connect point. A design common to many aircraft uses linkage as shown in **Dia.3**. This design also allows for a shorter brake pedal but has a major disadvantage.

This linkage can be configured to have a proper MA in the start position (with the master cylinder fully extended). The MA varies with rotation however, as shown in **Fig.2** of **Dia.3**, a 15 degree rotation of the linkage reduces the MA at the start position from 1.5 to 1 down to only 1.12 to 1. In actual operation, this has the effect of causing a nearly constant brake torque even though increasing force is applied. For example, if the geometry is set for an initial MA 2.5 to 1. In the start position and the pilot applies pedal force, the MC will begin to stroke as pressure builds. As the rotation occurs, the MA decreases. If there is any air in the brake lines or if there are long brake line runs, hydraulic system expansion will occur as pressure increases requiring more MC stroke. If the pilot applies more pedal force, more MC stroke occurs, and the MA decreases further. Even though the pilot has now increased his pedal force, the force applied to the MC will be only marginally increased because more rotation will result and cause a further decrease in MA. A geometry like that in **Dia.2** will provide the same reduced pedal height and is not prone to the effect of rotation since the MC is essentially connected to the brake pedal pivot. **Dia.4** illustrates the benefit of pivot connect geometry during rotation. The MA remains virtually unchanged for expected rotation angles and results in a linear pressure increase with applied pedal force.

HEEL BRAKES

A common means of providing pilots with differential braking ability without resorting to a more complicated geometry of toe brakes is to use heel brakes. The same design requirements exist for the MA of a system using heel brakes as for toe brakes. It is not uncommon to see MC's configured to allow the pilot to apply heel force directly to the MC by means of a pad or button connected on the end of the shaft. This configuration is shown in **Fig.1** of **Dia.5**. The MA of this system is 1 to 1 and produces very low pressure for reasonable heel force. Perhaps a larger concern however is the potential for causing damage to the MC. The MC is designed to accept loads applied along the length of the shaft.

Loads applied off axis or perpendicular to the shaft cause bending moments in the MC shaft that it is not designed for. Damage to the MC end gland, or bending of the MC shaft may result if the off axis loads are high enough. A more desirable configuration for heel brakes is shown in **Fig.2** of **Dia.5**. This system uses a short linkage connected to the MC that provides the 2.5 to 1 MA while insuring that loads will be applied along the length on the MC and prevent any damage during actuation.

CONCLUSION

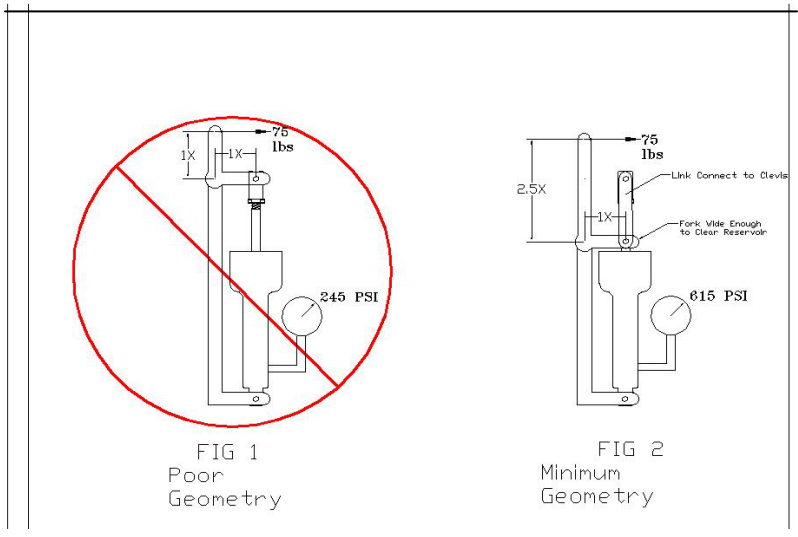
Like any system on an aircraft, the hydraulic system has many engineering options for providing the necessary requirements. The systems common on light aircraft must be engineered to provide adequate pressure to the brakes to achieve the rated torque.

<p>NOTE MATCO mfg. Brakes require 450 psi to achieve Their rated torque.</p>

The pedal geometry whether hand, toe, or heel operated, requires a mechanical advantage of at least 2.5 to 1. This allows the pilot to easily generate the required 450-psi with moderate applied force. Pivot connected geometry provides the best means of accomplishing this requirement without the problem of rotational effect that reduces mechanical advantage.

