

**TRANSACTIONS OF SOCIETY OF ACTUARIES  
1981 VOL. 33**

**REPORT OF THE SPECIAL COMMITTEE TO  
RECOMMEND NEW MORTALITY  
TABLES FOR VALUATION**

**T**HE 1980 CSO Tables (formerly known as K Tables) were developed by the Special Committee to Recommend New Mortality Tables for Valuation, to replace the existing 1958 CSO Tables as the minimum standard for valuation. The National Association of Insurance Commissioners has endorsed the new tables, and bills to make them the new standard have been introduced in about three-fourths of the states. As of this writing, approximately half of these bills have been passed.

Appendix A contains the 1980 CSO Tables, and the 1980 CET Tables are shown in Appendix B. Appendix C is a reprint of the committee's memorandum to Society members dated July, 1979, wherein information regarding the development of the tables and some useful comparative data are contained.

It was originally indicated that the committee would develop only ultimate tables. However, because of the growing concern over deficiency reserve problems for certain plans of life insurance, Ten-Year Selection Factors have been developed and endorsed by the NAIC. These factors are for use in conjunction with 1980 CSO Tables as an alternative minimum standard for both valuation and deficiency reserves on a plan-by-plan basis. Companies would have the option of using 1980 CSO rates or applying the selection factors to 1980 CSO rates. The basis chosen for a particular plan should be used to value both the basic life insurance reserve and the deficiency reserves.

The factors were presented to Society members in December, 1980, in the "Report on Development of Selection Factors to Be Applied to Table K as an Alternative Method of Determining Life Insurance Reserves and Deficiency Reserve Requirements," which is reprinted here as Appendix D.

APPENDIX A

NEW MORTALITY TABLES—VALUES OF  $1,000q_x$

Age $x$	Table K (M)	Table K (F)	Age $x$	Table K (M)	Table K (F)
0	4.18	2.89	50	6.71	4.96
1	1.07	0.87	51	7.30	5.31
2	0.99	0.81	52	7.96	5.70
3	0.98	0.79	53	8.71	6.15
4	0.95	0.77	54	9.56	6.61
5	0.90	0.76	55	10.47	7.09
6	0.86	0.73	56	11.46	7.57
7	0.80	0.72	57	12.49	8.03
8	0.76	0.70	58	13.59	8.47
9	0.74	0.69	59	14.77	8.94
10	0.73	0.68	60	16.08	9.47
11	0.77	0.69	61	17.54	10.13
12	0.85	0.72	62	19.19	10.96
13	0.99	0.75	63	21.06	12.02
14	1.15	0.80	64	23.14	13.25
15	1.33	0.85	65	25.42	14.59
16	1.51	0.90	66	27.85	16.00
17	1.67	0.95	67	30.44	17.43
18	1.78	0.98	68	33.19	18.84
19	1.86	1.02	69	36.17	20.36
20	1.90	1.05	70	39.51	22.11
21	1.91	1.07	71	43.30	24.23
22	1.89	1.09	72	47.65	26.87
23	1.86	1.11	73	52.64	30.11
24	1.82	1.14	74	58.19	33.93
25	1.77	1.16	75	64.19	38.24
26	1.73	1.19	76	70.53	42.97
27	1.71	1.22	77	77.12	48.04
28	1.70	1.26	78	83.90	53.45
29	1.71	1.30	79	91.05	59.35
30	1.73	1.35	80	98.84	65.99
31	1.78	1.40	81	107.48	73.60
32	1.83	1.45	82	117.25	82.40
33	1.91	1.50	83	128.26	92.53
34	2.00	1.58	84	140.25	103.81
35	2.11	1.65	85	152.95	116.10
36	2.24	1.76	86	166.09	129.29
37	2.40	1.89	87	179.55	143.32
38	2.58	2.04	88	193.27	158.18
39	2.79	2.22	89	207.29	173.94
40	3.02	2.42	90	221.77	190.75
41	3.29	2.64	91	236.98	208.87
42	3.56	2.87	92	253.45	228.81
43	3.87	3.09	93	272.11	251.51
44	4.19	3.32	94	295.90	279.31
45	4.55	3.56	95	329.96	317.32
46	4.92	3.80	96	384.55	375.74
47	5.32	4.05	97	480.20	474.97
48	5.74	4.33	98	657.98	655.85
49	6.21	4.63	99	1,000.00	1,000.00

APPENDIX B

NEW MORTALITY TABLES—VALUES OF  $1,000q_x$

Age $x$	Table KET (M)	Table KET (F)	Age $x$	Table KET (M)	Table KET (F)
0	5.43	3.76	50	8.72	6.45
1	1.82	1.62	51	9.49	6.90
2	1.74	1.56	52	10.35	7.41
3	1.73	1.54	53	11.32	8.00
4	1.70	1.52	54	12.43	8.59
5	1.65	1.51	55	13.61	9.22
6	1.61	1.48	56	14.90	9.84
7	1.55	1.47	57	16.24	10.44
8	1.51	1.45	58	17.67	11.01
9	1.49	1.44	59	19.20	11.62
10	1.48	1.43	60	20.90	12.31
11	1.52	1.44	61	22.80	13.17
12	1.60	1.47	62	24.95	14.25
13	1.74	1.50	63	27.38	15.63
14	1.90	1.55	64	30.08	17.23
15	2.08	1.60	65	33.05	18.97
16	2.26	1.65	66	36.21	20.80
17	2.42	1.70	67	39.57	22.66
18	2.53	1.73	68	43.15	24.49
19	2.61	1.77	69	47.02	26.47
20	2.65	1.80	70	51.36	28.74
21	2.66	1.82	71	56.29	31.50
22	2.64	1.84	72	61.95	34.93
23	2.61	1.86	73	68.43	39.14
24	2.57	1.89	74	75.65	44.11
25	2.52	1.91	75	83.45	49.71
26	2.48	1.94	76	91.69	55.86
27	2.46	1.97	77	100.26	62.45
28	2.45	2.01	78	109.07	69.49
29	2.46	2.05	79	118.37	77.16
30	2.48	2.10	80	128.49	85.79
31	2.53	2.15	81	139.72	95.68
32	2.58	2.20	82	152.43	107.12
33	2.66	2.25	83	166.74	120.29
34	2.75	2.33	84	182.33	134.95
35	2.86	2.40	85	198.84	150.93
36	2.99	2.51	86	215.92	168.08
37	3.15	2.64	87	233.42	186.32
38	3.35	2.79	88	251.25	205.63
39	3.63	2.97	89	269.48	226.12
40	3.93	3.17	90	288.30	247.98
41	4.28	3.43	91	308.07	271.53
42	4.63	3.73	92	329.49	297.45
43	5.03	4.02	93	353.74	326.96
44	5.45	4.32	94	384.67	363.10
45	5.92	4.63	95	428.95	412.52
46	6.40	4.94	96	499.92	488.46
47	6.92	5.27	97	624.26	617.46
48	7.46	5.63	98	855.37	852.61
49	8.07	6.02	99	1,000.00	1,000.00

## APPENDIX C

## MEMORANDUM TO THE MEMBERS OF THE SOCIETY OF ACTUARIES

*Re: Recommendation to the Board of Governors for a New Minimum Mortality Standard for the Valuation of Standard Individual Ordinary Life Insurance*

The attached Report by the Special Committee to Recommend New Mortality Tables for Valuation was sent to the Board of Governors as our recommendation for Tables to replace the 1958 CSO Tables as a minimum mortality standard for new issues.

Several members of the Committee appeared before the Board at its Meeting on May 23 in Kansas City to present the highlights of the Report and to participate in a discussion of its contents.

It is now felt that the Report should be made available to the members of the Society so that it can be discussed at our Annual Meeting in Bal Harbour in October of this year. The Committee will be pleased to receive written comments in advance (to be sent to the Chairman at John Hancock, Post Office Box 111, Boston, Ma. 02117).

In reading the enclosed Report, it should be kept in mind that no recommended minimum mortality standard for valuation is intended to replace the judgment of the actuary responsible for the adequacy of reserves and overall financial soundness.

THE SPECIAL COMMITTEE TO RECOMMEND  
NEW MORTALITY TABLES  
FOR VALUATION

C. A. Ormsby, *Chairman*  
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July 1979

**REPORT ON NEW MORTALITY TABLES FOR VALUATION  
OF INDIVIDUAL ORDINARY INSURANCE**

*To: Board of Governors, Society of Actuaries*

*From: Special Committee to Recommend New Mortality Tables for Valuation*

**INTRODUCTION**

More than twenty years have elapsed since the exposure period of the 1958 Commissioners Standard Ordinary Table. During this period, there have been substantial reductions in the experience mortality rates for insured lives. These improvements have increased the differentials between experience mortality and the rates in the 1958 CSO Table.

As a result, the use of the 1958 CSO Table for life insurance reserves has created problems in several areas. It produces higher life insurance reserves and minimum cash values than would be produced by a table based on current mortality levels, thus affecting the pricing of life insurance. It also requires companies to set up deficiency reserves to a much greater extent than would be true if a more modern table were used.

The 1958 CSO Table represented male mortality, although a small component of the experience was on female lives. A three-year age setback was assumed as the most practical and reasonable way to reflect the lower level of female mortality. However, it has been realized that the setback approach is not a sufficiently accurate representation of current female mortality. Accordingly, this Committee was established by the Board of Governors on June 2, 1976, and given the following charge: "This Committee is to develop new mortality tables for possible adoption by appropriate authorities for valuation of Individual Ordinary Insurance."

Appended are new male and female mortality tables, temporarily designated as Table K (M) and Table K (F), constructed by this Committee, which are in the opinion of the Committee suitable as a minimum basis for the valuation of individual ordinary insurance.

The sections of this report deal with (I) recommendation of sex-distinct tables, (II) development of basic tables, and (III) development of margins and loaded tables.

The reader is reminded that a mortality table intended to provide a minimum basis for the valuation of individual ordinary insurance has company solvency as its prime concern. Generally, the use of such a table would be inappropriate for the pricing of individual ordinary insurance. Most major life insurance companies would rely on their own recent experience mortality for determining guaranteed gross premiums on nonparticipating insurance or for the setting of dividend scales on participating insurance.

## I. RECOMMENDATION OF SEX-DISTINCT TABLES

One of the initial questions facing the Committee was that of separate male and female mortality tables for valuation purposes. After considerable discussion by the Committee members and an extensive survey of other actuaries, particularly consultants and those employed by smaller companies, the Committee decided to develop and recommend sex-distinct tables. This recommendation that separate valuation tables for males and females be developed and that minimum valuation standards for each sex be derived from an appropriate sex-distinct experience table is based on the following considerations.

1. Mortality differences by sex are clearly demonstrated by current mortality studies, and the differences are becoming greater. Population statistics show that the ratio of the age-adjusted death rates for males and females increased between 1920 and 1970 from 108 to 175 percent.

RATIOS OF MALE TO FEMALE AGE-  
ADJUSTED DEATH RATES, UNITED  
STATES, 1920-70

Year	White	Nonwhite
1920 .....	108	97
1930 .....	121	109
1940 .....	132	117
1950 .....	148	125
1960 .....	164	136
1970 .....	175	163

The ratio of male to female mortality based on insured data from the Society's 1970-75 study of standard ordinary insurance was 158 percent for durations 16 and over and 156 percent for durations 1-15.

2. A single age setback cannot approximate the male-female mortality differential across the entire spectrum of ages. A comparison of graduated mortality rates from the 1965-70 Ultimate Basic Tables shows that the appropriate age setback differs substantially by age (see table at top of p. 623).
3. While mortality differentials by sex are most clearly appropriate for premium calculations, and most companies have reflected these differentials in their rate schedules for many years, reserve differentials also exist. With mortality rates such as those on the 1965-70 Ultimate Basic Table, reserves are demonstrably different. The net level reserve for ordinary life on one mortality table is greater than, equal to, or less than the corresponding reserve on another table in the same manner as the ratios of annuities on the two tables compare, where the ratio at

Attained Age	Number of Years' Setback Needed to Equate Mortality Rate of Females to Males Based on 1965-70 Ultimate Basic Tables
15-29 .....	*
30-36 .....	15 or more
37 .....	7
38-39 .....	4
40-42 .....	3
43-49 .....	4
50-53 .....	5
54-56 .....	6
57-63 .....	7
64-71 .....	8
72-73 .....	7
74 .....	6
75-77 .....	5
78-86 .....	4

\*At these ages, there is no age setback that will produce the correct mortality rate.

the issue age is compared with that at the attained age. The following table of annuity ratios demonstrates that reserves for females will be less than those for males at most issue ages and durations.

RATIO OF LIFE ANNUITIES  
1965-70 ULTIMATE BASIC TABLES AT 4 PERCENT

Age	Male/Female	Age	Male/Female
15 .....	.9723	55 .....	.8795
20 .....	.9679	60 .....	.8609
25 .....	.9629	65 .....	.8458
30 .....	.9559	70 .....	.8445
35 .....	.9468	75 .....	.8500
40 .....	.9342	80 .....	.8542
45 .....	.9183	85 .....	.8714
50 .....	.8996	90 .....	.9346

For example, since the ratio at age 30 is greater than the ratio at age 45, the fifteenth Ordinary Life net level reserve for issue age 30 is larger for males than for females.

4. More female mortality experience is now available, giving greater credibility to separate female tables. The earliest available intercompany data separated by sex are for the period 1955-57. Data from the Society of Actuaries' annual study of standard ordinary insurance show the following ratios of female to male exposure, by amount, for policy years 1-15:

Years	Ratio
1955-57 .....	11.4%
1970-75 .....	15.3%

- This increased proportion of female experience could result in a combined experience table that would generate inadequate reserves for male risks.
5. The use of male tables for females would result in reserves for permanent insurance that have excessive margins and might preclude offering coverage to females at the lowest possible cost. This would result from either providing females with larger-than-necessary nonforfeiture benefits or charging higher premiums to avoid or reduce deficiency reserves. The increased sophistication and precision of current life insurance pricing and the greater presence of females in today's life insurance marketplace make the development of sex-distinct mortality tables a much more important issue today than twenty years ago.
  6. Current data processing capabilities make the adoption of sex-distinct tables more feasible than it was twenty years ago.

## II. DEVELOPMENT OF BASIC TABLES

Before discussing the New Basic Tables, the Committee would like to review some of the decisions made regarding the development of the 1958 CSO Basic Tables.

Three different exposure periods, 1946-50, 1950-54, and 1946-54 were originally considered, but the period between 1950 and 1954 anniversaries was selected as the most appropriate because it provided a sufficiently large volume of homogeneous data and was most representative of the then recent mortality experience. The experience was generally submitted in quinquennial issue-age groups for policy years 1-15. The experience for policy years 16 and over was submitted on an individual attained-age basis. For the data submitted by issue-age group, the central issue age for each age group was assumed to be the average issue age for that group. Experience for policy years 6-15 for issue ages 65 and over was excluded, since it was difficult to determine a proper central issue age because of the lack of uniformity in maximum issue ages among the various contributing companies. All the data were on an age-nearest-birthday basis.

The data used to develop the table excluded the first five policy years of experience. For policy years 6-15, the data were based on medical issues only. The data for policy years 16 and over included nonmedical experience, which was only a relatively small proportion of the experience. All war deaths were excluded except for some isolated cases in the juvenile ages. The data were then grouped into quinquennial attained-age groups, and pivotal values were determined. For ages under 20, the mortality rates were based on the experience of four large companies. The pivotal values at ages 2, 7, 12, and 17 were the actual mortality rates at those ages and were not grouped values. A special study was made of population mortality data and the experience of one large company to develop an age 0 mortality rate which would be representative of an assumed issue age of one day.



In the original pivotal values, a dip in the mortality rates at age 27 was noted. In order to avoid anomalies in net premiums and reserves, the pivotal values at ages 22 and 32 were adjusted to remove that dip (see Exhibit 2).

Margins were then added to the crude pivotal values and a Jenkins fifth-difference modified osculatory interpolation formula was used for the graduation. Therefore, the basic experience values were not themselves graduated. Further adjustments were then made at the very high attained ages, and the mortality rate at age 99 set equal to 1.000.

The 1958 CSO Basic Table was derived by subtracting the margins from the graduated table, with subsequent minor adjustments. Since the table was considered a male table, a three-year age setback was suggested to reflect lower female mortality. Subsequently, the 1958 CSO Basic Female Table was developed with mortality rates at ages 15 and over equivalent to the mortality rates for ages 12 and over of the 1958 CSO Basic Table. The female rates for ages 0-14 were developed through a comparison of male and female population mortality rates (see *TSA*, XI, 1060).

### *New Basic Tables*

The Committee decided that the exposure period for the data would be from 1970 through 1975 policy anniversaries. This period was selected because it was the most recent period of experience available, and there were no epidemics or other unusual events that would have affected mortality. All war deaths were excluded. A five-year exposure period was used instead of the four-year period used for the 1958 CSO Basic Tables in order to provide more data, especially for the female table. Nonmedical and medical data were included at all durations. It was considered appropriate to include nonmedical data in the New Tables because of the industry trend, since the development of the 1958 CSO Table, toward the writing of larger proportions of nonmedical business for higher amounts and at higher ages. The nonmedical experience was also needed to provide sufficient data for the female table. (Nonmedical experience for durations 6-15 constituted about 37 percent of the male select experience and about 55 percent of the female select experience.)

There is virtually no paramedical experience in the tables, since paramedical business was not issued to any degree until 1970, and the first five years of experience were excluded for the tables.

Most of the data submitted were on an age-nearest-birthday basis. The data submitted on an age-last-birthday basis were adjusted by the same method as was used in developing the 1965-70 Basic Tables (see *TSA*, 1973 *Reports*, p. 207).

Exhibit 1 compares the underlying data of the New Basic Tables with the underlying data of the 1958 CSO Table.

For the New Basic Male Table, the total exposures for ages 20-94 are about four times that for the 1958 CSO Table, and the actual deaths are over twice the level. For the New Basic Female Table, the corresponding figures are about one-half for the exposures and about one-sixth for the actual deaths (the underlying 1958 CSO experience was nearly all male).

