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COMPOSITION OF SOME TRADE NAME SOLVENTS USED FOR CLEANING AND DEGREASING, AND FOR THINNING PAINTS¹

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As a result of a series of acute cases of systemic poisoning, with one fatality, among workers using solvents at a shell- and bomb-loading plant, it was decided to make available to the explosives plants² useful information on the composition and relative toxicity of many of the trade name solvent products used in these establishments. By means of questionnaires to approximately 90 Government-owned explosives manufacturing, loading, and storing plants a roster was obtained of all solvents in current use. From this list approximately 200 representative products were selected for chemical analysis. Samples of the selected products were sent by the respective establishments to the Army Industrial Hygiene Laboratory or to the Industrial Hygiene Division of the United States Public Health Service for chemical analysis.³ The results of these analyses were then compiled into a solvent index which contained all the pertinent data in a form which would permit their convenient use by the personnel of the plant, medical, safety, and engineering departments.

Since many of the products investigated are used also by many other industries it was deemed advisable to make the information available generally to everyone interested in industrial hygiene. It must be remembered, however, that the composition of the various products, as given in tables 1, 2, and 3, is the composition of the

¹ From the Industrial Hygiene Branch, Safety and Security Division, Ordnance Department, Army Service Forces.

² Plants assigned to the Safety and Security Division, Office of the Chief of Ordnance for production security inspection.

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specific sample analyzed and may represent accurately only one lot of the product. Manufacturers of materials of this type frequently change the ingredients or the proportions thereof for various reasons. Consequently, there is no assurance that these products would be exactly the same if purchased today as they were during the second quarter of the present calendar year (1945) when the analyses were made. The **only** way to be certain of the composition of products of this nature is to analyze a sample from each lot number as received. On the other hand, the general make-up of many of the products listed in tables 1, 2, and 3 will remain remarkably **similar** since the ingredients are selected by the manufacturers primarily on a functional basis.

The substances analyzed have been classified alphabetically under the names submitted by the users in tables 1, 2, and 3. The names of the suppliers or manufacturers are also given. The supplier or manufacturer listed is the one given by the plant using the particular substance and **many** of the products listed are available from other sources. The first column contains an index number which serves to identify the material for convenient reference in table 4.

It should be emphasized that the supplier or manufacturer listed in the tables is the one given by the plant which submitted the **sample**. Most of these same products can be obtained from a large variety of other suppliers. To obtain a fairly complete list of the suppliers would have required a prohibitive amount of time. Consequently, only the one from which the material was actually purchased is listed, with the thought that other plants which desire to use any of these products can obtain the names of the nearby dealers by writing to the one listed in the table.

The samples analyzed were divided into three **groups** according to their composition and use. In table 1 are listed the substances which are used as cleaners and degreasers, and which are composed, mainly of organic solvents. In table 2 are listed the substances which are used as thinners for paints, lacquers, and other finishing materials. The ingredients of these also are largely organic solvents. The miscellaneous materials which are used chiefly as cleaners, degreasers, and protective coatings, and which contain relatively little organic liquid are listed in table 3. Table 4 is a reference table which contains a list of the various substances used by different **plants** according to mode of use or type of operation at which employed.

The organic liquid components of the products, listed in the first three tables are divided into **four** all-inclusive groups **chemically**, which are physiologically more or less distinct. They are as follows:

1. **AROMATICS:** These materials are very toxic. The common ones have maximum allowable concentrations of 50 to 200 p. p. m. Examples are benzene, toluene, and xylene.

2. **HALOGENATED HYDROCARBONS:** These chemicals also are very toxic. Most of those encountered in the group of samples analyzed have maximum allowable

