

D. INDUSTRY PRODUCT DEVELOPMENT RESEARCH TO ENSURE AN ADEQUATE DOSE OF NICOTINE

1. Industry Emphasis on Nicotine in Product Development Research

Tobacco industry documents show that adequate nicotine delivery is a dominant consideration in product development research. As discussed above, many tobacco industry documents demonstrate the industry's understanding that the amount of nicotine delivered from tobacco must not fall below a certain threshold.³⁵¹ These and other documents also reflect the industry's recognition that below that threshold, tobacco fails to deliver a pharmacologically active dose of nicotine, and that consumers will reject the resulting product. The documents described in this and the next section reveal the industry's extensive product development research to maintain or increase nicotine delivery from tobacco products.

Industry patents disclose that the industry has long recognized the importance of developing methods to maintain or increase the amount of nicotine in tobacco, and that the purpose of these methods is to ensure that consumers experience nicotine's pharmacological effects. For example, a patent held by Philip Morris states:

Maintaining the nicotine content at a sufficiently high level to provide the desired physiological activity, taste, and odor . . . can thus be seen to be a significant problem in the tobacco art. The addition of nicotine to tobacco in such a way that it remains inert and stable in the product and yet is released in a controlled amount into the smoke aerosol when the tobacco is pyrolyzed, is a

³⁵¹ See documents cited in FINDINGS § II.C.1. and 2.

See also F.H. [Initials of BATCO R&D employee] Memorandum. *Developments in the Product in the Next Ten years. 1973-1974. Page 3.* ("The maintenance of adequate levels of nicotine in cigarettes could become a difficult problem as more synthetics are used.")

result which is greatly desirable. [Emphasis added.]³⁵²

In fact, over the past several decades, enhancing and optimizing nicotine delivery has been a major focus of tobacco industry product design research. The American Tobacco Company (ATC) devoted substantial research to finding methods of increasing the amount of nicotine delivered by its cigarettes. For example, in 1963, ATC conducted research on increasing the nicotine yield in Lucky Strike cigarettes by increasing the proportion of Burley tobacco, a high-nicotine tobacco, in the tobacco blend used to make the cigarettes.³⁵³ The company found that it could increase the nicotine yield of the cigarettes up to 10% in this manner and that smokers perceived the resulting cigarettes as having more "strength."³⁵⁴ In 1969, ATC test-marketed Lucky Strike cigarettes that had been enriched with added nicotine.³⁵⁵ ATC developed other methods for increasing the amount of nicotine delivered by its cigarettes over the subsequent decades, including:

- the use of carbon tips in the filter "impregnated with nicotine or nicotine salts" to

³⁵² U.S. Patent No. 3,280,823. Bavley A, Air D, Robb E II. *Additive-Releasing Filter for Releasing Additives into Tobacco Smoke*. Philip Morris, Inc. October 25, 1966. Page C1:43-48.

³⁵³ "Tobacco Blends for Filter Cigarettes: Effect of Increasing the Concentration of Burley Tobacco in a Blend" at Page 1. June 21, 1963. The various ATC documents discussed in this section were provided by the company to the Subcommittee on Health and the Environment of the House Energy and Commerce Committee, and attached as exhibits to the Dec. 20, 1994, Subcommittee Staff Report, entitled, "Evidence of Nicotine Manipulation by the American Tobacco Company."

³⁵⁴ *Id.* at pp. 4, 5. The company again experimented with increasing the nicotine content of Lucky Strikes through changes in the tobacco blend in 1968. Memo to Mr. H.V.H. Stoever, Jr., Manager, Durham Branch, from O.N. Coty, Manager-Quality Control, Research and Development (June 4, 1968). Pages 1-2; Tables X003384-3387. See also memo to R.F. MacDonald from O.N. Coty, July 5, 1968.

³⁵⁵ Letter from Chadbourne & Park, representing ATC, to the Honorable Henry A. Waxman, Chairman, Subcommittee on Health and the Environment of the House Committee on Energy and Commerce. Oct. 14, 1994. Page 3 of attachment to ATC Response.

increase the nicotine content of cigarette smoke;³⁵⁶

- direct addition of commercial nicotine to reconstituted tobacco;³⁵⁷
- addition of nicotine to the "finishing flavor" used in Pall Mall 85's;³⁵⁸
- growing tobacco plants in different locations to determine, among other things, whether varieties with different ratios of nicotine to tar could be produced;³⁵⁹
- addition of nicotine to the "dip casing" (one of several solutions used in the manufacture of cigarettes) to compensate for loss of nicotine from other manipulations

³⁵⁶ Memo to E.S. Harlow from ATC Analytical Chemistry Section, Group I, Aug. 8, 1963, Progress Report, March 1962-July 1963," with attached smoke analysis 2-12-68, 2-1-68, 1-29-68, 1-15-68, 1-4-68, 12-28-67, 12-22-67 (impregnating a carbon tip with nicotine permitted transfer of about 22% of the added nicotine to the smoke).

