Transmitted by the expert from CLEPA

Informal document No. **GRRF-63-39**
(63rd GRRF, 4-8 February 2008,
agenda item 3(g))

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.

EU Directive on Brake Assist

Systems sensitive to BRAKE PEDAL FORCE

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.

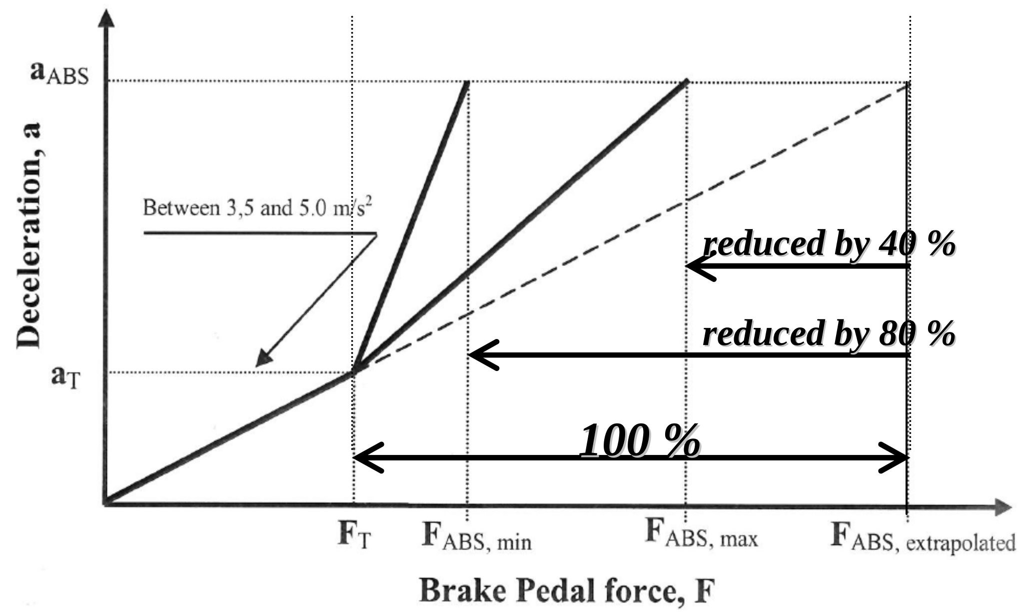
This is to be calculated using the following method:

Acceptance criteria for force sensing devices

a_{ABS} = Deceleration for ABS operation
F_{ABS} = Pedal force to obtain ABS operation
$F_{ABS\ extrapolated}$ = **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



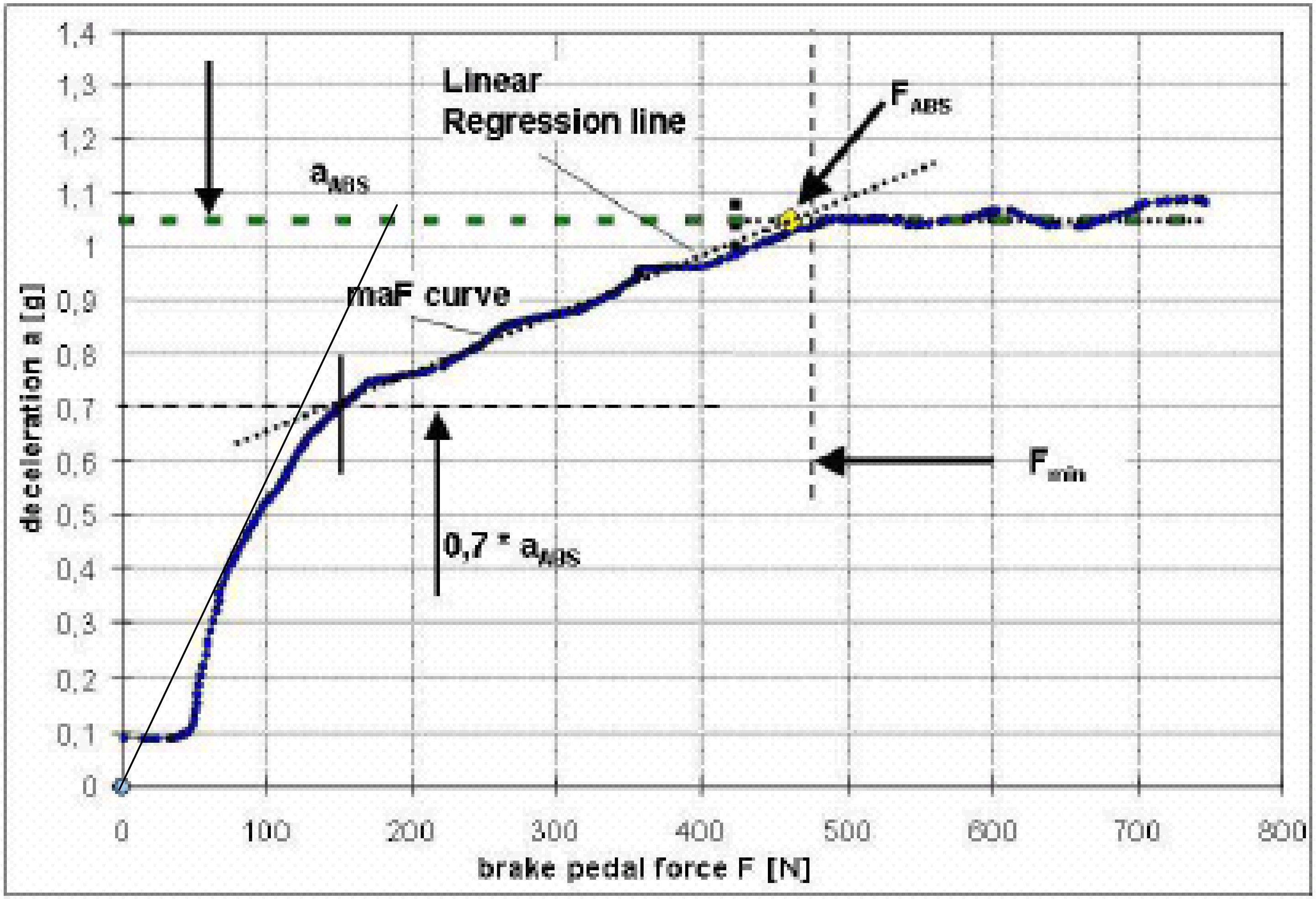
This appears to be based on the underlying assumption (shown dotted) that the projected braking characteristic will be **linear.**