TABLE 1.—Organic solvents used for cleaning or degreasing operations

Code No.	Name or trade name of product	Composition (percent)					Boiling range (°C.)	Supplier or manufacturer
		Aromatics (mac. 50-200 p. p. m.)	Halogenated hydrocarbons (mac. 50-200 p. p. m.)	Alcohols, esters, ethers, and ketones (mac. 200-400 p. p. m.)	Paraffins and naphthenes (mac. 500-1,000 p. p. m.)	Other		
C-1	Actisol (grease solvent)				100		155-205	Warren Refining Co., Cleveland, Ohio.
C-2	Amercoat #10	29		55	13		110-158	Grega Co., Philadelphia, Pa.
C-3	Amercoat #12	27		64	9		88-164	Do.
C-4	APCO-140				100		180-220	Bertram Naphtha Co., Kansas City, Mo.
C-5	Ber-to-sol	5	60		35		84-144	Do.
C-6	Blankrola	9	45		46		128-175	Addressograph-Multigraph Corp., Cleveland Ohio.
C-7	Castle Sludge Solvent	45			55		170-260	Graft Motor Co., Rapid City, S. D.
C-8	CC Sol.	10		17	73		80-146	Bertram Naphtha Co., Kansas City, Mo.
C-9	Cellosolve Acetate			100			155-158	Carbide & Carbon Chemicals Corp., Detroit, Mich.
C-10	Cleaners Naphtha				100		135-230	
C-11	C leanex Fluid				100		145-200	Quartermaster, Aberdeen Proving Ground, Aberdeen, Md.
C-12	Colonel Speedy Carbon and Rust Remover			45		Water	70-100	Jersey City Quartermaster Depot, Jersey City, N. J.
C-13	Dearboline Cleaning Compound				100		185-300	Dearborn Chemical Co., Philadelphia, Pa.
C-14	Degreassal		100				70-110	General Electric Supply Co., Denver, Colo.
C-15	Degreassal III T				100		160-222	General Electric Supply Co., Evansville, Ind.
C-16	Ditto Fluid			100			78 app.	Ditto Inc., Chicago, Ill.
C-17	Dry Cleaners Solvent				100		156-196	
C-18	Dry Cleaning Fluid		25		75		75-140	Shell Oil Co., Baltimore, Md.
C-19	Dry Cleaning Solvent				100		160-205	Paris Oil Co., Paris, Tex.
C-20	Dry Cleaning Solvent (FS 661A)				100		145-210	Standard Oil Co. (Ohio), Cleveland, Ohio.
C-21	Finger Print Remover				100			
C-22	Gas-O-Clenz				100		80-150	Gulf Oil Corp., Augusta, Ga.
C-23	Hylite				100		55-175	Socoony Vacuum Oil Co., New York, N. Y.
C-24	Imperial Washer Cleaner	20	70		10		75-120	Martindale Electric Co., Cleveland, Ohio.
C-25	Ink Cleaner #77			80	20		75-235	Superior Type Co., Chicago, Ill.
C-26	Keelite Z. C. Stripper	25		65	10		60-135	Keelite Products Inc., Houston, Tex.
C-27	Kerosene				100			
C-28	Kleen-O-Type	35	65				75-80	Gulf States Sales Co., Birmingham, Ala.
C-29	Lacquer Thinner #CT-350	16		47	37		78-134	E. I. duPont, Wilmington, Del.
C-30	Litholine				100		150-210	Sinclair and Valentine, Baltimore, Md.
C-31	Loosite	30		8	62		60-270	Petroleum Solvents Corp., New York, N. Y.
C-32	Magnolia Solvalsol				100		160-200	Magnolia Petroleum Co., Amarillo, Tex.
C-33	Magnus Carbon Remover		55		100	Cresylic acid	130-190	Magnus Chemical Co., Garwood, N. J.
							190-200	Standard Oil Co., Talladega, Ala.

C-26	Keelite Z. C. Stripper.....	25	65	10	60-135	Keelite Products Inc., Houston, Tex.
C-27	Kerosene.....			100	75-80	Gulf States Sales Co., Birmingham, Ala.
C-28	Kleen-O-Type.....	35	65	37	78-134	E. I. du Pont, Wilmington, Del.
C-29	Lacquer Thinner #CT-350.....	16	47	100	150-210	Sinclair and Valentine, Baltimore, Md.
C-30	Lithotine.....					
C-31	Loosite.....	30		62	160-200	Petroleum Solvents Corp., New York, N. Y.
C-32	Magnolia Solvisol.....			100	130-190	Magnolia Petroleum Co., Amarillo, Tex.
C-33	Magnus Carbon Remover.....		55	100	150-200	Magnus Chemical Co., Garwood, N. J.
C-34	Magnusol.....			100		Standard Oil Co., Talladega, Ala.
C-35	Mineral Spirits.....			100	160-210	Anderson Prichard Oil Co., Newark, N. J.
C-36	Mineral Spirits #12.....			100	155-220	Jamison Oil Co., Omaha, Nebr.
C-37	Naphtha, Cleaners.....	11		100	112-141	Cook Paint and Varnish Co., Omaha, Nebr.
C-38	Naphtha, V M & P.....	10	70	89	65-140	O'Brien Varnish Co., South Bend, Ind.
C-39	Nu-film #22.....	3	40	57		
C-40	O'Brien Lacquer Thinner L-156-XX.....					
C-41	Paco Solvent (denatured alcohol).....			100	75-100	Industrial Chemical Co., Omaha, Nebr.
C-42	Paint and Varnish Remover.....	50		50	64-75	V. J. Dolman and Co., Chicago, Ill.
C-43	Penolrite.....		20	80	139-186	General Solvents, Rochester, N. Y.
C-44	Pensolve.....			100	73-79	E. I. du Pont, Wilmington, Del.
C-45	Rifle Bore Cleaner.....			50	70-260	S. C. Johnson & Son, Inc., Racine, Wis.
C-46	Shamrock Solvent.....			100	160-200	Shamrock Oil & Gas, Amarillo, Tex.
C-47	Shellacol.....			100	78 app.	Shell Oil Co., New York, N. Y.
C-48	Solvisol #5 (Varnoline).....		100	100	160-190	Socony Vacuum Oil Co., New York, N. Y.
C-49	Solvental.....			94	185-245	Solvental Chemical Products Co., Pittsburgh, Pa.
C-50	Sovisol, Magnolia.....			100	160-200	Magnolia Petroleum Co., Amarillo, Tex.
C-51	Stanisol Solvent Mixture.....			100	150-200	Standard Oil Co., New York, N. Y.
C-52	Stoddard Solvent.....			100	157-188	Phillips Petroleum Co., St. Louis, Mo.
C-53	Stoddard Solvent.....			100	150-200	W. J. Hough Co., Chicago, Ill.
C-54	Stoddard Solvent.....			100	145-195	Actna Oil Co., Louisville, Ky.
C-55	Synsol.....			100	84 app.	Cook Paint & Varnish Co., Chicago, Ill.
C-56	Testors Thinner.....			40	60-110	Testor Chemical Co., Rockford, Ill.
C-57	Tonac Thinner.....			100	60-210	American Hospital Supply Co., Chicago, Ill.
C-58	Tri Sol.....		45	55	82-209	Bertram Naphtha Co., Kansas City, Mo.
C-59	Type Wash.....	39	33	23	64-142	Barco Chemical Products Co., Chicago, Ill.
C-60	Varnish and Paint Remover.....	50	50		64-75	V. J. Dolman & Co., Chicago, Ill.
C-61	Varsol.....			100	150-200	Standard Oil Co., New York, N. Y.
C-62	V M and P Naphtha.....	11		89	112-141	Jamison Oil Co., Omaha, Nebr.
C-63	Washurite.....		25	70	61-170	Davidson Mfg. Co., Chicago, Ill.