As was done for the 1958 CSO Tables, the first five policy years of experience were eliminated from the data (except for ages 0-4). This was done to reduce the effect on the mortality rates of differences in intercompany underwriting rules, nonmedical limits and suicide and incontestability provisions and, more importantly, to reflect conservatism by eliminating the favorable select experience of the early policy years. As Exhibits 10 and

## EXHIBIT 1

COMPARISON OF EXPOSURES AND DEATHS USED FOR THE 1958 CSO TABLE AND  
NEW BASIC TABLES

First Five Policy Years of Experience Excluded\*

(Amounts Shown in \$1,000s)

AGE GROUP	EXPOSURES			ACTUAL DEATHS		
	1958 CSO	New Basic Male	New Basic Female	1958 CSO	New Basic Male	New Basic Female
0-4 .....		\$ 9,080,481	\$ 5,790,000		\$ 5,370	\$ 2,786
5-9 .....		4,878,759	2,681,499		1,598	536
10-14 .....		7,396,564	3,784,947		3,273	913
15-19 .....		9,677,244	4,106,704		10,988	1,755
20-24 ....	\$ 2,726,330	21,909,568	5,684,593	\$ 2,699	27,399	2,841
25-29 ....	6,678,470	52,293,149	8,206,719	6,485	49,852	4,555
30-34 ....	11,958,832	76,197,100	8,222,401	13,213	75,349	5,723
35-39 ....	18,857,546	88,994,537	8,048,920	34,240	123,478	7,816
40-44 ....	24,027,264	97,955,287	9,023,209	71,649	230,190	16,473
45-49 ....	26,081,158	98,367,065	9,964,187	128,599	377,590	27,652
50-54 ....	24,154,781	80,631,564	8,950,659	198,273	482,668	36,537
55-59 ....	21,128,665	56,828,655	6,840,899	279,218	572,567	42,165
60-64 ....	15,681,399	36,363,229	4,801,732	331,905	572,045	39,053
65-69 ....	9,678,830	20,405,781	2,847,553	318,624	532,020	40,722
70-74 ....	5,281,637	11,431,731	1,707,986	271,458	464,321	36,676
75-79 ....	2,497,656	6,170,287	939,249	184,872	420,393	38,787
80-84 ....	921,787	2,750,751	405,401	103,828	278,853	28,306
85-89 ....	224,470	877,864	121,882	36,135	137,465	14,990
90-94 ....	38,228	197,933	32,460	8,576	39,180	5,481
95-99 ....		18,964	3,121		5,035	674
0-99 .....		\$682,426,513	\$92,164,121		\$4,409,634	\$354,441
20-94 .....	\$169,937,053	651,374,501	75,797,850	\$1,986,774	4,383,370	347,777

\* Except for ages 0-4.

11 will show, eliminating the first five policy years of experience did not significantly affect the level of model office reserves (including all years of experience would have lowered total model office reserves on the New Basic Tables by about 0.8 percent).

The Committee developed fifteen-year select and ultimate mortality tables as part of the model office testing. The Committee did not recommend select and ultimate tables for valuation because of the wide variation in individual company mortality during the select period. The mortality rates based on aggregate experience (excluding the first five policy years) would generally be higher than the select rates of individual companies. Also, select and ultimate tables would have necessitated calculating commutation functions varying by issue age.

Experience for policy years 1–15 was generally submitted in quinquennial issue-age groups. The central issue age for each group was assumed to be the average issue age for that group. The central issue age for ages 70 and over was assumed to be 72. The ultimate data were submitted on an attained-age basis.

The select data (policy years 6–15) were combined with the ultimate data (policy years 16 and over) in the following manner. For the select data, an attained age was determined for each specific issue-age group by adding the policy year of the data, minus one, to the assumed central issue age for that group. For example, data for policy year 9 for issue-age group 55–59, medical, were combined with ultimate data at attained age 65 ( $57 + 9 - 1$ ). Pivotal values were developed by summing all the actual deaths and exposures in the particular five-year attained-age groups.

The 1970–75 intercompany data were used for all ages, including those under 20.

A significant dip in individual attained-age mortality rates was evident in the twenties for the male experience rates, and a very slight dip was evident in the twenties for the female experience rates. However, as will be noted later, the process of developing pivotal values for the graduation removed the slight dip in the female rates. Although the dip in the rates was deliberately removed in developing the 1958 CSO Table, the Committee felt that the dip in the New Basic Male Table should not be removed, for several reasons. First, the magnitude of the dip was much more significant in the current data and therefore should be reflected in the table as a valid representation of experience. Second, as many as four pivotal values would have had to have been adjusted to remove the dip, which would have meant disregarding the experience at the main insuring ages. Also, the Committee felt that any consequent anomalies in premiums or reserves would not cause insoluble problems.

Exhibit 2 compares the pivotal values used for the graduation of the New Basic Tables with the pivotal values used for the 1958 CSO Table. The extent of the dip of the male rates (col. 1) can be seen. This dip was much less pronounced in the 1950-54 experience. The pivotal values for the Female Table display no dip after pivotal age 7. The pivotal values for the New Basic Tables at ages 2, 7, and 12 were adjusted because most modern tables show lower death rates at age 12 than at age 7. The Committee felt that the increase in the unadjusted crude values at ages 7-12 is a fluctuation due to the limited data at those ages.

The adjusted rates were graduated by a Jenkins fifth-difference modified osculatory interpolation formula with fourth differences at the endpoints set equal to zero. The age 1 rates in the tables are the crude values for this age

## EXHIBIT 2

COMPARISON OF PIVOTAL VALUES  
1970-75 EXPERIENCE VERSUS 1950-54 EXPERIENCE  
(Mortality Rates per 1,000)

PIVOTAL AGE	1970-75 EXPERIENCE				1950-54 EXPERIENCE	
	Male* (1)	Adjusted for Graduation (2)	Female* (3)	Adjusted for Graduation (4)	Pivotal Prior to Margins* (5)	Adjusted for Graduation (6)
2	0.59	0.51	0.48	0.36	0.75†	
7	0.33	0.30	0.20	0.25	0.44†	
12	0.44	0.24	0.24	0.20	0.37†	
17	1.14		0.43		0.72†	
22	1.25		0.50		0.99	0.89
27	0.95		0.56		0.97	
32	0.99		0.70		1.10	1.20
37	1.39		0.97		1.66	
42	2.35		1.83		2.98	
47	3.84		2.78		4.93	
52	5.99		4.08		8.21	
57	10.08		6.16		13.22	
62	15.73		8.13		21.17	
67	26.07		14.30		32.92	
72	40.62		21.47		51.40	
77	68.13		41.30		74.02	
82	101.37		69.82		112.64	
87	156.59		122.99		160.98	
92	197.95		168.84		224.34	
97	265.51		215.90			

\* Columns 1, 3, and 5: data of first five policy years are excluded (except for age 2).

† Column 5: rates are for individual ages 2, 7, 12, and 17 and are based on the experience of four large companies.

(the same approach as was used in the 1958 CSO Basic Table). The rates at the very high ages, ages 85 and over for the Male Table and ages 84 and over for the Female Table, were adjusted to grade smoothly into a rate of 1.000 at age 100.

It should be remembered that the 1958 CSO Basic Tables were not determined by graduating the underlying data, but were developed by subtracting the margins in the valuation tables.

Since the experience data for age 0 were relatively scant, and since the experience rates were extremely low, it was decided to develop appropriate age 0 rates by relating them to the age 1 rates. Ratios were determined from the 1958 CSO Basic Tables of the age 0 rates to the age 1 rates, 6.33 for males and 5.83 for females, and these ratios were applied against the crude age 1 rates of the New Basic Tables. This procedure resulted in an age 0 rate for males of 3.67 and an age 0 rate for females of 2.45.

The New Basic Table rates determined by the graduation process and the previously mentioned adjustments at age 0 and the high ages were then further adjusted to produce actual-to-expected ratios of 1.000 for the entire Male Basic Table and 1.000 for the entire Female Basic Table. The adjustment factors used were 1.0077 for the Male Table and 0.9993 for the Female Table.

Exhibit 3 shows the New Basic Tables along with tests for smoothness (third differences) and fit (ratios of actual to expected deaths by quinquennial age groups). For most of the age groups in the Tables, the actual-to-expected ratios are quite close to 1.000. The age groups where the ratios are significantly higher or lower than 1.000 are those at the younger ages, where the pivotal values were adjusted, or at the higher ages, where the rates were also adjusted.

By analyzing the sum of the third differences, we determined that the New Basic Tables are "smoother" than the 1958 CSO Basic Tables. We made our analysis for mortality rates through age 92 only, because the rates above that age in the 1958 CSO Basic Table were adjusted to grade into 1.000 at age 100 and were not the graduated experience rates. The following chart shows the sum of the absolute values of third differences for ages 0-92 for the four tables:

COMPARISON OF  $\sum |\Delta^3 q_x|$  FOR  $q_0$  THROUGH  $q_{92}$ 

	Male	Female
New Basic Tables .....	764	597
1958 CSO Basic Tables .....	888	678

EXHIBIT 3—NEW BASIC TABLES WITH TESTS OF FIT AND SMOOTHNESS

(Rates per 100,000)

BASIC MALE			BASIC MALE			BASIC FEMALE			BASIC FEMALE		
Age x	q <sub>x</sub>	Δ <sup>3</sup>	Age x	q <sub>x</sub>	Δ <sup>3</sup>	Age x	q <sub>x</sub>	Δ <sup>3</sup>	Age x	q <sub>x</sub>	Δ <sup>3</sup>
0	370	-296	51	551	-1	0	245	-193	51	379	-4
1	59	-10	52	608	-2	1	42	-4	52	411	1
2	51	2	53	674	1	2	36	0	53	448	3
3	50	1	54	748	-3	3	34	-1	54	486	-2
4	46	-1	55	828	1	4	32	2	55	526	1
5	41	2	56	915	2	5	30	-1	56	565	3
6	36	1	57	1,006	5	6	27	0	57	601	5
7	30	0	58	1,102	2	7	25	1	58	635	6
8	25	2	59	1,205	3	8	23	0	59	670	4
9	22	0	60	1,320	4	9	21	1	60	711	5
10	21	2	61	1,449	-2	10	20	-1	61	764	-5
11	24	-3	62	1,595	-1	11	20	0	62	833	-6
12	31	-2	63	1,762	-4	12	22	-1	63	923	-4
13	44	-1	64	1,948	-1	13	25	0	64	1,029	-7
14	60	-2	65	2,152	0	14	29	0	65	1,145	-2
15	77	-3	66	2,370	8	15	33	-1	66	1,267	11
16	94	1	67	2,601	11	16	37	1	67	1,388	13
17	109	1	68	2,845	10	17	41	-2	68	1,506	13
18	119	0	69	3,110	11	18	44	2	69	1,632	14
19	125	0	70	3,407	6	19	47	0	70	1,779	9
20	128	1	71	3,746	-7	20	48	0	71	1,960	-3
21	128	2	72	4,138	-12	21	49	0	72	2,189	-10
22	125	-2	73	4,589	-10	22	50	0	73	2,475	-6
23	120	3	74	5,092	-11	23	51	0	74	2,815	-9
24	115	1	75	5,635	-7	24	52	1	75	3,199	-2
25	108	-1	76	6,208	19	25	53	-1	76	3,621	15
26	102	1	77	6,800	23	26	54	0	77	4,072	24
27	98	-1	78	7,404	23	27	56	1	78	4,550	21
28	95	1	79	8,039	24	28	58	-1	79	5,070	22
29	94	-1	80	8,728	12	29	60	0	80	5,656	12
30	94	1	81	9,494	-26	30	63	0	81	6,329	-19
31	96	-1	82	10,361	-29	31	66	2	82	7,111	-16
32	99	1	83	11,341	-26	32	69	-2	83	8,014	-11
33	104	0	84	12,408	-16	33	72	3	84	9,019	-10
34	110	1	85	13,533	-8	34	77	-1	85	10,110	-3
35	118	-2	86	14,690	0	35	82	0	86	11,276	0
36	128	2	87	15,863	8	36	90	1	87	12,507	8
37	141	-1	88	17,044	16	37	100	-1	88	13,800	16
38	155	1	89	18,233	33	38	112	-1	89	15,155	32
39	172	-2	90	19,438	64	39	127	0	90	16,580	64
40	191	2	91	20,675	129	40	144	-2	91	18,091	128
41	213	-2	92	21,977	258	41	162	2	92	19,720	255
42	236	2	93	23,408	969	42	181	-1	93	21,531	512
43	262	-2	94	25,097	579	43	199	1	94	23,652	1,025
44	289	2	95	27,302	2,516	44	218	-1	95	26,338	2,301
45	319	-2	96	30,992	3,676	45	237	2	96	30,101	3,838
46	350	3	97	36,746	7,484	46	257	0	97	35,966	8,507
47	384	0	98	47,080	0	47	277	1	98	46,234	0
48	419	3	99	65,670	0	48	299	-1	99	64,743	0
49	458	0	100	100,000	0	49	323	1	100	100,000	0
50	501	2				50	350	2			

Σ[Δ<sup>3</sup>] = 16,439

Σ[Δ<sup>3</sup>] = 17,227

Age Group	A/E	Age Group	A/E	Age Group	A/E	Age Group	A/E
0-4	0.575	55-59	1.013	0-4	0.669	55-59	1.034
5-9	1.111	60-64	0.996	5-9	0.808	60-64	0.969
10-14	1.157	65-69	1.019	10-14	1.017	65-69	1.050
15-19	1.055	70-74	0.995	15-19	1.051	70-74	0.983
20-24	1.029	75-79	1.025	20-24	0.993	75-79	1.040
25-29	0.976	80-84	1.003	25-29	0.980	80-84	1.016
30-34	0.974	85-89	1.025	30-34	0.998	85-89	1.028
35-39	0.963	90-94	0.933	35-39	0.939	90-94	0.895
40-44	0.981	95-99	0.807	40-44	0.993	95-99	0.678
45-49	0.999			45-49	0.993		
50-54	0.985			50-54	0.987		

Total Actual-to-Expected Ratio = 1.000

Total Actual-to-Expected Ratio = 1.000

Exhibit 4 compares the New Male and Female Basic Table rates and shows the effect of the significant dip in the Male Basic Table rates relative to the corresponding female rates.

Exhibits 5–8 compare the New Basic Table rates with the rates of several other mortality tables.

Exhibit 5 compares the New Male Basic Table with the 1969–71 United States Male Population Table. The Male Basic Table rates are lower than the population rates at all ages, except for ages 96–100, where the Basic Table was graded to end at age 100. For the main insuring ages, the rates are about 45–70 percent of the population rates.

Exhibit 6 shows similar results for the New Female Basic Table compared with the 1969–71 United States Female Population Table, although the Female Basic Table rates are closer to the population rates than the Male Basic Table rates are (generally about 55–75 percent of the population rates). The Committee feels that this is because medical experience constitutes a larger proportion of the male data, and that male population mortality has a greater proportion of experience in occupations with significant accidental or environmental hazards than female population mortality.

Exhibit 7 compares the New Male Basic Table to the 1958 CSO Male Basic Table. Except for the age range of the dip in mortality rates, the New Male Basic Table rates are generally 75–85 percent of the 1958 CSO Male Basic Table rates. The New Female Basic Table rates, as shown in Exhibit 8, are about 55–85 percent of the 1958 CSO Female Basic Table rates. It should be clear, therefore, that a three-year setback approach on the New Male Basic Table would not generally be sufficient to reflect the lower female mortality recently experienced.

#### *Model Office Testing*

In the course of the development of the New Basic Tables, the Committee made extensive use of a model office for reserve calculations. The model office distribution of issues by age, sex, and underwriting class, shown in Exhibit 9, was based on the 1970–75 intercompany experience of exposures in policy year 1. The distribution by sex was graded from 80 percent male, 20 percent female in the first year of the model office to 75 percent male, 25 percent female over five years to reflect the expected higher proportion of female issues in the future. The distribution of issues by plan was based on the paid issues of one large company and the 1974 LIMRA study of "Life Insurance Buying": Whole Life, 73.6 percent; Life Paid Up at age 65, 12.6 percent; Endowment at age 65, 6.3 percent; and Twenty-Payment Life, 7.5 percent. Term plans were not included, since their effect on the level of model office reserves would have been insignificant.

EXHIBIT 4

NEW MALE BASIC TABLE VERSUS NEW FEMALE BASIC TABLE

Age x	New Male Basic Table 1,000q <sub>x</sub> (1)	New Female Basic Table 1,000q <sub>x</sub> (2)	(1)-(2) (3)	(1)+(2) (4)	Age x	New Male Basic Table 1,000q <sub>x</sub> (1)	New Female Basic Table 1,000q <sub>x</sub> (2)	(1)-(2) (3)	(1)+(2) (4)
0	3.70	2.45	1.25	151.0%	51	5.51	3.79	1.72	145.4%
1	0.59	0.42	0.17	140.5	52	6.08	4.11	1.97	147.9
2	0.51	0.36	0.15	141.7	53	6.74	4.48	2.26	150.4
3	0.50	0.34	0.16	147.1	54	7.48	4.86	2.62	153.9
4	0.46	0.32	0.14	143.7	55	8.28	5.26	3.02	157.4
5	0.41	0.30	0.11	136.7	56	9.15	5.65	3.50	161.9
6	0.36	0.27	0.09	133.3	57	10.06	6.01	4.05	167.4
7	0.30	0.25	0.05	120.0	58	11.02	6.35	4.67	173.5
8	0.25	0.23	0.02	108.7	59	12.05	6.70	5.35	179.9
9	0.22	0.21	0.01	104.8	60	13.20	7.11	6.09	185.7
10	0.21	0.20	0.01	105.0	61	14.49	7.64	6.85	189.7
11	0.24	0.20	0.04	120.0	62	15.95	8.33	7.62	191.5
12	0.31	0.22	0.09	140.9	63	17.62	9.23	8.39	190.9
13	0.44	0.25	0.19	176.0	64	19.48	10.29	9.19	189.3
14	0.60	0.29	0.31	206.9	65	21.52	11.45	10.07	187.9
15	0.77	0.33	0.44	233.3	66	23.70	12.67	11.03	187.1
16	0.94	0.37	0.57	254.1	67	26.01	13.88	12.13	187.4
17	1.09	0.41	0.68	265.9	68	28.45	15.06	13.39	188.9
18	1.19	0.44	0.75	270.5	69	31.10	16.32	14.78	190.6
19	1.25	0.47	0.78	266.0	70	34.07	17.79	16.28	191.5
20	1.28	0.48	0.80	266.7	71	37.46	19.60	17.86	191.1
21	1.28	0.49	0.79	261.2	72	41.38	21.89	19.49	189.0
22	1.25	0.50	0.75	250.0	73	45.89	24.75	21.14	185.4
23	1.20	0.51	0.69	235.3	74	50.92	28.15	22.77	180.9
24	1.15	0.52	0.63	221.2	75	56.35	31.99	24.36	176.1
25	1.08	0.53	0.55	203.8	76	62.08	36.21	25.87	171.4
26	1.02	0.54	0.48	188.9	77	68.00	40.72	27.28	167.0
27	0.98	0.56	0.42	175.0	78	74.04	45.50	28.54	162.7
28	0.95	0.58	0.37	163.8	79	80.39	50.70	29.69	158.6
29	0.94	0.60	0.34	156.7	80	87.28	56.56	30.72	154.3
30	0.94	0.63	0.31	149.2	81	94.94	63.29	31.65	150.0
31	0.96	0.66	0.30	145.5	82	103.61	71.11	32.50	145.7
32	0.99	0.69	0.30	143.5	83	113.41	80.14	33.27	141.5
33	1.04	0.72	0.32	144.4	84	124.08	90.19	33.89	137.6
34	1.10	0.77	0.33	142.9	85	135.33	101.10	34.23	133.9
35	1.18	0.82	0.36	143.9	86	146.90	112.76	34.14	130.3
36	1.28	0.90	0.38	142.2	87	158.63	125.07	33.56	126.8
37	1.41	1.00	0.41	141.0	88	170.44	138.00	32.44	123.5
38	1.55	1.12	0.43	138.4	89	182.33	151.55	30.78	120.3
39	1.72	1.27	0.45	135.4	90	194.38	165.80	28.58	117.2
40	1.91	1.44	0.47	132.6	91	206.75	180.91	25.84	114.3
41	2.13	1.62	0.51	131.5	92	219.77	197.20	22.57	111.4
42	2.36	1.81	0.55	130.4	93	234.08	215.31	18.77	108.7
43	2.62	1.99	0.63	131.7	94	250.97	236.52	14.45	106.1
44	2.89	2.18	0.71	132.6	95	273.02	263.38	9.64	103.7
45	3.19	2.37	0.82	134.6	96	309.92	301.01	8.91	103.0
46	3.50	2.57	0.93	136.2	97	367.46	359.66	7.80	102.2
47	3.84	2.77	1.07	138.6	98	470.80	462.34	8.46	101.8
48	4.19	2.99	1.20	140.1	99	656.70	647.43	9.27	101.4
49	4.58	3.23	1.35	141.8	100	1,000.00	1,000.00	0.00	100.0
50	5.01	3.50	1.51	143.1					