Dual Rate is OK, if :

$$40\% < \frac{(F_{ABS\ extrapolated} - F_{ABS})}{(F_{ABS\ extrapolated} - F_T)} < 80\%$$

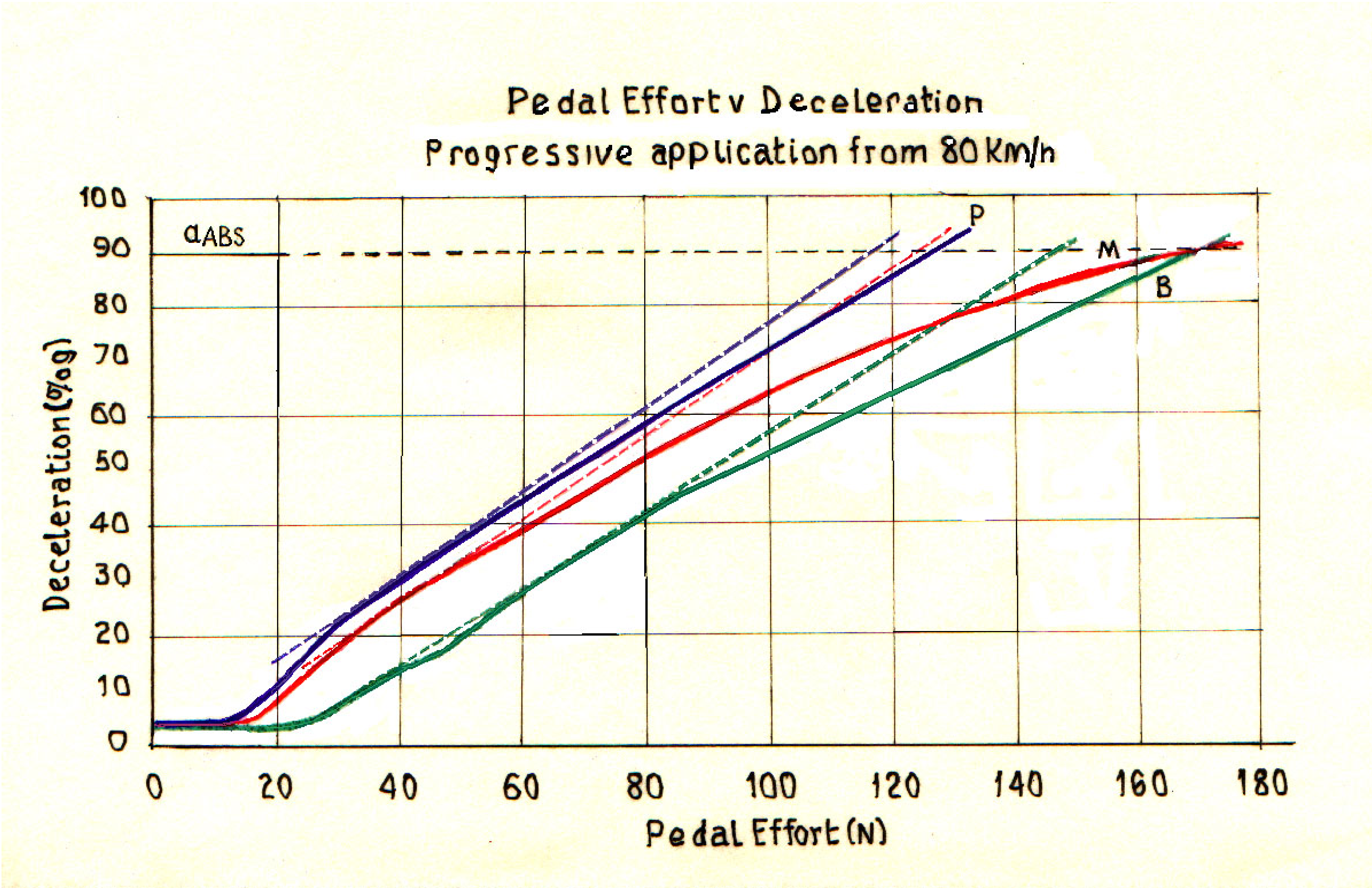
However,

THIS IS NOT ALWAYS THE CASE !