TABLE 2.—Organic solvents used as thinners

Code No.	Name or trade name of product	Composition (percent)			Boiling range (° C.)	Supplier or manufacturer
		Aromatics (mac. 50-200 p. p. m.)	Alcohols, esters, and ketones (mac. 300-400 p. p. m.)	Paraffins and naphthenes (mac. 500-1,000 p. p. m.)		
T-1	Acme Paint Thinner.....	25	60	15	70-125	Pittsburgh Auto Equipment Co., Meadville, Pa.
T-2	AMI Thinner.....	.....	.....	100	100-250	Sewell Paint Co., Kansas City, Mo.
T-3	ANA Thinner (enamel).....	.....	100	.....	82-128	Bertram Naphtha Co., Kansas City, Mo.
T-4	Apo Thinner.....	14	.....	86	122-147	McJunkin Supply Co., Charleston, W. Va.
T-5	Bitumastic Thinner.....	.....	.....	100	151-191	.....
T-6	Black Nitrocellulose Lacquer Enamel.....	10	50	40	70-140	Wabash Products Co., Terre Haute, Ind.
T-7	Black Stencil Paint Thinner.....	.....	.....	100	138-195	Phelan Faust, St. Louis, Mo.
T-8	Brit-Mark Stencil Ink Thinner.....	.....	65	35	125-180	Diagraph Bradley Stencil Machine Corp., St. Louis, Mo.
T-9	Butyl Cellosolve Thinner.....	.....	100	.....	171	Carbide and Carbon Chemical Corp., New York, N. Y.
T-10	Carbitol.....	.....	100	.....	198	Do.
T-11	Cellulose Nitrate Lacquer Thinner.....	.....	60	40	70-125	Pittsburgh Plate Glass Co., South Bend, Ind.
T-12	Chocolate Brown Lacquer Thinner.....	5	50	45	65-120	Jones-Dabney, Louisville, Ky.
T-13	Chromated Lacquer Thinner (Redox #66).....	100	.....	.....	.....	Grand Rapids Varnish Co., Grand Rapids, Mich.
T-14	Duco #3614.....	.....	60	40	37-147	E. I. du Pont Co., Wilmington, Del.
T-15	Duco Thinner (K-1486).....	29	42	29	64-142	Arthur Fulmer, Memphis, Tenn.
T-16	DuPont #200 Paint Thinner.....	55	.....	45	187-226	Koch's Paint & Supply Co., Burlington, Iowa.
T-17	DuPont #3322 Lacquer Thinner.....	30	50	20	75-139	E. I. du Pont Co., Wilmington, Del.
T-18	DuPont Lacquer Thinner #3673.....	.....	45	55	85-180	Do.
T-19	DuPont "Red" Thinner #3450.....	.....	70	30	60-120	E. I. du Pont Co., Dallas, Tex.
T-20	DuPont Synthetic Reducer (T-8879).....	.....	.....	100	80-125	The W. E. Wright Co., Akron, Ohio.
T-21	DuPont Synthetic Reducer (T-8879).....	25	.....	75	136-204	E. I. du Pont Co., St. Louis, Mo.
T-22	DuPont Thinner Mix.....	.....	50	50	.....	E. I. du Pont Co., Wilmington, Del.
T-23	Enamel Thinner.....	.....	.....	100	90-120	Sewell Paint & Varnish Co., Dallas, Tex.
T-24	Ethyl Cellulose Lacquer Thinner.....	15	50	35	78-143	Sewell Paint & Varnish Co., Kansas City, Mo.
T-25	Gensol.....	.....	Turpentine	.....	145-175	Newport Industries, Cincinnati, Ohio.
T-26	Glyptal Thinner.....	73	.....	27	126-143	General Electric Supply Co., Pittsburgh, Pa.
T-27	Hydro #1—Reducing—Spec. #2.....	75	.....	25	100-145	Western Rosin & Turpentine Co., Detroit, Mich.
T-28	Hydro Flex #195 Paint Thinner.....	22	.....	78	118-187	Phelan-Faust Paint Mfg. Co., St. Louis, Mo.
T-29	Ink Paste Thinner.....	.....	.....	100	165-201	Howard Flint Ink Co., Houston, Tex.
T-30	Ink Reducer.....	1	.....	99	153-205	Howard Flint Ink Co., Detroit, Mich.