EXHIBIT 5

NEW FEMALE BASIC TABLE VERSUS 1969-71 UNITED STATES  
FEMALE POPULATION TABLE

Age x	New Male Basic Table 1,000q <sub>x</sub>	1969-71 U.S. Male 1,000q <sub>x</sub>	(1)-(2)	(1)+(2)	Age x	New Male Basic Table 1,000q <sub>x</sub>	1969-71 U.S. Male 1,000q <sub>x</sub>	(1)-(2)	(1)+(2)
	(1)	(2)	(3)	(4)		(1)	(2)	(3)	(4)
0	3.70	22.45	- 18.75	16.48%	51	5.51	10.59	- 5.08	52.03%
1	0.59	1.33	- 0.74	44.36	52	6.08	11.61	- 5.53	52.37
2	0.51	0.94	- 0.43	54.26	53	6.74	12.75	- 6.01	52.86
3	0.50	0.78	- 0.28	64.10	54	7.48	14.00	- 6.52	53.43
4	0.46	0.64	- 0.18	71.87	55	8.28	15.34	- 7.06	53.98
5	0.41	0.58	- 0.17	70.69	56	9.15	16.76	- 7.61	54.59
6	0.36	0.54	- 0.18	66.67	57	10.06	18.27	- 8.21	55.06
7	0.30	0.51	- 0.21	58.82	58	11.02	19.87	- 8.85	55.46
8	0.25	0.46	- 0.21	54.35	59	12.05	21.58	- 9.53	55.84
9	0.22	0.41	- 0.19	53.66	60	13.20	23.39	- 10.19	56.43
10	0.21	0.36	- 0.15	58.33	61	14.49	25.32	- 10.83	57.23
11	0.24	0.35	- 0.11	68.57	62	15.95	27.38	- 11.43	58.25
12	0.31	0.42	- 0.11	73.81	63	17.62	29.60	- 11.98	59.53
13	0.44	0.59	- 0.15	74.58	64	19.48	32.00	- 12.52	60.87
14	0.60	0.84	- 0.24	71.43	65	21.52	34.63	- 13.11	62.14
15	0.77	1.14	- 0.37	67.54	66	23.70	37.46	- 13.76	63.27
16	0.94	1.42	- 0.48	66.20	67	26.01	40.44	- 14.43	64.32
17	1.09	1.67	- 0.58	65.27	68	28.45	43.50	- 15.05	65.40
18	1.19	1.85	- 0.66	64.32	69	31.10	46.65	- 15.55	66.67
19	1.25	1.98	- 0.73	63.13	70	34.07	49.91	- 15.84	68.26
20	1.28	2.12	- 0.84	60.38	71	37.46	53.44	- 15.98	70.10
21	1.28	2.26	- 0.98	56.64	72	41.38	57.40	- 16.02	72.09
22	1.25	2.35	- 1.10	53.19	73	45.89	61.93	- 16.04	74.10
23	1.20	2.35	- 1.15	51.06	74	50.92	67.03	- 16.11	75.97
24	1.15	2.28	- 1.13	50.44	75	56.35	72.64	- 16.29	77.57
25	1.08	2.17	- 1.09	49.77	76	62.08	78.56	- 16.48	79.02
26	1.02	2.06	- 1.04	49.51	77	68.00	84.62	- 16.62	80.36
27	0.98	1.99	- 1.01	49.25	78	74.04	90.70	- 16.66	81.63
28	0.95	1.98	- 1.03	47.98	79	80.39	96.88	- 16.49	82.98
29	0.94	2.03	- 1.09	46.31	80	87.28	103.67	- 16.39	84.19
30	0.94	2.10	- 1.16	44.76	81	94.94	111.25	- 16.31	85.34
31	0.96	2.18	- 1.22	44.04	82	103.61	119.29	- 15.68	86.86
32	0.99	2.28	- 1.29	43.42	83	113.41	127.70	- 14.29	88.81
33	1.04	2.39	- 1.35	43.51	84	124.08	136.63	- 12.55	90.81
34	1.10	2.52	- 1.42	43.65	85	135.33	147.30	- 11.97	91.87
35	1.18	2.68	- 1.50	44.03	86	146.90	159.79	- 12.89	91.93
36	1.28	2.88	- 1.60	44.44	87	158.63	172.81	- 14.18	91.79
37	1.41	3.12	- 1.71	45.19	88	170.44	185.21	- 14.77	92.03
38	1.55	3.39	- 1.84	45.72	89	182.33	196.81	- 14.48	92.64
39	1.72	3.69	- 1.97	46.61	90	194.38	208.39	- 14.01	93.28
40	1.91	4.01	- 2.10	47.63	91	206.75	221.22	- 14.47	93.46
41	2.13	4.35	- 2.22	48.97	92	219.77	235.12	- 15.35	93.47
42	2.36	4.73	- 2.37	49.89	93	234.08	250.23	- 16.15	93.55
43	2.62	5.18	- 2.56	50.58	94	250.97	265.46	- 14.49	94.54
44	2.89	5.68	- 2.79	50.88	95	273.02	279.62	- 6.60	97.64
45	3.19	6.23	- 3.04	51.20	96	309.92	290.90	19.02	106.54
46	3.50	6.81	- 3.31	51.40	97	367.46	301.35	66.11	121.94
47	3.84	7.44	- 3.60	51.61	98	470.80	311.11	159.69	151.33
48	4.19	8.12	- 3.93	51.60	99	656.70	320.17	336.53	205.11
49	4.58	8.87	- 4.29	51.63	100	1,000.00	328.57	671.43	304.35
50	5.01	9.69	- 4.68	51.70					

EXHIBIT 6

NEW FEMALE BASIC TABLE VERSUS 1969-71 UNITED STATES FEMALE  
POPULATION TABLE

Age x	New Female Basic Table 1,000q <sub>x</sub> (1)	1969-71 U.S. Female 1,000q <sub>x</sub> (2)	(1)-(2) (3)	(1)÷(2) (4)	Age x	New Female Basic Table 1,000q <sub>x</sub> (1)	1969-71 U.S. Female 1,000q <sub>x</sub> (2)	(1)-(2) (3)	(1)÷(2) (4)
0	2.45	17.46	-15.01	14.03%	51	3.79	5.65	- 1.86	67.08%
1	0.42	1.16	- 0.74	36.21	52	4.11	6.11	- 2.00	67.27
2	0.36	0.77	- 0.41	46.75	53	4.48	6.60	- 2.12	67.88
3	0.34	0.60	- 0.26	56.67	54	4.86	7.12	- 2.26	68.26
4	0.32	0.51	- 0.19	62.75	55	5.26	7.68	- 2.42	68.49
5	0.30	0.43	- 0.13	69.77	56	5.65	8.29	- 2.64	68.15
6	0.27	0.38	- 0.11	71.05	57	6.01	8.94	- 2.93	67.23
7	0.25	0.34	- 0.09	73.53	58	6.35	9.62	- 3.27	66.01
8	0.23	0.31	- 0.08	74.19	59	6.70	10.35	- 3.65	64.73
9	0.21	0.28	- 0.07	75.00	60	7.11	11.13	- 4.02	63.88
10	0.20	0.26	- 0.06	76.92	61	7.64	12.00	- 4.36	63.67
11	0.20	0.25	- 0.05	80.00	62	8.33	12.98	- 4.65	64.18
12	0.22	0.27	- 0.05	81.48	63	9.23	14.11	- 4.88	65.41
13	0.25	0.33	- 0.08	75.76	64	10.29	15.38	- 5.09	66.91
14	0.29	0.40	- 0.11	72.50	65	11.45	16.78	- 5.33	68.24
15	0.33	0.49	- 0.16	67.35	66	12.67	18.32	- 5.65	69.16
16	0.37	0.58	- 0.21	63.79	67	13.88	20.04	- 6.16	69.26
17	0.41	0.66	- 0.25	62.12	68	15.06	21.95	- 6.89	68.61
18	0.44	0.69	- 0.25	63.77	69	16.32	24.07	- 7.75	67.80
19	0.47	0.71	- 0.24	66.20	70	17.79	26.32	- 8.53	67.59
20	0.48	0.72	- 0.24	66.67	71	19.60	28.79	- 9.19	68.08
21	0.49	0.73	- 0.24	67.12	72	21.89	31.65	- 9.76	69.16
22	0.50	0.75	- 0.25	66.67	73	24.75	35.03	- 10.28	70.65
23	0.51	0.77	- 0.26	66.23	74	28.15	38.93	- 10.78	72.31
24	0.52	0.79	- 0.27	65.82	75	31.99	43.25	- 11.26	73.97
25	0.53	0.81	- 0.28	65.43	76	36.21	47.90	- 11.69	75.59
26	0.54	0.83	- 0.29	65.06	77	40.72	52.95	- 12.23	76.90
27	0.56	0.86	- 0.30	65.12	78	45.50	58.40	- 12.90	77.91
28	0.58	0.90	- 0.32	64.44	79	50.70	64.32	- 13.62	78.82
29	0.60	0.96	- 0.36	62.50	80	56.56	70.97	- 14.41	79.70
30	0.63	1.02	- 0.39	61.76	81	63.29	78.34	- 15.05	80.79
31	0.66	1.10	- 0.44	60.00	82	71.11	86.12	- 15.01	82.57
32	0.69	1.19	- 0.50	57.98	83	80.14	94.19	- 14.05	85.08
33	0.72	1.29	- 0.57	55.81	84	90.19	102.75	- 12.56	87.78
34	0.77	1.40	- 0.63	55.00	85	101.10	112.82	- 11.72	89.61
35	0.82	1.52	- 0.70	53.95	86	112.76	124.62	- 11.86	90.48
36	0.90	1.65	- 0.75	54.55	87	125.07	136.85	- 11.78	91.39
37	1.00	1.80	- 0.80	55.56	88	138.00	148.59	- 10.59	92.87
38	1.12	1.97	- 0.85	56.85	89	151.55	160.06	- 8.51	94.68
39	1.27	2.15	- 0.88	59.07	90	165.80	172.64	- 6.84	96.04
40	1.44	2.33	- 0.89	61.80	91	180.91	187.18	- 6.27	96.65
41	1.62	2.51	- 0.89	64.54	92	197.20	202.43	- 5.23	97.42
42	1.81	2.73	- 0.92	66.30	93	215.31	217.50	- 2.19	98.99
43	1.99	2.97	- 0.98	67.00	94	236.52	231.86	- 4.66	102.01
44	2.18	3.25	- 1.07	67.08	95	263.38	245.84	- 17.54	107.13
45	2.37	3.54	- 1.17	66.95	96	301.01	258.54	- 42.47	116.43
46	2.57	3.84	- 1.27	66.93	97	359.66	269.80	- 89.86	133.31
47	2.77	4.16	- 1.39	66.59	98	462.34	279.96	- 182.38	165.15
48	2.99	4.49	- 1.50	66.59	99	647.43	289.49	- 357.94	223.65
49	3.23	4.84	- 1.61	66.74	100	1,000.00	298.36	- 701.64	335.17
50	3.50	5.23	- 1.73	66.92					

EXHIBIT 7

NEW MALE BASIC TABLE VERSUS 1958 CSO MALE BASIC TABLE

Age x	New Male Basic Table 1,000q <sub>x</sub>	1958 CSO Male Basic Table 1,000q <sub>x</sub>	(1)-(2)	(1)÷(2)	Age x	New Male Basic Table 1,000q <sub>x</sub>	1958 CSO Male Basic Table 1,000q <sub>x</sub>	(1)-(2)	(1)÷(2)
	(1)	(2)	(3)	(4)		(1)	(2)	(3)	(4)
0	3.70	6.33	-2.63	58.5%	51	5.51	7.42	-1.91	74.3%
1	0.59	1.00	-0.41	59.0	52	6.08	8.19	-2.11	74.2
2	0.51	0.75	-0.24	68.0	53	6.74	9.03	-2.29	74.6
3	0.50	0.68	-0.18	73.5	54	7.48	9.94	-2.46	75.3
4	0.46	0.61	-0.15	75.4	55	8.28	10.93	-2.65	75.8
5	0.41	0.55	-0.14	74.5	56	9.15	12.02	-2.87	76.1
6	0.36	0.49	-0.13	73.5	57	10.06	13.22	-3.16	76.1
7	0.30	0.44	-0.14	68.2	58	11.02	14.54	-3.52	75.8
8	0.25	0.40	-0.15	62.5	59	12.05	15.98	-3.93	75.4
9	0.22	0.37	-0.15	59.5	60	13.20	17.56	-4.36	75.2
10	0.21	0.36	-0.15	58.3	61	14.49	19.26	-4.77	75.2
11	0.24	0.37	-0.13	64.9	62	15.95	21.10	-5.15	75.6
12	0.31	0.39	-0.08	79.5	63	17.62	23.09	-5.47	76.3
13	0.44	0.44	0.00	100.0	64	19.48	25.25	-5.77	77.1
14	0.60	0.50	0.10	120.0	65	21.52	27.61	-6.09	77.9
15	0.77	0.56	0.21	137.5	66	23.70	30.21	-6.51	78.5
16	0.94	0.63	0.31	149.2	67	26.01	33.08	-7.07	78.6
17	1.09	0.70	0.39	155.7	68	28.45	36.24	-7.79	78.5
18	1.19	0.76	0.43	156.6	69	31.10	39.66	-8.56	78.4
19	1.25	0.80	0.45	156.2	70	34.07	43.30	-9.23	78.7
20	1.28	0.84	0.44	152.4	71	37.46	47.09	-9.63	79.5
21	1.28	0.87	0.41	147.1	72	41.38	51.00	-9.62	81.1
22	1.25	0.89	0.36	140.4	73	45.89	55.01	-9.12	83.4
23	1.20	0.91	0.29	131.9	74	50.92	59.23	-8.31	86.0
24	1.15	0.92	0.23	125.0	75	56.35	63.80	-7.45	88.3
25	1.08	0.93	0.15	116.1	76	62.08	68.85	-6.77	90.2
26	1.02	0.95	0.07	107.4	77	68.00	74.52	-6.52	91.3
27	0.98	0.97	0.01	101.0	78	74.04	80.92	-6.88	91.5
28	0.95	1.00	-0.05	95.0	79	80.39	87.99	-7.60	91.4
29	0.94	1.04	-0.10	90.4	80	87.28	95.64	-8.36	91.3
30	0.94	1.08	-0.14	87.0	81	94.94	103.78	-8.84	91.5
31	0.96	1.13	-0.17	85.0	82	103.61	112.32	-8.71	92.2
32	0.99	1.18	-0.19	83.9	83	113.41	121.20	-7.79	93.6
33	1.04	1.24	-0.20	83.9	84	124.08	130.45	-6.37	95.1
34	1.10	1.31	-0.21	84.0	85	135.33	140.12	-4.79	96.6
35	1.18	1.41	-0.23	83.7	86	146.90	150.27	-3.37	97.8
36	1.28	1.53	-0.25	83.7	87	158.63	160.98	-2.35	98.5
37	1.41	1.68	-0.27	83.9	88	170.44	172.39	-1.95	98.9
38	1.55	1.88	-0.33	82.4	89	182.33	184.75	-2.42	98.7
39	1.72	2.10	-0.38	81.9	90	194.38	198.38	-4.00	98.0
40	1.91	2.36	-0.45	80.9	91	206.75	213.71	-6.96	96.7
41	2.13	2.65	-0.52	80.4	92	219.77	231.24	-11.47	95.0
42	2.36	2.95	-0.59	80.0	93	234.08	251.47	-17.39	93.1
43	2.62	3.28	-0.66	79.9	94	250.97	274.90	-23.93	91.3
44	2.89	3.64	-0.75	79.4	95	273.02	303.03	-30.01	90.1
45	3.19	4.03	-0.84	79.2	96	309.92	343.36	-33.44	90.3
46	3.50	4.46	-0.96	78.5	97	367.46	409.79	-42.33	89.7
47	3.84	4.94	-1.10	77.7	98	470.80	522.62	-51.82	90.1
48	4.19	5.47	-1.28	76.6	99	656.70	708.55	-51.85	92.7
49	4.58	6.06	-1.48	75.6	100	1,000.00	1,000.00	0.00	100.0
50	5.01	6.71	-1.70	74.7					