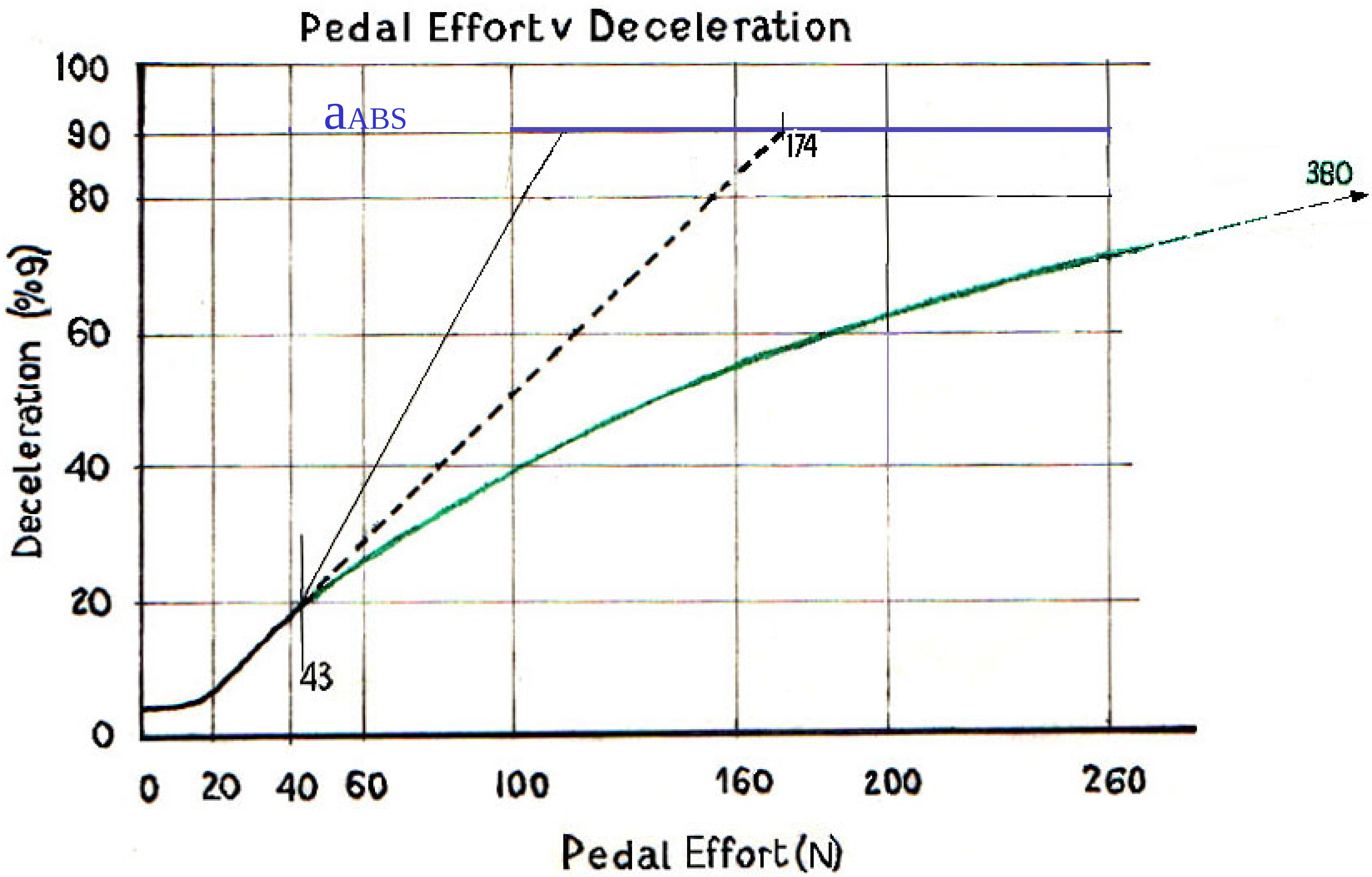
Linear
Regression line
F_{ABS}
a_{ABS}
maF curve
$0,7 * a_{ABS}$
F_{min}
deceleration a [g]
brake pedal force F [N]
1,4
1,3
1,2
1,1
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
100
200
300
400
500
600
700
800

