BOILER AND MACHINERY INSURANCE

BY

SEYMOUR E. SMITH

The boiler and machinery lines are two of the basic coverages comprising the casualty insurance field. While they do not produce a premium volume of such size as automobile liability and workmen's compensation, they are nevertheless of considerable importance, and have been given wide acceptance by the general public for many years. To date the proceedings of the Casualty Actuarial Society have not contained any papers or discussions relating to this type of insurance. The most probable reason for the neglect of these lines of insurance by this society is that boiler and machinery insurance have been considered by most people to be the exclusive domain of the engineer. While it is perfectly true that a competent engineering staff is essential to the successful underwriting and inspection of boiler and machinery objects, it will not be amiss for the actuary and statistician to become familiar with these fields of insurance, and to study the ratemaking and statistical procedures that are involved. It is the intent of this paper to outline very briefly the coverage and rating of boiler and machinery objects, to review the ratemaking method used in the recent manual revision, and to suggest a few points in the rating procedure which seem to offer possibilities for further investigation.

Coverage and Type of Object Insured

Modern commercial activity and industrial technique demand machines of constantly greater power, pressure and speed, with the corresponding increase in the potential destructive forces that are released when structural or mechanical failure occurs. This has created the demand for insurance coverage that will provide trained engineering inspection service that will keep accidents to a minimum, and that will indemnify the assured for his loss when an accident does occur.

As an indication of the wide field of coverage offered to the public, the following list enumerates a few of the different objects insured under boiler and machinery policies.

Fire Tube Boilers
Water Tube Boilers
Locomotive Boilers
Tanks
Digesters
Vulcanizers
Economizers
Refrigerating Systems
Fly-wheels
Gear Wheels
Steam Engines
Internal Combustion Engines
Compressors and Pumps
Fans and Blowers
Steam Turbines
Water Turbines
Electric Generators
Electric Motors
Rotary Converters
Transformers

The Conference Form Policy for Boiler or Machinery Insurance, which is used by almost all companies writing this kind of insurance, has five sections agreeing to pay to or on behalf of the assured for different types of direct loss. Three of these sections provide coverage on all policies, while the other two are optional and may be obtained by the assured upon the payment of additional premium. These five sections in the policy are as follows:

"Section I — To PAY the Assured for loss on the property of the Assured directly damaged by such accident (or, if the Company so elects, to repair or replace such damaged property), excluding (a) loss from fire (or from the use of water or other means to extinguish fire), (b) loss from an accident caused by fire, (c) loss from delay or interruption of business or manufacturing or process, (d) loss from lack of power, light, heat, steam or refrigeration, and (e) loss from any indirect result of an accident;

Section II (Optional) — To PAY the Assured, if loss under Section II is stated above as included but not otherwise, for the extra cost represented by items of expense for temporary repair or for expediting the repair of such damaged property of the Assured including overtime and the extra cost of express or other rapid means of transporting material, but if the Company's payment under Section I is $1,000 or less the Company's liability under Section II shall not exceed an amount equal to said payment under Section I, and if said payment under Section I exceeds $1,000, the Company's liability under Section II shall not exceed $1,000 plus 25% of the amount by which the Company's payment under Section I exceeds $1,000; and the Company's liability under Section II shall be a part of and not in addition to the Limit per Accident;

Section III — To PAY, to the extent of any indemnity remaining after payment of all loss as may be required under Sections I and II, such amounts as the Assured shall become obligated to pay by reason of the liability of the Assured for loss on the property of others directly damaged by such accident, including liability for loss of use of such damaged property of others; to DEFEND the Assured against any claim or suit alleging such damage unless or until the Company shall elect to effect settlement thereof;

Section IV (Optional) — To PAY, to the extent of any indemnity remaining after payment of all loss as may be required under Sections I, II and III, if loss under Section IV is stated above as included but not otherwise, such amounts as the Assured shall become obligated to pay by reason of the liability of the Assured, including liability for loss of services, on account of bodily injuries (including death at any time resulting therefrom)

sustained by any person and caused by such accident, except that the indemnity hereunder shall in no event apply to any liability or obligation under any workmen's compensation law; to PAY, if loss under Section IV is stated above as included but not otherwise, irrespective of the Limit per Accident, for such immediate surgical relief as shall be rendered at the time of the accident; to DEFEND the Assured, if loss under Section IV is stated above as included but not otherwise, against any claim or suit alleging such liability unless or until the Company shall elect to effect settlement thereof; and

Section V To PAY, irrespective of the Limit per Accident, all costs taxed against the Assured in any legal proceeding defended by the Company in accordance with Section III or IV, all interest accruing after entry of judgment rendered in connection therewith up to the date of payment by the Company of its share of such judgment, all premium charges on attachment or appeal bonds required in such legal proceedings, and all expenses incurred by the Company for such defense;

PROVIDED the accident happens while the object is in use, or connected ready for use, at the location specified for it in the Schedule."

It will be noted that the words "accident" and "object" as used in the above sections are not defined therein. This is because the definitions are necessarily varied for the individual kinds of objects. To each policy is attached one or more schedules, one for each type of object insured, and the individual schedule lists the object or objects insured, provides a definition of the object and of the word "accident" as applied to that particular type of object. For example, for steel boilers an accident is:

> "a sudden and accidental tearing asunder of the object or any part thereof caused by pressure of steam or water therein, or the sudden and accidental crushing inward of a cylindrical furnace or flue of the object so caused,"

while for steam turbine breakdown coverage an accident is:

> "a sudden and accidental breaking, deforming, burning out or rupturing of the object or any part thereof, which manifests itself at the time of its occurrence by immediately preventing continued operation or by immediately impairing the functions of the object and which necessitates repair or replacement before its operation can be resumed or its functions restored; and clause (a) of Section I is changed to read '(a) loss from fire outside the object (or from the use of water or other means to extinguish fire)'."

