RESTRICTED

SRE/PSB/46D-2

PROPOSED EXPERIMENT ON VENTILATED CIGARETTES

At the Biological Research Meeting held in October the design of the proposed long-term experiment was simplified. The samples included were: (1) a control; a set of samples designed to achieve a 50% reduction in delivery using (2) random perforated, (3) line perforated, (4) porous tipping, (5) a naturally highly porous paper. Additionally, it was agreed to examine (6) the effect of using citrate as a paper additive.

It was also agreed that these samples should serve as "bench marks" for a number of additional samples so that each effect could be examined in greater detail in short-term tests. Further, it was requested that sufficient cigarettes should be produced so that analytical and human smoking studies and inhalation experiments could be undertaken. The special analytical studies to be undertaken would be agreed between laboratory managers.

Detailed discussion of specific problems relating to the cigarettes have been held with the various experts in G.R. & D.C. It soon became apparent that (1) in commercial practice the pressure drop of the filters used for ventilated cigarettes are generally higher than those for unventilated cigarettes and (2) the design of cigarettes with porous plugwrap and ventilated tips is not sufficiently advanced to be able to predict deliveries with any accuracy.

For these reasons it is considered that in the final design the control should be examined with low and a high pressure drop filters. Because of the uncertainties in predicting deliveries of some cigarettes, a preliminary experiment has been undertaken with the proposed samples

(excluding citrate) and including two variants of the sample with ventilated tipping.

Although there were some delays in obtaining the components these samples have now been produced and the analyses completed. The samples manufactured are described in Table 1.

TABLE 1

Description of Samples Examined

Sample	Cigarette Paper		Filter	Plugwrap	Ventilated Tipping
	Type	Porosity (WTU)	PD(c)	Porosity (WTU)	Type
1	66M	80	Low	Std	-
2	66M	80	High	Std	-
3(a)	66M	80	High	100,000	M1000
4(a)	66M	80	High	100,000	M1500
5	95P	850	High	Std	-
6	66M ep 1200 (fine random perforated)	1,200	High	Std	-
7	66M ep 1500 (broad line perforated)	1,200	High	Std	-
8	Wattens 200	2,000	High	Std	-
9(b)	Wattens 200	2,000	High	100,000	M1000

Note: (a) Only one sample 3 or 4 to be taken forward into long-term experiment.

(b) Sample included for analytical comparison.

(c) All filters 20 mm long.
Low pd ≑ 3 cm WG, high pd ≑ 8 cm WG

The results of the smoke analysis are given in Table 2.

TABLE 2

Smoke Analysis

Sample No.	Paper		Filter PD	Tipping	Puff No.	TPM (mg/cig)	TNA (mg/cig)	CO (mg/cig)
	Type	Porosity						
1	66M	80	Low	Std	11.5	33.5	1.99	25.6
2	66M	80	High	Std	11.1	23.9	1.53	23.8
3	66M	80	"	Vent.	11.0	16.4	1.14	20.0
4	66M	80	"	Vent.	10.9	14.5	1.23	20.3
5	95P	850	"	Std	9.9	16.4	1.10	17.2
6	66M ep	1,200	"	Std	11.2	16.8	1.25	16.3
7	66M ep	1,200	"	Std	12.3	18.1	1.40	16.9
8	Wattens	2,000	"	Std	10.2	13.1*	0.98	16.6
9	200	2,000	"	Vent.	10.0	10.9*	0.91	14.8

*Samples 8 and 9 were also analysed on a PMWNF basis with the following results - Sample 8, 11.1 mg/cig: Sample 9, 9.3 mg/cig.

From the results it is apparent that the samples with a ventilated tip (No. 3), 95P paper (No. 5) and random e.s. perforations (No. 6) are very close to the proposed 50% reduction in TPM. The sample with line e.s. perforations (No. 7) is slightly higher than the target reduction but is probably acceptable. The Wattens paper (No. 8) leads to a TPM lower than anticipated but could well prove to be of interest in that it will allow comparison of results from a very high naturally porous paper with those from ventilated tippings.