Fig.4

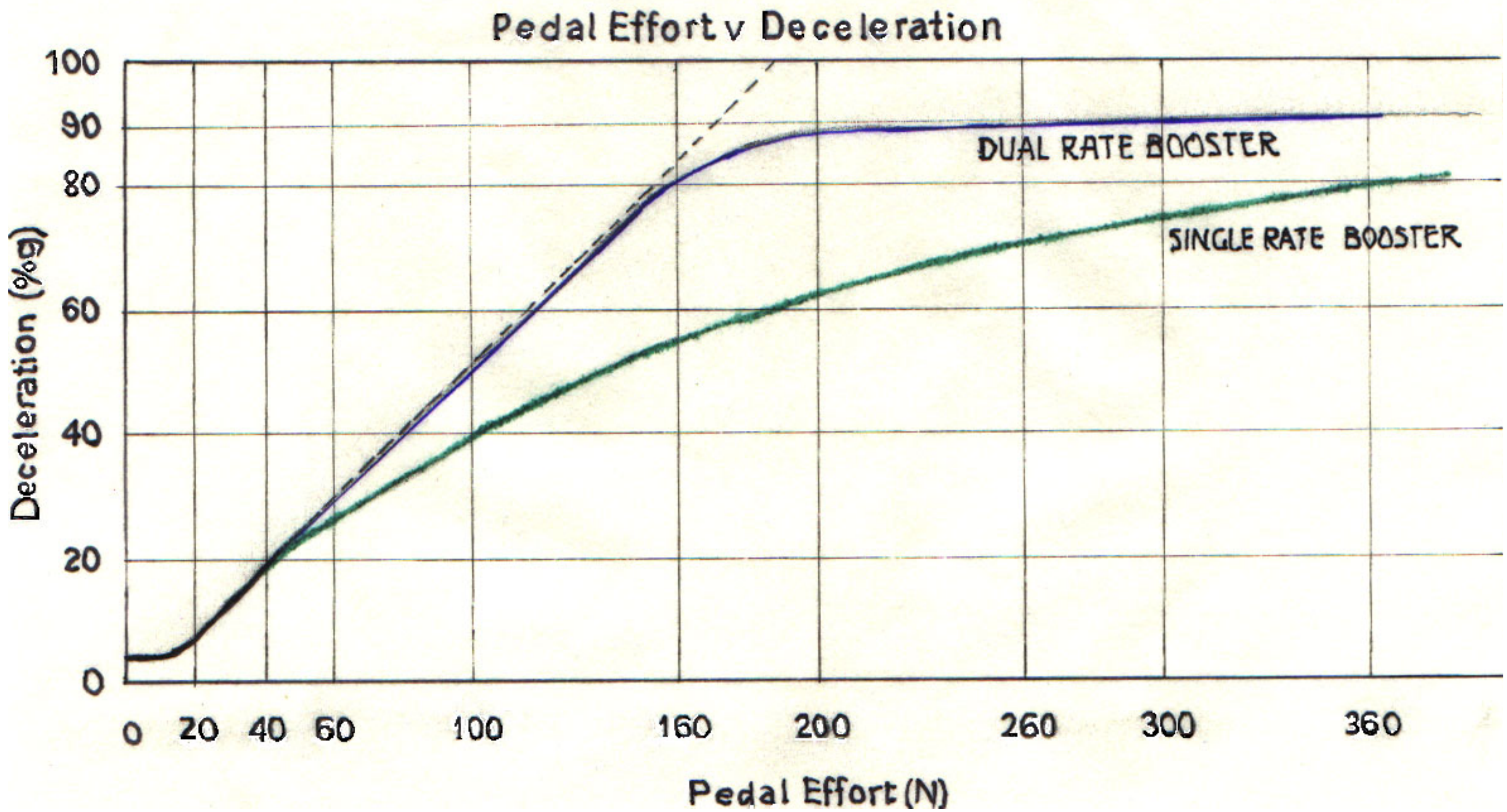


Linearity depends on where the line drawn. Response P is the nearest to being linear. Response B is clearly not linear and M is notably non-linear at the high end ....

…. and some heavier vehicles such as N_1s are seriously non linear.
However restoring linearity, gives some 60% reduction in pedal effort.

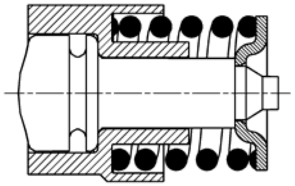


An **optimized Dual-rate booster** can make a large improvement by virtually restoring linearity. This also produces a very good pedal feel especially if the high rate is brought in at a slightly lower deceleration.