EXHIBIT 8

NEW FEMALE BASIC TABLE VERSUS 1958 CSO FEMALE BASIC TABLE

Age x	New Female Basic Table 1,000q <sub>x</sub>	1958 CSO Female Basic Table 1,000q <sub>x</sub>	(1)-(2)	(1)÷(2)	Age x	New Female Basic Table 1,000q <sub>x</sub>	1958 CSO Female Basic Table 1,000q <sub>x</sub>	(1)-(2)	(1)÷(2)
	(1)	(2)	(3)	(4)		(1)	(2)	(3)	(4)
0	2.45	5.48	-3.03	44.7%	52	4.11	6.06	- 1.95	67.8%
1	0.42	0.94	-0.52	44.7	53	4.48	6.71	- 2.23	66.8
2	0.36	0.67	-0.31	53.7	54	4.86	7.42	- 2.56	65.5
3	0.34	0.60	-0.26	56.7	55	5.26	8.19	- 2.93	64.2
4	0.32	0.53	-0.21	60.4	56	5.65	9.03	- 3.38	62.6
5	0.30	0.47	-0.17	63.8	57	6.01	9.94	- 3.93	60.5
6	0.27	0.41	-0.14	65.9	58	6.35	10.93	- 4.58	58.1
7	0.25	0.36	-0.11	69.4	59	6.70	12.02	- 5.32	55.7
8	0.23	0.32	-0.09	71.9	60	7.11	13.22	- 6.11	53.8
9	0.21	0.30	-0.09	70.0	61	7.64	14.54	- 6.90	52.5
10	0.20	0.29	-0.09	69.0	62	8.33	15.98	- 7.65	52.1
11	0.20	0.29	-0.09	69.0	63	9.23	17.56	- 8.33	52.6
12	0.22	0.30	-0.08	73.3	64	10.29	19.26	- 8.97	53.4
13	0.25	0.32	-0.07	78.1	65	11.45	21.10	- 9.65	54.3
14	0.29	0.35	-0.06	82.9	66	12.67	23.09	- 10.42	54.9
15	0.33	0.39	-0.06	84.6	67	13.88	25.25	- 11.37	55.0
16	0.37	0.44	-0.07	84.1	68	15.06	27.61	- 12.55	54.5
17	0.41	0.50	-0.09	82.0	69	16.32	30.21	- 13.89	54.0
18	0.44	0.56	-0.12	78.6	70	17.79	33.08	- 15.29	53.8
19	0.47	0.63	-0.16	74.6	71	19.60	36.24	- 16.64	54.1
20	0.48	0.70	-0.22	68.6	72	21.89	39.66	- 17.77	55.2
21	0.49	0.76	-0.27	64.5	73	24.75	43.30	- 18.55	57.2
22	0.50	0.80	-0.30	62.5	74	28.15	47.09	- 18.94	59.8
23	0.51	0.84	-0.33	60.7	75	31.99	51.00	- 19.01	62.7
24	0.52	0.87	-0.35	59.8	76	36.21	55.01	- 18.80	65.8
25	0.53	0.89	-0.36	59.6	77	40.72	59.23	- 18.51	68.7
26	0.54	0.91	-0.37	59.3	78	45.50	63.80	- 18.30	71.3
27	0.56	0.92	-0.36	60.9	79	50.70	68.85	- 18.15	73.6
28	0.58	0.93	-0.35	62.4	80	56.56	74.52	- 17.96	75.9
29	0.60	0.95	-0.35	63.2	81	63.29	80.92	- 17.63	78.2
30	0.63	0.97	-0.34	64.9	82	71.11	87.99	- 16.88	80.8
31	0.66	1.00	-0.34	66.0	83	80.14	95.64	- 15.50	83.8
32	0.69	1.04	-0.35	66.3	84	90.19	103.78	- 13.59	86.9
33	0.72	1.08	-0.36	66.7	85	101.10	112.32	- 11.22	90.0
34	0.77	1.13	-0.36	68.1	86	112.76	121.20	- 8.44	93.0
35	0.82	1.18	-0.36	69.5	87	125.07	130.45	- 5.38	95.9
36	0.90	1.24	-0.34	72.6	88	138.00	140.12	- 2.12	98.5
37	1.00	1.31	-0.31	76.3	89	151.55	150.27	1.28	100.9
38	1.12	1.41	-0.29	79.4	90	165.80	160.98	4.82	103.0
39	1.27	1.53	-0.26	83.0	91	180.91	172.39	8.52	104.9
40	1.44	1.68	-0.24	85.7	92	197.20	184.75	12.45	106.7
41	1.62	1.88	-0.26	86.2	93	215.31	198.38	16.93	108.5
42	1.81	2.10	-0.29	86.2	94	236.52	213.71	22.81	110.7
43	1.99	2.36	-0.37	84.3	95	263.38	231.24	32.14	113.9
44	2.18	2.65	-0.47	82.3	96	301.01	251.47	49.54	119.7
45	2.37	2.95	-0.58	80.3	97	359.66	274.90	84.76	130.8
46	2.57	3.28	-0.71	78.4	98	462.34	303.03	159.31	152.6
47	2.77	3.64	-0.87	76.1	99	647.43	343.36	304.07	188.6
48	2.99	4.03	-1.04	74.2	100	1,000.00	409.79	590.21	244.0
49	3.23	4.46	-1.23	72.4	101	1,000.00	522.62	477.38	191.3
50	3.50	4.94	-1.44	70.9	102	1,000.00	708.55	291.45	141.1
51	3.79	5.47	-1.68	69.3	103	1,000.00	1,000.00	0.00	100.0

## EXHIBIT 9

## DISTRIBUTION OF MODEL OFFICE ISSUES: FIRST MODEL OFFICE YEAR

AGE	MALE				FEMALE			
	Whole Life	Life Paid Up at 65	20-Pay Life	Endowment at 65	Whole Life	Life Paid Up at 65	20-Pay Life	Endowment at 65
	Medical Distribution							
0 .....	273,144	47,449	18,482	28,256	150,595	27,348	25,564	16,281
1 .....	197,530	34,314	13,366	20,434	116,384	21,135	19,756	12,582
2-4 .....	352,329	61,205	23,840	36,448	187,334	34,020	31,800	20,252
5-9 .....	658,600	114,409	44,564	68,131	379,895	68,989	64,487	41,070
10-14 .....	891,085	154,795	60,295	92,181	399,210	72,497	67,766	43,158
15-19 .....	2,598,491	451,397	175,825	268,809	672,038	122,043	114,078	72,653
20-24 .....	20,281,088	3,523,130	1,372,305	2,098,044	1,821,295	330,750	309,165	196,897
25-29 .....	50,763,242	8,818,338	3,434,859	5,251,370	3,545,443	643,857	601,839	383,291
30-34 .....	68,086,222	11,827,600	4,607,006	7,043,402	5,511,758	1,000,943	935,621	595,866
35-39 .....	62,573,837	10,870,015	4,234,014	6,473,156	6,224,806	1,130,434	1,056,661	672,952
40-44 .....	53,034,550	9,212,898	3,588,545	5,486,333	6,446,630	1,170,717	1,094,315	696,933
45-49 .....	37,421,975	6,500,759	2,532,131	3,871,239	6,030,312	1,095,113	1,023,645	651,926
50-54 .....	21,000,057	3,648,025	1,420,954	2,172,420	3,972,064	721,332	674,258	429,412
55-59 .....	11,730,045	333,574	649,656	198,645	2,440,809	71,970	336,368	42,844
60-64 .....	4,118,692	0	218,209	0	1,127,333	0	148,378	0
65-69 .....	1,041,003	0	10,582	0	387,258	0	9,223	0
70 and over .....	233,143	0	0	0	106,536	0	0	0
Totals .....	335,255,033	55,597,907	22,404,633	33,108,867	39,519,698	6,511,150	6,512,922	3,876,116
Total by sex .....	446,366,440				56,419,886			
Total medical .....	502,786,326							

EXHIBIT 9—Continued

AGE	MALE				FEMALE			
	Whole Life	Life Paid Up at 65	20-Pay Life	Endowment at 65	Whole Life	Life Paid Up at 65	20-Pay Life	Endowment at 65
	Nonmedical Distribution							
0 .....	5,610,419	974,614	379,625	580,388	4,407,195	800,353	748,121	476,453
1 .....	2,341,414	406,739	158,430	242,215	1,772,511	321,891	300,884	191,623
2-4 .....	4,178,742	725,910	282,752	432,284	3,192,256	579,718	541,885	345,109
5-9 .....	5,486,510	953,089	371,241	567,570	3,991,594	724,879	677,573	431,524
10-14 .....	7,297,353	1,267,660	493,770	754,899	4,432,061	804,869	752,342	479,142
15-19 .....	33,414,431	5,804,589	2,260,964	3,456,665	14,137,401	2,567,372	2,399,823	1,528,368
20-24 .....	97,061,591	16,861,056	6,567,603	10,040,854	26,638,877	4,837,657	4,521,948	2,879,879
25-29 .....	69,628,820	12,095,572	4,711,385	7,202,981	20,685,948	3,756,597	3,511,439	2,236,319
30-34 .....	26,871,230	4,667,936	1,818,223	2,779,782	11,150,660	2,024,976	1,892,824	1,205,477
35-39 .....	8,740,499	1,518,356	591,420	904,190	5,197,837	943,934	882,333	561,928
40-44 .....	1,903,951	330,745	128,829	196,960	2,474,597	449,390	420,063	267,524
45-49 .....	279,554	48,563	18,916	28,919	261,989	47,578	44,473	28,323
50 and over .....	143,775	24,976	9,728	14,873	36,039	6,545	6,118	3,896
Totals .....	262,958,289	45,679,805	17,792,885	27,202,581	98,378,967	17,865,758	16,699,825	10,635,564
Total by sex .....	353,633,560				143,580,114			
Total nonmedical .....	497,213,674							
Grand total by sex .....	800,000,000				200,000,000			
Grand total .....	1,000,000,000							

Terminal reserves using continuous functions were calculated for the various mortality tables tested. These reserves were calculated under both the Commissioners Reserve Valuation Method and the net level premium method, at 4 percent interest, and were projected over twenty years with assumptions for lapses and mortality. The mortality tables used were the 1970-75 Intercompany Fifteen-Year Select and Ultimate Tables mentioned earlier. The lapse-rate assumptions used were the LIMRA 1971-72 expected lapse rates for permanent plans with a fifteen-year select period (Joseph R. Brzezinski, *TSA*, XXVII, 267-90).

The model office reserves were calculated for assumed issues of \$1 billion on both a dynamic and static basis. The dynamic basis assumed a 10 percent increase in issues annually, and the static basis assumed one year of issues projected over twenty years.

Exhibit 10 shows the model office results for the various tables tested under both the static and dynamic bases. Exhibit 11 compares the results for each specific table with results on each of the other tables on the dynamic basis.

Results are shown in these two exhibits for certain special analyses. Some of the ultimate mortality experience (generally the data at very long durations) contributed was not split by sex and, in order to determine the effect of having excluded these data, we split them between males and females according to the proportions at each attained age of the ultimate data that were split by sex. Exhibit 11 shows that this approximation would have increased reserves calculated excluding those data by about 0.9 percent and, therefore, the Committee was not concerned about excluding the experience which was not split by sex.

For the purpose of comparison, the Committee computed model office reserves for a table combining the experience of males, females, and data not split by sex. This ungraduated unisex table resulted in total model office reserves 2.8 percent higher than reserves calculated on the ungraduated male and female tables. Note that the unisex table is based on a much higher proportion of male exposures (about 90 percent) than is typical of current issues.

The New Basic Tables produced total model office reserves 4.2 percent less than reserves based on the 1970-75 fifteen-year select and ultimate experience and 8.0 percent less than total model office reserves based on the 1958 CSO Basic Tables. As noted earlier, it was expected that the margins to be added to the New Basic Tables rates would increase the model office reserves to the general level of the model office reserves under the 1970-75 Fifteen-Year Select and Ultimate Tables.

## III. DEVELOPMENT OF MARGINS AND LOADED TABLES

*Background*

A paper entitled "The Commissioners 1941 Standard Ordinary Mortality Table" by John S. Thompson (*TASA*, XLII, 314-32) stated: "It was considered that such a table . . . should contain reasonable margins for adverse fluctuations in mortality and for contingencies." And subsequently:

In fixing a margin along the lines described . . . above, the committee considered that such an addition to the observed rate of mortality at adult ages should increase in magnitude as the rate of mortality increased but that the ratio of the increase to the "experience" rate of mortality should show a tendency to decrease. It was also thought that such a margin should not be less than, say, 1 per 1000. Five per cent of the reciprocal of the expectation of life meets these conditions and was adopted as a suitable addition to the "experience rate."

## EXHIBIT 10

MODEL OFFICE NET LEVEL PREMIUM RESERVE VALUES AT TWENTIETH DURATION  
ALL PLANS, ISSUE AGES, AND UNDERWRITING CLASSES COMBINED  
(Amounts Shown in \$1,000 Units)

TABLES	ASSUMING \$1 BILLION OF ISSUES IN YEAR 1 AND INCREASING 10% EACH YEAR THEREAFTER (DYNAMIC BASIS)			ASSUMING \$1 BILLION OF ISSUES IN YEAR 1 AND NO ISSUES THEREAFTER (STATIC BASIS)		
	Male	Female	Total	Male	Female	Total
1970-75 Select and Ultimate .....	\$2,444,359	\$610,971	\$3,055,330	\$ 97,580	\$19,970	\$117,550
1970-75 Crude Aggregate, policy years 1-5 omitted .....	2,349,588	587,876	2,937,465	95,210	19,407	114,617
1958 CSO Valuation ...	2,591,005	691,638	3,282,643	103,877	22,672	126,549
1958 CSO Basic .....	2,513,158	669,731	3,182,889	100,724	21,935	122,659
1970-75 Crude Aggregate Unisex, policy years 1-5 omitted ...	2,335,961	683,412	3,019,373	94,595	22,375	116,970
1970-75 Crude Aggregate, all policy years included .....	2,333,003	581,340	2,914,342	94,584	19,202	113,786
1970-75 Crude Aggregate adjusted for data not split by sex, policy years 1-5 omitted ...	2,370,681	593,200	2,963,881	95,981	19,567	115,548
1970-75 Graduated Aggregate, policy years 1-5 omitted (New Basic) .....	2,342,022	584,962	2,926,984	94,948	19,328	114,276

NOTE.—Reserves calculated at 4 percent interest.



EXHIBIT 11

COMPARISON OF RESULTS FOR MODEL OFFICE RESERVE VALUES AT TWENTIETH DURATION  
 ALL PLANS, ISSUE AGES, SEXES, AND UNDERWRITING CLASSES COMBINED; ASSUMING  
 \$1 BILLION OF ISSUES, INCREASING 10 PERCENT ANNUALLY (DYNAMIC BASIS)  
 RATIO OF RESULTS UNDER TABLES A TO RESULTS UNDER TABLES B  
 (Net Level Premium at 4 Percent Interest)

TABLES A	TABLES B							
	1970-75 Select and Ultimate	1970-75 Crude Aggregate, Policy Years 1-5 Omitted	1958 CSO Valuation	1958 CSO Basic	1970-75 Crude Aggregate Unisex, Policy Years 1-5 Omitted	1970-75 Crude Aggregate All Years of Data	1970-75 Crude Aggregate Adjusted for Data Not Split by Sex, Policy Years 1-5 Omitted	1970-75 Graduated Aggregate, Policy Years 1-5 Omitted (New Basic)
1970-75 Select and Ultimate .....		104.0%	93.1%	96.0%	101.2%	104.8%	103.1%	104.4%
1970-75 Crude Aggregate, policy years 1-5 omitted .....	96.1%		89.5	92.3	97.3	100.8	99.1	100.4
1958 CSO Valuation .....	107.4	111.8		103.1	108.7	112.6	110.8	112.2
1958 CSO Basic .....	104.2	108.4	97.0		105.4	109.2	107.4	108.7
1970-75 Crude Aggregate Unisex, policy years 1-5 omitted .....	98.8	102.8	92.0	94.9		103.6	101.9	103.2
1970-75 Crude Aggregate, all years of data .....	95.4	99.2	88.8	91.6	96.5		98.3	99.6
1970-75 Crude Aggregate adjusted for data not split by sex, policy years 1-5 omitted .....	97.0	100.9	90.3	93.1	98.2	101.7		101.3
1970-75 Graduated Aggregate, poli- cy years 1-5 omitted (New Basic) .....	95.8*	99.6	89.2†	92.0‡	96.9	100.4	98.8	

\* 95.8 percent for males, 95.7 percent for females.

† 90.4 percent for males, 84.6 percent for females.

‡ 93.2 percent for males, 87.4 percent for females.

Prior to the final development of the 1958 CSO Tables, a special Committee on New Mortality Tables of the Society of Actuaries proposed a loaded mortality table X-17 as described in a paper entitled "The New Standard Ordinary Mortality Table," by Charles M. Sternhell (*TSA*, IX, 1-23). The preliminary margins were described in the paper as

a U-shaped pattern of margins . . . with a minimum margin of from 10% to 15% in the central range of ages between 47 & 77 and with higher percentage margins at younger and older ages.

Subsequently, the preliminary margins were modified, and

account was taken of the suggestion of the NAIC Subcommittee on Deficiency Reserves that the mortality rates in the final table should not exceed those shown in the U.S. White Males 1949-51 Table except at the very old ages.

This restriction resulted in margins as low as 0.23 per thousand at ages 8-11. The final margins adopted for X-17 are described as follows:

The percentage margins provided by Mortality Table X-17 . . . are generally similar to the percentage margins provided by the 1941 CSO Table . . . at ages 62 & under and are higher at ages 67 & over.

Subsequently, the 1958 CSO Table was presented in a "Report of Industry Advisory Committee to NAIC Subcommittee on Deficiency Reserves and Mortality Tables Review" (*NAIC Proceedings*, I [1959], 209-91).

The restriction imposed by the NAIC that the loaded mortality rates should not exceed those shown in the United States White Males 1949-51 Table was removed, and the principal change from X-17 to the 1958 CSO Table was an increase in margins at the younger ages with a minimum margin of 0.75 per thousand at age 0.

The final margins adopted for the 1958 CSO Table were the following:

Ages	Margin per 1,000
0-32 . . . . .	$0.75 + 0.01x$
62 and over . . .	15% of basic mortality rate
32-62 . . . . .	Third-degree polynomial to grade smoothly from age 32 to age 62

Reviewing this background in the light of mortality experience since 1958, the committee concluded:

1. Margins that are a function of the reciprocal of the curtate expectation of life derived from the basic table are desirable in order that margins be monotonic nondecreasing.

2. Margins in the 1958 CSO Table have proved redundant both absolutely at the younger ages and percentage-wise at the higher ages. In the Committee's opinion, margins at the younger ages need be no more than 0.50 per one thousand and as low as 10 percent of the basic mortality rates at higher ages.

#### *Constraints on Margins*

The prime constraint on margins was that reserves on the loaded table not be materially less than reserves developed using underlying select and ultimate mortality. Other constraints included the following:

1. Loaded mortality rates should encompass the standard mortality experience in the 1970-75 period of most companies writing ordinary insurance with normal underwriting standards.
2. Terminal reserves on the loaded table should not be significantly distorted when compared with terminal reserves on the graduated basic table.
3. The methodology should be consistent in providing margins for both female and male tables.
4. Loaded mortality rates should not result in unreasonable statutory premium deficiencies on term insurance plans.

#### *Margins*

A number of margin variations were developed and tested on the model office to compare loaded-table net premiums and reserves with the New Basic Table values. In order to achieve the prime requirement of reserve adequacy, it was necessary to maximize the slope of the margin function. This resulted in the final margin formula:

$$\text{Margin} = \frac{0.035 - 0.00025x + 0.000009x^2}{e_x^{\beta}},$$

where  $e_x^{\beta}$  is the curtate expectation of life calculated from the New Basic Tables.

The constant term in the numerator of the margin function was set at 0.035, since this produced a desirable dollar loading at age 0 of 0.48 per thousand for the male table and 0.44 per thousand for the female table.

The negative term involving  $x$ , that is,  $0.00025x$ , was necessary to keep loadings at appropriate levels at ages under 50, and to help minimize premium deficiencies on current issues.

The positive term involving  $x^2$ , that is,  $0.000009x^2$ , was chosen to maximize the slope of the loaded table without providing overly redundant margins as a percentage of the Basic Tables at higher ages.