³⁵⁷ ATC experimented with adding nicotine to reconstituted tobacco on several occasions. See:

"The Effect of the Addition of 1% Nicotine on the Quality of RC Tobacco" (Oct. 8, 1963) (nicotine citrate was added to reconstituted tobacco to triple its nicotine content, from about 1/2% to about 1 1/2%). Pages 1,2,6.

"Evaluation of Nicotine-Fortified RC-A Tobacco" (May 2, 1968) (nicotine malate was added to reconstituted tobacco to increase its nicotine content from .94% to 1.27%; the company concluded that "to markedly improve RC [reconstituted tobacco] . . . in addition to increasing its nicotine content it should also include the other constituents present in natural leaf tobacco, particularly those tobaccos of high nicotine content."). Pages 1-2.

Memo to J.B. McCarthy, Executive Vice President, from R.M. Irby, Jr., Manager-New Products Div., Research and Development, "Nicotine Content of Reconstituted Tobacco." June 5, 1974. (Nicotine added to tobacco extract which is applied to reconstituted tobacco, doubling the nicotine content of the reconstituted tobacco from 0.9% to about 1.8%.) Page 1.

³⁵⁸ Memo to E.S. Harlow from O.N. Coty *Special PALL MALL 85's with added nicotine*. July 12, 1968. (Nicotine content of final blend increased by 0.47%; smoke panel preferred regular blend.)

³⁵⁹ Memo to Dr. E.C. Cogbill, Manager-Analytical Research, Research and Development from J.M. Moseley Manager-Basic Materials Research, Research and Development. *Genetic Variation in "Tar" Delivery*. January 8, 1969.

of the tobacco blend;³⁶⁰

- addition of nicotine to both Pall Mall and Lucky Strike cigarettes, increasing their nicotine content 35% per cigarette (41% per puff for Pall Mall, slightly less per puff for Lucky Strike);³⁶¹ and
- addition of nicotine to tobacco stems (which are used in the manufacture of cigarettes) to increase their nicotine content from 0.5% to 1.87%.³⁶²

ATC also considered replacing the tobacco used in its reconstituted tobacco with "high nicotine tobacco such as Malawi sun-cured scrap (5% nicotine)" to increase the nicotine content from 0.9% to about 1.6%,³⁶³ increasing "nicotine transfer to the smoke" by dilution or use of filter additives,³⁶⁴ and increasing, in various ways, the proportion of nicotine relative to tar by adding nicotine to the tobacco, the filter, and the cigarette paper.³⁶⁵

Philip Morris documents show that it, too, conducted research on altering and optimizing nicotine delivery from its cigarettes. According to a 1972 memo from William

³⁶⁰ Memo to Mr. J.B. McCarthy, Vice President, Manufacture and Leaf from J.T. Ashworth, Manager - Process Development, Research and Development. "Experimental *LUCKY STRIKE Cigarettes (RC-E)*." May 29, 1969. (The author recommends that the experimental cigarettes with added nicotine replace the regular Lucky Strike brand; these may be the cigarettes that were test marketed in 1969). This memo refers to nicotine as "Compound W". An earlier ATC memo instructs employees to refer to nicotine as "Compound W" in all future experimental work, reports, and memorandums. ATC memo to W.W. Sadler, J.G. Brooks, and R.D. Chumney, from John T. Ashworth, "Compound W" (May 14, 1969).

³⁶¹ Memo to Mr. V.B. Lougee, III, from R.M. Irby, Jr. *Compound W*. April 29, 1974. Pages 1-2.

³⁶² *Id.* at p. 2.

³⁶³ Irby memo, note 357, *supra*, at p. 2.

³⁶⁴ *Id.* at p. 3.

³⁶⁵ Memo to Dr. P.H. Leake from P.M. Pedersen, transmitting a copy of *A Study of the Nicotine to Tar Ratio*. April 18, 1977. Pages 3-4.

Dunn, a senior official at Philip Morris, research was underway to identify optimal nicotine levels for menthol cigarettes:

This study has a three stage design. The first stage is designed to identify those nicotine delivery levels which we might reasonably wish to consider for menthol cigarettes. Having identified these nicotine delivery levels, in stage 2 we will determine combinations of nicotine and menthol which make for optimal acceptability. And then in stage 3, cigarettes with these combinations will be tested against current brands of known quality and sales potential.^{365a}

Philip Morris was thus engaged in research in which nicotine delivery was systematically manipulated, independent of other tobacco variables.