The policy coverage mentioned above provides so-called "direct-damage" coverage for the individual objects. In addition the assured may purchase several different forms of "indirect-damage" coverage. The most important of these additional coverages are:

(a) Use and Occupancy
(b) Consequential Damage
(c) Outage (coverage providing a specified indemnity for each hour during which the functions of an insured object are prevented by accident to the object)
(d) Power Interruption

Separate endorsements are provided for (a), (b) and (c) above; and a separate policy for (d).

The balance of the boiler and machinery policy contains the usual provisions for cancelation, subrogation, suits against the company and assured, changes etc., and there is only one section that is unusual compared to other casualty policies. Under the policy conditions, section 5 relates to the inspection of the insured objects and premises, and in addition permits any representative of the company to immediately suspend the insurance by written notice upon the discovery of a dangerous condition with respect to any object insured. The assured is allowed the pro-rata earned premium for the period of such suspension. It is clearly in the public interest that this provision be inserted, since it permits the insurer to stop immediately the operation of an object that is in dangerous condition and which might cause severe damage at any time. The main emphasis in boiler and machinery coverage is placed on inspection service and accident prevention. All insured objects are regularly inspected by trained engineers. An indication of the extent of this accident prevention service is given by the countrywide figures of stock companies entered in New York as reported in the Casualty Experience Exhibit, where the total amount expended for inspection service for boiler and machinery exceeds that expended for workmen's compensation inspection service, even though the boiler and machinery premium is less than 8% of that for compensation.

Rating Procedure

Boiler and machinery insurance does not provide for any experience, equity, retrospective or schedule rating, and all risks are rated in accordance with the manual rules. The manual rates contemplate coverage for three years, and policies written for a lesser period are charged short rates based on the three year premium. Policies may be written for four years by extension of the three year rate at slightly less than pro-rata.

Until the 1942 manual revision, boiler policy premiums were comprised of three parts; a basic charge, charged once for each policy, and similar to a policy fee except that it varied by policy limits; a location charge, charged for each location under the policy and varying by territory and policy limits; and an object charge for each individual object. The manual contains a printed object charge rate for every kind, size and type of insurable object.

The basic and location charges were quite formidable, amounting over all to slightly more than one-third of the total boiler earned premium. These charges performed the three-fold function of expense constants, increased limits factors and territorial differentials in a rather unsatisfactory manner and were subject to severe criticism from the New York Insurance Department.

The recent manual revision has placed the rating of boiler risks on the same basis as machinery risks have been written in the past, with an insurance charge, varying by policy limits, collected for each location under the policy, and an object charge for each individual object. The basic charge and territorial differentials have been eliminated. Graded company expenses and commissions have also been introduced. Separately for boiler and machinery insurance, each policy is subject to a 10% reduction on all manual premium in excess of $500 up to $3,000, and a 30% reduction on all manual premium in excess of $3,000. The full commission rate is payable on the first $2,750 of net collectible premium, and 60% of the normal commission rate on all net collectible premium in excess of $2,750 per policy.

The rating procedure used in the past, although out of line for certain classifications, has produced over all rate-level results that have been reasonably satisfactory. The boiler rate-level has been a little low, but the machinery experience has produced underwriting results more favorable than the expected. The following exhibit (Exhibit A) shows for each line for the five latest available calendar years, the countrywide earned premiums and underwriting results for all stock carriers entered in New York as reported in the Casualty Experience Exhibit. The loss and expense items provided for in the manual rates have been shown so that a comparison of actual and expected results may be made. The experience of stock companies only was used since some mutual companies charge higher policy rates than stock companies for boiler and machinery coverage to assure high dividends, and the inclusion of this experience would tend to distort the underwriting results.

Rate Making Procedure

Since the results of any rate-making procedure are strongly determined by the form of the underlying statistical data, it is not inappropriate to outline briefly the form of the experience data before going to the rate-making procedure used in the latest manual revision.

Boiler and machinery experience is maintained on a calendar year basis. Each company reports its writings on the basis of object months exposure for each of the various types of objects and kinds of coverage. Basic and location charge months exposure for boiler and insurance charge months exposure for machinery are reported in total. Written premiums for the

Exhibit A

BOILER AND MACHINERY EXPERIENCE
Countrywide Results of All Stock Carriers Entered in New York
Calendar Years 1937-1941

Calendar Year	Earned Premium	Incurred Loss Ratio	Incurred Inspection Ratio	Losses and Inspection	Acquisition*	Claim	Administration	Taxes	Profit & Contingency
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
BOILER INSURANCE									
1937	7,239,974	.112	.424	.536	.303	.015	.105	.049	—.008
1938	7,543,695	.111	.441	.552	.314	.014	.101	.055	—.036
1939	7,662,792	.112	.431	.543	.317	.017	.099	.051	—.027
1940	7,735,240	.122	.391	.513	.296	.015	.120	.048	.008
1941	8,008,310	.155	.383	.538	.289	.017	.113	.045	—.002
Total	38,190,011	.123	.413	.536	.303	.016	.108	.050	—.013
Provision in Manual Rates				.490	.300	.020	.090	.050	.050
MACHINERY INSURANCE									
1937	3,466,013	.258	.194	.452	.276	.035	.092	.051	.094
1938	3,656,527	.239	.190	.429	.318	.032	.092	.057	.072
1939	3,710,951	.216	.179	.395	.318	.031	.091	.064	.101
1940	3,915,487	.269	.179	.448	.281	.030	.118	.054	.069
1941	4,452,356	.360	.166	.526	.267	.036	.118	.050	.003
Total	19,201,334	.272	.181	.453	.286	.033	.103	.055	.070
Provision in Manual Rates				.490	.300	.020	.090	.050	.050

