INTERPRETATION OF SIMRET RESULTS

SIMRET was specifically designed by the Research Division of the UK Health and Safety Executive (HSE) to test heavy off-road machine and vehicle brakes and to automatically compensate for any variation in test track gradient when doing so. Other brake testers are available but these were first and foremost designed for testing normal road going vehicles on good level surfaces, consequently any variation in gradient could lead to significant and potentially dangerous errors in their measurement.

A machine with brakes that operate quickly and develop their full brake effort virtually instantaneously will always produce the same SIMRET Brake Efficiency reading whatever track gradient it is tested on and from whatever speed. For in this case the time taken for the brake effort to fully develop will be short compared to the total time taken for the machine to come to rest.

The faster the machine is travelling or the steeper the downward slope, the longer the machine takes to stop and hence the time to develop full brake effort becomes less and less significant compared to the total time to stop. On virtually all machines, once the full brake effort has developed it will remain constant (unless the brakes start to fade) until the machine finally stops. The constant brake effort produces a level "plateau" on the SIMRET graphical printout. If the machine is travelling faster or working on a steeper down-slope the length or duration of this "plateau" will increase but its height in % g will remain the same for a given machine. This "plateau height" represents the brake performance of that machine. This is clearly illustrated by the sample printout (Figure 1). Note that for light road going vehicles the height of the plateau will be limited by the coefficient of friction between the tyres and the road surface (typically 70 % or 80% g) as the wheels lock, this is unlikely to be the case for heavy machines.

Guidelines for the minimum brake performance of rubber-tyred machines can be found in the International Standard BS EN ISO 3450:1996. The test speeds and downward inclines suggested in the Standard ensure that the brakes have to work at the upper levels of their capacity in order to bring the machine to rest. Brakes should also be tested with the machine fully laden, this ensures that they are capable of generating sufficient work (or brake effort) to stop the machine to the required standard in all circumstances. The following table reproduces its recommendations in terms of SIMRET brake efficiency readings.

Minimum Brake Performance

Minimum brake performance for rubber-tyred machines. Derived from BS EN ISO 3450:1996 in terms of SIMRET brake efficiency		
	Service	***Secondary***
Machines tested without payload - see ISO 3450:1996 Table 2	**28 %**	**14 %**
Machines tested with payload except rigid frame or articulated dumpers with a machine mass over 32 tonnes - see ISO 3450:1996 Table 3	**17 %**	**12 %**
Rigid frame and articulated steer dump trucks with a machine mass over 32 tonnes and tested with payload - see ISO 3450:1996 Table 4	**19 %**	**14 %**
All tests to be carried out with a fully loaded machine (except where stated), on any safe down-slope, and from the maximum safe machine speed subject to a maximum of 32 kph. Figures have been rounded up to nearest %.		

In certain circumstances, depending on local safety regulations and site conditions, it may not be possible to carry out a brake test in which the brake effort fully develops. That is the machine has stopped before the constant plateau region has been reached, or the time taken for the brake effort to develop is a significant portion of the total time to stop. This can lead to anomalies such as apparently better brake efficiency when tested on downward sloping ground compared to level ground tests and even failure to meet ISO 3450 if tests are done from very low speeds. In such cases care needs to be taken when interpreting the SIMRET results and analysis of the graphical printout must be done to determine the safe SIMET Brake Efficiency reading for a particular machine or machine type.

Figure 2 shows SIMRET printouts from such a situation were site conditions prevented testing from the ISO 3450 recommended 32 kph. The test speed was just over half this and the resulting Brake Efficiency is shown as 23.4% g. With default SIMRET settings, this is calculated as the average brake effort between the Start and Stop thresholds. The Brake Delay time between the Brake Trigger and the Start is excluded from the average. It can be seen from the graph that the brake effort takes about 1 second to fully develop and that a “plateau” has just developed at about 30% g before the machine stops. Had the machine been tested from 32 kph or on a 10%

downward incline, the SIMRET reading would have been closer to 30% g since the time to stop would have been greater and the "plateau" extended.

In the above situation, rather than use the average between start and stop, it would have been more appropriate to use the SIMRET Peak Reading over a 1 second time window. This would represent the Brake Effort in % g that can be sustained for at least 1 second (♦).

In all cases it is for the HSE, operators, and plant manufacturers to ensure that it is safe to extrapolate the brake effort that can be maintained for just 1 second (or whatever time window is chosen) to that which would be required to be maintained in emergency situations.