T-26	Glyptal Thinner.....	73	100	27	126-143	General Electric Supply Co., Pittsburgh, Pa.
T-27	Hydro #1—Reducing—Spec. #2.....	75	40	25	100-145	Western Rosin & Turpentine Co., Detroit, Mich.
T-28	Hydro Flex #195 Paint Thinner.....	22	25	78	118-187	Phelen-Faust Paint Mfg. Co., St. Louis, Mo.
T-29	Ink Paste Thinner.....	1	45	100	165-201	Howard Flint Ink Co., Houston, Tex.
T-30	Ink Reducer.....			99	133-205	Howard Flint Ink Co., Detroit, Mich.
T-31	Ink Thinner #77.....	97	100	3	77-97	The Superior Type Co., Chicago, Ill.
T-32	Insulating Varnish Thinner #5052.....			100	79-126	Westinghouse Electric Supply Co., Pittsburgh, Pa.
T-33	Japan Dryer.....	35	40	25	130-210	O'Brien Varnish Co., South Bend, Ind.
T-34	Lacquer Enamel Thinner.....	45	25	30	70-135	Do.
T-35	Lacquer Thinner.....					
T-36	Lacquer Thinner.....	11	50	30	69-134	Cook Paint & Varnish Co., Houston, Tex.
T-37	Lacquer Thinner.....	15	51	38	72-137	Pittsburgh Plate Glass Co., St. Louis, Mo.
T-38	Lacquer Thinner.....	15	45	40	75-140	Gilman Paint & Varnish Co., Chattanooga, Tenn.
T-39	Lacquer Thinner 250-C-656.....	15	55	40	75-140	Cook Paint & Varnish Co., Houston, Tex.
T-40	Lacquer Thinner #1055A.....	2	72	26	75-120	Sewell Paint & Varnish Co., Kansas City, Mo.
T-41	Lacquer Thinner #1173B.....	20	52	28	79-141	P. D. George Co., St. Louis, Mo.
T-42	Lacquer Thinner (FL-19830).....	15	60	25	80-139	Pittsburgh Plate Glass Co., St. Louis, Mo.
T-43	Lacquer Thinner (FL-20300).....	3	60	35	73-135	Pittsburgh Plate Glass Co., Birmingham, Ala.
T-44	Lacquer Thinner (U. L. 10045).....	15	60	25	70-140	O'Brien Varnish Co., South Bend, Ind.
T-45	Mineral Spirits.....			100	154-198	Standard Oil Co., Huntsville, Ala.
T-46	Naphtha.....	5		95	88-150	Jameson Oil Co., Omaha, Nebr.
T-47	Naphtha.....	10		90	96-143	F. J. Donahoe Varnish Co., Detroit, Mich.
T-48	Nitrocellulose Lacquer Thinner.....	45	35	20	75-140	Grand Rapids Varnish Co., Grand Rapids, Mich.
T-49	Nitrocellulose Nitrate Dope Thinner.....	30	55	15	75-140	E. I. duPont Co., Wilmington, Del.
T-50	N. R. C. Thinner.....	3	70	27	67-121	
T-51	O'Brien Lacquer Thinner (L-165-3).....	46	30	24	98-136	O'Brien Varnish Co., South Bend, Ind.
T-52	Paint #2923A Thinner.....	20	10	100		Pittsburgh Plate Glass Co., Cleveland, Ohio.
T-53	Pentol O. D. Enamel Thinner.....		100	70		Paint & Varnish Co., Kansas City, Mo.
T-54	Phenolic Thinner.....			64		Sewell & Nudge Co., Pittsburgh, Pa.
T-55	Pittsburgh Minimax.....		36			Pittsburgh Plate Glass Co., Pittsburgh, Pa.
T-56	Proxylene Thinner.....	4	55	41		S. C. Johnson & Son, Inc., Racine, Wis.
T-57	Red Lacquer Thinner.....	15	50	35	68-145	Pittsburgh Plate Glass Co., Memphis, Tenn.
T-58	Reducer #74.....	30	40	100	145-205	Sherwin-Williams Paint Co., Baltimore, Md.
T-59	Sea Lac Lacquer Thinner.....	75		30	65-130	Duralac Chemical Corporation, Newark, N. J.
T-60	Sewell #3551 Paint Thinner.....			25	134-175	Sewell Paint & Varnish Co., Kansas City, Mo.
T-61	Sherwin-Williams Paint Thinner.....	5		95	64-130	Sherwin-Williams Co., Dallas, Tex.
T-62	Sol Naphtha.....		100	100	160-194	Shell Petroleum Co., New York, N. Y.
T-63	Solox.....	60	100	40	77-107	McKesson-Robbins Co., Omaha, Nebr.
T-64	Solrosso #1 Thinner.....	70		30	85-135	Standard Oil Co., Norfolk, Va.
T-65	Solrosso #3.....			30	170-220	Colonial Beacon Oil Co., Springfield, Mass.
T-66	Solrosso—Sohio #1.....	70		30		Standard Oil Co., Akron, Ohio.
T-67	Special Fast Dry Stencil Thinner.....	18		82	111-141	Wm. H. Witte & Sons Paint Co., Burlington, Vt.
T-68	Spruance Thinner.....	7	65	38	69-140	Gilbert Spruance Co., Philadelphia, Pa.
T-69	Stencil Thinner Solvent #50.....	25	65	10	60-195	Garvey Fountain Brush & Ink Co., St. Louis, Mo.
T-70	Superior #77 Ink Thinner.....		100		80-200	The Superior Type Co., Chicago, Ill.
T-71	Synthetic Enamel Thinner.....	40		60	135-200	Rinsched Mason Co., Detroit, Mich.
T-72	Synthetic Thinner for O. D. Paint.....			100	90-145	Dyke Motor Supply Co., Akron, Ohio.
T-73	Synthetic Thinner—Latex.....			40	70-165	Graybar Electric Co., Newark N. J.
T-74	Thinner #30.....				56-125	Sherwin-Williams Co., Des Moines, Iowa.
T-75	Thinner #74.....	60	40	100	160-210	