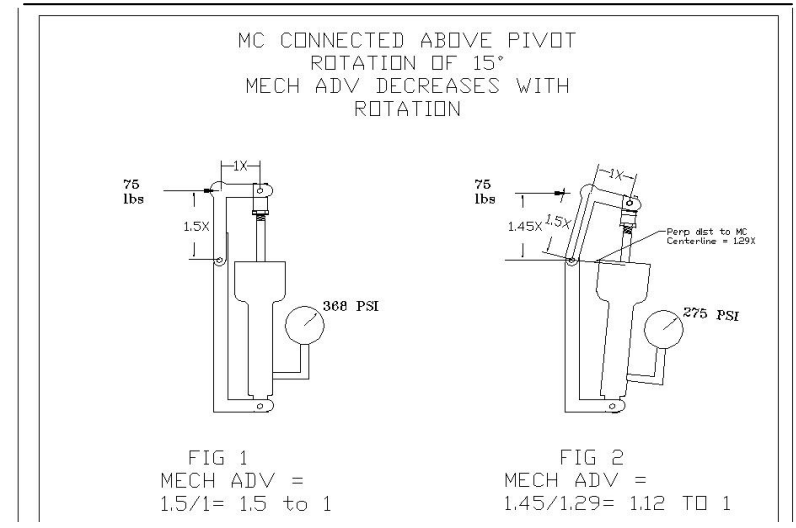
PEDAL GEOMETRY / POOR & MINIMUM

Dia. 1 Figures 1 & 2



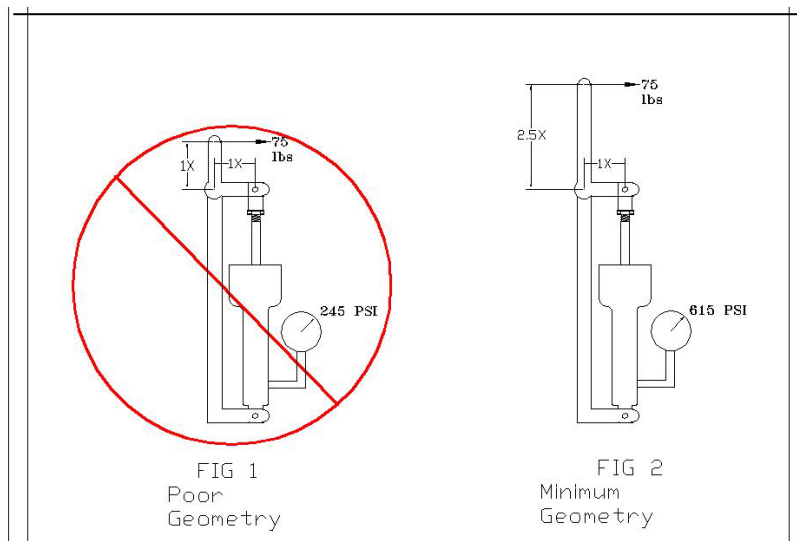
PEDAL GEOMETRY / MECHANICAL ADVANTAGE

Dia. 3 Figures 1 & 2



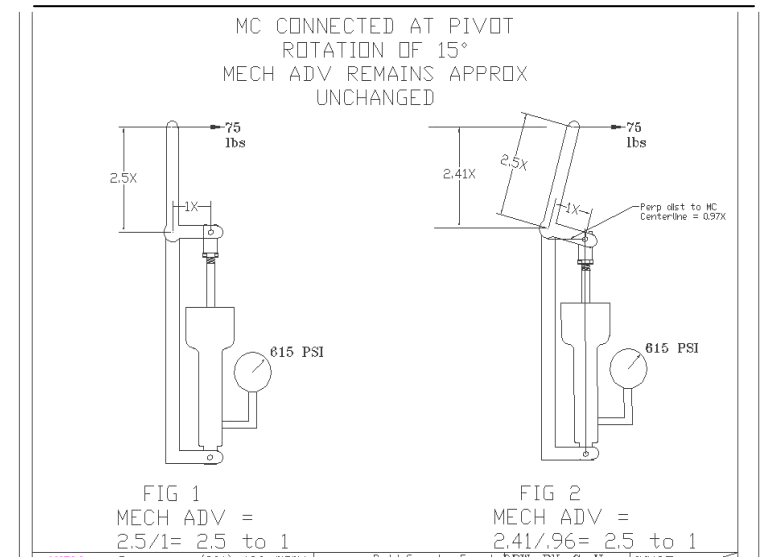
PEDAL GEOMETRY / POOR & MINIMUM

Dia. 2 Figures 1 & 2



PEDAL GEOMETRY / PIVOT CONNECT

Dia. 4 Figures 1 & 2



PEDAL GEOMETRY / HEEL BRAKES

Dia. 5 Figures 1 & 2

MASTER CYLINDER INFORMATION PAGE

MODEL NUMBER _____

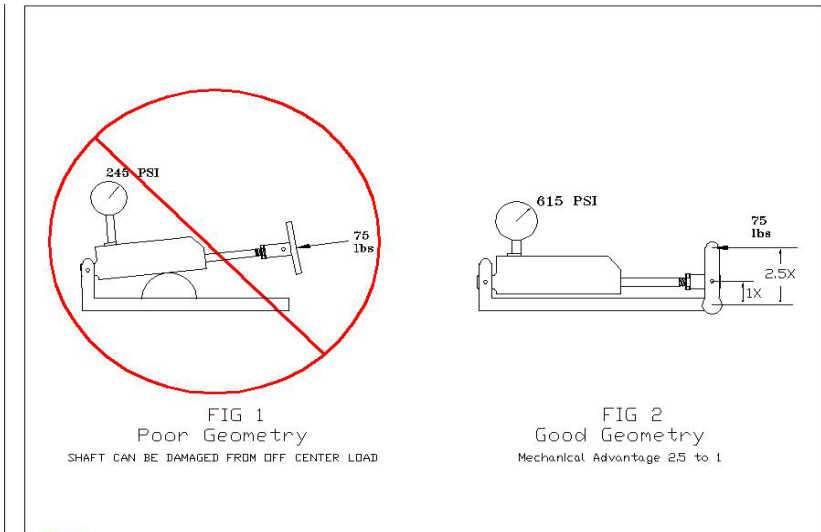
BORE / DISPLACEMENT (pg. 3) _____

INSTALL LENGTH (pg. 3) _____

STROKE (pg. 3) _____

CLEVIS (pg 7 or 8) MC-17S _____ MC-17 _____ MC-17L _____

HYDRAULIC FLUID _____ MIL-H-5606 _____



N. TECHNICAL ASSISTANCE

For technical Information, Product Matching, and Helpful Hints, see our website at:

www.matcomfg.com

E-mail our technical service manager for specific information at:

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To speak with someone in person about specific products or receive answers to technical questions, please contact us at

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