(♦) *Note that the default SIMRET Peak Time Window is set to 0.2 seconds, refer to the Manual for instructions on how to alter it.*

MJL, Issue 1, June 2003

Figure 1

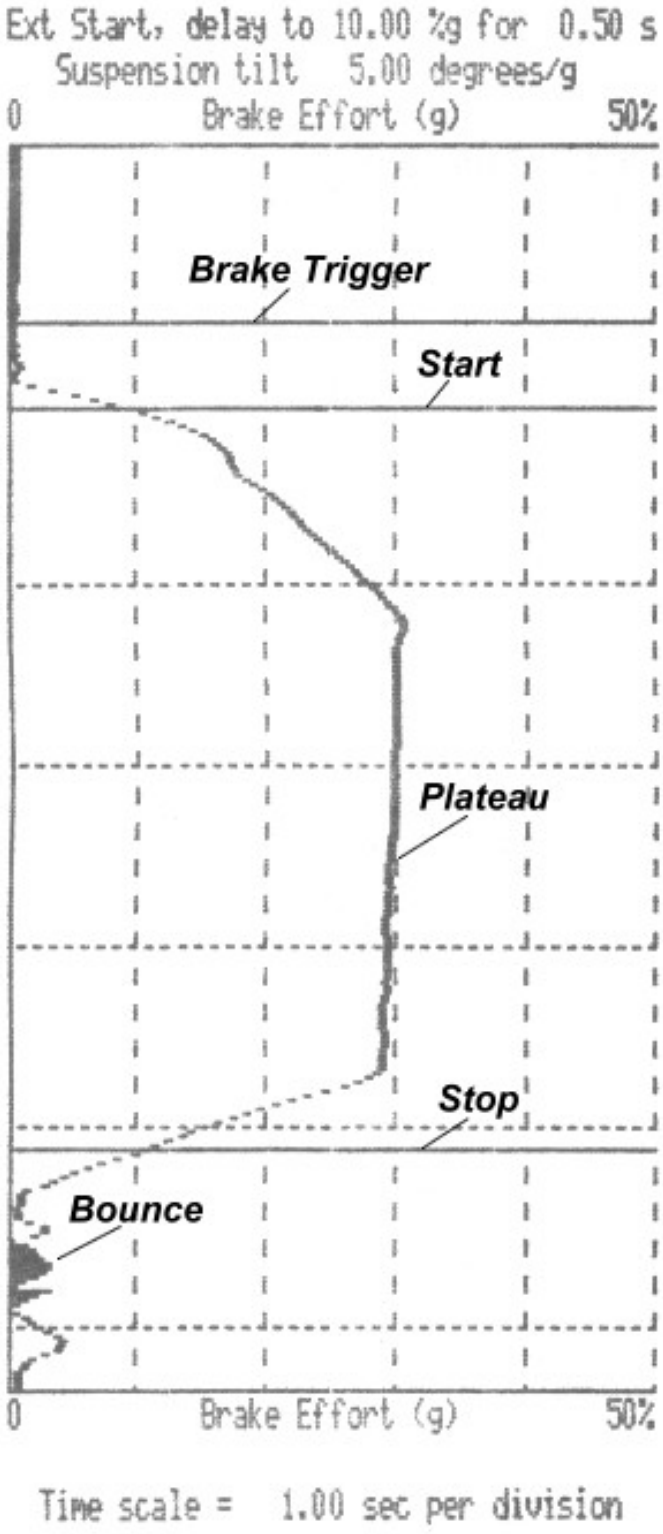

Ext Start, delay to 10.00 %g for 0.50 s
Suspension tilt 5.00 degrees/g
0
Brake Effort (g)
50%
Brake Trigger
Start
Plateau
Stop
Bounce
0
Brake Effort (g)
50%
Time scale = 1.00 sec per division

Figure 2

DEMO SIMRET
SIMRET BRAKE METER

BRAKE EFFICIENCY: 23.4 % g

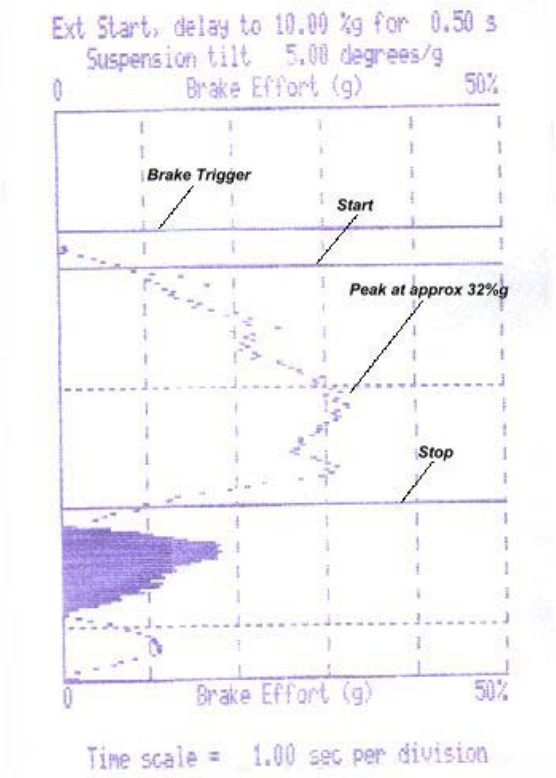
TIME TO STOP: 2.15 sec
BRAKE DELAY TIME: 0.23 sec
SPEED AT BRAKING: 17.9 km per hour
STOPPING DISTANCE: 6.0 metres

UPWARD SLOPE OF: 2.0 % (1 in 50.0)

Plant ID: _____
Operator ID: _____

Signature _____

Test 14 carried out 12:12 on 06-MAR-03
Serial No: 13685 Next Cal. 05-MAR-04
Software Rev 08.04 Turnkey Instruments



Time scale = 1.00 sec per division