TABLE 2.—Organic solvents used as thinners—Continued

Code No.	Name or trade name of product	Composition (percent)			Boiling range (° C.)	Supplier or manufacturer
		Aromatics (mac. 50-200 p. p. m.)	Alcohols, esters, and ketones (mac. 200-400 p. p. m.)	Paraffins and naphthenes (mac. 500-1,000 p. p. m.)		
T-76	Thinner, Acid Proof Black Paint.....	15	.....	85	120-147	Testor Chemical Co., Rockford, Ill.
T-77	Thinner, Cooks.....	20	50	30	.....	Cook Paint & Varnish Co., Houston, Tex.
T-78	Thinner, O. E. #1500.....	70	.....	30	105-145	Graybar Electric Co., Newark, N. J.
T-79	Thinner, Lacquer #20.....	22	32	26	69-153	Acme White Lead & Color Works, Detroit, Mich.
T-80	Thinner, Lacquer (du Pont) (3-162-1).....	21	32	47	.....	E. I. duPont, Co., Wilmington, Del.
T-81	Thinner, Lacquer Enamel (3-162-A).....	20	50	30	70-130	Wabash Products Co., Terre Haute, Ind.
T-82	Thinner, Lacquer Enamel (Cooks).....	34	.....	66	67-141	Cook Paint & Varnish Co., Kansas City, Mo.
T-83	Thinner, Lacquer Enamel (Nitro Cellulose).....	.....	60	40	.....	S. C. Johnson & Son, Inc., Racine, Wis.
T-84	Thinner, Marking Ink #4.....	.....	100	.....	124	Hilton Hawley Co., Cincinnati, Ohio.
T-85	Thinner—Paint (#76).....	10	63	25	.....	.....
T-86	Thinner, Pedigree #150.....	100	.....	.....	133-151	H. A. Holden, Inc., Minneapolis, Minn.
T-87	Thinner, Testor's.....	26	33	41	.....	Testor Chemical Co., Rockford, Ill.
T-88	Thinner, Witte's Lacquer Thinner.....	26	30	44	82-124	Wm. H. Witte & Sons Paint Co., Burlington, Iowa.
T-89	V. M. & P. Naphtha.....	5	.....	95	99-176	Socony Vacuum Co., St. Louis, Mo.
T-90	Warren's Deodorized Leptine.....	.....	.....	100	165-210	Warren Paint and Color Co., Nashville, Tenn.
T-91	Wash #5916 Thinner.....	10	75	15	70-140	George Rutledge Co., Montclair, N. J.
T-92	Westinghouse #8110 Thinner.....	.....	100	.....	73-107	Westinghouse Electric Supply Co., Pittsburgh, Pa.
T-93	Westinghouse Tuffnell Thinner 1609.....	3	.....	97	155-196	Westinghouse Electric Supply Co., St. Paul, Minn.
T-94	Xyol Solvesso.....	100	.....	.....	135-180	Standard Oil Co., Akron, Ohio.
T-95	Zapon Cellite A.....	15	80	5	70-130	Zapon Division, Atlas Powder Co., Philadelphia, Pa.

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concentrations in the range of 50 to 200 p. p. m. Examples are carbon tetrachloride, trichloroethylene, and dichlorobenzene.

3. ALCOHOLS, ESTERS, ETHERS, AND KETONES: These chemical groups are less toxic than 1 and 2. Most of those encountered in the samples analyzed fall into a maximum allowable concentration toxicity range of 200 to 400 p. p. m. Examples are acetone, methyl ethyl ketone, the alcohols, and the acetates.

4. PARAFFINS AND NAPHTHENES: This group is not particularly toxic. It includes materials such as gasoline, Stoddard solvent, petroleum naphtha, and V M and P naphtha. The maximum allowable concentrations for the materials in this group range from 500 to 1,000 p. p. m.

In addition to the substances described in paragraphs 1, 2, 3, and 4 above, some of the products listed in table 3 contain other ingredients. These are of little concern, as a rule, from the inhalation viewpoint but are of importance as regards skin contact. Free alkali and various acids may produce burns or dermatitis if brought in contact with the skin, and others may act as sensitizers and cause allergic eczema.

The results of the analyses were classified as described above because it was felt that this arrangement would be more useful to the majority of personnel than would the actual specific analyses. Hence, an estimate of the danger associated with using a given product may be obtained by noting what percentages of the ingredients fall in the more toxic groups, and observing the boiling range. It should be emphasized that for many operations the boiling range is important and high boiling products should be selected in preference to low boiling ones since, other things being equal, the natural evaporation rate decreases as the boiling point increases and the atmospheric concentration of the vapors of the ingredients will therefore be lower with the higher boiling products.