Industry patents from various tobacco companies show that substantial research throughout the industry has been directed at developing methods for selectively increasing nicotine levels and the amount of nicotine delivered by tobacco products.³⁶⁶ BATCO documents show significant research efforts directed at increasing nicotine delivery. A 1978 BATCO R&D Conference included a discussion of the economic importance of increasing the proportion of nicotine that is actually delivered from the tobacco to the smoker during the consumption of the product:

^{365a} P.A. Eichorn and W.L. Dunn. Quarterly Report-Projects 1600 and 2302. October 5, 1972. *In* Cong Rec. H7649 (daily ed. July 25, 1995).

³⁶⁶ *See, e.g.:*

U.S. Patent No. 5,031,646 at C5:65-68 ("nicotine can be incorporated into the expansion solvents used to provide a volume expanded processed tobacco material having a high nicotine content").

U.S. Patent No. 4,676,259 at C2:30-33, 53-56 ("The present invention provides a nicotine-enhanced smoking device with a high nicotine release efficiency").

U.S. Patent No. 4,898,188 at C1:37-47 (utilizing supercritical extraction to transfer nicotine from high-nicotine tobacco to lower-nicotine tobaccos, thereby increasing the nicotine content of the latter).

U.S. Patent No. 5,065,775 (describing technology for modifying the nicotine content of tobacco filler, enabling a manufacturer to double the nicotine content of tobacco).

*With conventional cigarettes, the transfer of nicotine to the smoker from the tobacco has very low efficiency. Potentially, therefore, opportunities exist for very big savings in tobacco if this low efficiency can be greatly increased.*³⁶⁷

In other words, BATCO wanted to increase the amount of nicotine delivered to the consumer without changing the amount of nicotine already present in the tobacco. (This is what one or more tobacco companies have in fact achieved by the use of the "ammonia technology" described in § II.E., *infra*.) A 1968 BATCO study approached the objective of enhancing nicotine delivery from a different angle. This study was intended to help develop methods of increasing the smoker's absorption of nicotine, while decreasing other undesirable physiological effects of inhaling tobacco smoke. The study examined the factors that influence the amount of nicotine that is absorbed from tobacco through the oral mucosa (mouth), with an eye toward designing products that would increase nicotine absorption in the mouth, thus avoiding or reducing the need to inhale smoke into the lungs. The study authors maintained that:

*If it can be shown that appreciable amounts of nicotine can be absorbed via the mouth, and which factors contribute to enhanced absorption, it may be possible to design cigarettes so that it would only be necessary to inhale the smoke to a very limited extent.*³⁶⁸

This focus on absorption makes clear that the industry's primary interest is in delivering nicotine to the blood for its systemic effects, rather than in the immediate sensory effects in the mouth (e.g., flavor). Methods of optimizing nicotine delivery were also discussed at two

³⁶⁷ BATCO Group Research & Development Conference, Sydney. March 1978. Page 4. Notes on Group Research R&D.

³⁶⁸ Evelyn SR. BATCO Group Research & Development. *Absorption of Nicotine via the Mouth: Studies Using Model Systems*. Report No. RD 560-R. May 9, 1968. Page 4.

separate BATCO R&D conferences in 1984.³⁶⁹

The industry has also developed product design options to manipulate the amount of nicotine delivered to ensure smoker satisfaction, even at the level of the individual puff. For example, an industry patent states:

*It is a further object of this invention to provide a cigarette which delivers a larger amount of nicotine in the first few puffs of the cigarette than in the last few puffs.*³⁷⁰

The focus on nicotine delivery in product development and the fact that nicotine manipulation is intended to ensure that consumers experience nicotine's pharmacological effects is also shown by the tobacco industry's research to improve tobacco "satisfaction." "Satisfaction" is one of the industry's principal product development research objectives. As already described in FINDINGS § II.C.1., supra, the term "satisfaction" is generally used by the tobacco industry to refer to the ability of a tobacco product to satisfy the consumer's desire for the pharmacological

³⁶⁹ See BATCO Group R&D Research Conference. September 1984. Proposed Revisions for 1985-1987. Pages 1-2:

The experimental cigarettes used in 1(b) [denicotinized, then supplemented with varying levels of nicotine] will also be used to improve the efficient use of smoke nicotine through pH modification. These studies will identify the relationship between nicotine dose and nicotine-related subjective improvement. This will further help to identify the relationship between product acceptability and smoker satisfaction. [Emphasis added.]

Proceedings of the BATCO Group R&D Smoking Behaviour-Marketing Conference, Session III. July 9-12, 1984. Ferris at p. 81:

How we use this perspective in terms of marketing action requires careful consideration since most of this evidence is ostensibly of industry strategic defence value. However product development to optimise efficiency of nicotine delivery, and a better understanding of the "visual-tactile" smoker (albeit limited segment) are obvious starting points. [Emphasis added.]