* Related to Written Premium.

calendar year are also reported. Object charges written are reported by type of object, indirect damage premiums by kind of coverage, and basic and location charges for boiler, and insurance charges for machinery, are reported in total. From this information calendar year earned premiums and earned object years are calculated by the National Bureau. As an example of the method used consider a steel boiler written for three years on July 1, 1941 with an object charge of $90. The carrier would report its calendar year writings as follows:

	Exposure — Number of Object Months				Object Premiums Written
	1941	1942	1943	1944	
Steel Boilers	6	12	12	6	$90

From this form it is readily seen that the calendar year 1941 exposure is ½ an earned object year with an earned premium of $15. To this are added the earned object years and earned premiums for 1941 on boilers written in previous calendar years, but with exposure carrying over into 1941. In this manner the complete earned object years and earned object charge premiums are determined for the calendar year. Outstanding losses at the beginning and end of the calendar year and losses paid during the year are reported for each of the exposure groups, so that calendar year incurred losses are readily available. The earned premiums for basic and location charges for boiler (these will be eventually replaced by the new insurance charges in future reportings) and insurance charges for machinery are determined in total by the same method of calculation as the object charges. These total basic and location and insurance charges, separately for boiler and machinery, are averaged over all of the direct damage earned premiums, on the assumption that on the average each classification will incur from these charges the same percentage of its total earned premium. In calendar year 1940 the ratio of basic and location charges to object charges for boiler insurance was .5021, and the ratio of insurance charges to object charges for machinery insurance was .1202. The 1940 final statistical data for each classification showed earned premiums which consisted of the actual earned object charges multiplied by 1.5021 for boiler and 1.1202 for machinery.

Since inspection expense is such a large portion of the boiler and machinery pure premium, the correct statistical reporting of inspection costs is of major importance. The procedure used to determine inspection cost by type of object probably varies in small degree between companies, but the method used by one multiple line carrier with an appreciable volume of business will serve as an illustration. It is safe to assume that other methods will not show any major differences. The total company inspection cost is allocated to line of insurance on the basis of inspectors' time sheets for the field and

time estimates and analyses of duties for the home office. The field inspectors' time sheets show the number of hours (including travel time) spent on each particular type of object, and the time spent on inspections for rate surveys, special mechanical services, accident investigation and indirect damage coverage. In the report to the National Bureau, the total inspection expense for boiler and machinery insurance is shown, and this is distributed to type of object on the basis of the time distribution shown in the field inspectors' reports. The effect of this method is to assume that the cost per hour of inspection is the same for each type of object, and to allocate the home office expense as an item of general overhead. The report to the National Bureau also shows the total number for each of the foregoing types of inspections.

From the above statistical information, a compilation of boiler and machinery insurance is able to show the following information for each calendar year:

1. Type of Object
2. Number of earned object years
3. Earned Premium (including loading for basic and location or insurance charges)
4. No. of losses incurred
5. Amount of losses incurred
6. Loss Frequency
7. Loss Ratio
8. Inspection Expense
9. Inspection Expense Ratio
10. Number of Inspections per object year
11. Inspection Cost per object
12. Cost per inspection

The boiler and machinery lines are less affected by many economic changes than the other casualty lines, being influenced to a much smaller degree by wage levels, unemployment, or general prosperity. For this reason the indicated rate level does not usually show the yearly fluctuations that are apt to accur in other lines of casualty insurance, and so rate changes are not a periodic procedure. The last complete revision of the manual was made in 1930, although some individual changes have taken place since that time. However, by the spring of 1941 it was realized that business and economic changes were taking place that might have a seriously adverse effect on the experience. Industrial plants were operating at a greatly increased tempo, many on a 24 hour a day basis, with a greatly increased strain on their power plants. Priorities were being introduced which threatened long delays and greatly increased material and labor costs for replacements and repairs

in the event of accidents. The threat of unavoidable delays in affecting repairs made Use and Occupancy rates seem most in need of review in the light of future possibilities. The experience under Use and Occupancy in the past had been favorable, but it was decided for the purpose of review to increase the indicated losses by 50% and the estimated inspection cost of 5% by 15%. The selected rate increases of 3.2% for Boiler, 32.4% for Fly-wheel, Engine and Turbine and 17.1% for Electrical Machinery were approved by the New York Insurance Department and adopted immediately.

The degree to which boiler and machinery rates should be adjusted over all to compensate for the expected adverse trend in experience was a difficult question that had to be settled purely on the basis of underwriting judgment, since if the carriers waited for the experience to develop the emergency situation calling for higher rates might have passed before these increased rates could become effective, and higher rates would be very difficult to justify after the need for them had passed. It was finally decided that the boiler and machinery experience should be reviewed by classification, and that the indicated premium adjustment should be based on a 50% increase in the experienced losses and a 15% increase in the inspection costs. It was felt that these loadings would serve as proper indications of increased hazard and cost. (Note the sharp rise in the calendar year 1941 loss ratio for both boiler and machinery, as shown in Exhibit A.) The expense loading was left at 51% of the final rate. The experience used was the five latest available calendar years for exposure and losses, and the two latest available calendar years for inspection expense ratios. The following exhibits show the development of the indicated premium and object charge adjustments by class groups on the above basis, the selected object charge adjustments and the effect on the premium at the then effective rates. Since the proposed rate adjustments were to be made only on the object charges, the indicated object charge adjustment shown in column (7) is (for those classifications whose earned premiums were loaded flat for basic and location or insurance charges) equal to the indicated premium adjustment increased by 50.34% for boiler and 12.75% for machinery. These percentages represent the five year average ratio to object charges of basic and location charges and insurance charges respectively.

