

Dual-Rate* Vacuum Brake Booster

LSC130T-HEDR-F

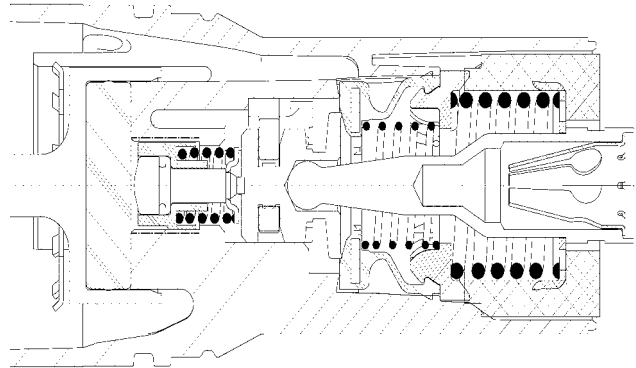
It must first be pointed out that the name **Dual-Rate** is a misnomer. The design of this system causes two slope changes in the control area of the characteristic curve (the later kneepoint is the third bend). This is however (in our opinion) an advantage, since this type of curve gives the customer exactly what he wants in an emergency namely => **Progressive pedal feeling.**

As in the case of conventional boosters the input/output ratio depends on the relationship between the loaded surface areas of the ratio disc and the output rod. The main difference from the standard booster is that the effective area of the ratio disc in the **Dual-Rate** case is divided into two parts. This effects the required area change during actuation.

When loaded to a given point (stress increase in the reaction disc) the outer ring **Dual-Rate-Sleeve** is displaced relative to the core area of the ratio disc. The start of the relative movement is determined by the preload force of the **Dual-Rate-Spring**. This force can be set to match customer requirements. The first knee point should occur at about 35 to 40 bar of master cylinder.

The second kneepoint occurs when the the external pressure area, which is determined by the Dual-Rate-Sleeve, abuts the carrier step of the valve body (vacuum piston). From this point on the pressure or effective area, originally determined by the ratio disc alone, extends into the external annular area of the valve body (servo area) and becomes virtually an integral part of the vacuum piston. The actual nominal boost ratio of the **Dual-Rate** now takes effect. The characteristic curve remains at this boost ratio right up to the power run-out knee point. The distance between these two knee points is determined by the **sleeve gap** and the rate of the Dual-Rate-Spring. The smaller the gap and the lower the spring rate the closer the two knee points.

The above description applies to the standard boost curve test, with a pressure build rate of 20 ± 10 bar/s. The peculiar properties of the Dual-Rate curve can only be fully displayed at this actuation speed. Fast actuation shifts the curve to the right, i.e. pressure lag occurs also in this case. The ratio change is then less noticeable.



Response times are not affected by the Dual-Rate function. This applies when comparisons are made on the same criteria, i.e. the same controlled pressure. In this case one must take account of the fact that the Dual-Rate function lowers the boost run-out point. However the performance above run-out remains on the same level. The advantages of **Dual-Rate** are confined to the control area of the curve (up to kneepoint pressure). The step in the curve is still visible in the return stroke but is not so distinct.

The remarkable feature of this Dual-Rate is that the whole function takes up no more space than the normal ratio disc of a tandem booster, which means that an interchange can be made in both directions. The five (four) part Dual-Rate packet can be assembled in place of the solid ratio disc

Der Dual-Rate is in production since end of 2001

Specifications (LSC130T-HEDR-F / Opel-Epsilon)

- Length of booster = 140 +/- 1,5 mm
- Outside diameter = 246 mm (max)
- Front bolted (101,8 mm diagonal)
- HE valve
- Click fit / Input rod
- Shell material = 1,0 mm steel sheets
- Whole weight = 4200 gr
- Dual-Rate / Ratio step = 5,5 to 12
- Threshold load = 85 +/- 15 N
- Pressure level at 200 N input = 27 +/- 3 bar
- Kneepoint pressure about 120 bar (at 0,8 bar vac.)
- Master cylinder diameter = 25,4 mm