The data contained in tables 1, 2, and 3 make it possible for personnel of the medical and safety departments to estimate the degree of hazard associated with the use of any of the products investigated; and those in table 4 make it possible to select a less toxic substitute for the same operation.

Even though the data in this paper pertain largely to the health hazard associated with the use of these materials, it must be remembered that most solvents, thinners, and cleaners with the exception of the halogenated hydrocarbons also present important fire and explosion hazards. As a rule the proper control of the health hazard will automatically control the fire or explosion hazard but such is not always the case. It is necessary, therefore, that adequate precautions be taken to prevent the existence or creation of a fire hazard. The potential fire and explosion hazard is influenced greatly by the flash point and by the boiling point of the material used; hence these factors as well as the toxicity must be taken into consideration when selecting the best product for a given operation or use.

TABLE 3.—Materials or products used for cleaning, degreasing, cementing, or finishing operations

Code No.	Name or trade name of material	Composition 1								Boiling range (° C.)	Supplier or manufacturer
		Aro-matics (mac. 50-200 p.p.m.)	Halo-genated hydro-carbons (mac. 50-200 p.p.m.)	Alco-hols, esters, naph-thenes (mac. 200-400 p.p.m.)	Para-fins and naph-thenes (mac. 500-1,000 p.p.m.)	Free alkali	Alkaline salts	Deter-gents and soap	Water			Other
M-1	Apex.....						36	7	x	Neutral salts	Apex Alkali Products Co., Philadel-phia, Pa.
M-2	Bendix Cleaner.....		22	8	35					Cresylic acid	Chain Battery & Auto Supply Co., Shreveport, La.
M-3	Blufilm No. 30.....	5		60	35						Sherwin-Williams Paint Co., Balti-more, Md.
M-4	Brex.....						83	13	4		Rudolph Ramell Co., Milan, Tenn.
M-5	Carbon Remover Solvent.....		Water solution containing chromate and cresol					15	5	Cresylic acid	San Antonio Arsenal, San Antonio, Tex.
M-6	Carbon Remover Solvent.....									High boiling oil	Reichman Crosby & Co., Memphis, Tenn.
M-7	Cassite (Penetrating Oil).....					32	46	14		Neutral salts	Cowles Detergent Co., Cleveland, Ohio.
M-8	Cowles Cleaner (metal clean-er).....									High boiling oil	Dearborn Chemical Co., Chicago, Ill.
M-9	Dearborn.....		Water solution of acid salt		25						Multigraph Sales Co., Erie, Pa.
M-10	Decoxit.....							x	10	Cresylic acid	Third Service Command Shop, Read-ing, Pa.
M-11	Duosol Ameroid.....										Standard Oil Co. of New York.
M-12	Enn-Jay Naphtha (xylol).....	90		10					2	Residue	Quaker Chemical Products Co., Con-shohocken, Pa.
M-13	Ferrocole #360.....			53					5	Sulfonated oil	Turco Products Co., Atlanta, Ga.
M-14	Furze (motor cleaner & car-bon remover).....		40								Curran Corp., Malden, Mass.
M-15	Gunk.....			40				10	40	Cresols	
M-16	Gunk-990A Concentrate.....							3	83	do	
M-17	Keelite AAF Star.....		35	25				x	30	Cresylic acid	Keelite Products Inc., Huston, Tex.
M-18	Keelite #24 Cleaner.....					19	73		8		Do.
M-19	Keelite 50 (motor cleaning com-pound).....					14	46	15	25		Do.
M-20	Keelite (radiator cleaning com-pound).....					13	10	10	65	Glycol	Do.
M-21	Keelite Superfoam.....		10					4	96		Do.
M-22	Keelite Terol Cleaner.....				45			35	10		Do.

Multigraph Sales Co., Birmingham, Ala.
 Clayton Mfg. Co., Alhambra, Calif.
 Houston, Tex.

Water solution of mucilage

M-23 | Keepeze.....

M-24 | Kendal Tbln Film (AXS 673).....

Residue.....

16

7

63

60

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M-22 Kellite Tetro Cleaner	Multigraph Sales Co., Birmingham, Ala.									
	Clayton Mfg. Co., Alhambra, Calif. Kellite Products Inc., Houston, Tex. Sherwin-Williams Paint Co., Balti- more, Md. The Penetone Co., Tenefy, N. J. Do. Turco Products Co., Los Angeles, Calif. Multigraph Sales Co., Erie, Pa. Neilson Chemical Co., Detroit, Mich. Multigraph Sales Co., Erie, Pa. American Chemical Paint Co., Am- bler, Pa. Allied Products Co., Chicago, Ill.									
	Water solution of mucilage					Residue				
	60	15	62	7	16	60-270				
M-23 Kelpex					10	Cresylic acid				
M-24 Kendal Thin Film (AXS 673)										
M-25 Kerneed	35									
M-26 Ketrex (asphalt removing com- pound)	70									
M-27 Nuflum No. 22										
M-28 Penetone						Residue, 25				
M-29 Penetone Senior						Residue, 30				
M-30 Penetrol	20					Cresylic acid				
M-31 Platex	Water solution of salts and glycerin									
M-32 Prepikl #4580 Rust Remover	3									
M-33 Repelex	Water solution of salts and glycerin									
M-34 Ridelene #23 Metal Cleaner	41	36								
M-35 Rust Preventive Compound	(Insoluble in water)									
M-36 3-Zygo Solution Solvent										

Numbers indicate percent of ingredient present, and x indicates presence of ingredient in undetermined amount.

