EU Directive on Brake Assist

The target of a Brake Assist System ...

... is to significantly **reduce the pedal force** needed for full activation of braking up to the ABS operation level, in order to gain an advantage in any **emergency situation**.

According to “ECE/TRANS/WP29/GRRF/2008/2”

There are 3 types of BAS are being considered:

- Systems sensitive to brake pedal force
- Systems sensitive to brake pedal application speed
- Systems sensitive to combinations of brake pedal application speed and further qualifying parameters such as force.

**All systems adjust the pressure response to brake pedal input**
To meet the target of a Brake Assist System

In an EMERGENCY situation the driver must:
a) be paying attention to the road ahead...
b) detect the pedestrian...
c) see that this is an emergency !!!
d) immediately release the throttle and rapidly....
e) hit the brake pedal as hard as possible.

Brake Assist helps those drivers who, for some reason, cannot apply sufficient force to the pedal.
ACEA / WP29 on 20 Jan 2005, described a force sensitive systems as:

“Systems sensitive to brake pedal force have a different characteristic of pedal force versus brake pressure for small and high pedal forces....”

This requirement can, as one cost effective solution, be fulfilled by an optimized Dual Rate booster.
EU Directive 2003/102/EC

Acceptance criteria for FORCE sensing devices using dual rate boost:

The additional pedal effort from the threshold point up to the line pressure level which achieves ABS operation on a high adhesion surface, must be reduced by between 40% & 80% compared to a vehicle using a standard braking system having only the single (initial) boost ratio.

This is to be calculated using the following method:
Acceptance criteria for force sensing devices

\( a_{ABS} \) = Deceleration for ABS operation
\( F_{ABS} \) = Pedal force to obtain ABS operation
\( F_{ABS \text{ extrapolated}} \) = **Theoretical** pedal force to obtain ABS operation if only an initial boost ratio is present

**Remark:**
\( a_T \) shall be between 3.5 ~5m/s\(^2\)

This appears to be based on the underlying assumption (shown dotted) that the projected braking characteristic will be **linear**.

**Dual Rate is OK, if:**

\[
40\% < \left( \frac{F_{ABS \text{ extrapolated}} - F_{ABS}}{F_{ABS \text{ extrapolated}} - F_T} \right) < 80\%
\]

However,

**THIS IS NOT ALWAYS THE CASE !**
Fig. 4
Linearity depends on where the line drawn. Response P is the nearest to being linear. Response B is clearly not linear and M is notably non-linear at the high end....
…. and some heavier vehicles such as $N_1$s are seriously non linear. However restoring linearity, gives some 60% reduction in pedal effort.
An optimized Dual-rate booster can make a large improvement by virtually restoring linearity. This also produces a very good pedal feel especially if the high rate is brought in at a slightly lower deceleration.
Dual Rate (DR) Booster

The cost is the addition of a small DR cartridge.
Dual Rate (DR) - the gradient increase is easily seen in the Line pressure characteristic. This can be produced in a static test.
SR booster

Pressure response

Vacuum [in.]

Hydraulic output pressure [bar]

P ABS

325 N

Pedal Force [N]

SR booster 10" + 10"

i = 6.28

26.99 m/cyl
Dual Rate Boost Pressure response

LSC160THEDR

i = 6 / 18
26.99 m/cyl
Dual Rate (DR) - pressure response measurement

\[ DR = \text{OK, if:} \]
\[ 40\% < \frac{(F_{\text{ABS extrapolated}} - F_{\text{ABS}})}{(F_{\text{ABS extrapolated}} - F_T)} < 80\% \]
\[ \frac{(330 \text{ N} - 175 \text{ N})}{(330 \text{ N} - 70 \text{ N})} = 60\% \]
Optimized Dual Rate (DR) Booster

**Conclusion from pressure measurement:**

with DR the Pedal force reduction is met if: \[40\% < \frac{(F_{\text{ABS extrapolated}} - F_{\text{ABS}})}{(F_{\text{ABS extrapolated}} - F_T)} < 80\%\]

Pressure measurement shows \[40\% < 60\% < 80\%\]

**Pedal Force reduction** is significant & the....

**Requirement for Force based Brake Assit is fulfilled.**
This proposal seeks to permit a pressure assessment option as an alternative to deceleration measurement in Cat A BAS. The optimized DR booster can then be recognised as a BAS.

![Diagram showing pressure assessment](image_url)
Regulation 13-H, Annex 10

A Proposal.

Add an additional paragraph 3.2.5, and amend the title of Figure 1 to read Figure 1a and add an additional Figure 1b.

“3.2.5. As an alternative, which can be selected by the manufacturer, the pedal force figures for $F_T$, $F_{ABS, min}$, $F_{ABS, max}$ and $F_{AB, extrapolated}$ may be derived from the brake line pressure response characteristic instead of the vehicle deceleration characteristic. This shall be measured as the brake pedal force is increasing.

3.2.5.1. The pressure, at which ABS cycling commences, shall be determined by making five tests from 80 km/h in which the brake pedal is applied up to the level which produces ABS operation and the five pressures at which this occurs as determined from front wheel pressure records, shall be recorded and the mean value obtained as $P_{ABS}$.

3.2.5.2. The threshold pressure $P_T$ shall be stated by the manufacturer.

3.2.5.3. Figure 1b shall be constructed in the manner set out in paragraph 3.2.4, but using line pressure measurements to define the parameters set out in paragraph 3.2.5 above where:

$$F_{ABS, extrapolated} = \frac{F_T \times P_{ABS}}{P_T}$$

![Figure 1b](image-url)