Although the TPM values are not as low as originally hoped, the values would be lower if expressed on a water and nicotine free basis.

It is recommended that the long-term experiment should proceed with the following 8 samples.

(1) 66M paper, low PD filter.
(2) 66M paper, high PD filter.
(4) 66M paper, high PD filter, ventilated tip.
(5) 95P paper, high PD filter.
(6) 66M random e.p. paper, high PD filter.
(7) 66M line e.p. paper, high PD filter.
(8) Wattens 200 paper, high PD filter.
(10) Citrate paper, porosity 850 (to match 95P), high PD filter.

This design includes two additional samples as follows:

No.2: a high pressure drop filter to ensure that it is possible to distinguish between the effects of filter pressure drop and ventilation, high natural or perforated papers (it is understood that, in commercial practice, the PD of the filter is nearly always increased as porosity or ventilation is increased so that the overall draw resistance of the cigarette is not altered appreciably).

No.5: this intermediate porosity paper, close to current practice, is included to provide an intermediate point in the wide range of porosity examined (WTU 80, 850, 2,000).

Having made the above recommendations to meet the aim of examining a 50% reduction in TPM, reconsideration of the samples in toto suggests that sample No. 1 with the low pressure drop filter is anomalous since the available evidence indicates that the effects of conventional filters are analogous to a reduced puff volume or flow-rate. For this

reason, it is suggested that there are two possibilities:

(a) Sample No. 1 is deleted and the number of samples reduced to 7.

(b) Sample No. 1 is deleted and is replaced by condensate obtained by smoking sample No. 2 with a reduced puff volume: the percentage reduction of puff volume being set to the average percentage reduction of samples 4-10.

If the objective of the experiment is considered, i.e. to intercompare the biological effects of various forms of ventilation, it is suggested that the second alternative should be adopted. The advantage of including such a sample appears to be very worthwhile since it should enable us to demonstrate whether or not the various forms of ventilation lead to condensates with tumorigenicities significantly different from that achieved by a simple reduction in puff volume.

Finally, it should be recognised that while it is hoped that the results may indicate a preferred approach to ventilation, it is equally or more probable that no differences may be found. It is contended, however, that the 'no-difference' result would be equally valuable since, commercially, it would allow the greatest freedom of action.

ADDITIONAL SAMPLES FOR SHORT-TERM TESTS

Effectively many of the options on a low porosity base paper are included in the samples (1,2,3,4,6,7) described in Table 1 although sample 3 or 4 will be dropped from the long-term test.

It is suggested that a similar series of 6 or 7 samples should be built around the De Mauduit paper 95P. For example this should be perforated in two ways (1) random and (2) broad lines to give approximately similar porosities. The effect of ventilated tipping, at two levels of porosity, should also be examined using (a) the basic paper and (b) the random e.s. perforated paper.

The inclusion of samples 8 and 9 could examine the effect of ventilated tipping (M1000) on a cigarette with a naturally porous paper.

It is proposed that all these (15 or 16) samples should be manufactured and "screened". The series would provide information on:

(1) 3 basic papers (66M, 95P and Wattens) with one having citrate as additive;

(2) the effect of perforating two of these papers by random and line e.p;

(3) the effects of two levels of tip ventilation on two papers and one level on the Wattens.

In addition to the above, the effect of transverse banding with gelatine will be examined in a separate experiment. Plans have already been made to treat two types of paper (De Mauduit 511-C and Fletcher 137P) with three gelatin solutions differing in citrate concentration and incorporating tartrate

in place of citrate. Some of these bobbins will subsequently be perforated to varying degrees. From this exercise approximately 30-40 different samples will be produced and submitted for analytical measurements. Samples will then be selected for examination in the NMFI and sebaceous gland tests.