Dual Rate (DR) Booster

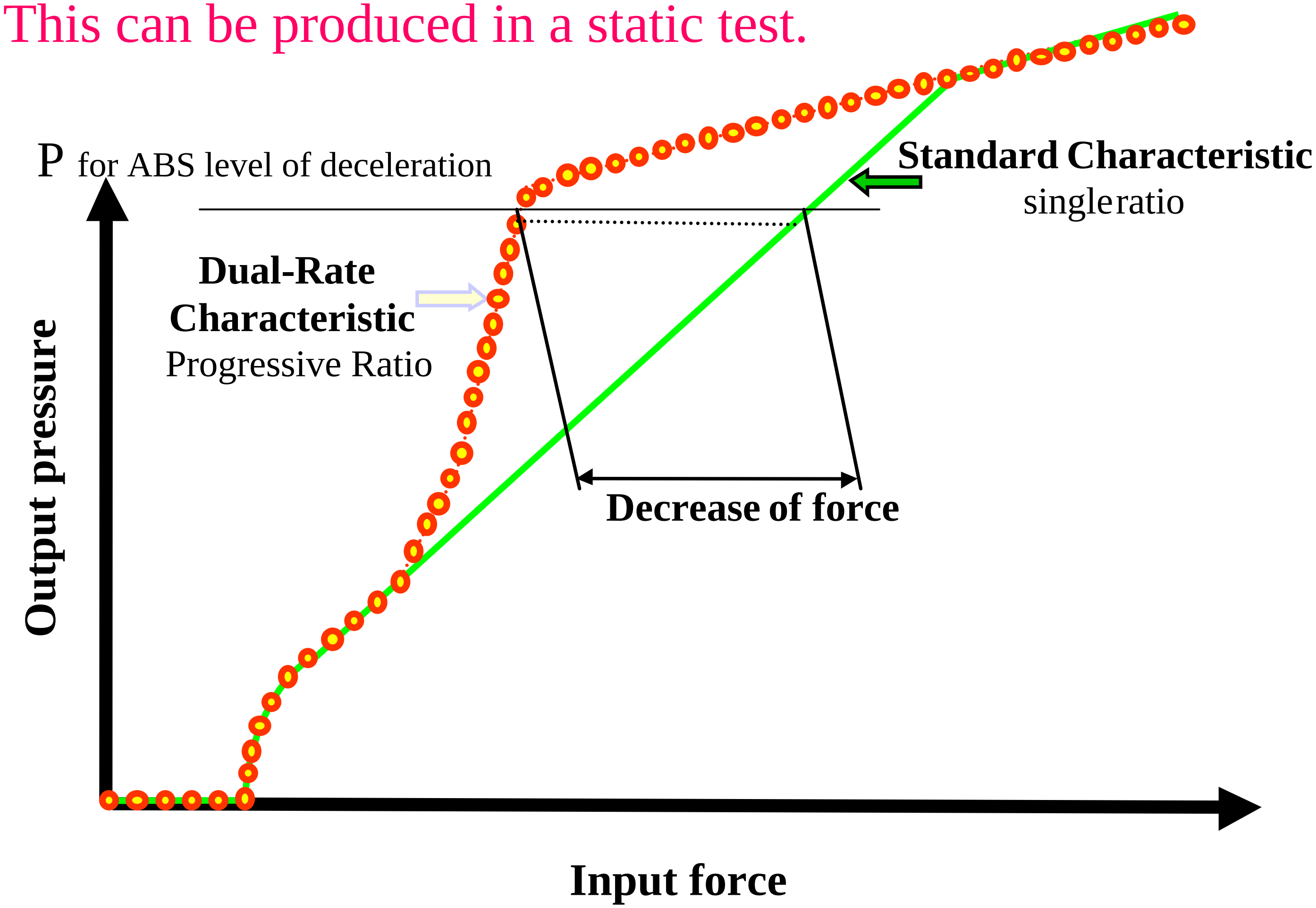
The cost is the addition of a small DR cartridge.