³⁷⁰ U.S. Patent No. 4,595,024. Greene TB, Townsend DE, Perfetti TA. *Segmented Cigarette*. R.J. Reynolds Tobacco Company. June 17, 1986. C2:23-26.

See also U.S. Patent No. 3,280,823 Bavelly A, Air B, Robb II EW. *Additive-Releasing Filter for Releasing Additives into Tobacco Smoke*. Philip Morris Inc. October 25, 1966. C2:37-40 ("This invention permits the release into tobacco smoke, in controlled amounts . . . and when desired of nicotine into tobacco smoke").

effects of nicotine, and is understood by the industry as an essential component of consumer acceptance of tobacco products. The conferees at a 1983 BATCO Research Conference in Rio de Janeiro sought to expand research efforts on nicotine as the principal source of smoker satisfaction and to "develop products that give improved smoker satisfaction."³⁷¹ The conferees agreed that to achieve this goal, BATCO must know as much as possible about nicotine, including:

- *factors that affect the transfer of nicotine from leaf to smoke aerosol*
- *factors that influence the rate of transfer of nicotine from particulate matter to the vapour phase*
- *the contribution of nicotine to smoke sensory characteristics (including harshness and irritation)*
- *the site and mechanisms of absorption of nicotine within the human system*
- *the way nicotine stimulates both the central nervous system and the peripheral organs (eg heart and lung)*
- *the metabolism of nicotine within the body, including rates and equilibrium levels. [Emphasis added.]³⁷²*

³⁷¹ BATCO Group R&D Research Conference. Rio de Janeiro, Brazil. August 22-26, 1983. Page BW-W2-01837.

³⁷² *Id.* at p. 13. Philip Morris documents similarly show that that company's research on manipulating nicotine delivery was aimed at ensuring that smokers experience nicotine's pharmacological effects. See e.g.:

Philip Morris employee (almost certainly W.L. Dunn). *Smoker Psychology Program Review*. October 19, 1977. This paper sets forth questions being asked by researchers at Philip Morris, at pages 5-6:

- a) *What is the lower delivery level limit beyond which the smoking act is not reinforced?*
- b) *Within what limits can we vary nicotine concentration relative to other smoke constituents?*
 - 1) *What is the optimum nicotine/tar ratio?*
- c) *Given a fixed quantity of nicotine in the tobacco, what factors in cigarette design determine its availability for delivery to the smoker? . . .*
- e) *Does the smoker seek spike effects, bloodstream constancy? . . .*
- g) *How important is the form of the delivered nicotine? (salt vs. free base? pH? particle size?)*

Ryan, FJ, Jones, BW, Martin, PG, Dunn, WL. *Behavioral Research Annual Report*. July 18, 1975. Page

This list of product development research objectives makes clear BATCO's interest in the delivery of nicotine for absorption into the bloodstream and in its systemic effects once absorbed.

The tobacco industry's product development research on manipulating the amount and manner in which nicotine is delivered to the consumer demonstrates the industry's intent to sell tobacco products that provide a pharmacologically active dose of nicotine.

17:

As deliveries drop we reasoned that eventually they could reach a point where all the cigarettes in a pack would be unsatisfying.

The same document reports on Philip Morris studies of: 1) acceptability of various nicotine/tar ratios in a 10 mg tar cigarette, and 2) methods of producing a low delivery cigarettes "with impact and flavor." Pages 23-25.

Dunn, W.L. Project 1600/Consumer Psychology/Annual Report. November 18, 1966. Page 9.

Is the transition to preference for a lower delivery cigarette more explicable in terms of (a) Reduction in sought dosage level, or (b) Adaptation of puffing pattern?

Memo to T.S. Osdene from W.L. Dunn. Plans and Objectives - 1982. November 5, 1981. Discusses Philip Morris research on changes in inhalation behavior and puff parameters as a result of changes in nicotine delivery, and on which parameters influence nicotine retention. Pages 7-8.

2. Industry Research on Maintaining Adequate Nicotine Delivery When Lowering Tar

Product design to ensure adequate nicotine absorption by the smoker appears to have been driven, to a large extent, by the growing awareness of smoking-related diseases and the resulting efforts of the tobacco companies to provide cigarettes that delivered lower quantities of known toxic smoke constituents, in particular tar. However, reducing tar levels tends to also reduce the nicotine content.³⁷³ Thus, the industry has known that in designing lower-yield products, nicotine delivery could not be reduced below a certain threshold.³⁷⁴ In order to reduce tar while maintaining a level of nicotine delivery that would satisfy consumers' desire for the pharmacological effects of nicotine, the industry has focused considerable attention and research on how to maintain or enhance the amount of nicotine delivered by lower-tar products.