ANALYSIS OF BOILER EXPERIENCE—ALL COMPANIES—U. S. A.

Exhibit B

EXPERIENCE OF CALENDAR YEARS 1936–1940

Classification Group	Earned Object Years	Earned Premiums at Current Rates	Loss Frequency*	Loss Ratio at Current Rates	1939-40 Average Inspection Ratio	Indicated Premium Adjustment**	Indicated Object Charge Adjustment	Selected Object Charge Adjustment	Effect on Premium at Current Rates	
									Amount	Percent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Steel Boilers—(15 lbs. or less)	347,444	$3,877,239	1.3	2.2%	60.4%	+ 48.6%	+ 73.1%	+ 25.0%†	+ 644,745	+ 16.6%
2. Fire Tube Boilers—(over 15 lbs.)										
(a) All Other than (b) and (c)	437,454	7,603,670	2.9	6.1	53.4	+ 44.1	+ 66.3	+ 40.0	+ 2,023,060	+ 26.6
(b) Oil or Gas Drilling	6,459	238,785	3.6	17.5	53.4	+ 79.0	+ 118.8	+ 40.0	+ 63,532	+ 26.6
(c) Track Locomotives	23,816	457,530	1.1	15.2	53.4	+ 71.8	+ 107.9	+ 40.0	+ 121,732	+ 26.6
Total	467,729	8,299,985	2.8	7.0	53.4	+ 46.7	+ 70.2	+ 40.0	+ 2,208,324	+ 26.6
3. Water Tube Boilers—(Over 15 lbs.)										
(a) 3,750 Sq. Ft. or less	98,949	2,442,313	8.1	11.5	47.2	+ 46.1	+ 69.3	+ 35.0	+ 568,584	+ 23.3
(b) 3,750–10,000 Sq. Ft.	55,417	2,066,772	11.4	12.1	36.9	+ 23.7	+ 35.6	+ 25.0	+ 343,683	+ 16.6
(c) Over 10,000 Sq. Ft.	10,195	1,031,432	29.6	13.7	19.9	− 11.2	− 16.8	—	—	—
Total	164,561	5,540,517	10.5	12.2	37.8	+ 26.1	+ 39.2	+ 24.8	+ 912,267	+ 16.5
4. Cast Iron Boilers—Explosion	410,223	4,052,897	0.9	1.9	47.4	+ 17.1	+ 25.7	+ 20.0†	+ 539,164	+ 13.3
Cast Iron Boilers—Cracking	167,008	4,941,834	40.1	31.1	0.0	− 4.7	− 4.7	− 8.7	− 429,940	− 8.7
Total	410,223	8,994,731	17.2	18.0	22.6	+ 8.2	+ 9.7	+ 1.4	+ 109,224	+ 1.2
5. Unfired Vessels										
(a) Class 1—Excluding Digesters	795,555	4,421,472	0.8	8.8	49.0	+ 42.0	+ 63.1	+ 40.0	+ 1,176,393	+ 26.6
(b) Digesters—Class 1	4,147	287,494	5.1	6.3	11.1	− 54.5	− 81.9	—	—	—
(c) Class 2 and Miscellaneous	103,076	895,744	1.9	8.8	23.4	− 18.2	− 27.4	—	—	—
Total	902,778	5,604,710	0.9	8.6	43.3	+ 28.0	+ 42.1	+ 31.6	+ 1,176,393	+ 21.0
6. Economizers	3,523	65,010	13.9	19.0	29.7	+ 28.0	+ 42.1	—	—	—
7. Refrigerating Systems	23,685	759,336	13.0	19.9	22.6	+ 14.1	+ 21.2	—	—	—
8. Piping	418,723	1,434,546	1.3	8.5	20.8	− 25.1	− 37.7	− 23.1	− 220,420	− 15.4
Total Above (Items 1 through 8)	2,738,666	34,576,074	4.5	10.8	39.6	+ 25.9	+ 36.3	+ 19.6	+ 4,830,533	+ 14.0

(Continued)

*Per 1,000 Object Years.
**Including Loadings of 50% on Losses and 15% on Inspection Cost. Expense Loading = 51%.
†Rates actually increased 17.0%—exclusion of part time operation estimated to bring net increase up to selected.

ANALYSIS OF BOILER EXPERIENCE—ALL COMPANIES—U. S. A. Exhibit B (Continued)