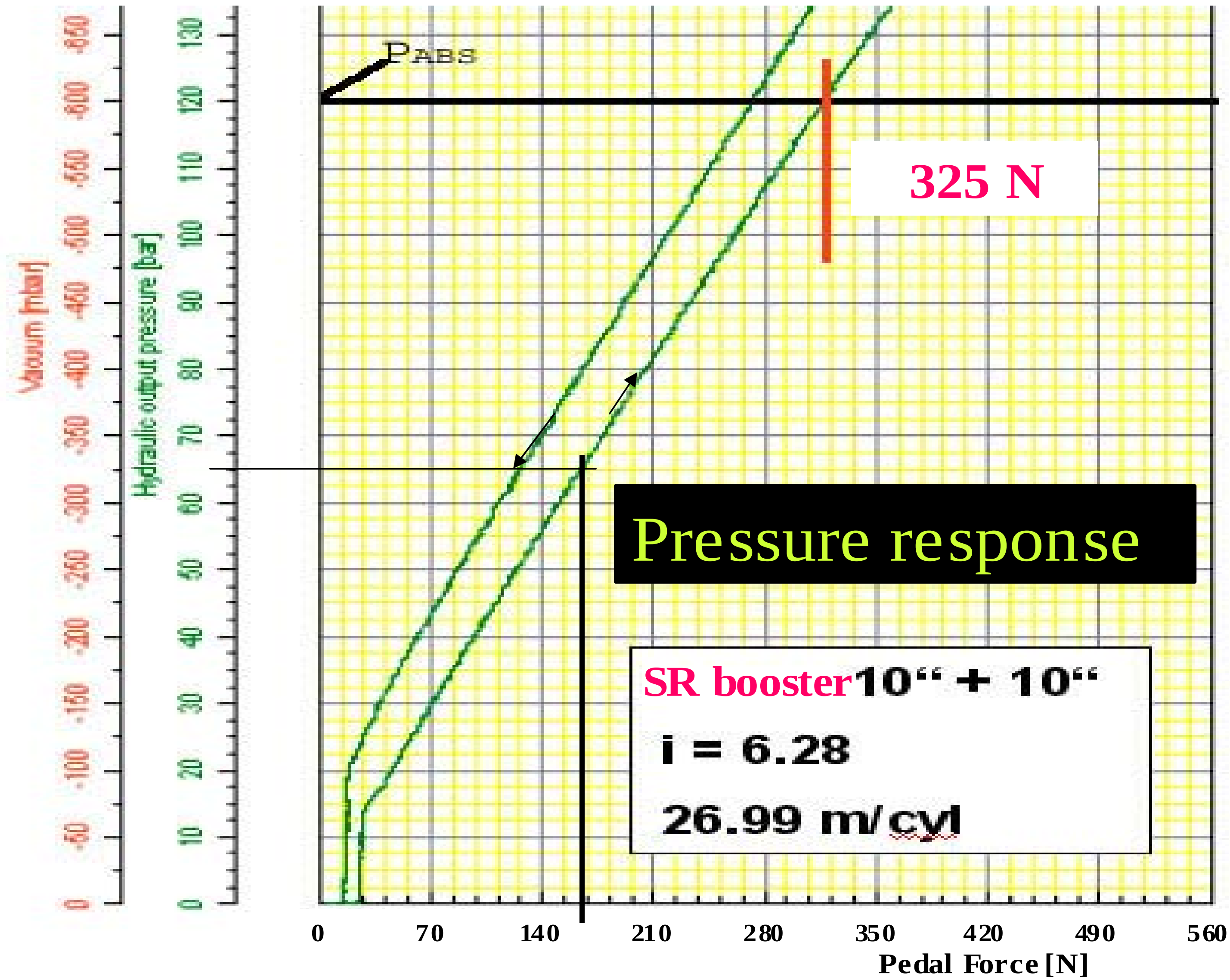


ratio disc replaced by DR cartridge

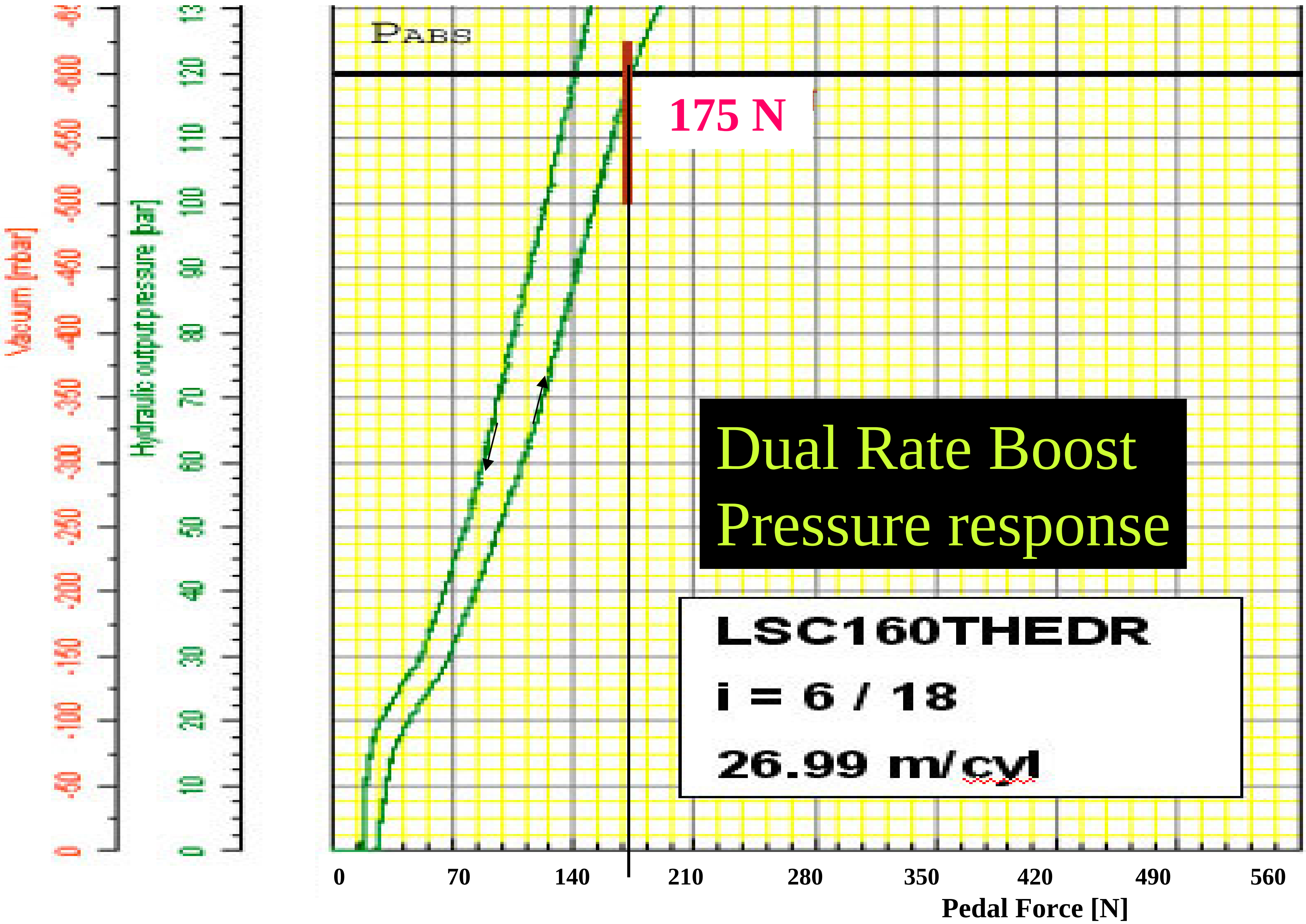
Dual Rate (DR) - the gradient increase is easily seen in the **Line pressure characteristic**.