A patent held by Imperial Tobacco Ltd. states that the purpose of the technology described in the patent is to permit a cigarette manufacturer to maintain or increase nicotine levels while lowering levels of "undesirable" smoke constituents:

[This] invention concerns . . . the problem of maintaining or increasing the nicotine content of the smoke whilst avoiding an undesirable level of particulate

³⁷³ See:

Spears AW, Jones ST. Chemical and physical criteria for tobacco leaf of modern day cigarettes. *Recent Advances in Tobacco Science*. 1981;7:19-39.

Regulation of Nicotine under the Federal Food, Drug and Cosmetic Act: Hearings Before the Subcommittee on Health and the Environment of the House Committee on Energy and Commerce, 103rd Cong., 2d Sess. (March 25, 1994) (statement of AW Spears, at pp. 1-3).

³⁷⁴ See Project Wheat - Part 2, note 204, *supra*, at p. 48:

Concern for the possible health risks of smoking influences consumers in the direction of trying low delivery brands. . . . However, there is evidence of a conflict between concern for health and the desire for a satisfying cigarette, from which it follows that low tar brands would be much more widely accepted if their nicotine deliveries could be brought within the range required by groups of consumer[s].

*matter in the smoke . . .*³⁷⁵

A 1976 BATCO "Smoking Behavior" conference report states the industry's dilemma more succinctly:

*[I]n that the 'benefits' of smoking appear to be related to nicotine, we can infer that the 'benefits' of smoking might disappear if cigarettes with low levels of nicotine became the norm . . .*³⁷⁶

Philip Morris conducted research to find the optimum nicotine delivery level and the optimum nicotine-to-tar ratio for low tar cigarettes. In 1970, a company document stated that Philip Morris planned to conduct a test in which it would reduce tar and add nicotine to Marlboro:

We are initiating a study of the effect of systematic variation of the nicotine/tar ratio upon smoking rate and acceptability measures. Using Marlboro as a base cigarette we will reduce the tar delivery incrementally . . . and increase the nicotine delivery by adding a nicotine salt [a commercial form of nicotine].^{376a}

A 1972 Philip Morris document identifies the natural nicotine-to-tar ratio in tobacco as 0.07, which is "characteristic of a broad range of natural leaf."^{376b} Within the next three years, Philip Morris had studied and found the "optimal" nicotine-to-tar ratio for consumer ratings of acceptability and "strength." A 1975 Philip Morris document containing the results of a study

³⁷⁵ U.S. Patent No. 3,861,400. Perkins PR, Bale CR. *Nicotine Fortification of Smoking Products*. Imperial Tobacco Group Limited. January 21, 1975. C1:1-10.

³⁷⁶ BATCO Group R&D Conference. Southampton, England. October 11-12, 1976. Page 4.

^{376a} P.A. Eichorn and W.L. Dunn. Quarterly Report of Projects 1600 and 2302. December 31, 1970. *In* 141 Cong. Rec. H8008 (daily ed. July 31, 1995)(statement of Rep. Waxman). These studies of optimal nicotine/tar ratios were intended to be used "to provide insight leading to new cigaret designs." Philip Morris, USA. Research and Development Five Year Plan, 1974-1978. May 1973. *In* 141 Cong. Rec. H8008, *supra*.

^{376b} Memorandum to P.A. Eichorn from W.L. Dunn et al. Plans for 1972. September 8, 1971. *In* 141 Cong. Rec. H8008 (daily ed. July 31, 1995)(statement of Rep. Waxman).

conducted by the company stated that the optimal nicotine-to-tar ratio was about 0.1, higher than the "natural" ratio:

This study provides evidence that the optimum nicotine-to-tar (N/T) ratio for a 10mg tar cigarette is somewhat higher than occurring in smoke from the natural state of tobacco.^{376c}

In other words, the study showed that for a given level of tar (10 mg), it was optimal to supply a higher level of nicotine than would occur naturally in tobacco. According to the authors, the study shows that smokers prefer a higher nicotine delivery in low tar cigarettes than the delivery level that would occur if nicotine were allowed to fall proportionately with tar:

[T]he experimental cigarette with the moderate level of nicotine addition was rated higher in acceptability than the proportional reduction cigarette and equal to the Marlboro control.^{376d}

A later quote from the same document, reported in the New York Times, indicates that this study was conducted to provide data on how to alter the natural nicotine-to-tar ratio of a low tar cigarette in such a way as to make the cigarette comparable to Marlboro (Philip Morris' most popular high tar cigarette) in consumer acceptability and "strength":

We are using the guidelines suggested by this study to attempt to make a 10mg tar cigarette that will equal a Marlboro in both subjective acceptability and strength.^{376e}

^{376c} Low Delivery Cigarettes and Increased Nicotine/Tar Ratios, A Replication. Approved by W.L. Dunn and distributed to H. Wakeham. October, 1975. In 141 Cong. Rec. H8009 (daily ed. July 31, 1995)(statement of Rep. Waxman).