EXPERIENCE OF CALENDAR YEARS 1936–1940

Classification Group	Earned Object Years	Earned Premiums at Current Rates	Loss Frequency*	Loss Ratio at Current Rates	1939-40 Average Inspection Ratio	Indicated Premium Adjustment**	Indicated Object Charge Adjustment	Selected Object Charge Adjustment	Effect on Premium at Current Rates	
									Amount	Percent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
9. Furnace Explosion	218,385	$1,129,016	4.9	24.6%	5.0(Est.)%	− 12.9%	− 12.9%	− 11.4%	− 128,708	− 11.4%
10. Residence Boilers	45,912	620,757	18.7	18.2	28.5	+ 22.7	+ 22.7	—	—	—
11. Personal Injury	1,684,339	961,809	—	3.5	—	− 89.2	− 89.2	− 50.0	− 480,905	− 50.0
12. Miscellaneous Direct Damage	27,317	105,831	0.3	7.8	5.0(Est.)	− 64.3	− 64.3	—	—	—
(A) Total Direct Damage		37,393,487		11.1	37.3	+ 21.6	+ 29.4	+ 15.4	+ 4,220,920	+ 11.3
13. Boiler Use and Occupancy	37,162	2,180,512	19.0	29.8	5.0(Est.)	+ 3.1	+ 3.1	+ 3.2	+ 69,776	+ 3.2
14. Consequential Damage	3,392	143,942	13.9	13.2	5.0(Est.)	− 47.8	− 47.8	—	—	—
15. Expediting Charges	51,052	163,883	0.9	6.3	5.0(Est.)	− 68.8	− 68.8	− 50.0	− 81,942	− 50.0
16. Outage	537	12,133	29.8	109.5	5.0(Est.)	+ 247.1	+ 247.1	+ 78.0	+ 9,464	+ 78.0
17. Loss of Use—Power Interruption	37	7,821	27.0	0.7	5.0(Est.)	− 85.9	− 85.9	—	—	—
18. Miscellaneous Indirect Damage	884	3,228	24.9	113.1	5.0(Est.)	+ 258.2	+ 258.2	—	—	—
(B) Total Indirect Damage		2,511,519		27.7	5.0(Est.)	− 3.3	− 3.3	− 0.1	− 2,702	− 0.1
Total—All Boiler (A) + (B)		39,905,006		12.2	35.3	+ 20.2	+ 26.9	+ 14.1	+ 4,218,218	+ 10.6

*Per 1,000 Object Years.
**Including Loadings of 50% on Losses and 15% on Inspection Cost. Expense Loading = 51%.

ANALYSIS OF MACHINERY EXPERIENCE—ALL COMPANIES—U. S. A.

Exhibit C

EXPERIENCE OF CALENDAR YEARS 1936–1940

Classification Group	Earned Object Years	Earned Premiums at Current Rates	Loss Frequency*	Loss Ratio at Current Rates	1939-40 Average Inspection Ratio	Indicated Premium Adjustment**	Indicated Object Charge Adjustment	Selected Object Charge Adjustment	Effect on Premium at Current Rates	
									Amount	Percent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. Fly-wheels	75,398	$599,123	3.3	19.3%	35.5%	+ 42.4%	+ 47.8%	+ 32.2%	+ $171,079	+ 28.6%
2. Steam Engines	21,528	1,484,138	83.7	46.9	21.8	+ 94.9	+ 107.0	+ 57.0	+ 570,296	+ 50.6
3. Internal Combustion Machines	3,335	741,602	312.4	35.6	16.8	+ 48.4	+ 54.6	—	—	—
4. Compressors and Pumps										
(a) Steam Type	7,537	652,933	50.9	24.9	9.4	− 1.6	− 1.8	—	—	—
(b) Separately Driven Type	28,635	1,021,080	26.3	15.4	18.9	− 8.6	− 9.7	—	—	—
Total	36,172	1,674,013	31.5	19.1	15.4	− 5.3	− 6.0	—	—	—
5. Miscellaneous Machines	18,661	291,194	20.6	40.1	22.3	+ 75.1	+ 84.7	+ 28.0	+ 72,231	+ 24.8
Total Engines (Items 2, 3, 4 and 5)	79,696	4,190,947	54.8	33.3	18.3	+ 44.9	+ 50.6	+ 22.1	+ 822,527	+ 19.6
6. Turbines										
(a) Steam Turbines—All Coverages										
1. 100 Kilowatts or less	9,665	137,239	11.1	18.4	55.4	+ 86.3	+ 97.3	+ 39.3	+ 47,875	+ 34.9
2. 101 to 1,000 Kilowatts	10,859	1,286,294	35.5	19.2	17.6	—	—	+ 7.0	+ 79,423	+ 6.2
3. 1,001 to 9,000 Kilowatts	6,196	2,541,700	52.6	22.0	8.9	− 11.8	− 13.3	− 8.3	− 187,066	− 7.4
4. Over 9,000 Kilowatts (Incl. Mercury Boilers)	1,559	1,896,719	38.5	20.2	4.5	− 27.6	− 31.1	− 15.0	− 252,058	− 13.3
Total Steam Turbines	28,279	5,861,952	31.1	20.7	10.4	− 12.0	− 13.5	− 6.0	− 311,826	− 5.3
(b) Water Turbines	1,885	182,486	96.6	46.5	12.1	+ 70.8	+ 79.8	+ 30.2	+ 48,909	+ 26.8

(Continued)

*Per 1,000 Object Years.
**Including Loadings of 50% on Losses and 15% on Inspection Cost. Expense Loading = 51%.

ANALYSIS OF MACHINERY EXPERIENCE—ALL COMPANIES—U. S. A. Exhibit C (Continued)