MBA Mechanical Brake Assist

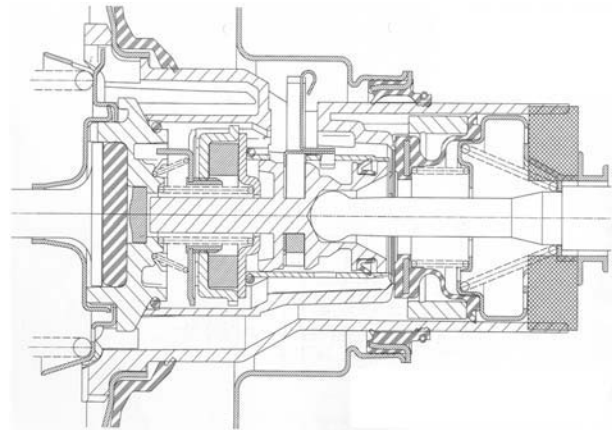
LSC95 – F mBA

Basic design and main components of the mechanical brake assist comply with the conventional vacuum brake booster. With normal brake operation, which corresponds to the majority of vehicle operations, the mechanical brake assist does not differ in power or in function from the conventional brake booster.

Beyond this, the mechanical brake assist is designed in such a way as to provide the driver with another highly important function, besides the old, familiar and highly valued characteristics. It already provides its full power at a very low force level from a certain application speed in brake actuation. As with our earlier SL-version, the MBA, in this case, also utilizes the relative travel between input rod and vacuum piston occurring at higher application speeds, because of the mass inertia. However, while with the SL-booster the relative travel related to the fast application of a normal brake booster cannot be maintained for the duration of the application (the vacuum piston will catch up with the input rod due to the expansion in the atmosphere chamber), a permanent magnet in the MBA maintains the reached position and keeps the valve fully open. The inlet valve (plunger or control piston) maintains its maximum opening stroke, as long as the driver keeps up the application. Just like the electric brake assist, the rear working chamber of the booster in this case is permanently connected to the atmosphere, which ensures full application of the vacuum piston and therefore maximum servo power. The ABS regulates (reduces) the often too high kneepoint or brake assist pressure to a usable level. This ensures that optimal brake power is always available for the driver in emergency situations. The brake pressure is main-tained in the system until the driver has reduced the pedal force to a relatively low level (pedal force of < 20 N). When this low pedal force is reached, the brake pressure is quickly reduced. The pressure remaining in the brake depends on the force the driver applies to the brake pedal after releasing the MBA.

The brake assist application threshold can mainly be determined and adjusted via the clearance between magnet and armature. To a certain extent, further criteria additionally influence the activation performance. Besides the shore hardness of the reaction disc, the ratio disc setting dimension, the system stiff-ness, the spring forces, etc., the value of the applied vacuum must be mentioned here first. The lower the vacuum, the earlier the brake assist is activated. This is caused by the fact that a lower vacuum energy supports the relative movement needed for activation, but lowers the kneepoint pressure at the same time. In this respect it is important to know that due to the design the MBA is automatically activated no matter how fast the application is performed.

With respect to the brake assist function, exactly the same requirements as for the electrical brake assist also apply for the mechanical solution.



Additional parts for BA - function (compared to standard)

1. Magnet (permanent)
2. Magnet retainer spring
3. Control piston (armature)
4. Control piston spring
5. Plunger seal
6. Shock absorber + silencer unit (return stroke)

Comparison of both brake assy types

a) Electrical brake - assist b) Mechanical Brake assist

- Stroke sensor (vac. piston)	=> not required
- Control unit (electrical)	=> not required
- Solenoid	=> permanent magnet
- Release switch	=> not required
- Wiring harness	=> not required

The mechan. brake assist is in production since end of 2001

Specifications (LSC95 - F / Renault P2)