See also:

Hilts PJ. "Documents Disclose Philip Morris Studied Nicotine's Effect on Body." *New York Times*. June 8, 1995.

^{376d} Low Delivery Cigarettes and Increased Nicotine/Tar Ratios, A Replication. Approved by W.L. Dunn and distributed to H. Wakeham. October, 1975. In 141 Cong. Rec. H8009 (daily ed. July 31, 1995)(statement of Rep. Waxman).

^{376e} Hilts PJ. "Documents Disclose Philip Morris Studied Nicotine's Effect on Body." *New York Times*. June 8, 1995.

The term "strength," as used in industry documents, is associated with nicotine delivery. A Philip Morris document from 1978 describes further studies being conducted by that company to systematically vary the nicotine-to-tar ratio to find the "optimal" ratio for the company's ultra low (5-7 mg) tar products.^{376f}

As early as 1965, a Brown and Williamson official reported to other Brown and Williamson executives that BATCO research was focused on "the smoking and health problem" and that:

Their approach seems to be to find ways of obtaining maximum nicotine for minimum tar. Approaches being used include:

- (a) P.E.I. treatment of filters*
- (b) Nicotine fortification of cigarette paper*
- (c) Addition of nicotine containing powders to tobacco*
- (d) Alteration of blends.³⁷⁷*

Minutes from BATCO Group Research & Development Conferences in 1967 and 1969 reflect the importance of nicotine to the industry when considering product modifications to respond to concerns about smoking and health issues. Among other things, it was recommended that:

The development of low TPM [tar], normal nicotine cigarettes should continue. In this connection, the use of filter additives, such as PEI could be helpful in rendering the nicotine more available to the smoker.

The development of a low TPM, low nicotine cigarette should be expanded. This raises the question of the level of nicotine required and the consumer study by

^{376f} Memorandum to T.S. Osdene from W.L. Dunn. Plans and Objectives-1979. December 6, 1978. In 141 Cong Rec. H7670 (daily ed. July 25, 1995).

[W]e will evaluate low delivery experimental cigarettes in the 5-7 mg FTC tar range but with nicotine levels which are discernibly higher than, equal to, and lower than the typical level expected of cigarettes in this range (which would be .53 mg).

³⁷⁷ Griffith RB. Report to the Executive Committee. With attached handwritten note. July 1, 1965. Page 2.

*Bristol can be helpful in determining this. [It was] pointed out that there was evidence that . . . per capita cigarette consumption increased for the lower nicotine brands. It cannot, however, be assumed that the minimum nicotine offered to the smoker is the optimal level, and some consideration should be given to establishing this. [Emphasis added.]*³⁷⁸

Similarly, a 1975 BATCO Group Research & Development Conference report states that:

*Once again the need for normal nicotine low tar cigarettes which appeal to the consumer was identified.*³⁷⁹ [Emphasis added.]

Another BATCO document recommended in 1976 that when tar levels are lowered, nicotine delivery should be maintained:

*A second approach which could be made both with existing brands and with new brands is to aim at a lower smoke production per cigarette (i.e. lower tar) while maintaining "normal" nicotine. Work along these lines is already going on. A further modification of this approach is to maintain normal nicotine reaction for the smoker while actually reducing the total amount of nicotine per cigarette. It is believed that this can be done, e.g. by the use of P.E.I. or by alkali treatment of tobacco stems. [Emphasis added.]*³⁸⁰

At the 1976 BATCO "Smoking Behavior" conference it was also observed that "there would

³⁷⁸ See:

BATCO Group R&D Conference. Montreal, Canada. October 25, 1967. Pages 4-5.

BATCO R&D Conference. Kronberg, Germany. June 2-6, 1969.

³⁷⁹ BATCO Group R&D Conference. Merano, N. Italy. April 2-8, 1975. Page 4.

See also BATCO Group Research & Development, Conference on Smoking Behavior, Southampton, UK, October 11-12, 1976. Page 8:

Provided we can get smokers to dissociate tar from nicotine in their minds in terms of a possible health hazard, then there is a clear opportunity for a range of products which at present do not exist in order to suit those who combine above average inner need [nicotine requirement - see p. 184, supra] with above average concern for health. This is very much in line with some of Russell's pronouncements, and the fact that he is advocating the 'low tar normal nicotine' cigarette fairly forcibly is something we could turn to our advantage when considering how to market such cigarettes.