## EXHIBIT 12

COMPARISON OF MODEL OFFICE RESERVES  
NET LEVEL PREMIUM RESERVE VALUES  
ALL PLANS, ISSUE AGES, SEXES, AND UNDERWRITING CLASSES COMBINED  
(Amounts Shown in \$1,000 Units)

DURATION	ASSUMING \$1 BILLION OF ISSUES IN YEAR 1 AND INCREASING 10% EACH YEAR THEREAFTER (DYNAMIC BASIS)				ASSUMING \$1 BILLION OF ISSUES IN YEAR 1 AND NO ISSUES THEREAFTER (STATIC BASIS)			
	1958 CSO	New Basic Table	Tables K (M) and K (F)	Select and Ultimate	1958 CSO	New Basic Table	Tables K (M) and K (F)	Select and Ultimate
1 .....	10,091	8,889	9,350	9,527	10,091	8,889	9,350	9,527
5 .....	156,027	138,016	144,548	146,051	43,389	38,503	40,247	40,525
10 .....	634,739	563,273	588,703	592,033	77,917	69,642	72,567	72,701
15 .....	1,592,728	1,417,217	1,479,245	1,484,035	105,829	95,091	98,891	98,697
20 .....	3,282,643	2,926,984	3,052,339	3,055,330	126,549	114,276	118,643	117,550

Using this margin formula, the ends of the loaded tables (ages 95 and over) were not smooth. To correct this problem, a method similar to the method used to grade the ends of the Basic Tables was adopted. The loaded-table values for  $q_{92}$  and  $q_{93}$  were retained while the tables were shortened by setting  $q_{99}$  equal to unity. Shortening the loaded tables by one year is consistent with the methodology used on the 1941 CSO and the 1958 CSO Tables. This procedure also removes the inconsistency of a loading equal to zero at age 100.

Tests of the loaded tables on the model office described earlier produced net level premium reserves of 104.3 percent of the New Basic Table reserves. These reserves were very close to the reserve levels associated with the select and ultimate table, which were 104.4 percent of the New Basic Table reserves. The loaded tables are referred to as Tables K (M), for males, and K (F), for females, in Exhibits 12–21.

#### *Comparison of Tables K with Other Tables*

Exhibits 13–15 compare Tables K with the underlying New Basic Tables, the 1958 CSO Table, and the United States Life Tables, 1969–1971 (all males and all females). For this purpose, the 1958 CSO Table—Female is the 1958 CSO Table with a three-year setback at ages 15 and above. For ages below 15, the 1958 CSO Table—Female mortality rates are those derived by the Society's General Committee on Publication of Monetary Tables and shown in their report (*TSA*, XI, 1060–69).

EXHIBIT 13

TABLES K VERSUS NEW BASIC TABLES

AGE <i>x</i>	MALE				FEMALE			
	Basic Table	Table K	(3)-(2)	(4)÷(2)	Basic Table	Table K	(7)-(6)	(8)÷(6)
	1,000 <sub>qx</sub>	1,000 <sub>qx</sub>	(4)	(5)	1,000 <sub>qx</sub>	1,000 <sub>qx</sub>	(8)	(9)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
0	3.70	4.18	0.48	12.97%	2.45	2.89	0.44	17.96%
1	0.59	1.07	0.48	81.36	0.42	0.87	0.45	107.14
2	0.51	0.99	0.48	94.12	0.36	0.81	0.45	125.00
3	0.50	0.98	0.48	96.00	0.34	0.79	0.45	132.35
4	0.46	0.95	0.49	106.52	0.32	0.77	0.45	140.63
5	0.41	0.90	0.49	119.51	0.30	0.76	0.46	153.33
6	0.36	0.86	0.50	138.89	0.27	0.73	0.46	170.37
7	0.30	0.80	0.50	166.67	0.25	0.72	0.47	188.00
8	0.25	0.76	0.51	204.00	0.23	0.70	0.47	204.35
9	0.22	0.74	0.52	236.36	0.21	0.69	0.48	228.57
10	0.21	0.73	0.52	247.62	0.20	0.68	0.48	240.00
11	0.24	0.77	0.53	220.83	0.20	0.69	0.49	245.00
12	0.31	0.85	0.54	174.19	0.22	0.72	0.50	227.27
13	0.44	0.99	0.55	125.00	0.25	0.75	0.50	200.00
14	0.60	1.15	0.55	91.67	0.29	0.80	0.51	175.86
15	0.77	1.33	0.56	72.73	0.33	0.85	0.52	157.58
16	0.94	1.51	0.57	60.64	0.37	0.90	0.53	143.24
17	1.09	1.67	0.58	53.21	0.41	0.95	0.54	131.71
18	1.19	1.78	0.59	49.58	0.44	0.98	0.54	122.73
19	1.25	1.86	0.61	48.80	0.47	1.02	0.55	117.02
20	1.28	1.90	0.62	48.44	0.48	1.05	0.57	118.75
21	1.28	1.91	0.63	49.22	0.49	1.07	0.58	118.37
22	1.25	1.89	0.64	51.20	0.50	1.09	0.59	118.00
23	1.20	1.86	0.66	55.00	0.51	1.11	0.60	117.65
24	1.15	1.82	0.67	58.26	0.52	1.14	0.62	119.23
25	1.08	1.77	0.69	63.89	0.53	1.16	0.63	118.87
26	1.02	1.73	0.71	69.61	0.54	1.19	0.65	120.37
27	0.98	1.71	0.73	74.49	0.56	1.22	0.66	117.86
28	0.95	1.70	0.75	78.95	0.58	1.26	0.68	117.24
29	0.94	1.71	0.77	81.91	0.60	1.30	0.70	116.67
30	0.94	1.73	0.79	84.04	0.63	1.35	0.72	114.29
31	0.96	1.78	0.82	85.42	0.66	1.40	0.74	112.12
32	0.99	1.83	0.84	84.85	0.69	1.45	0.76	110.14
33	1.04	1.91	0.87	83.65	0.72	1.50	0.78	108.33
34	1.10	2.00	0.90	81.82	0.77	1.58	0.81	105.19
35	1.18	2.11	0.93	78.81	0.82	1.65	0.83	101.22
36	1.28	2.24	0.96	75.00	0.90	1.76	0.86	95.56
37	1.41	2.40	0.99	70.21	1.00	1.89	0.89	89.00
38	1.55	2.58	1.03	66.45	1.12	2.04	0.92	82.14
39	1.72	2.79	1.07	62.21	1.27	2.22	0.95	74.80
40	1.91	3.02	1.11	58.12	1.44	2.42	0.98	68.06
41	2.13	3.29	1.16	54.46	1.62	2.64	1.02	62.96
42	2.36	3.56	1.20	50.85	1.81	2.87	1.06	58.56
43	2.62	3.87	1.25	47.71	1.99	3.09	1.10	55.28
44	2.89	4.19	1.30	44.98	2.18	3.32	1.14	52.29
45	3.19	4.55	1.36	42.63	2.37	3.56	1.19	50.21
46	3.50	4.92	1.42	40.57	2.57	3.80	1.23	47.86
47	3.84	5.32	1.48	38.54	2.77	4.05	1.28	46.21
48	4.19	5.74	1.55	36.99	2.99	4.33	1.34	44.82
49	4.58	6.21	1.63	35.59	3.23	4.63	1.40	43.34

EXHIBIT 13—Continued

AGE x (1)	MALE				FEMALE			
	Basic Table 1,000q <sub>x</sub> (2)	Table K 1,000q <sub>x</sub> (3)	(3) - (2) (4)	(4) ÷ (2) (5)	Basic Table 1,000q <sub>x</sub> (6)	Table K 1,000q <sub>x</sub> (7)	(7) - (6) (8)	(8) ÷ (6) (9)
50	5.01	6.71	1.70	33.93%	3.50	4.96	1.46	41.71%
51	5.51	7.30	1.79	32.49	3.79	5.31	1.52	40.11
52	6.08	7.96	1.88	30.92	4.11	5.70	1.59	38.69
53	6.74	8.71	1.97	29.23	4.48	6.15	1.67	37.28
54	7.48	9.56	2.08	27.81	4.86	6.61	1.75	36.01
55	8.28	10.47	2.19	26.45	5.26	7.09	1.83	34.79
56	9.15	11.46	2.31	25.25	5.65	7.57	1.92	33.98
57	10.06	12.49	2.43	24.16	6.01	8.03	2.02	33.61
58	11.02	13.59	2.57	23.32	6.35	8.47	2.12	33.39
59	12.05	14.77	2.72	22.57	6.70	8.94	2.24	33.43
60	13.20	16.08	2.88	21.82	7.11	9.47	2.36	33.19
61	14.49	17.54	3.05	21.05	7.64	10.13	2.49	32.59
62	15.95	19.19	3.24	20.31	8.33	10.96	2.63	31.57
63	17.62	21.06	3.44	19.52	9.23	12.02	2.79	30.23
64	19.48	23.14	3.66	18.79	10.29	13.25	2.96	28.77
65	21.52	25.42	3.90	18.12	11.45	14.59	3.14	27.42
66	23.70	27.85	4.15	17.51	12.67	16.00	3.33	26.28
67	26.01	30.44	4.43	17.03	13.88	17.43	3.55	25.58
68	28.45	33.19	4.74	16.66	15.06	18.84	3.78	25.10
69	31.10	36.17	5.07	16.30	16.32	20.36	4.04	24.75
70	34.07	39.51	5.44	15.97	17.79	22.11	4.32	24.28
71	37.46	43.30	5.84	15.59	19.60	24.23	4.63	23.62
72	41.38	47.65	6.27	15.15	21.89	26.87	4.98	22.75
73	45.89	52.64	6.75	14.71	24.75	30.11	5.36	21.66
74	50.92	58.19	7.27	14.28	28.15	33.93	5.78	20.53
75	56.35	64.19	7.84	13.91	31.99	38.24	6.25	19.54
76	62.08	70.53	8.45	13.61	36.21	42.97	6.76	18.67
77	68.00	77.12	9.12	13.41	40.72	48.04	7.32	17.98
78	74.04	83.90	9.86	13.32	45.50	53.45	7.95	17.47
79	80.39	91.05	10.66	13.26	50.70	59.35	8.65	17.06
80	87.28	98.84	11.56	13.24	56.56	65.99	9.43	16.67
81	94.94	107.48	12.54	13.21	63.29	73.60	10.31	16.29
82	103.61	117.25	13.64	13.16	71.11	82.40	11.29	15.88
83	113.41	128.26	14.85	13.09	80.14	92.53	12.39	15.46
84	124.08	140.25	16.17	13.03	90.19	103.81	13.62	15.10
85	135.33	152.95	17.62	13.02	101.10	116.10	15.00	14.84
86	146.90	166.09	19.19	13.06	112.76	129.29	16.53	14.66
87	158.63	179.55	20.92	13.19	125.07	143.32	18.25	14.59
88	170.44	193.27	22.83	13.39	138.00	158.18	20.18	14.62
89	182.33	207.29	24.96	13.69	151.55	173.94	22.39	14.77
90	194.38	221.77	27.39	14.09	165.80	190.75	24.95	15.05
91	206.75	236.98	30.23	14.62	180.91	208.87	27.96	15.46
92	219.77	253.45	33.68	15.33	197.20	228.81	31.61	16.03
93	234.08	272.11	38.03	16.25	215.31	251.51	36.20	16.81
94	250.97	295.90	44.93	17.90	236.52	279.31	42.79	18.09
95	273.02	329.96	56.94	20.86	263.38	317.32	53.94	20.48
96	309.92	384.55	74.63	24.08	301.01	375.74	74.73	24.83
97	367.46	480.20	112.74	30.68	359.66	474.97	115.31	32.06
98	470.80	657.98	187.18	39.76	462.34	655.85	193.51	41.85
99	656.70	1,000.00	343.30	52.28	647.43	1,000.00	352.57	54.46

EXHIBIT 14

TABLES K VERSUS 1958 CSO

AGE x  (1)	MALE				FEMALE			
	1958 CSO 1,000q <sub>x</sub> (2)	Table K 1,000q <sub>x</sub> (3)	(3)-(2) (4)	(4)+(2) (5)	1958 CSO 1,000q <sub>x</sub> (6)	Table K 1,000q <sub>x</sub> (7)	(7)-(6) (8)	(8)+(6) (9)
0	7.08	4.18	- 2.90	-40.96%	6.20	2.89	- 3.31	- 53.39%
1	1.76	1.07	- 0.69	-39.20	1.67	0.87	- 0.80	- 47.90
2	1.52	0.99	- 0.53	-34.87	1.41	0.81	- 0.60	- 42.55
3	1.46	0.98	- 0.48	-32.88	1.35	0.79	- 0.56	- 41.48
4	1.40	0.95	- 0.45	-32.14	1.29	0.77	- 0.52	- 40.31
5	1.35	0.90	- 0.45	-33.33	1.24	0.76	- 0.48	- 38.71
6	1.30	0.86	- 0.44	-33.85	1.19	0.73	- 0.46	- 38.66
7	1.26	0.80	- 0.46	-36.51	1.15	0.72	- 0.43	- 37.39
8	1.23	0.76	- 0.47	-38.21	1.12	0.70	- 0.42	- 37.50
9	1.21	0.74	- 0.47	-38.84	1.11	0.69	- 0.42	- 37.84
10	1.21	0.73	- 0.48	-39.67	1.11	0.68	- 0.43	- 38.74
11	1.23	0.77	- 0.46	-37.40	1.12	0.69	- 0.43	- 38.39
12	1.26	0.85	- 0.41	-32.54	1.14	0.72	- 0.42	- 36.84
13	1.32	0.99	- 0.33	-25.00	1.17	0.75	- 0.42	- 35.90
14	1.39	1.15	- 0.24	-17.27	1.21	0.80	- 0.41	- 33.88
15	1.46	1.33	- 0.13	- 8.90	1.26	0.85	- 0.41	- 32.54
16	1.54	1.51	- 0.03	- 1.95	1.32	0.90	- 0.42	- 31.82
17	1.62	1.67	0.05	3.09	1.39	0.95	- 0.44	- 31.65
18	1.69	1.78	0.09	5.33	1.46	0.98	- 0.48	- 32.88
19	1.74	1.86	0.12	6.90	1.54	1.02	- 0.52	- 33.77
20	1.79	1.90	0.11	6.15	1.62	1.05	- 0.57	- 35.19
21	1.83	1.91	0.08	4.37	1.69	1.07	- 0.62	- 36.69
22	1.86	1.89	0.03	1.61	1.74	1.09	- 0.65	- 37.36
23	1.89	1.86	- 0.03	- 1.59	1.79	1.11	- 0.68	- 37.99
24	1.91	1.82	- 0.09	- 4.71	1.83	1.14	- 0.69	- 37.70
25	1.93	1.77	- 0.16	- 8.29	1.86	1.16	- 0.70	- 37.63
26	1.96	1.73	- 0.23	-11.73	1.89	1.19	- 0.70	- 37.04
27	1.99	1.71	- 0.28	-14.07	1.91	1.22	- 0.69	- 36.13
28	2.03	1.70	- 0.33	-16.26	1.93	1.26	- 0.67	- 34.72
29	2.08	1.71	- 0.37	-17.79	1.96	1.30	- 0.66	- 33.67
30	2.13	1.73	- 0.40	-18.78	1.99	1.35	- 0.64	- 32.16
31	2.19	1.78	- 0.41	-18.72	2.03	1.40	- 0.63	- 31.03
32	2.25	1.83	- 0.42	-18.67	2.08	1.45	- 0.63	- 30.29
33	2.32	1.91	- 0.41	-17.67	2.13	1.50	- 0.63	- 29.58
34	2.40	2.00	- 0.40	-16.67	2.19	1.58	- 0.61	- 27.85
35	2.51	2.11	- 0.40	-15.94	2.25	1.65	- 0.60	- 26.67
36	2.64	2.24	- 0.40	-15.15	2.32	1.76	- 0.56	- 24.14
37	2.80	2.40	- 0.40	-14.29	2.40	1.89	- 0.51	- 21.25
38	3.01	2.58	- 0.43	-14.29	2.51	2.04	- 0.47	- 18.73
39	3.25	2.79	- 0.46	-14.15	2.64	2.22	- 0.42	- 15.91
40	3.53	3.02	- 0.51	-14.45	2.80	2.42	- 0.38	- 13.57
41	3.84	3.29	- 0.55	-14.32	3.01	2.64	- 0.37	- 12.29
42	4.17	3.56	- 0.61	-14.63	3.25	2.87	- 0.38	- 11.69
43	4.53	3.87	- 0.66	-14.57	3.53	3.09	- 0.44	- 12.46
44	4.92	4.19	- 0.73	-14.84	3.84	3.32	- 0.52	- 13.54
45	5.35	4.55	- 0.80	-14.95	4.17	3.56	- 0.61	- 14.63
46	5.83	4.92	- 0.91	-15.61	4.53	3.80	- 0.73	- 16.11
47	6.36	5.32	- 1.04	-16.35	4.92	4.05	- 0.87	- 17.68
48	6.95	5.74	- 1.21	-17.41	5.35	4.33	- 1.02	- 19.07
49	7.60	6.21	- 1.39	-18.29	5.83	4.63	- 1.20	- 20.58