This can be produced in a static test.

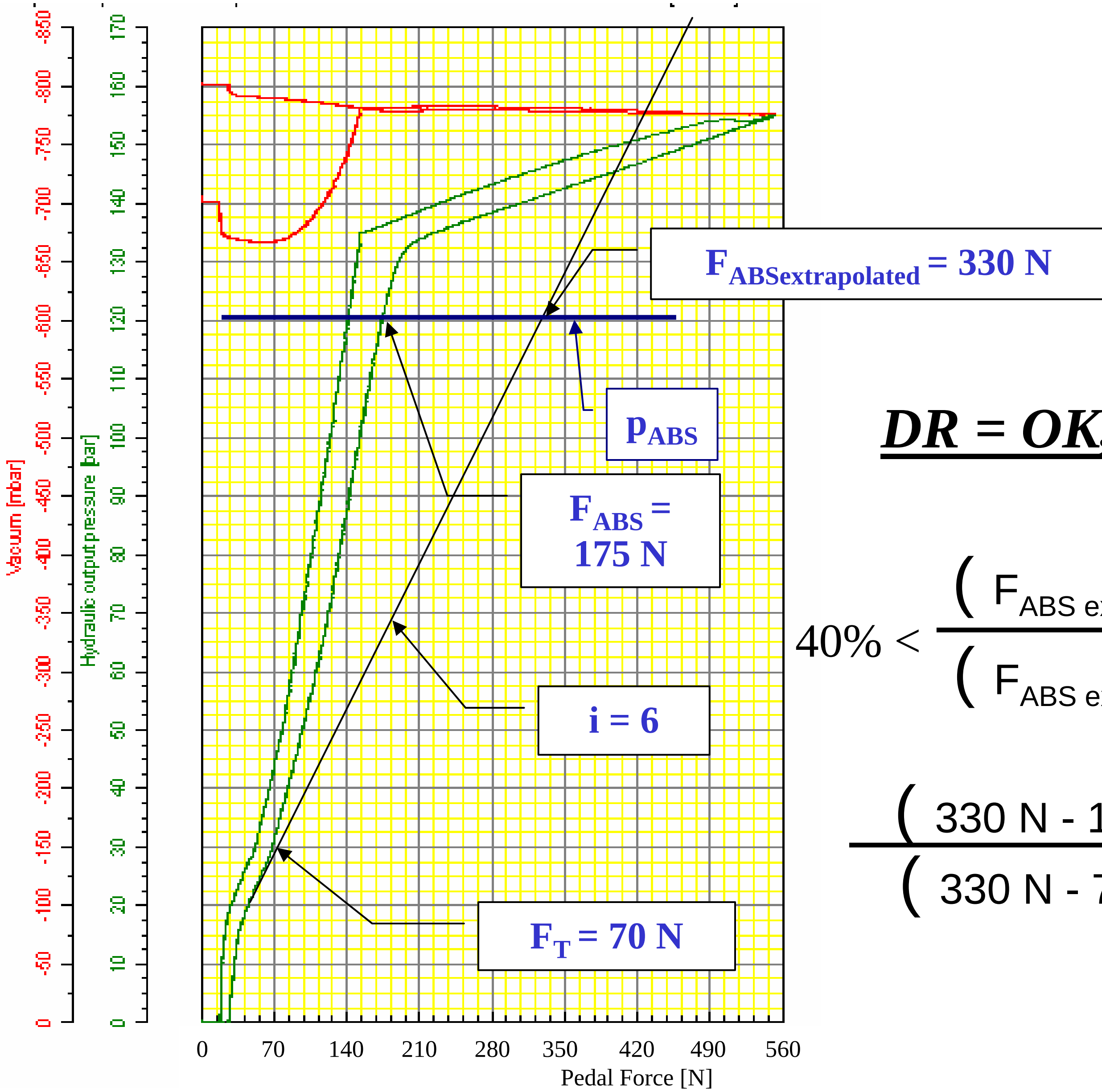




PABS
325 N
Pressure response
SR booster 10“ + 10“
i = 6.28
26.99 m/cyl
Vacuum [mbar]
Hydraulic output pressure [bar]
0
70
140
210
280
350
420
490
560
Pedal Force [N]


Vacuum [mbar]
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
-500
-550
-600
Hydraulic output pressure [bar]
0
10
20
30
40
50
60
70
80
90
100
110
120
130
PABS
175 N
Dual Rate Boost
Pressure response
LSC160THEDR
i = 6 / 18
26.99 m/cyl
0
70
140
210
280
350
420
490
560
Pedal Force [N]

Dual Rate (DR) - pressure response measurement



DR = OK, if :

$$40\% < \frac{(F_{ABS\ extrapolated} - F_{ABS})}{(F_{ABS\ extrapolated} - F_{T})} < 80\%$$

$$\frac{(330\ N - 175\ N)}{(330\ N - 70\ N)} = 60\%$$

Optimized Dual Rate (DR) Booster

Conclusion from pressure measurement:

with DR the Pedal force reduction is met if :