³⁸⁰ Morini HA. *Cigarettes with health reassurance*. BATCO Opinion. 1976. Page 1.

appear to be a forthcoming demand for high nicotine tobaccos³⁸¹ in order to develop cigarettes that provide a higher nicotine to tar ratio.

A 1978 BATCO Group R&D Conference, which focused on product design issues, discussed several options for maintaining pharmacological satisfaction from low-tar cigarettes, including use of pharmacologically active nicotine substitutes:

Marketing opportunities will exist for cigarettes which are designed to replace the '1 mg cigarette.' Innovation on taste, tighter control of deliveries which may include a wider range of specified compounds, and improved control of the physical properties of the cigarette will obviously require attention. The pressure to retain smoking satisfaction may require more attention to be paid to the puff-by-puff delivery profile of the cigarette and perhaps the use of alternative active materials to augment or replace nicotine. [Emphasis added.]³⁸²

A 1979 BATCO R&D Policy Conference recommended continued research on aerosol growth, yet another means of reducing tar without simultaneously reducing nicotine:

Research on aerosol growth between inhalation and exhalation offers a way of reducing the retention of tar without at the same time reducing nicotine retention; this offers great potential to the Industry and should be continued.³⁸³

A report by Imperial Tobacco Ltd. also focused on the importance of developing low-yield cigarettes that address smokers' concerns about health, but that nevertheless provide the desired "physiological satisfaction":

A cigarette that delivers physiological satisfaction, yet is low in T & N, must

³⁸¹ BATCO Conference on Smoking and Behavior, Southampton, England. October 11, 1976. Page BW-W2-02311.

³⁸² Green SJ. Notes on Group Research & Development Conference. Sydney, Australia. March 1978. Page 3.

³⁸³ BATCO Notes on the R&D Policy Conference. Chewton Glen (February 10, 1979), Torquay (February 12-14, 1979). Page 4.

*surely be a major objective and represents an R & D challenge.*³⁸⁴

American Tobacco Company memoranda written in 1980 reveal a similar focus on increasing nicotine in relation to tar deliveries. The company conducted research on the addition of potassium carbonate to Tareyton and Pall Mall cigarettes to "increas[e] the amount of nicotine that is transferred from the tobacco to the mainstream smoke while leaving the 'tar' level unchanged."³⁸⁵ One of these memoranda states that the company plans additional research on "addition of sodium carbonate, [and] treatment of stems with alkali base" with the apparent goal of "liberat[ing] nicotine as a free base . . . and thereby increas[ing] the amount of nicotine in the smoke."³⁸⁶

A large number of industry patents also demonstrate that the industry has focused substantial resources on developing methods of maintaining adequate nicotine delivery to ensure smoker satisfaction while lowering levels of other smoke constituents.³⁸⁷

³⁸⁴ Imperial Tobacco Ltd. Summary of Matinee marketing plans 1971. Page 11.

³⁸⁵ See:
Bodenhamer NL. *Leaf Services Monthly Report for June; Increasing Nicotine Transfer in Smoke*. Memo to Dr. Eugene Glock. June 30, 1980.

Bodenhamer NL. *Leaf Services Monthly Report for August*. Memo to Dr. Eugene Glock. August 29, 1980.

³⁸⁶ Memo to Dr. Eugene Glock dated July 31, 1980. Page 2. [The first page of this memo is missing from the exhibits to the Staff Report prepared by the majority Staff of the Subcommittee on Health and the Environment, 103 Cong. 2d. Sess., entitled "Evidence of Nicotine Manipulation by the American Tobacco Company" (Dec. 20, 1994).]

³⁸⁷ See, e.g.:
U.S. Patent No. 3,584,630. Inskip GE. *Tobacco Product Having Low Nicotine Content Associated with a Release Agent Having Nicotine Weakly Absorbed Thereon*. Philip Morris Inc. June 15, 1971. C2:5-15

U.S. Patent No. 3,861,400. Perkins PR, Bale CR. *Nicotine Fortification of Smoking Products*. Imperial Tobacco Group Limited. January 21, 1975. C1:1-10.

Industry studies on smoker compensation³⁸⁸ have also led companies to be concerned that decreases in tar and nicotine yields will lead to dissatisfaction with smoking unless cigarettes are designed to allow smokers to compensate for the reduction in nicotine.³⁸⁹ Consequently, tobacco manufacturers have actually attempted to assist smokers to compensate for lower nicotine yields, *i.e.*, to obtain more nicotine from a cigarette than its machine-tested yield. They have done so by attempting to design cigarettes with "elasticity." "Elasticity" refers to the ability of a cigarette, whatever its nicotine yield as measured by a smoking machine, to deliver enough smoke to permit a smoker to obtain the nicotine he needs, *e.g.*, through more or longer puffs or by covering ventilation holes.³⁹⁰

BATCO researchers described corporate policy on compensation and elasticity at a 1984 conference:

U.S. Patent No. 4,215,706. Larson TM, Moring TB, Ireland MS. *Nicotine Transfer Process*. Loew's Theatres, Inc. C1:40-48, C3:61-66.