EXPERIENCE OF CALENDAR YEARS 1936–1940

Classification Group	Earned Object Years	Earned Premiums at Current Rates	Loss Frequency*	Loss Ratio at Current Rates	1939-40 Average Inspection Ratio	Indicated Premium Adjustment**	Indicated Object Charge Adjustment	Selected Object Charge Adjustment	Effect on Premium at Current Rates	
									Amount	Percent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
7. Electric Generators										
(a) 100 Kilowatts or less	16,456	$322,030	25.3	12.7%	36.0%	+ 23.5%	+ 26.5%	—	—	—
(b) 101 to 1,000 Kilowatts	9,199	636,901	32.7	18.2	15.8	− 7.1	− 8.0	—	—	—
(c) 1,001 to 9,000 Kilowatts	498	80,952	60.2	42.6	12.4(Est.)	+ 59.6	+ 67.2	—	—	—
(d) Over 9,000 Kilowatts	31	6,351	64.5	13.6	6.0(Est.)	− 44.3	− 49.9	—	—	—
Total	26,184	1,046,234	28.6	18.4	21.6	+ 6.9	+ 7.8	—	—	—
8. Electric Motors										
(a) 5 H.P. or less	41,054	266,541	32.2	15.1	71.2	+ 113.5	+ 128.0	+ 50.0	+ 118,200	+ 44.3
(b) 6 to 25 H.P.	29,286	521,268	32.0	12.3	28.9	+ 5.5	+ 6.2	+ 10.0	+ 46,232	+ 8.9
(c) 26 to 100 H.P.	26,228	944,792	52.3	19.5	17.9	+ 1.8	+ 2.0	+ 2.0	+ 16,759	+ 1.8
(d) 101 to 1,000 H.P.	12,148	882,038	58.6	21.5	11.6	− 6.9	− 7.8	—	—	—
(e) Over 1,000 H.P.	1,020	195,220	61.8	27.1	5.7	− 3.5	− 3.9	—	—	—
Total	109,736	2,809,859	40.1	18.9	21.7	+ 9.0	+ 10.1	+ 7.3	+ 181,191	+ 6.4
9. Rotary Converters	550	99,616	158.2	35.6	11.1	+ 35.1	+ 39.6	+ 32.8	+ 28,956	+ 29.1
10. Transformers and Induction Feed Regulators										
(a) 25 Kilowatts or less	7,462	60,881	10.2	11.5	37.3	+ 22.9	+ 25.8	+ 25.0	+ 13,499	+ 22.2
(b) 26 to 200 Kilowatts	12,149	227,526	10.5	13.4	20.5	− 10.8	− 12.2	+ 10.0	+ 20,180	+ 8.9
(c) 201 to 1,000 Kilowatts	4,424	268,137	15.8	23.1	11.0	− 3.3	− 3.7	− 10.0	− 23,782	− 8.9
(d) Over 1,000 Kilowatts	1,339	163,678	21.7	15.8	8.5	− 31.6	− 35.6	− 25.0	− 36,292	− 22.2
Total	25,374	720,222	11.9	17.4	15.7	− 9.8	− 11.0	− 4.1	− 26,395	− 3.7

(Continued)

*Per 1,000 Object Years.
**Including Loadings of 50% on Losses and 15% on Inspection Cost. Expense Loading = 51%.

ANALYSIS OF MACHINERY EXPERIENCE—ALL COMPANIES—U. S. A. Exhibit C (Continued)

EXPERIENCE OF CALENDAR YEARS 1936–1940

Classification Group	Earned Object Years	Earned Premiums at Current Rates	Loss Frequency*	Loss Ratio at Current Rates	1939-40 Average Inspection Ratio	Indicated Premium Adjustment**	Indicated Object Charge Adjustment	Selected Object Charge Adjustment	Effect on Premium at Current Rates	
									Amount	Percent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
11. Other Electrical Machinery	59,123	$1,105,966	36.2	18.5%	11.8%	− 15.5%	− 17.5%	—	—	—
Total Electrical Machinery (Items 7-11)	220,967	5,781,897	34.8	18.8	18.8	+ 1.6	+ 1.8	+ 3.6	+ 183,752	+ 3.2
12. Personal Injury	106,381	132,119	—	—	—	− 100.0	− 100.0	− 50.0	− 66,060	− 50.0
13. Miscellaneous Direct Damage	6,794	17,811	0.3	0.2	5.0(Est.)	− 87.6	− 87.6	—	—	—
Total Machinery Direct Damage (A)		16,766,335		23.3	16.1	+ 9.2	+ 10.4	+ 5.7	+ 848,381	+ 5.1
14. Use and Occupancy										
(a) Fly-wheel, Engine & Turbine	8,155	2,174,287	120.3	36.4	5.0(Est.)	+ 23.3	+ 23.3	+ 32.4	+ 704,469	+ 32.4
(b) Electrical Machinery	9,551	1,757,491	100.9	37.8	5.0(Est.)	+ 27.6	+ 27.6	+ 17.1	+ 300,531	+ 17.1
Total	17,706	3,931,778	109.8	37.1	5.0(Est.)	+ 25.5	+ 25.5	+ 25.6	+ 1,005,000	+ 25.6
15. Consequential Damage	1,860	126,800	91.4	42.5	5.0(Est.)	+ 42.0	+ 42.0	+ 25.0	+ 31,700	+ 25.0
16. Expediting Charges	4,515	76,452	2.7	6.8	5.0(Est.)	− 67.3	− 67.3	− 33.3	− 25,459	− 33.3
17. Outage	1,549	108,751	106.5	69.9	5.0(Est.)	+ 125.9	+ 125.9	+ 78.0	+ 84,826	+ 78.0
18. Loss of Use—Power Interruption	427	59,161	796.3	74.5	5.0(Est.)	+ 140.0	+ 140.0	+ 100.0	+ 59,161	+ 100.0
19. Miscellaneous Indirect Damage	45	5,145	177.8	53.9	5.0(Est.)	+ 76.9	+ 76.9	+ 42.0	+ 2,161	+ 42.0
Total Machinery Indirect Damage (B)		4,308,087		38.0	5.0(Est.)	+ 28.2	+ 28.2	+ 26.9	+ 1,157,389	+ 26.9
Total—All Machinery (A)+(B)		21,074,422		26.3	13.8	+ 13.1	+ 14.4	+ 10.4	+ 2,005,770	+ 9.5

*Per 1,000 Object Years.
**Including Loadings of 50% on Losses and 15% on Inspection Cost. Expense Loading=51%.