TABLE 4.—List of products by operation or use

Operation or use	Solvents or cleaners used	Operation or use	Solvents or cleaners used
Affixing stencils to silk screens.....	M-3, M-27.	Multilith machines, operation.....	M-31.
Ammunition reconditioning.....	C-9, T-13, T-49, T-64.	Multilith machines, plates and rolls, cleaning.....	C-6, M-10, M-31, M-33.
Ammunition renovation.....	C-9, T-13, T-49, T-64.	Operating multilith machines.....	M-31.
Asphalt removal.....	M-22.	Paint remover.....	C-42, C-60, T-13.
Carbon removal.....	C-7, C-12, C-31, C-33, M-2, M-5, M-6, M-14	Preserving multigraph plates.....	M-23.
Cleaning automobiles.....	M-18, M-21.	Preserving ordnance material.....	C-11, M-1, M-9, M-13, M-24.
Cleaning auto parts.....	C-11, C-35, M-5, M-6.	Preserving small arms.....	M-1, M-9, M-13, M-24, M-35.
Cleaning bombs.....	C-42, C-60, C-62.	Protecting against acid or corrosion.....	C-2, C-12, C-31, C-33, M-2, M-5, M-6, M-14.
Cleaning brushes.....	C-29, T-71.	Removing carbon.....	C-7, C-12, C-31, C-33, M-2, M-5, M-6, M-14.
Cleaning brushes.....	C-7, C-12, C-31, C-33, M-2, M-5, M-6, M-14	Removing dry ink from press rolls.....	C-42, C-60, T-43.
Cleaning carburetors.....	C-34, M-2.	Removing enamel.....	C-42, C-60, T-13, T-23.
Cleaning clocks.....	C-23.	Removing fingerprints.....	C-21.
Cleaning components.....	C-42, C-48, C-60, C-61, T-49.	Removing rust.....	C-16, C-25, C-42, C-60, T-43.
Cleaning Davidson machine mats.....	C-63.	Removing stencil.....	C-42, C-57, C-60, T-13.
Cleaning Ditto machines.....	C-16.	Removing paint.....	C-42, C-60, T-13.
Cleaning electric motors.....	C-16.	Removing rubber gaskets.....	M-12.
Cleaning equipment.....	C-4, C-15, C-27, T-45, T-55, M-16, M-34.	Removing rust.....	C-12, M-1, M-7, M-32.
Cleaning fags.....	C-13, C-27, C-52, C-53.	Removing stencils.....	C-18.
Cleaning, general purpose.....	C-10, C-19, C-27, C-35, C-41, C-52, C-53, C-55, C-61, T-45, M-34.	Renovation.....	C-9, C-12, T-13, T-49, T-64, M-35.
Cleaning ignition points.....	C-35.	Rifle bore cleaner.....	C-45.
Cleaning instruments.....	C-23, C-34.	Rumbling cartridges.....	C-5, C-8.
Cleaning lithograph plates.....	C-30.	Rust-proofing ordnance material.....	M-9, M-13, M-24, M-35.
Cleaning machine parts.....	C-4, C-27, C-35, C-46, C-51, C-52, C-53.	Rust remover.....	C-12, M-1, M-7, M-32.
Cleaning mechanical equipment.....	C-4, C-15, C-27, M-16, M-34.	Solvent and dryer.....	T-33.
Cleaning motors.....	C-7, C-14, M-14, M-19.	Stencil paint and ink remover.....	C-25, C-59.
Cleaning multilith machines, plates, and rolls.....	C-6, M-10, M-31, M-33.	Thinner, acid proof black paint.....	T-66, T-76.
Cleaning office machines.....	C-52, C-53.	Thinner, acid resisting enamel.....	T-3, T-76.
Cleaning ordnance material.....	C-3, C-11, M-1.	Thinner, anti-paint-bubbling.....	T-94.
Cleaning paint brushes.....	C-29, C-40, C-42, C-60.	Thinner, auto paint.....	T-1, T-73, T-74, T-79.
Cleaning paint fixtures.....	C-29, C-40, C-42, C-60, M-30.	Thinner, bullet tipping lacquer.....	T-24, T-40.
Cleaning press rolls.....	C-42, C-60.	Thinner, China-wood oil finish.....	T-65.
Cleaning primer assembly.....	C-52, C-53.	Thinner, completed rounds ink.....	T-70.
Cleaning production parts.....	C-29, C-43, M-28, M-29, M-36.	Thinner, completed rounds lacquer.....	T-23, T-34.
Cleaning radiators.....	M-20.	Thinner, enamel.....	T-11.
Cleaning, renovation.....	C-9, C-42, C-60, M-1, M-7, M-32.	Thinner, completed rounds paint.....	T-10.
Cleaning rifle bores.....	C-45.	Thinner, components paints.....	T-10, T-57.
Cleaning rubber printing rolls.....	C-6.	Thinner, core lacquer.....	T-43.
Cleaning rubber stamps.....	C-36.	Thinner, "du Pont Red".....	T-19.
Cleaning rust.....	C-12, M-1, M-7, M-32.	Thinner, electric motor paint.....	T-26, T-92, T-93.
Cleaning scales.....	C-23.	Thinner, enamel.....	T-6, T-34, T-51, T-53, T-71, T-82, T-83, T-89.
Cleaning shells.....	C-42, C-60, C-62.	Thinner, fins and shells paint.....	T-6, T-39, T-52, T-72, T-80, T-88, T-89.
Cleaning silk screens.....	C-18, C-39.	Thinner, fuzze paint.....	T-11, T-57.
Cleaning spray booths.....	C-40, M-30.	Thinner, hot surfaces paint.....	T-5, T-53, T-82, T-83.
		Thinner, ink.....	T-2, T-8, T-10, T-43, T-69, T-70, T-84.