U.S. Patent No. 4,236,532. Schweizer AD, et al. *Smoking Rod Wrapper*. Gallaher Limited. December 2, 1980. C1:35-40.

U.S. Patent No. 4,830,028. Lawson JW, Bullings BR, Perfetti A. *Salts Provided From Nicotine and Organic Acid as Cigarette Additives*. R.J. Reynolds Tobacco Company. May 16, 1989. C1:40-47.

³⁸⁸ See FINDINGS § II.C.3., *supra*.

³⁸⁹ See Adams, note 326, *supra*, at p. 108:

We believe in overall conclusion, that our data shows Firstly, that individual smokers adapt their smoking habit to the type of cigarette being smoked in order to try to obtain what they need from their cigarette

.....
Thirdly, that if because of the design of the cigarette they cannot adapt sufficiently, dissatisfaction will result.

³⁹⁰ BATCO R&D Conference. 1983. Brazil. Page BW-W2-03952: A paper on the effects of filters on cigarette smoke stated that elasticity was one of the factors that allowed a greater impression of "strength" (which is related to nicotine delivery) "within a given tar segment."

Compensation by modifying smoking regime [increasing or decreasing/puff volume, duration, puff frequency, amount inhaled] is a topic which is being explored at GR & DC and this includes designing products which aid smoker compensation.

The marketing policy concerning this type of product is not clear but it is believed it will depend largely on the degree of elasticity in the design and how overtly this elasticity is achieved. The consensus is that small improvements in elasticity which are less obvious, visually or otherwise is likely to be an acceptable route. [Emphasis added.]³⁹¹

Tobacco companies have attempted to improve elasticity through a variety of techniques. BATCO researchers noted at a 1983 conference that "elasticity can be designed into a cigarette using tobacco blend and pressure drop components. . . ."³⁹² Researchers at a 1972 BATCO Conference cited the need for "means of increasing the puff number of low density, low delivery cigarettes . . . in addition to those at present available."³⁹³ At a 1975 conference, BATCO researchers were told about a German cigarette that had a number of design features that were intended to allow human smokers to obtain higher yields than the smoking machine. These design features included a higher than normal moisture content, reduced humectant, shorter cigarette rods, increased paper burn rate, additives, porous tipping, perforated tipping, acid filters, and the addition of sugars.³⁹⁴

At a 1983 BATCO R&D Conference, one of the workshops was entitled "Making the Smoke Work Harder." Notes of suggestions from that workshop include the question "What

³⁹¹ Proceedings of the BATCO Group R&D Smoking Behaviour-Marketing Conference, Session III. July 9-12, 1984. Page 55.

³⁹² BATCO Smoking Behavior Conference Overview, 1983. Page BW-W2-03292.

³⁹³ BATCO. Notes from Group R&D Conference, Chelwood; 1972. Page BW-W2-01764.

³⁹⁴ BATCO Group R&D Conference, 1975, note 379, *supra*, at p. 4.

factors control human ability to change T[ar]/N[icotine] ratios?" i.e., how can a smoker, through his own behavior, alter the amount of tar and nicotine he obtains from a cigarette of a particular machine-derived yield? Many of the remaining suggestions from the workshop offer possible methods to alter the tar/nicotine ratio of a cigarette, including manipulating the pH of the smoke, and altering the ratio of free to bound nicotine. By 1984, BATCO marketing and product development personnel were recommending the use of "compensatable" filters, intended "[t]o make it easier for smokers to take what they require from a cigarette."³⁹⁵

These documents show the extent of the tobacco industry's focus on nicotine in the face of increasing pressure to alter other characteristics of their products for health reasons. The documents reveal the industry's concern with the trend toward lower-tar products, and the industry's intense preoccupation with the need to provide adequate nicotine deliveries despite lowered tar deliveries. The documents establish that the industry's rationale for seeking to provide adequate nicotine deliveries in lower-delivery products is to ensure that these low-delivery products provide smoker satisfaction. These and other documents have shown the tobacco industry's awareness that smoker satisfaction is a function of the pharmacological effects of nicotine on the brain, and the industry's keen desire to be able to offer cigarettes that will allow smokers to obtain the threshold level of nicotine necessary to experience these effects.

³⁹⁵ Structured Creativity Conference, Southampton, June 25-28, 1984. Page BW-W2-01993; attended by Ted Parrack of Brown and Williamson.