The foregoing exhibits show that the rates for many classification groups were seriously out of line with the experience indications. However, the relatively small exposure and low accident frequency rate for many groups mean that for these groups very little credence may be given to the loss experience, and the underlying expected losses must be considered as well as the actual losses in determining premium adjustments. This does not hold for inspection expense, however, which should receive full credibility except for those few classes with such small exposure that the fortuitous occurrence or omission of a few inspections during the calendar period would have a measurable effect.

In selecting the actual object charge adjustments to be made, consideration was given to these points, although no formula was employed. This underwriting judgment was influenced to some degree by the desire to avoid disturbing the business. It had been so long since the rates had been changed for many classifications, that most underwriters felt that large indicated increases or decreases should not be effected in one adjustment, but should be spread over several years. The net over all result of the selected rate changes was to produce for boiler insurance 52.5% and for machinery insurance 72.5% of the net increase indicated by the experience with the losses increased 50% and the inspection cost 15%. The boiler rates were increased by 10.6% over all compared with an indicated increase of 20.2%, and the machinery rates were increased 9.5% compared to the indicated of 13.1%.

After the rate level adjustments by classification group had been determined a set of insurance charges was selected to replace the object and location charges for boiler risks. Although an all-company distribution of basic and location charges by accident limits and a policy count were not available, the best judgment of the underwriters, based in part upon an earlier test of these insurance charges, was that the new insurance charges would produce 30% less premium than the basic and location charges. Since these basic and location charges had comprised 33.5% of the total premium for objects with direct damage coverage $\left(1.000 - \frac{1.0000}{1.5034} = .335\right)$, it was necessary to increase the object charges on these classes by 15% to obtain the same amount of premium, as shown in the following calculation:

$$.665X + (.335 \times .70) = 1.00$$
$$X = 1.15$$

The next step was the introduction of graded company expense and acquisition. The statistical plan did not provide a distribution of premium by size of risk, but in May of 1940 five companies had made a study of their risks by premium size covering several years, and then combined their results, so that there was available a boiler and machinery size of risk distri-

bution based upon more than $25,000,000 of premium. The experience for the boiler and machinery lines was combined to produce a uniform basis of expense and acquisition graduation, and the following adjusted distribution was obtained:

First	$ 500	Manual	Premium	48.8%
Next	2,500	"	"	25.7
Over	3,000	"	"	25.5
				100.0

The adjustment made was to offset the increase in the average risk premium produced by the new rates and to allow for the expected size of risk increase due to increased industrial activity. In the actual distribution, 10% of the premium under $500 per risk was transferred on a judgment basis to the higher premium groups and distributed proportionately over these two size groups to produce the final adjusted distribution.

With the premium distribution by size of risk determined, consideration was then given to the degree to which company administration and other production expense should be graded. Although accurate cost records by size of risk are not available and would be extremely difficult to maintain, it is known that there is an appreciable percentage differential in the administration cost between large and small boiler and machinery risks. With the lack of exact information, recourse to judgment was necessary. Experienced opinion was that a 30% increase in the administration and other production provision on the small risks would closely reflect actual costs, and that for the very large risks the provision could be reduced by 50% or slightly more. Commission was to be payable at the regular rate on the net premium determined from the first $3,000 of full manual premium, and at 60% of the regular rate on all net premium over this amount. Based upon the above, and with the provision that the graduation overall should have no effect in the total amount available for administration and other production, losses and inspection and claim, it was calculated that an increase in manual premium level of 8.5%, with a 10% reduction in all manual premium over $500 up to $3,000 and a 31% reduction in all manual premium over $3,000 per risk would produce the desired result. The tax, profit and contingency items were left at 10% of the final premium. The following exhibit (Exhibit D) shows the distribution of the various items in the three premium groups, as well as the net over all effect. It will be noted that the manual premium distribution differs from that shown in Exhibit A, in that acquisition is shown at 25% instead of 30%, while the administration item of 9% in Exhibit A has been changed to administration and other production at 14%. The reason for this is that 5 points out of the 30 available for acquisition are not for commissions, but are for the expense of salaried company boiler and machinery rating experts who assist in the

solicitation and rating of risks. The top boiler and machinery commission paid is 25%, except in a very few instances where a registered producer has his own salaried expert.

Exhibit D

BOILER AND MACHINERY INSURANCE
Distribution of Expense Items — Graded Expenses*

Item	Former Manual Provision	New Manual Provision	Manual Prem. $500-$3,000 per Risk		Manual Prem. Over $3,000 per Risk		Net Overall Result
			Amount	Per cent	Amount	Per cent	
Acquisition	.250	.271	.244	25.0%	.112	15.0%	.224
Admin. & Other Prod.	.140	.182	.137	14.0	.063	8.4	.140
Claim	.020	.020	.020	2.0	.020	2.7	.020
Loss & Inspection...	.490	.503	.478	49.0	.479	63.9	.491
Tax, Profit & Contingency	.100	.109	.098	10.0	.075	10.0	.097
TOTAL.....	1.000	1,085	.977	100.0	.749	100.0	.972

* Ratios shown are in terms of former manual provision.

The slight variation by size of risk in the provision for losses and inspection was necessary to balance out the various expense items with the total premium for each size group, and still maintain the same net overall amount available for administration and other production, losses and inspection, and claim. In the actual application of the plan, the 31% discount on all manual premium over $3,000 has been rounded to 30%.