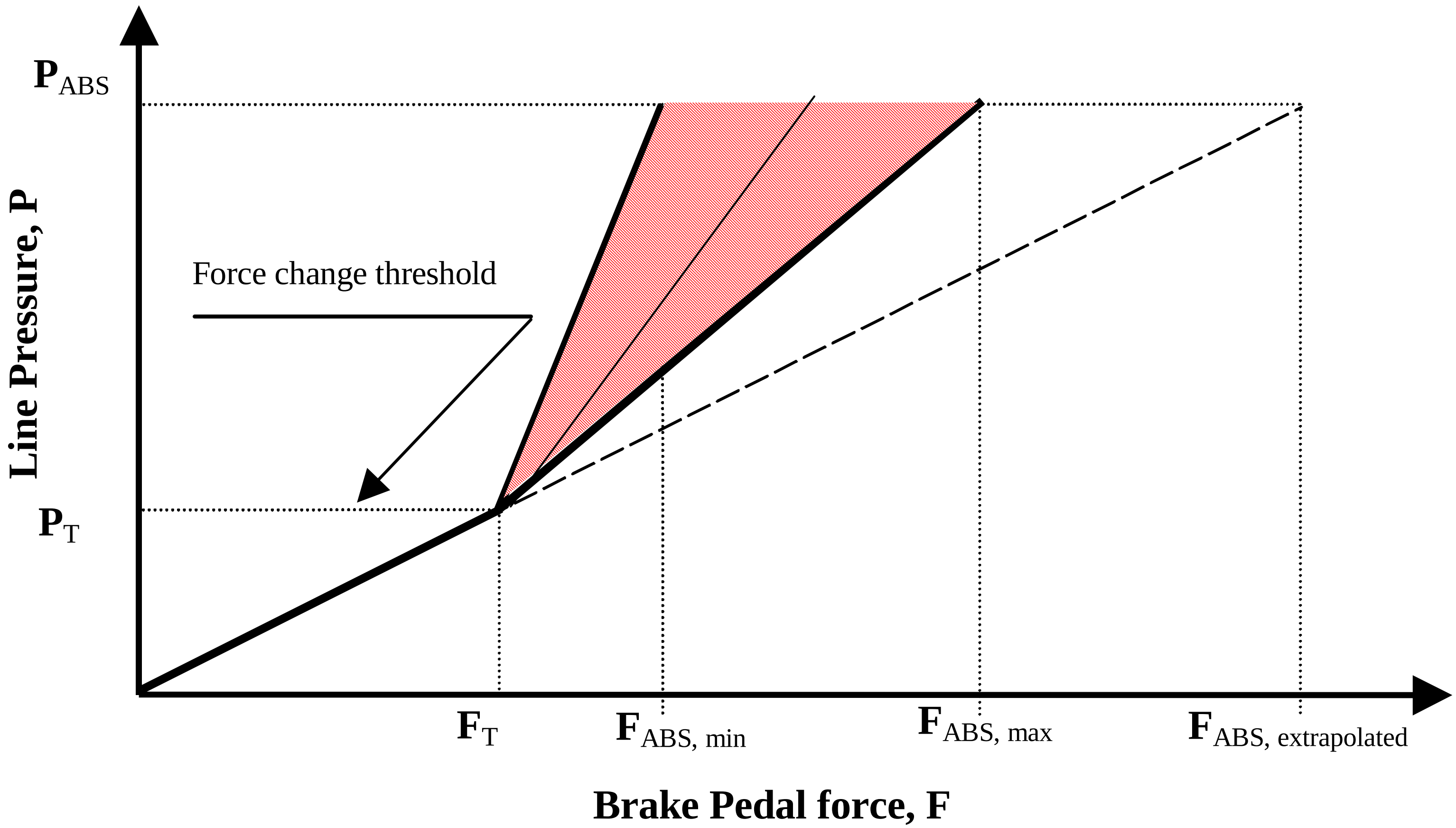
$$40\% < \frac{(F_{ABS\ extrapolated} - F_{ABS})}{(F_{ABS\ extrapolated} - F_{T})} < 80\%$$

Pressure measurement shows 40% < 60% < 80%

Pedal Force reduction is significant & the....

Requirement for Force based Brake Assist 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



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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:

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

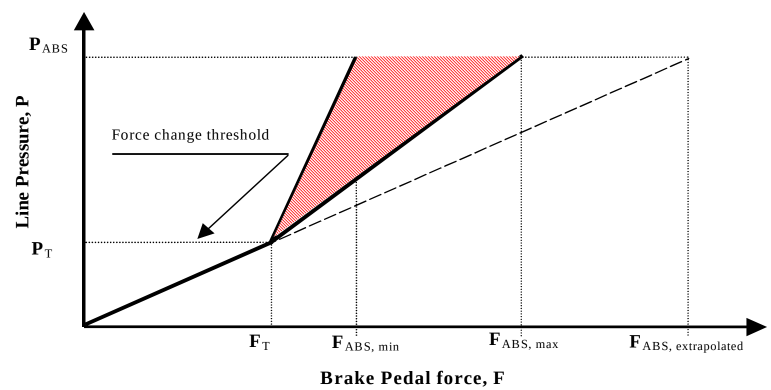

Figure 1b