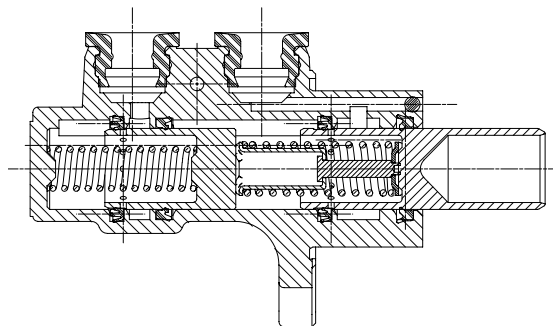
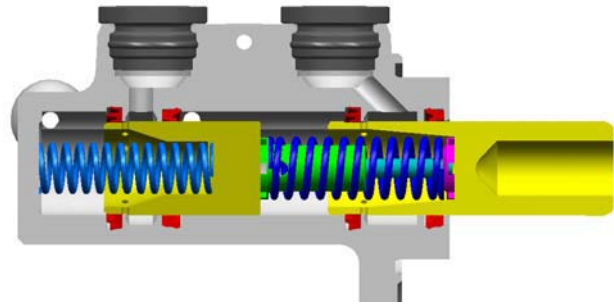
- Length of booster only = 87 +/- 0,75 mm
- Outside diameter = 298,4 mm (max)
- Front bolted (101,8 mm diagonal)
- Click fit / Input rod
- Shell material = 0,8 mm steel sheets
- Whole weight = 3700 g
- Boost ratio = 6,5 (nom)
- Threshold load = 84 +/- 20 N
- Pressure level at 200 N input = 33 +/- 4 bar
- Kneepoint pressure about 115 bar (at 0,8 bar vac.)
- Master cylinder diameter = 23,81 mm
- Activation of brake assist at 95 mm/s (at 600 N)

FS Master Cylinder

The FS-Master Cylinder enables a range of applications with diameters from $\varnothing 20.64$ mm up to $\varnothing 26.99$ mm, and strokes from 31 mm up to 52 mm. The Mounting distances are able to cover the European standards 90 or 101.8 mm under 45° as well as the Japanese standards 80x60 or 80 mm under 0° , considering installation angles from 0° to 30° upwards.

The denomination of FS-Master Cylinder reflects a design characteristic of this product. "FS = Fixed Seal". The seals in charge of isolating the brake fluid in two different circuits are located in the Master Cylinder housing, not on the MC Plungers (Compact Master Cylinder Design). In this way the design can be optimized regarding space and provides a shorter overhang of Master Cylinder being mounted into the booster. Therefore, this design characteristic enables a more **compact installation packaging**.

The overhang in case of standard Master Cylinder applications is 95 mm. When a short overhang is required, it can be reduced to 83.5 mm.



This stationary seal design offers a **short lost stroke** due to a special seal design. It enables a high flow rate even for short cut-off values of 1.75 mm Max., and therefore provides **compatibility with latest generation of VSC systems** in vehicle.

In comparison to other stationary seal concepts, the FS-Master Cylinder design shows a higher integration of functions. Guiding and recuperation functions as well as positioning and retention of the seals in the Master Cylinder housing have been reviewed. In this way, the number of components has been dramatically reduced in comparison to Compact Master Cylinders equipped with central valves. The FS design shows **less components** with positive impact on cost and quality.

FS-Master Cylinder SOP Nov 2005

Specifications (FS Master Cylinder)

- MC diameters range : $\varnothing 20.64$ to $\varnothing 26.99$ mm
- Stroke ranges: from 31 mm to 52 mm
- Mounting distances:
90 or 101.8 mm under 45° (EU stds.)
80x60, or 80 mm under 0° (Japanese stds.)
- Installation angle 0° - 30° upwards
- Overhang from booster
Standard: 95 mm
Short overhang: 83.5 mm
- Input/output efficiency at 50 bar and RT: $>90\%$
- Cut-off: 1.75 mm Max
- Compatibility with all slip control systems, including the latest generation of vehicle stability control systems