

TO  
WHOM IT MAY CONCERN  
ON

METHODOLOGY EMPLOYED IN DETERMINATION  
OF TAR AND NICOTINE CONTENT OF  
CIGARETTE SMOKE FOR READER'S DIGEST

From: Foster D. Snell, Inc., Consulting Chemists-Engineers

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FOSTER D. SMELL, INC.  
29 West 15th Street, New York 11, N. Y.

CONSULTING CHEMISTS  
ENGINEERS

METHODS FOR DETERMINING  
TAR AND NICOTINE CONTENT OF CIGARETTE SMOKE

The following are excerpts from our report to Reader's Digest.

The cigarettes were conditioned at 77°F. (25°C) and 50 per cent relative humidity. The average weight of the cigarettes was determined and only those cigarettes were selected for test which were fully packed and did not deviate from the average weight by more than 20 milligrams. A mark was made on each cigarette to be smoked 23 millimeters from the mouth-piece end of the cigarettes and the cigarettes were smoked to this butt length.

Five cigarettes were smoked for each single determination. Determinations for tars were carried out in triplicate. Determinations for nicotine were carried out in duplicate.

Smoking

Cigarette smoking was carried out in a manner similar to that described by Bradford, Harlan and Hammer in Industrial and Engineering Chemistry, vol. 28 (1936) page 836-839 under the title "Nature of Cigarette Smoke. Technic of Experimental Smoking". This is the same method employed by W. Wolman and described in "A Study of Cigarettes, Cigarette Smoke and Filters", Journal of the American Medical Association, July 4, 1953, Pages 917 - 920.

Smoking of the cigarettes was performed with a "Smoke Sampling Apparatus" designed by the Research Laboratories of American Tobacco Co., Inc., and manufactured by Phipps & Bird, Richmond, Va. This is a four-place solenoid-actuated mechanical smoking machine. Puffs of 35 milliliter volume and 2 seconds duration were taken at 1 minute intervals until the cigarettes were burned to the predetermined butt length.

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The smoke passed through an absorption train consisting of a Kjeldahl flask containing 1 ml. of 0.5N hydrochloric acid and 10 ml. of alcohol and then through 2 bubble traps. The first bubbler contained 5 ml. of 0.5N alcoholic hydrochloric acid. The second bubbler contained 5 ml. of 0.5N aqueous hydrochloric acid.

At the conclusion of the run the smoke was allowed to settle for 20 minutes. All portions of the smoke collection train were washed into the flask with a minimum of hot water and alcohol.

Determination of Tar Content

The tar content of the smoke was determined by condensing and collecting it, at ambient room temperature, in the manner described above under Smoking. The apparatus train was washed with alcohol and water to remove tars condensed in the train and all washings placed in the tar condensate flask.

These were transferred to a beaker for evaporation of the solvent and the quantity of tars was determined by complete evaporation of the solvent and weighing of the residue.

Determination of Nicotine Content

Nicotine was determined in accordance with the method described in Methods of Analysis of the Association of Official Agricultural Chemists, Eighth Edition, 1955, page 66. The nicotine was steam distilled into dilute hydrochloric acid solution and precipitated with silicotungstic acid. The reagent was prepared by dissolving 120 grams of silicotungstic acid ( $4H_2O \cdot SiO_2 \cdot 12WO_3 \cdot 22H_2O$ ) in water and diluting to 1 liter. The precipitate was filtered through a Gooch crucible and dried at  $105^\circ C$  for 3 hours.

The values for tar and nicotine content of cigarette smoke shown on page 35 of the July issue of Reader's Digest are the averages of nine determinations for tar and six determinations for nicotine.

Respectfully submitted,

FOSTER D. SNELL, INC.

*Cyril S. Kimball*  
Cyril S. Kimball  
Executive Vice-President

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