Cleaning rifle bores.....	C-45.	Thinner, components paints.....	T-10, T-57.
Cleaning rubber printing rolls.....	C-6.	Thinner, core lacquer.....	T-43.
Cleaning rubber stamps.....	C-36.	Thinner, "duPont Red".....	T-19.
Cleaning rust.....	C-12, M-1, M-7, M-32.	Thinner, electric motor paint.....	T-26, T-92, T-93.
Cleaning scales.....	C-23.	Thinner, enamel.....	T-6, T-34, T-51, T-53, T-71, T-82, T-83, T-89.
Cleaning shells.....	C-42, C-60, C-62.	Thinner, fins and shells paint.....	T-6, T-39, T-52, T-72, T-80, T-88, T-89.
Cleaning silk screens.....	C-18, C-39.	Thinner, fuze paint.....	T-11, T-57.
Cleaning spray booths.....	C-40, M-30.	Thinner, hot surfaces paint.....	T-5, T-53, T-82, T-83.
Cleaning stencil ink.....	C-25.	Thinner, ink.....	T-2, T-8, T-10, T-43, T-69, T-70, T-84.
Cleaning stencil screens.....	C-18, C-39.	Thinner, insulation varnish.....	T-26, T-32, T-59.
Cleaning stencil type.....	C-59.	Thinner, interior enamel.....	T-51.
Cleaning tetryl.....	C-26.	Thinner, lacquer.....	T-12, T-17, T-18, T-35, T-36, T-37, T-38, T-40.
Cleaning tools.....	C-14, C-27, C-48, C-52, C-53, C-55, A. 47.	Thinner, metal sealing compound.....	T-41, T-43, T-44, T-48, T-50, T-54, T-68, T-71.
Cleaning tractor machines.....	C-58.	Thinner, motor insulating paint.....	T-74, T-77, T-78, T-79, T-80, T-87, T-93.
Cleaning truck bodies.....	M-26.	Thinner, motor winding paint.....	T-23, T-34, T-82, T-83, T-87.
Cleaning type.....	C-35, C-59.	Thinner, Navy tracer paint.....	T-20, T-21, T-60, T-73, T-80.
Cleaning typewriters.....	C-24, C-28, M-15.	Thinner, nitrocellulose lacquer.....	T-2, T-8, T-9, T-30, T-60, T-84.
Cleaning vehicles.....	M-8, M-18.	Thinner, N. R. C. lacquer.....	T-19.
Cleaning zinc plates.....	C-6.	Thinner, O. D. shell and bomb paint.....	T-26, T-32, T-59, T-86, T-92, T-93.
Components renovation.....	C-48, C-61, T-10, T-11, T-13, T-49.	Thinner, paint.....	T-26, T-32, T-86, T-92, T-93.
Degreasing clocks.....	C-23.	Thinner, Pittman cement.....	T-56.
Degreasing floors.....	C-1.	Thinner, silk screen.....	T-6, T-48, T-83.
Degreasing, general purposes.....	C-10, C-27, C-35, C-40, C-52, C-53, C-61, M-11, M-15.	Thinner, silk screen reproduction paint.....	T-37, T-50.
Degreasing instruments.....	C-23.	Thinner, small arms repack paint.....	T-88, T-89.
Degreasing motors.....	C-14.	Thinner, stencil ink.....	C-52, C-53, T-4, T-6, T-10, T-12, T-15, T-16.
Degreasing parts.....	C-27, M-4, M-28, M-29, M-34, M-56.	Thinner, stencil paint.....	T-25, T-27, T-28, T-39, T-40, T-45, T-46, T-47.
Degreasing scales.....	C-23.	Thinner, synthetic lacquer.....	T-32, T-72, T-76, T-80, T-88, T-89.
Degreasing tools.....	C-14, C-27, C-48, M-34.	Thinner, wooden box paint.....	T-63.
Degreasing watch parts.....	C-22.	Varnish remover.....	T-91.
Ditto machine operation.....	C-16.	Washing automobiles.....	T-58, T-91.
Dry cleaning.....	C-17, C-19, C-20, C-32, C-50.		
Dryer and solvent.....	T-33.		
Enamel remover.....	C-42, C-60, T-13, T-23.		
Experimental purposes.....	T-14.		
Finger print remover.....	C-21.		
Finishing ordnance material.....	C-3, C-11, M-1, M-9, M-13, M-24.		
Grease removal.....	C-1, M-18.		
Ink remover.....	C-16, C-25, C-42, C-60, T-43.		
Lacquer remover.....	C-42, C-57, C-60, T-13.		
Metal sealing.....	M-12.		