EXHIBIT 14—Continued

AGE x (1)	MALE				FEMALE			
	1958 CSO 1,000q <sub>x</sub> (2)	Table K 1,000q <sub>x</sub> (3)	(3)-(2) (4)	(4)÷(2) (5)	1958 CSO 1,000q <sub>x</sub> (6)	Table K 1,000q <sub>x</sub> (7)	(7)-(6) (8)	(8)÷(6) (9)
50	8.32	6.71	- 1.61	-19.35%	6.36	4.96	- 1.40	- 22.01%
51	9.11	7.30	- 1.81	-19.87	6.95	5.31	- 1.64	- 23.60
52	9.96	7.96	- 2.00	-20.08	7.60	5.70	- 1.90	- 25.00
53	10.89	8.71	- 2.18	-20.02	8.32	6.15	- 2.17	- 26.08
54	11.90	9.56	- 2.34	-19.66	9.11	6.61	- 2.50	- 27.44
55	13.00	10.47	- 2.53	-19.46	9.96	7.09	- 2.87	- 28.82
56	14.21	11.46	- 2.75	-19.35	10.89	7.57	- 3.32	- 30.49
57	15.54	12.49	- 3.05	-19.63	11.90	8.03	- 3.87	- 32.52
58	17.00	13.59	- 3.41	-20.06	13.00	8.47	- 4.53	- 34.85
59	18.59	14.77	- 3.82	-20.55	14.21	8.94	- 5.27	- 37.09
60	20.34	16.08	- 4.26	-20.94	15.54	9.47	- 6.07	- 39.06
61	22.24	17.54	- 4.70	-21.13	17.00	10.13	- 6.87	- 40.41
62	24.31	19.19	- 5.12	-21.06	18.59	10.96	- 7.63	- 41.04
63	26.57	21.06	- 5.51	-20.74	20.34	12.02	- 8.32	- 40.90
64	29.04	23.14	- 5.90	-20.32	22.24	13.25	- 8.99	- 40.42
65	31.75	25.42	- 6.33	-19.94	24.31	14.59	- 9.72	- 39.98
66	34.74	27.85	- 6.89	-19.83	26.57	16.00	- 10.57	- 39.78
67	38.04	30.44	- 7.60	-19.98	29.04	17.43	- 11.61	- 39.98
68	41.68	33.19	- 8.49	-20.37	31.75	18.84	- 12.91	- 40.66
69	45.61	36.17	- 9.44	-20.70	34.74	20.36	- 14.38	- 41.39
70	49.79	39.51	-10.28	-20.65	38.04	22.11	- 15.93	- 41.88
71	54.15	43.30	-10.85	-20.04	41.68	24.23	- 17.45	- 41.87
72	58.65	47.65	-11.00	-18.76	45.61	26.87	- 18.74	- 41.09
73	63.26	52.64	-10.62	-16.79	49.79	30.11	- 19.68	- 39.53
74	68.12	58.19	- 9.93	-14.58	54.15	33.93	- 20.22	- 37.34
75	73.37	64.19	- 9.18	-12.51	58.65	38.24	- 20.41	- 34.80
76	79.18	70.53	- 8.65	-10.92	63.26	42.97	- 20.29	- 32.07
77	85.70	77.12	- 8.58	-10.01	68.12	48.04	- 20.08	- 29.48
78	93.06	83.90	- 9.16	- 9.84	73.37	53.45	- 19.92	- 27.15
79	101.19	91.05	-10.14	-10.02	79.18	59.35	- 19.83	- 25.04
80	109.98	98.84	-11.14	-10.13	85.70	65.99	- 19.71	- 23.00
81	119.35	107.48	-11.87	- 9.95	93.06	73.60	- 19.46	- 20.91
82	129.17	117.25	-11.92	- 9.23	101.19	82.40	- 18.79	- 18.57
83	139.38	128.26	-11.12	- 7.98	109.98	92.53	- 17.45	- 15.87
84	150.01	140.25	- 9.76	- 6.51	119.35	103.81	- 15.54	- 13.02
85	161.14	152.95	- 8.19	- 5.08	129.17	116.10	- 13.07	- 10.12
86	172.82	166.09	- 6.73	- 3.89	139.38	129.29	- 10.09	- 7.24
87	185.13	179.55	- 5.58	- 3.01	150.01	143.32	- 6.69	- 4.46
88	198.25	193.27	- 4.98	- 2.51	161.14	158.18	- 2.96	- 1.84
89	212.46	207.29	- 5.17	- 2.43	172.82	173.94	1.12	0.65
90	228.14	221.77	- 6.37	- 2.79	185.13	190.75	5.62	3.04
91	245.77	236.98	- 8.79	- 3.58	198.25	208.87	10.62	5.36
92	265.93	253.45	-12.48	- 4.69	212.46	228.81	16.35	7.70
93	289.30	272.11	-17.19	- 5.94	228.14	251.51	23.37	10.24
94	316.66	295.90	-20.76	- 6.56	245.77	279.31	33.54	13.65
95	351.24	329.96	-21.28	- 6.06	265.93	317.32	51.39	19.32
96	400.56	384.55	-16.01	- 4.00	289.30	375.74	86.44	29.88
97	488.42	480.20	- 8.22	- 1.68	316.66	474.97	158.31	49.99
98	668.15	657.98	-10.17	- 1.52	351.24	655.85	304.61	86.72
99	1,000.00	1,000.00	0.00	0.00	400.56	1,000.00	599.44	149.65



## EXHIBIT 15

TABLES K VERSUS UNITED STATES LIFE TABLES 1969-71

AGE x	MALE				FEMALE			
	U.S. Life Tables 1969-71 1,000q <sub>x</sub>	Table K 1,000q <sub>x</sub>	(3)-(2)	(4)÷(2)	U.S. Life Tables 1969-71 1,000q <sub>x</sub>	Table K 1,000q <sub>x</sub>	(7)-(6)	(8)÷(6)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	22.45	4.18	- 18.27	- 81.38%	17.46	2.89	- 14.57	- 83.45%
1	1.33	1.07	- 0.26	- 19.55	1.16	0.87	- 0.29	- 25.00
2	0.94	0.99	0.05	5.32	0.77	0.81	0.04	5.19
3	0.78	0.98	0.20	25.64	0.60	0.79	0.19	31.67
4	0.64	0.95	0.31	48.44	0.51	0.77	0.26	50.98
5	0.58	0.90	0.32	55.17	0.43	0.76	0.33	76.74
6	0.54	0.86	0.32	59.26	0.38	0.73	0.35	92.11
7	0.51	0.80	0.29	56.86	0.34	0.72	0.38	111.76
8	0.46	0.76	0.30	65.22	0.31	0.70	0.39	125.81
9	0.41	0.74	0.33	80.49	0.28	0.69	0.41	146.43
10	0.36	0.73	0.37	102.78	0.26	0.68	0.42	161.54
11	0.35	0.77	0.42	120.00	0.25	0.69	0.44	176.00
12	0.42	0.85	0.43	102.38	0.27	0.72	0.45	166.67
13	0.59	0.99	0.40	67.80	0.33	0.75	0.42	127.27
14	0.84	1.15	0.31	36.90	0.40	0.80	0.40	100.00
15	1.14	1.33	0.19	16.67	0.49	0.85	0.36	73.47
16	1.42	1.51	0.09	6.34	0.58	0.90	0.32	55.17
17	1.67	1.67	- 0.00	0.00	0.66	0.95	0.29	43.94
18	1.85	1.78	- 0.07	- 3.78	0.69	0.98	0.29	42.03
19	1.98	1.86	- 0.12	- 6.06	0.71	1.02	0.31	43.66
20	2.12	1.90	- 0.22	- 10.38	0.72	1.05	0.33	45.83
21	2.26	1.91	- 0.35	- 15.49	0.73	1.07	0.34	46.58
22	2.35	1.89	- 0.46	- 19.57	0.75	1.09	0.34	45.33
23	2.35	1.86	- 0.49	- 20.85	0.77	1.11	0.34	44.16
24	2.28	1.82	- 0.46	- 20.18	0.79	1.14	0.35	44.30
25	2.17	1.77	- 0.40	- 18.43	0.81	1.16	0.35	43.21
26	2.06	1.73	- 0.33	- 16.02	0.83	1.19	0.36	43.37
27	1.99	1.71	- 0.28	- 14.07	0.86	1.22	0.36	41.86
28	1.98	1.70	- 0.28	- 14.14	0.90	1.26	0.36	40.00
29	2.03	1.71	- 0.32	- 15.76	0.96	1.30	0.34	35.42
30	2.10	1.73	- 0.37	- 17.62	1.02	1.35	0.33	32.35
31	2.18	1.78	- 0.40	- 18.35	1.10	1.40	0.30	27.27
32	2.28	1.83	- 0.45	- 19.74	1.19	1.45	0.26	21.85
33	2.39	1.91	- 0.48	- 20.08	1.29	1.50	0.21	16.28
34	2.52	2.00	- 0.52	- 20.63	1.40	1.58	0.18	12.86
35	2.68	2.11	- 0.57	- 21.27	1.52	1.65	0.13	8.55
36	2.88	2.24	- 0.64	- 22.22	1.65	1.76	0.11	6.67
37	3.12	2.40	- 0.72	- 23.08	1.80	1.89	0.09	5.00
38	3.39	2.58	- 0.81	- 23.89	1.97	2.04	0.07	3.55
39	3.69	2.79	- 0.90	- 24.39	2.15	2.22	0.07	3.26
40	4.01	3.02	- 0.99	- 24.69	2.33	2.42	0.09	3.86
41	4.35	3.29	- 1.06	- 24.37	2.51	2.64	0.13	5.18
42	4.73	3.56	- 1.17	- 24.74	2.73	2.87	0.14	5.13
43	5.18	3.87	- 1.31	- 25.29	2.97	3.09	0.12	4.04
44	5.68	4.19	- 1.49	- 26.23	3.25	3.32	0.07	2.15
45	6.23	4.55	- 1.68	- 26.97	3.54	3.56	0.02	0.56
46	6.81	4.92	- 1.89	- 27.75	3.84	3.80	- 0.04	- 1.04
47	7.44	5.32	- 2.12	- 28.49	4.16	4.05	- 0.11	- 2.64
48	8.12	5.74	- 2.38	- 29.31	4.49	4.33	- 0.16	- 3.56
49	8.87	6.21	- 2.66	- 29.99	4.84	4.63	- 0.21	- 4.34

EXHIBIT 15—Continued

AGE x	MALE				FEMALE			
	U.S. Life Tables 1969-71 1,000q <sub>x</sub>	Table K 1,000q <sub>x</sub>	(3)-(2)	(4)÷(2)	U.S. Life Tables 1969-71 1,000q <sub>x</sub>	Table K 1,000q <sub>x</sub>	(7)-(6)	(8)÷(6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
50	9.69	6.71	- 2.98	- 30.75%	5.23	4.96	- 0.27	- 5.16%
51	10.59	7.30	- 3.29	- 31.07	5.65	5.31	- 0.34	- 6.02
52	11.61	7.96	- 3.65	- 31.44	6.11	5.70	- 0.41	- 6.71
53	12.75	8.71	- 4.04	- 31.69	6.60	6.15	- 0.45	- 6.82
54	14.00	9.56	- 4.44	- 31.71	7.12	6.61	- 0.51	- 7.16
55	15.34	10.47	- 4.87	- 31.75	7.68	7.09	- 0.59	- 7.68
56	16.76	11.46	- 5.30	- 31.62	8.29	7.57	- 0.72	- 8.69
57	18.27	12.49	- 5.78	- 31.64	8.94	8.03	- 0.91	- 10.18
58	19.87	13.59	- 6.28	- 31.61	9.62	8.47	- 1.15	- 11.95
59	21.58	14.77	- 6.81	- 31.56	10.35	8.94	- 1.41	- 13.62
60	23.39	16.08	- 7.31	- 31.25	11.13	9.47	- 1.66	- 14.91
61	25.32	17.54	- 7.78	- 30.73	12.00	10.13	- 1.87	- 15.58
62	27.38	19.19	- 8.19	- 29.91	12.98	10.96	- 2.02	- 15.56
63	29.60	21.06	- 8.54	- 28.85	14.11	12.02	- 2.09	- 14.81
64	32.00	23.14	- 8.86	- 27.69	15.38	13.25	- 2.13	- 13.85
65	34.63	25.42	- 9.21	- 26.60	16.78	14.59	- 2.19	- 13.05
66	37.46	27.85	- 9.61	- 25.65	18.32	16.00	- 2.32	- 12.66
67	40.44	30.44	- 10.00	- 24.73	20.04	17.43	- 2.61	- 13.02
68	43.50	33.19	- 10.31	- 23.70	21.95	18.84	- 3.11	- 14.17
69	46.65	36.17	- 10.48	- 22.47	24.07	20.36	- 3.71	- 15.41
70	49.91	39.51	- 10.40	- 20.84	26.32	22.11	- 4.21	- 16.00
71	53.44	43.30	- 10.14	- 18.97	28.79	24.23	- 4.56	- 15.84
72	57.40	47.65	- 9.75	- 16.99	31.65	26.87	- 4.78	- 15.10
73	61.93	52.64	- 9.29	- 15.00	35.03	30.11	- 4.92	- 14.05
74	67.03	58.19	- 8.84	- 13.19	38.93	33.93	- 5.00	- 12.84
75	72.64	64.19	- 8.45	- 11.63	43.25	38.24	- 5.01	- 11.58
76	78.56	70.53	- 8.03	- 10.22	47.90	42.97	- 4.93	- 10.29
77	84.62	77.12	- 7.50	- 8.86	52.95	48.04	- 4.91	- 9.27
78	90.70	83.90	- 6.80	- 7.50	58.40	53.45	- 4.95	- 8.48
79	96.88	91.05	- 5.83	- 6.02	64.32	59.35	- 4.97	- 7.73
80	103.67	98.84	- 4.83	- 4.66	70.97	65.99	- 4.98	- 7.02
81	111.25	107.48	- 3.77	- 3.39	78.34	73.60	- 4.74	- 6.05
82	119.29	117.25	- 2.04	- 1.71	86.12	82.40	- 3.72	- 4.32
83	127.70	128.26	0.56	0.44	94.19	92.53	- 1.66	- 1.76
84	136.63	140.25	3.62	2.65	102.75	103.81	1.06	1.03
85	147.30	152.95	5.65	3.84	112.82	116.10	3.28	2.91
86	159.79	166.09	6.30	3.94	124.62	129.29	4.67	3.75
87	172.81	179.55	6.74	3.90	136.85	143.32	6.47	4.73
88	185.21	193.27	8.06	4.35	148.59	158.18	9.59	6.45
89	196.81	207.29	10.48	5.32	160.06	173.94	13.88	8.67
90	208.39	221.77	13.38	6.42	172.64	190.75	18.11	10.49
91	221.22	236.98	15.76	7.12	187.18	208.87	21.69	11.59
92	235.12	253.45	18.33	7.80	202.43	228.81	26.38	13.03
93	250.23	272.11	21.88	8.74	217.50	251.51	34.01	15.64
94	265.46	295.90	30.44	11.47	231.86	279.31	47.45	20.46
95	279.62	329.96	50.34	18.00	245.84	317.32	71.48	29.08
96	290.90	384.55	93.65	32.19	258.54	375.74	117.20	45.33
97	301.35	480.20	178.85	59.35	269.80	474.97	205.17	76.05
98	311.11	657.98	346.87	111.49	279.96	655.85	375.89	134.27
99	320.17	1,000.00	679.83	212.33	289.49	1,000.00	710.51	245.44

To test the effect on nonforfeiture values of modernizing mortality levels, the Society of Actuaries' Special Committee on Valuation and Nonforfeiture Laws developed in 1975 the Modern CSO Table, which was intended to be a modern version of the 1958 CSO Table. The table was constructed by applying the same numerical margins as in the 1958 CSO Table at the younger ages to more recent mortality rates based on intercompany experience between 1965 and 1970 policy anniversaries. At the older ages, the same margin percentages as were used in the 1958 CSO Table were applied to these recent experience rates. The Modern CSO Table was adopted in several states as a valuation standard for renewable term life insurance. Since the mortality rates of Tables K are generally lower than those of the Modern CSO Table, acceptance of Tables K as the minimum valuation standard of individual ordinary insurance will lower the minimum reserve requirements for renewable term life insurance.

#### *Premiums and Reserves*

Exhibits 16-18 compare net premiums, terminal reserves, and cash values derived from Tables K with those derived from the 1958 CSO Table.

#### *Tests of Extension of Tables K beyond Age 99*

In developing the Basic Tables, the Committee decided to end both the male and female tables at age 100, the same approach as was used for the 1958 CSO Male Basic Table. Intercompany mortality data were not available above age 99 and the intercompany data at ages 90 and over were very scanty and considered to be unreliable. The Committee also examined other available mortality data at the advanced ages, including the United States Life Tables and data compiled by the Social Security Administration, but these data were also considered to be generally unreliable.

In order to test the effect of extending the proposed valuation tables beyond age 99, the Committee constructed two sets of extensions of Tables K (M) and K (F). For the 1958 CSO Tables, the female table ends three years after the male table, because a three-year setback was used for female rates. In comparing our overall male and female basic rates, it seemed that a setback of five years was more appropriate. Because of this, we decided to extend the Table K (M) to age 104 ( $q_{104}^M = 1$ ) while extending the Table K (F) to age 109 ( $q_{109}^F = 1$ ).

Tables K (M) and K (F) were extended using two different methods. The first method used was to fit a cubic polynomial to three consecutive points (in our case, ages 88, 89, and 90) and requiring  $q_{\omega} = 1$ . This method is suggested by Morton Miller in his monograph *Elements of Graduation*. (The mortality rates were adjusted only for values above age 90.) The second

EXHIBIT 16

NET ANNUAL PREMIUMS: 4 PERCENT INTEREST, CURTATE FUNCTIONS, NET LEVEL PREMIUM BASIS

ISSUE AGE (1)	MALE			FEMALE		
	1958 CSO (2)	Table K (M) (3)	(3) ÷ (2) (4)	1958 CSO (5)	Table K (F) (6)	(6) ÷ (5) (7)
Whole Life						
0	4.14	3.59	86.7%	3.74	2.91	77.8%
5	4.50	4.06	90.2	4.06	3.31	81.5
10	5.31	4.86	91.5	4.78	3.93	82.2
15	6.35	5.86	92.3	5.70	4.72	82.8
20	7.60	6.97	91.7	6.82	5.67	83.1
25	9.17	8.34	90.9	8.18	6.86	83.9
30	11.21	10.17	90.7	9.92	8.36	84.3
35	13.90	12.60	90.6	12.20	10.28	84.3
40	17.45	15.77	90.4	15.21	12.73	83.7
45	22.10	19.88	90.0	19.16	15.82	82.6
50	28.24	25.27	89.5	24.35	19.78	81.2
55	36.37	32.49	89.3	31.21	24.98	80.0
60	47.28	42.21	89.3	40.35	32.04	79.4
65	62.00	55.64	89.7	52.64	42.11	80.0
Five-Year Term						
0	2.64	1.62	61.4%	2.38	1.21	50.8%
5	1.22	0.78	63.9	1.12	0.69	61.6
10	1.23	0.86	69.9	1.10	0.70	63.6
15	1.54	1.56	101.3	1.33	0.90	67.7
20	1.78	1.81	101.7	1.66	1.05	63.3
25	1.92	1.66	86.5	1.83	1.18	64.5
30	2.17	1.77	81.6	2.00	1.40	70.0
35	2.72	2.32	85.3	2.32	1.83	78.9
40	4.01	3.42	85.3	3.14	2.74	87.3
45	6.12	5.11	83.5	4.73	3.90	82.5
50	9.57	7.67	80.1	7.31	5.49	75.1
55	14.92	11.97	80.2	11.43	7.67	67.1
60	23.30	18.46	79.2	17.84	10.65	59.7
65	36.38	29.08	79.9	27.82	16.62	59.7
Ten-Year Term						
0	2.00	1.25	62.5%	1.81	0.98	54.1%
5	1.23	0.82	66.7	1.11	0.70	63.1
10	1.37	1.17	85.4	1.21	0.79	65.3
15	1.65	1.67	101.2	1.48	0.97	65.5
20	1.84	1.74	94.6	1.74	1.11	63.8
25	2.03	1.71	84.2	1.91	1.27	66.5
30	2.41	2.02	83.8	2.14	1.59	74.3
35	3.29	2.81	85.4	2.69	2.24	83.3
40	4.95	4.17	84.2	3.85	3.26	84.7
45	7.64	6.25	81.8	5.88	4.61	78.4
50	11.90	9.56	80.3	9.12	6.46	70.8
55	18.50	14.78	79.9	14.21	8.98	63.2
60	28.72	22.95	79.9	22.06	13.24	60.0
65	44.00	35.80	81.4	34.19	20.62	60.3

EXHIBIT 17

NET PREMIUMS AND TERMINAL RESERVES  
4 PERCENT INTEREST, CURTATE FUNCTIONS,  
NET LEVEL PREMIUM BASIS  
ORDINARY LIFE

	MALE			FEMALE		
	1958 CSO (1)	Table K (M) (2)	(2)÷(1) (3)	1958 CSO (4)	Table K (F) (5)	(5)÷(4) (6)
Issue Age 5						
Net premium Reserves	4.50	4.06	90.2%	4.06	3.31	81.5%
End of year						
1	3.34	3.32	99.4	2.99	2.68	89.6
5	18.53	18.48	99.7	16.64	14.75	88.6
10	41.20	40.68	98.7	37.09	32.73	88.2
20	98.03	91.42	93.3	88.30	78.33	88.7
Issue Age 20						
Net premium Reserves	7.60	6.97	91.7%	6.82	5.67	83.1%
End of year						
1	6.13	5.36	87.4	5.48	4.85	88.5
5	32.96	29.24	88.7	29.20	26.13	89.5
10	72.72	65.94	90.7	64.12	57.41	89.5
20	176.22	162.35	92.1	156.26	137.93	88.3
Issue Age 35						
Net premium Reserves	13.90	12.60	90.6%	12.20	10.28	84.3%
End of year						
1	11.98	11.02	92.0	10.46	9.06	86.6
5	63.57	58.40	91.9	56.05	47.91	85.5
10	135.47	124.66	92.0	120.90	102.01	84.4
20	300.27	280.30	93.3	272.91	231.74	84.9
Issue Age 50						
Net premium Reserves	28.24	25.27	89.5%	24.35	19.78	81.2%
End of year						
1	21.22	19.70	92.8	19.09	15.69	82.2
5	108.69	101.77	93.6	98.44	82.01	83.3
10	222.08	209.99	94.6	202.95	173.87	85.7
20	445.05	434.89	97.7	416.75	387.03	92.9
Issue Age 65						
Net premium Reserves	62.00	55.64	89.7%	52.64	42.11	80.0%
End of year						
1	33.80	33.29	98.5	31.19	29.63	95.0
5	164.14	165.65	100.9	154.13	152.05	98.7
10	313.83	324.49	103.4	297.61	311.97	104.8
20	567.41	584.47	103.0	547.34	597.92	109.2

EXHIBIT 18

MINIMUM CASH VALUES  
4 PERCENT INTEREST, CURTATE FUNCTIONS  
ORDINARY LIFE

	MALE			FEMALE		
	1958 CSO (1)	Table K (M) (2)	(2) ÷ (1) (3)	1958 CSO (4)	Table K (F) (5)	(5) ÷ (4) (6)
Issue Age 5						
Nonforfeiture factor	5.51	5.05	91.7%	5.05	4.26	84.4%
Cash value						
End of year 5 ..	4.61	4.37	94.8	6.26	7.68	122.7
10 ..	18.59	18.34	98.7	14.67	10.71	73.0
15 ..	45.28	42.26	93.3	39.01	32.06	82.2
20 ..	76.75	70.27	91.6	67.07	57.35	85.5
At age 65 .....	562.25	537.63	95.6	522.34	469.79	89.9
Issue Age 20						
Nonforfeiture factor	8.78	8.11	92.4%	7.96	6.75	84.8%
Cash value						
End of year 5 ..	8.10	4.70	58.0	4.77	2.38	49.9
10 ..	48.88	42.33	86.6	40.56	34.42	84.9
15 ..	97.69	87.91	90.0	83.66	72.47	86.6
20 ..	155.04	141.18	91.1	135.02	116.91	86.6
At age 65 .....	529.70	505.02	95.3	490.44	438.87	89.5
Issue Age 35						
Nonforfeiture factor	15.47	14.09	91.1%	13.66	11.62	85.1%
Cash value						
End of year 5 ..	35.42	30.94	87.4	28.79	21.68	75.3
10 ..	109.48	99.13	90.5	95.51	77.26	80.9
15 ..	191.35	175.39	91.7	170.23	140.05	82.3
20 ..	279.24	259.31	92.9	251.91	210.57	83.6
At age 65 .....	463.11	441.49	95.3	427.86	378.36	88.4
Issue Age 50						
Nonforfeiture factor	30.91	27.69	89.6%	26.70	21.77	81.5%
Cash value						
End of year 5 ..	72.95	67.64	92.7	64.76	50.66	78.2
10 ..	190.90	179.97	94.3	173.18	145.66	84.1
15 ..	309.45	296.96	96.0	284.72	252.43	88.7
20 ..	422.80	413.41	97.8	394.96	366.10	92.7
At age 65 .....	309.45	296.96	96.0	284.72	252.43	88.7
Issue Age 65						
Nonforfeiture factor	66.62	59.97	90.0%	56.83	45.81	80.6%
Cash value						
End of year 5 ..	125.69	127.26	101.2	115.22	113.04	98.1
10 ..	282.27	293.42	104.0	265.30	280.32	105.7
15 ..	426.62	438.79	102.9	403.37	438.02	108.6
20 ..	547.51	565.36	103.3	526.52	579.42	110.0

method used to extend the tables was to increase the third differences above a certain age geometrically. (Mortality rates were adjusted starting at age 88.) It will be remembered that this was the method which was used to end Tables K (M) and K (F) as well as the Basic Tables.

Tests were made to compare reserves calculated on Tables K with reserves calculated on both extensions of Tables K. Net level premium reserves at 4 percent interest were compared at various durations for whole life policies issued at ages 25, 45, and 65. While the decrease in reserves is slightly greater using the geometric extensions than using the cubic polynomial extensions, the effect on reserves of either set of extensions is insignificant, with virtually no effect except at the very high durations for issue ages 65 and over. Reserves under Tables K would always be higher (i.e., more conservative) than reserves under either extension of Tables K.

#### *Extended Term Tables*

The extended term versions of Tables K (KET) are derived from Tables K in the same way that the 1958 CET Table was derived from the 1958 CSO Table; by adding a loading of 0.75 deaths per 1,000 or 30 percent of the Table K mortality rates, whichever is greater, to the Table K mortality rates. Exhibits 19 and 20 compare the KET Tables to Tables K and the 1958 CET Table.

The use of the same loading formula for the KET Tables as was used for the 1958 CET Table was not completely arbitrary. The 1958 extended term margins (as was the case in the 1941 table) were intended to cover demonstrated higher mortality experience on extended term insurance as well as to provide for expenses incurred in connection with extended term insurance.

The Society of Actuaries' Special Committee on Valuation and Nonforfeiture Laws endorsed a continuation of similar procedures in connection with extended term insurance in its January, 1976, report to the Society.

Review of the latest intercompany study of extended term insurance mortality experience for the five-year period 1957-62 produced an overall ratio of actual to expected claims by amount of insurance of 115 percent, using the 1955-60 Basic Ultimate Table for expected claims. Individual company ratios fluctuated widely.

Since the underlying basic mortality rates in the present study are materially less than those underlying the 1958 tables, while unit expenses are probably higher, the Committee found it appropriate to derive the KET Tables from Tables K in an identical fashion to that employed in deriving the 1958 CET Table from the 1958 CSO Table.

## EXHIBIT 19

## TABLES KET VERSUS TABLES K

AGE x  (1)	MALE				FEMALE			
	Table K 1,000q <sub>x</sub> (2)	Table KET 1,000q <sub>x</sub> (3)	(3) - (2) (4)	(4) ÷ (2) (5)	Table K 1,000q <sub>x</sub> (6)	Table KET 1,000q <sub>x</sub> (7)	(7) - (6) (8)	(8) ÷ (6) (9)
0	4.18	5.43	1.25	29.90%	2.89	3.76	0.87	30.10%
1	1.07	1.82	0.75	70.09	0.87	1.62	0.75	86.21
2	0.99	1.74	0.75	75.76	0.81	1.56	0.75	92.59
3	0.98	1.73	0.75	76.53	0.79	1.54	0.75	94.94
4	0.95	1.70	0.75	78.95	0.77	1.52	0.75	97.40
5	0.90	1.65	0.75	83.33	0.76	1.51	0.75	98.68
6	0.86	1.61	0.75	87.21	0.73	1.48	0.75	102.74
7	0.80	1.55	0.75	93.75	0.72	1.47	0.75	104.17
8	0.76	1.51	0.75	98.68	0.70	1.45	0.75	107.14
9	0.74	1.49	0.75	101.35	0.69	1.44	0.75	108.70
10	0.73	1.48	0.75	102.74	0.68	1.43	0.75	110.29
11	0.77	1.52	0.75	97.40	0.69	1.44	0.75	108.70
12	0.85	1.60	0.75	88.24	0.72	1.47	0.75	104.17
13	0.99	1.74	0.75	75.76	0.75	1.50	0.75	100.00
14	1.15	1.90	0.75	65.22	0.80	1.55	0.75	93.75
15	1.33	2.08	0.75	56.39	0.85	1.60	0.75	88.24
16	1.51	2.26	0.75	49.67	0.90	1.65	0.75	83.33
17	1.67	2.42	0.75	44.91	0.95	1.70	0.75	78.95
18	1.78	2.53	0.75	42.13	0.98	1.73	0.75	76.53
19	1.86	2.61	0.75	40.32	1.02	1.77	0.75	73.53
20	1.90	2.65	0.75	39.47	1.05	1.80	0.75	71.43
21	1.91	2.66	0.75	39.27	1.07	1.82	0.75	70.09
22	1.89	2.64	0.75	39.68	1.09	1.84	0.75	68.81
23	1.86	2.61	0.75	40.32	1.11	1.86	0.75	67.57
24	1.82	2.57	0.75	41.21	1.14	1.89	0.75	65.79
25	1.77	2.52	0.75	42.37	1.16	1.91	0.75	64.66
26	1.73	2.48	0.75	43.35	1.19	1.94	0.75	63.03
27	1.71	2.46	0.75	43.86	1.22	1.97	0.75	61.48
28	1.70	2.45	0.75	44.12	1.26	2.01	0.75	59.52
29	1.71	2.46	0.75	43.86	1.30	2.05	0.75	57.69
30	1.73	2.48	0.75	43.35	1.35	2.10	0.75	55.56
31	1.78	2.53	0.75	42.13	1.40	2.15	0.75	53.57
32	1.83	2.58	0.75	40.98	1.45	2.20	0.75	51.72
33	1.91	2.66	0.75	39.27	1.50	2.25	0.75	50.00
34	2.00	2.75	0.75	37.50	1.58	2.33	0.75	47.47
35	2.11	2.86	0.75	35.55	1.65	2.40	0.75	45.45
36	2.24	2.99	0.75	33.48	1.76	2.51	0.75	42.61
37	2.40	3.15	0.75	31.25	1.89	2.64	0.75	39.68
38	2.58	3.35	0.77	29.84	2.04	2.79	0.75	36.76
39	2.79	3.63	0.84	30.11	2.22	2.97	0.75	33.78
40	3.02	3.93	0.91	30.13	2.42	3.17	0.75	30.99
41	3.29	4.28	0.99	30.09	2.64	3.43	0.79	29.92
42	3.56	4.63	1.07	30.06	2.87	3.73	0.86	29.97
43	3.87	5.03	1.16	29.97	3.09	4.02	0.93	30.10
44	4.19	5.45	1.26	30.07	3.32	4.32	1.00	30.12
45	4.55	5.92	1.37	30.11	3.56	4.63	1.07	30.06
46	4.92	6.40	1.48	30.08	3.80	4.94	1.14	30.00
47	5.32	6.92	1.60	30.08	4.05	5.27	1.22	30.12
48	5.74	7.46	1.72	29.97	4.33	5.63	1.30	30.02
49	6.21	8.07	1.86	29.95	4.63	6.02	1.39	30.02



EXHIBIT 19—Continued

AGE x  (1)	MALE				FEMALE			
	Table K 1,000q <sub>x</sub>	Table KET 1,000q <sub>x</sub>	(3) - (2)	(4) ÷ (2)	Table K 1,000q <sub>x</sub>	Table KET 1,000q <sub>x</sub>	(7) - (6)	(8) ÷ (6)
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
50	6.71	8.72	2.01	29.96%	4.96	6.45	1.49	30.04%
51	7.30	9.49	2.19	30.00	5.31	6.90	1.59	29.94
52	7.96	10.35	2.39	30.03	5.70	7.41	1.71	30.00
53	8.71	11.32	2.61	29.97	6.15	8.00	1.85	30.08
54	9.56	12.43	2.87	30.02	6.61	8.59	1.98	29.95
55	10.47	13.61	3.14	29.99	7.09	9.22	2.13	30.04
56	11.46	14.90	3.44	30.02	7.57	9.84	2.27	29.99
57	12.49	16.24	3.75	30.02	8.03	10.44	2.41	30.01
58	13.59	17.67	4.08	30.02	8.47	11.01	2.54	29.99
59	14.77	19.20	4.43	29.99	8.94	11.62	2.68	29.98
60	16.08	20.90	4.82	29.98	9.47	12.31	2.84	29.99
61	17.54	22.80	5.26	29.99	10.13	13.17	3.04	30.01
62	19.19	24.95	5.76	30.02	10.96	14.25	3.29	30.02
63	21.06	27.38	6.32	30.01	12.02	15.63	3.61	30.03
64	23.14	30.08	6.94	29.99	13.25	17.23	3.98	30.04
65	25.42	33.05	7.63	30.02	14.59	18.97	4.38	30.02
66	27.85	36.21	8.36	30.02	16.00	20.80	4.80	30.00
67	30.44	39.57	9.13	29.99	17.43	22.66	5.23	30.01
68	33.19	43.15	9.96	30.01	18.84	24.49	5.65	29.99
69	36.17	47.02	10.85	30.00	20.36	26.47	6.11	30.01
70	39.51	51.36	11.85	29.99	22.11	28.74	6.63	29.99
71	43.30	56.29	12.99	30.00	24.23	31.50	7.27	30.00
72	47.65	61.95	14.30	30.01	26.87	34.93	8.06	30.00
73	52.64	68.43	15.79	30.00	30.11	39.14	9.03	29.99
74	58.19	75.65	17.46	30.01	33.93	44.11	10.18	30.00
75	64.19	83.45	19.26	30.00	38.24	49.71	11.47	29.99
76	70.53	91.69	21.16	30.00	42.97	55.86	12.89	30.00
77	77.12	100.26	23.14	30.01	48.04	62.45	14.41	30.00
78	83.90	109.07	25.17	30.00	53.45	69.49	16.04	30.01
79	91.05	118.37	27.32	30.01	59.35	77.16	17.81	30.01
80	98.84	128.49	29.65	30.00	65.99	85.79	19.80	30.00
81	107.48	139.72	32.24	30.00	73.60	95.68	22.08	30.00
82	117.25	152.43	35.18	30.00	82.40	107.12	24.72	30.00
83	128.26	166.74	38.48	30.00	92.53	120.29	27.76	30.00
84	140.25	182.33	42.08	30.00	103.81	134.95	31.14	30.00
85	152.95	198.84	45.89	30.00	116.10	150.93	34.83	30.00
86	166.09	215.92	49.83	30.00	129.29	168.08	38.79	30.00
87	179.55	233.42	53.87	30.00	143.32	186.32	43.00	30.00
88	193.27	251.25	57.98	30.00	158.18	205.63	47.45	30.00
89	207.29	269.48	62.19	30.00	173.94	226.12	52.18	30.00
90	221.77	288.30	66.53	30.00	190.75	247.98	57.23	30.00
91	236.98	308.07	71.09	30.00	208.87	271.53	62.66	30.00
92	253.45	329.49	76.04	30.00	228.81	297.45	68.64	30.00
93	272.11	353.74	81.63	30.00	251.51	326.96	75.45	30.00
94	295.90	384.67	88.77	30.00	279.31	363.10	83.79	30.00
95	329.96	428.95	98.99	30.00	317.32	412.52	95.20	30.00
96	384.55	499.92	115.37	30.00	375.74	488.46	112.72	30.00
97	480.20	624.26	144.06	30.00	474.97	617.46	142.49	30.00
98	657.98	855.37	197.39	30.00	655.85	852.61	196.76	30.00
99	1,000.00	1,000.00	0.00	0.00	1,000.00	1,000.00	0.00	0.00

EXHIBIT 20

TABLES KET VERSUS 1958 CET

AGE x	MALE				FEMALE			
	1958 CET 1,000q <sub>x</sub>	Table KET 1,000q <sub>x</sub>	(3)-(2)	(4)÷(2)	1958 CET 1,000q <sub>x</sub>	Table KET 1,000q <sub>x</sub>	(7)-(6)	(8)÷(6)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	9.20	5.43	- 3.77	-40.98%	8.06	3.76	- 4.30	-53.35%
1	2.51	1.82	- 0.69	-27.49	2.42	1.62	- 0.80	-33.06
2	2.27	1.74	- 0.53	-23.35	2.16	1.56	- 0.60	-27.78
3	2.21	1.73	- 0.48	-21.72	2.10	1.54	- 0.56	-26.67
4	2.15	1.70	- 0.45	-20.93	2.04	1.52	- 0.52	-25.49
5	2.10	1.65	- 0.45	-21.43	1.99	1.51	- 0.48	-24.12
6	2.05	1.61	- 0.44	-21.46	1.94	1.48	- 0.46	-23.71
7	2.01	1.55	- 0.46	-22.89	1.90	1.47	- 0.43	-22.63
8	1.98	1.51	- 0.47	-23.74	1.87	1.45	- 0.42	-22.46
9	1.96	1.49	- 0.47	-23.98	1.86	1.44	- 0.42	-22.58
10	1.96	1.48	- 0.48	-24.49	1.86	1.43	- 0.43	-23.12
11	1.98	1.52	- 0.46	-23.23	1.87	1.44	- 0.43	-22.99
12	2.01	1.60	- 0.41	-20.40	1.89	1.47	- 0.42	-22.22
13	2.07	1.74	- 0.33	-15.94	1.92	1.50	- 0.42	-21.87
14	2.14	1.90	- 0.24	-11.21	1.96	1.55	- 0.41	-20.92
15	2.21	2.08	- 0.13	- 5.88	2.01	1.60	- 0.41	-20.40
16	2.29	2.26	- 0.03	- 1.31	2.07	1.65	- 0.42	-20.29
17	2.37	2.42	0.05	2.11	2.14	1.70	- 0.44	-20.56
18	2.44	2.53	0.09	3.69	2.21	1.73	- 0.48	-21.72
19	2.49	2.61	0.12	4.82	2.29	1.77	- 0.52	-22.71
20	2.54	2.65	0.11	4.33	2.37	1.80	- 0.57	-24.05
21	2.58	2.66	0.08	3.10	2.44	1.82	- 0.62	-25.41
22	2.61	2.64	0.03	1.15	2.49	1.84	- 0.65	-26.10
23	2.64	2.61	- 0.03	- 1.14	2.54	1.86	- 0.68	-26.77
24	2.66	2.57	- 0.09	- 3.38	2.58	1.89	- 0.69	-26.74
25	2.68	2.52	- 0.16	- 5.97	2.61	1.91	- 0.70	-26.82
26	2.71	2.48	- 0.23	- 8.49	2.64	1.94	- 0.70	-26.52
27	2.74	2.46	- 0.28	-10.22	2.66	1.97	- 0.69	-25.94
28	2.78	2.45	- 0.33	-11.87	2.68	2.01	- 0.67	-25.00
29	2.83	2.46	- 0.37	-13.07	2.71	2.05	- 0.66	-24.35
30	2.88	2.48	- 0.40	-13.89	2.74	2.10	- 0.64	-23.36
31	2.94	2.53	- 0.41	-13.95	2.78	2.15	- 0.63	-22.66
32	3.00	2.58	- 0.42	-14.00	2.83	2.20	- 0.63	-22.26
33	3.07	2.66	- 0.41	-13.36	2.88	2.25	- 0.63	-21.87
34	3.15	2.75	- 0.40	-12.70	2.94	2.33	- 0.61	-20.75
35	3.26	2.86	- 0.40	-12.27	3.00	2.40	- 0.60	-20.00
36	3.43	2.99	- 0.44	-12.83	3.07	2.51	- 0.56	-18.24
37	3.64	3.15	- 0.49	-13.46	3.15	2.64	- 0.51	-16.19
38	3.91	3.35	- 0.56	-14.32	3.26	2.79	- 0.47	-14.42
39	4.23	3.63	- 0.60	-14.18	3.43	2.97	- 0.46	-13.41
40	4.59	3.93	- 0.66	-14.38	3.64	3.17	- 0.47	-12.91
41	4.99	4.28	- 0.71	-14.23	3.91	3.43	- 0.48	-12.28
42	5.42	4.63	- 0.79	-14.58	4.23	3.73	- 0.50	-11.82
43	5.89	5.03	- 0.86	-14.60	4.59	4.02	- 0.57	-12.42
44	6.40	5.45	- 0.95	-14.84	4.99	4.32	- 0.67	-13.43
45	6.96	5.92	- 1.04	-14.94	5.42	4.63	- 0.79	-14.58
46	7.58	6.40	- 1.18	-15.57	5.89	4.94	- 0.95	-16.13
47	8.27	6.92	- 1.35	-16.32	6.40	5.27	- 1.13	-17.66
48	9.04	7.46	- 1.58	-17.48	6.96	5.63	- 1.33	-19.11
49	9.88	8.07	- 1.81	-18.32	7.58	6.02	- 1.56	-20.58

EXHIBIT 20—Continued

AGE x  (1)	MALE				FEMALE			
	1958 CET 1,000q <sub>x</sub>	Table KET 1,000q <sub>x</sub>	(3)-(2)	(4)÷(2)	1958 CET 1,000q <sub>x</sub>	Table KET 1,000q <sub>x</sub>	(7)-(6)	(8)÷(6)
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
50	10.82	8.72	- 2.10	-19.41%	8.27	6.45	- 1.82	-22.01%
51	11.84	9.49	- 2.35	-19.85	9.04	6.90	- 2.14	-23.67
52	12.95	10.35	- 2.60	-20.08	9.88	7.41	- 2.47	-25.00
53	14.16	11.32	- 2.84	-20.06	10.82	8.00	- 2.82	-26.06
54	15.47	12.43	- 3.04	-19.65	11.84	8.59	- 3.25	-27.45
55	16.90	13.61	- 3.29	-19.47	12.95	9.22	- 3.73	-28.80
56	18.47	14.90	- 3.57	-19.33	14.16	9.84	- 4.32	-30.51
57	20.20	16.24	- 3.96	-19.60	15.47	10.44	- 5.03	-32.51
58	22.10	17.67	- 4.43	-20.05	16.90	11.01	- 5.89	-34.85
59	24.17	19.20	- 4.97	-20.56	18.47	11.62	- 6.85	-37.09
60	26.44	20.90	- 5.54	-20.95	20.20	12.31	- 7.89	-39.06
61	28.91	22.80	- 6.11	-21.13	22.10	13.17	- 8.93	-40.41
62	31.60	24.95	- 6.65	-21.04	24.17	14.25	- 9.92	-41.04
63	34.54	27.38	- 7.16	-20.73	26.44	15.63	-10.81	-40.89
64	37.75	30.08	- 7.67	-20.32	28.91	17.23	-11.68	-40.40
65	41.28	33.05	- 8.23	-19.94	31.60	18.97	-12.63	-39.97
66	45.16	36.21	- 8.95	-19.82	34.54	20.80	-13.74	-39.78
67	49.45	39.57	- 9.88	-19.98	37.75	22.66	-15.09	-39.97
68	54.18	43.15	-11.03	-20.36	41.28	24.49	-16.79	-40.67
69	59.29	47.02	-12.27	-20.69	45.16	26.47	-18.69	-41.39
70	64.73	51.36	-13.37	-20.66	49.45	28.74	-20.71	-41.88
71	70.40	56.29	-14.11	-20.04	54.18	31.50	-22.68	-41.86
72	76.25	61.95	-14.30	-18.75	59.29	34.93	-24.36	-41.09
73	82.24	68.43	-13.81	-16.79	64.73	39.14	-25.59	-39.53
74	88.56	75.65	-12.91	-14.58	70.40	44.11	-26.29	-37.34
75	95.38	83.45	-11.93	-12.51	76.25	49.71	-26.54	-34.81
76	102.93	91.69	-11.24	-10.92	82.24	55.86	-26.38	-32.08
77	111.41	100.26	-11.15	-10.01	88.56	62.45	-26.11	-29.48
78	120.98	109.07	-11.91	- 9.84	95.38	69.49	-25.89	-27.14
79	131.55	118.37	-13.18	-10.02	102.93	77.16	-25.77	-25.04
80	142.97	128.49	-14.48	-10.13	111.41	85.79	-25.62	-23.00
81	155.16	139.72	-15.44	- 9.95	120.98	95.68	-25.30	-20.91
82	167.92	152.43	-15.49	- 9.22	131.55	107.12	-24.43	-18.57
83	181.19	166.74	-14.45	- 7.98	142.97	120.29	-22.68	-15.86
84	195.01	182.33	-12.68	- 6.50	155.16	134.95	-20.21	-13.03
85	209.48	198.84	-10.64	- 5.08	167.92	150.93	-16.99	-10.12
86	224.67	215.92	- 8.75	- 3.89	181.19	168.08	-13.11	- 7.24
87	240.67	233.42	- 7.25	- 3.01	195.01	186.32	- 8.69	- 4.46
88	257.73	251.25	- 6.48	- 2.51	209.48	205.63	- 3.85	- 1.84
89	276.20	269.48	- 6.72	- 2.43	224.67	226.12	1.45	0.65
90	296.58	288.30	- 8.28	- 2.79	240.67	247.98	7.31	3.04
91	319.50	308.07	-11.43	- 3.58	257.73	271.53	13.80	5.35
92	345.71	329.49	-16.22	- 4.69	276.20	297.45	21.25	7.69
93	376.09	353.74	-22.35	- 5.94	296.58	326.96	30.38	10.24
94	411.66	384.67	-26.99	- 6.56	319.50	363.10	43.60	13.65
95	456.61	428.95	-27.66	- 6.06	345.71	412.52	66.81	19.33
96	520.73	499.92	-20.81	- 4.00	376.09	488.46	112.37	29.88
97	634.95	624.26	-10.69	- 1.68	411.66	617.46	205.80	49.99
98	868.60	855.37	-13.23	- 1.52	456.61	852.61	396.00	86.73
99	1,000.00	1,000.00	0.00	0.00	520.73	1,000.00	479.27	92.04

A comparison of extended term periods derived from Tables KET and the 1958 CET Table is given in Exhibit 21.

### Monte Carlo Testing

In order to measure the adequacy of the loaded mortality rates to encompass smaller companies' experience, a random selection of about \$100 million of a mature company's ordinary insurance in force was made. Using Monte Carlo techniques, 100 years of claim experience were developed using the New Basic Tables mortality rates.

To minimize the effect of large policies in the exposure, results were obtained using a \$50,000 retention limit and a \$25,000 retention limit in addition to no retention limit. No account was taken of reinsurance costs when the retention was limited.

Generally, the use of either a \$50,000 or \$25,000 retention limit on both exposure and claims tended to reduce actual/expected results by amount toward a limiting value best represented by the actual/expected results by number of claims. (Results by number of claims may be viewed as the same as results by amount where the retention limit is \$1.) The exception to this rule was on female lives, where the use of a retention limit reduced the exposures relatively more than the "Monte Carlo Actual" claims, resulting in a higher actual/expected ratio with a retention limit than without.

### EXHIBIT 21

#### EXTENDED TERM INSURANCE PROVIDED BY TENTH YEAR MINIMUM CASH VALUES; 4 PERCENT INTEREST, CURTATE FUNCTIONS ORDINARY LIFE

ISSUE AGE	1958 CSO AND CET		TABLES K AND KET		INCREASE IN PERIOD OF EXTENDED TERM INSURANCE		PERCENTAGE INCREASE
	Years	Days	Years	Days	Years	Days	
Male							
5 .....	9	109	9	18	0	- 91	- 2.7
20 .....	16	333	16	353	0	20	0.3
35 .....	12	302	13	307	1	5	7.9
50 .....	7	32	8	52	1	20	14.9
65 .....	3	105	3	314	0	209	17.4
Female							
5 .....	7	304	7	120	0	- 184	- 6.4
20 .....	16	202	16	290	0	88	1.5
35 .....	14	8	14	316	0	308	6.0
50 .....	8	45	10	226	2	181	30.7
65 .....	3	313	5	243	1	295	46.9

The "Monte Carlo Actual" results were then compared with expected mortality using the loaded Tables K. This comparison demonstrated that Tables K adequately encompassed a smaller company's actual mortality experience if the company used a rational retention limit. This is best demonstrated by the fact that a company with more than \$100 million of insurance in force, using a \$25,000 retention limit, had "Monte Carlo Actual" results less than Table K results for 98 years out of 100 by number of claims and for 94 years out of 100 by amount of claims.

Based on the Monte Carlo results, the Committee concluded that it could recommend the Tables K as adequate tables from a solvency standpoint.

The testing is described in more detail in Exhibit 22.

EXHIBIT 22

MONTE CARLO SIMULATION

From Company A's regular ordinary in force, we randomly selected policies at then attained age to test. After appropriate adjustments for joint and family-type policies and riders, we obtained the following:

SEX	NUMBER OF LIVES	AMOUNT OF INSURANCE	EXPECTED (NEW BASIC TABLE)	
			Number of Claims	Amount of Claims
Male .....	7,447	\$ 79,213,842	39.77056	\$308,031
Female .....	4,902	28,485,471	11.08306	45,172
Total .....	12,349	\$107,699,313	50.85362	\$353,203

After 100 passes of the file against a random-number generator, the deaths were as follows:

SEX	NUMBER OF CLAIMS	AMOUNT OF CLAIMS	A/E (%)	
			Number	Amount
Male .....	4,089	\$32,542,817	102.8	105.6
Female .....	1,129	4,611,937	101.9	102.1
Total .....	5,218	\$37,154,754	102.6	105.2

With a \$50,000 retention limit, the results by amount were as follows:

Sex	Amount of Insurance	100-Year Expected Claims (New Basic Table)	Monte Carlo Actual	A/E (%)
Male .....	\$ 72,835,680	\$28,711,100	\$29,784,729	103.7
Female .....	27,356,771	4,253,800	4,386,937	103.1
Total .....	\$100,192,451	\$32,965,000	\$34,171,666	103.7

With a \$25,000 retention limit, the results by amount were the following:

Sex	Amount of Insurance	100-Year Expected Claims (New Basic Table)	Monte Carlo Actual	A/E (%)
Male .....	\$64,513,586	\$25,258,900	\$26,198,222	103.7
Female .....	25,917,205	3,989,600	4,092,813	102.6
Total .....	\$90,430,791	\$29,248,500	\$30,291,035	103.6

EXHIBIT 22—Continued

The distribution of the Monte Carlo results as a percentage of the expected on New Basic Table rates was as follows:

	BY NUMBER OF CLAIMS			BY AMOUNT OF CLAIMS \$50,000 RETENTION			\$25,000 RETE- TION
	Male	Female	Total	Male	Female	Total	Total
20-30%					3%		
30-40%		1%			3		
40-50%		0			6		
50-60%		2		3%	13	1%	2%
60-70%	1%	4		5	8	4	1
70-80%	4	6	4%	12	4	13	5
80-90%	13	19	11	12	13	13	19
90-100%	28	20	30	16	7	19	20
100-110%	22	16	22	11	14	11	19
110-120%	14	7	20	15	5	11	10
120-130%	14	13	11	10	2	15	14
130-140%	3	3	2	6	7	5	6
140-150%	1	7		5	3	5	2
150-160%		0		3	3	3	2
160-170%		2		2	5		
Over 170%					4		
Total over 100%	54	48	55	52	43	50	53

Using loaded mortality rates (Tables K (M) and K (F)), expected mortality with a \$50,000 retention was as follows:

SEX	EXPECTED		RATIO LOADED BASIC (%)	
	Number of Claims	Amount of Claims	By Number	By Amount
Male	50.45556	\$381,421	126.9	132.8
Female	15.99725	66,999	144.3	157.5
Total	66.45282	\$448,421	130.7	136.0

The distribution of the Monte Carlo results with a \$50,000 retention as a percentage of the expected on Table K loaded rates was as follows:

	BY NUMBER OF CLAIMS			BY AMOUNT OF CLAIMS		
	Male	Female	Total	Male	Female	Total
Number below expected	92%	91%	98%	88%	86%	89%
Number above expected	8	9	2	12	14	11

With a \$25,000 retention, the distribution of the Monte Carlo results as a percentage of expected on the Table K loaded rates was as follows:

	BY NUMBER OF CLAIMS			BY AMOUNT OF CLAIMS		
	Male	Female	Total	Male	Female	Total
Number below expected	92%	91%	98%	90%	88%	94%
Number above expected	8	9	2	10	12	6

Actual company experience would be different from the results produced by the Monte Carlo simulation for the following reasons:

1. The company would actually experience select mortality (the New Basic Table was used for expected claims).
2. Reserves released would ameliorate the results.
3. Each year of experience and individual policies within each year are assumed to be independent. In actual experience, this may not be the case.

The Committee would like to express appreciation to Mark D. J. Evans, Melvin J. Feinberg, Thomas R. Huber, Denis W. Loring, and Robert W. Vose for their contributions and assistance in preparing this report.

Respectfully submitted,

C. A. ORMSBY, *Chairman*

February 2, 1979

THE SPECIAL COMMITTEE TO RECOMMEND  
NEW MORTALITY TABLES  
FOR VALUATION

Joseph C. Sibigroth, *Vice-Chairman*

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## APPENDIX D

## MEMORANDUM TO THE MEMBERS OF THE SOCIETY OF ACTUARIES

*Re: Appendix to the Report by the Special Committee to Recommend New Mortality Tables for Valuation of Standard Individual Ordinary Life Insurance*

The Special Committee to Recommend New Mortality Tables for Valuation has been aware of growing deficiency reserve problems for certain plans of life insurance. Although these problems would be lessened through the adoption of Tables K as the minimum valuation standard for ordinary life insurance, in some cases they would not be completely alleviated.

In consultation with the NAIC (C4) Technical Subcommittee, the Special Committee has developed 10 year selection factors to be used in conjunction with Tables K as an alternative minimum standard for both valuation and deficiency reserves on a plan-by-plan basis.

The attached Appendix to the Report by the Special Committee describes the development of these factors.

It is felt that the Appendix to the Report should be made available to the members of the Society for their comments (as the Report was made available). The Committee will be pleased to receive written comments (to be sent to the Chairman at John Hancock, Post Office Box 111, Boston, MA 02117).

THE SPECIAL COMMITTEE TO RECOMMEND  
NEW MORTALITY TABLES  
for VALUATION

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December 1980

REPORT ON DEVELOPMENT OF SELECTION FACTORS TO BE APPLIED TO TABLES K AS AN ALTERNATIVE METHOD OF DETERMINING LIFE INSURANCE RESERVES AND DEFICIENCY RESERVE REQUIREMENTS

The proposed new valuation tables (Tables K) are aggregate mortality tables, excluding the first five policy years of experience (except for ages 0-4). The Committee feels that aggregate tables are the most suitable for life insurance reserves as discussed in the report recommending new valuation tables. However, it also recognizes that not reflecting the lower select mortality experience of the early policy years in determining deficiency reserves places an unwarranted strain on certain renewable term insurance plans which are priced on the basis of select mortality experience.

In order to relieve some of this strain on term insurance plans, the Committee has developed and is recommending that selection factors be approved for use with the Table K (M) and K (F) mortality rates in the first ten policy years as an alternative method of determining both life insurance reserves and deficiency reserve requirements. Companies would have the option, on a plan-by-plan basis, of valuing their life insurance reserves by either using Table K rates or applying the following recommended selection factors to the Table K rates. However, the basis chosen for a particular plan should be used to value both the basic life insurance reserves and deficiency reserves.

The Committee felt that it would be reasonably conservative to develop ten-year selection factors to be used with the K Tables. Although Tables K (M) and K (F) are based on the experience of policy years 6 and over, and the selection factors for policy years 6-10 affect the underlying experience of the table, this effect is relatively small as compared to the improvement in intercompany mortality experience since the 1970-75 period.

The recommended selection factors are listed in the attached Table A. Note that separate factors were developed for males and females to be applied to Tables K (M) and K (F), respectively, and that the factors only apply during the first ten policy years. (The factors were generally developed in quinquennial issue-age groups.)

In developing the factors, crude select mortality rates were first obtained from the 1970-75 intercompany medical mortality data. The amount of margins in Tables K (M) and K (F) were then added to these select mortality rates at central ages and the resulting loaded rates were divided by the appropriate Table K central age rates. The selection factors were modified to eliminate random fluctuations and then smoothed so as to produce select mortality rates that increased with age.

The Committee reviewed the possibility of separate factors within the range of male issue ages 20-39. However, ratios of select to ultimate mortality for medically examined business do not decrease with increasing issue age, in accord with the general pattern, when this age range is subdivided. This result is consistent with previously published basic tables. (Reference: *TSA, 1973 Reports*, p. 222; *TSA, 1962 Reports*, p. 58.)

For renewable term plans with provisions for reunderwriting the existing policy, it is recommended that the selection period begin anew and the appropriate selection factors be applied. These selection factors are for reserve requirements only, and were not developed to be used for any other purpose such as premium rates and dividend scales.

TABLE A

SELECTION FACTORS FOR ALTERNATE METHOD OF DETERMINING  
LIFE INSURANCE RESERVES AND DEFICIENCY RESERVE REQUIREMENTS

ISSUE AGES	POLICY YEAR									
	1	2	3	4	5	6	7	8	9	10
	Males									
Under 20 .....	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20-39 .....	75	80	85	90	90	95	95	95	95	95
40-44 .....	70	75	80	85	85	90	95	95	95	95
45-49 .....	65	70	75	80	80	85	90	90	90	90
50-54 .....	61	65	70	75	75	80	85	85	85	85
55-59 .....	56	60	65	70	70	75	80	80	80	80
60-64 .....	52	56	60	65	65	70	75	75	75	75
65 and over ...	48	52	55	60	60	65	70	70	70	70
	Females									
Under 20 .....	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
20-29 .....	96	96	96	100	100	100	100	100	100	100
30-34 .....	92	92	96	96	96	100	100	100	100	100
35-39 .....	88	88	92	96	96	96	96	100	100	100
40-44 .....	84	84	88	92	92	92	92	95	95	95
45-49 .....	80	80	84	88	88	88	88	90	90	90
50-54 .....	76	76	80	84	84	84	84	85	85	85
55-59 .....	72	72	76	80	80	80	80	80	80	80
60-64 .....	68	68	72	76	76	76	80	80	80	80
65-69 .....	64	64	68	72	72	72	75	75	80	80
70 and over ...	60	60	64	68	68	72	75	75	80	80

NOTE.—Selection factor equals 100 percent for policy years 11 and over.