Since the manual premium level had to be increased by 8.5%, adjustment was made in all manual rates except the boiler and machinery insurance charges. As a result the manual rates for objects with direct damage coverage were increased by 8.5% times 1.5034 for boiler and 1.1275 for machinery. Factors used were rounded to two decimal places and were 1.13 for boiler and 1.10 for machinery direct damage objects and 1.09 for all other manual rates. In the actual determination of manual rates, a single factor for each type of object was used to apply to the old manual rates. This factor was obtained by adding the increase factors for the change in the basic and location charge and the increase factor for the premium graduation to unity and multiplying by the experience adjustment factor. The following example shows the calculation of the multiplier to be applied to the old manual rate for fire tube boilers over 15 lbs. pressure:

Increase factor for change in basic & location charges	.15
Increase factor for premium graduation	.13
Total plus one	1.28
Experience Adjustment Factor ×	1.40
Final factor	1.79

The following exhibit (Exhibit E) shows the various factors making up the final multipliers used in the manual revision by classification for boiler and machinery.

Exhibit E

Boiler and Machinery Rates

Summary showing effect of various rate adjustments

Manual Page No.	Classifications	Experience Adjustment Factor	Manual Rate Multipliers			
			Insurance Charge Factor*	Premium Graduation Factor	Colums (4) + (5)	Total (3) × (6)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	I. Boiler					
B210	Insurance Charges*.....	New Table	..	..	..	..
B211	Fire Tube Boilers					
	Low Pressure	1.17	1.15	1.13	1.28	1.50
	High Pressure	1.40	1.15	1.13	1.28	1.79
B212	Water Tube Boilers					
	Low Pressure	1.17	1.15	1.13	1.28	1.50
	High Pressure	1.25	1.15	1.13	1.28	1.60
	(Mostly on sizes below 10,000 sq. ft.)					
B213	Cast Iron Boilers					
	Explosion Only	1.17	1.15	1.13	1.28	1.50
	Cracking					
	Horiz. Group 1.....	0.90	..	1.09	1.09	0.98
	Horiz. Group 2.....	0.90	..	1.09	1.09	0.98
	Horiz. Group 3.....	1.20	..	1.09	1.09	1.31
	Horiz. Group 4.....	1.30	..	1.09	1.09	1.42
	Total Cracking	0.91	..	1.09	1.09	0.99
B214	Miscell. Fired Vessels					
	Track Locomotives	1.40	1.15	1.13	1.28	1.79
	All Others	..	1.15	1.13	1.28	1.28
	(Some minor revisions for consistency)					
B215	Economizers	..	1.15	1.13	1.28	1.28
B216	Unfired Vessels — Cl. 1					
	Except Digesters	1.40	1.15	1.13	1.28	1.79
	Digesters	..	1.15	1.13	1.28	1.28
B217	Unfired Vessels — Cl. 2...	..	1.15	1.13	1.28	1.28
B218	Unfired Vessels — Cl. 3...	..	1.15	1.13	1.28	1.28
B219	Refrig. Systems — Comp. .	..	1.15	1.13	1.28	1.28
B219b	Refrig. Systems — Abs....	..	1.15	1.13	1.28	1.28
B220	Auxiliary Piping	..	1.15	1.13	1.28	1.28
B230	Residence Boilers & Vessels					
	Direct Damage	..	..	..	..	..
	Furnace Explosion	0.80	..	..	..	0.80
B240	Furnace Explosion					
	Solid Fuel	0.70	..	1.09	1.09	0.76
	Liquid Fuel	0.90	..	1.09	1.09	0.98
	Gas Fuel	..	..	1.09	1.09	1.09
	Pulverized Fuel	..	..	1.09	1.09	1.09
	Total Furnace Explosion	0.89	..	1.09	1.09	0.97
B250	Personal Injury	0.50	..	..	..	0.50
ID122 to 122b	Use and Occupancy.....	1.03	..	1.09	1.09	1.12
ID222	Consequential Damage	..	..	1.09	1.09	1.09
ID321	Power Interruption					
	Loss of Use.....	..	..	1.09	1.09	1.09
	Spoilage	0.80	..	1.09	1.09	0.87
ID400	Expediting Charges	0.50	..	..	..	0.50
ID522	Outage	1.78	..	1.09	1.09	1.94

* The new Boiler Insurance Charge Table results in a 30% reduction from old Basic and Location Charges.

Exhibit E (Continued)

BOILER AND MACHINERY RATES

Summary showing effect of various rate adjustments

Manual Page No.	Classifications	Experience Adjustment	Manual Rate Multipliers: Premium Graduation Factor	Manual Rate Multipliers: Total (3)×(4)
(1)	(2)	(3)	(4)	(5)
	II. MACHINERY			
M210	Insurance Charges	..	..	1.00
M211	Steam Engines	1.57	1.10	1.73
M212 to M212e	Int. Comb. Engines	..	1.10	1.10
M213 to M213e	I. C. Compressors or Pumps	..	1.10	1.10
M214 to M225	Recipr. Compr. & Pumps	..	1.10	1.10
M227 to M227f	Miscell. Machines			
	Class 1	..	1.10	1.10
	Class 2	1.50	1.10	1.65
	Class 3			
	Type 1	1.50	1.10	1.65
	Type 2	1.25	1.10	1.38
	Type 3	1.50	1.10	1.65
	Type 4	..	1.10	1.10
	Class 4	..	1.10	1.10
M228 & M228a	Wheels			
	Balance Wheels Pulleys & Couplings.	1.30	1.10	1.43
	Gear Wheels	..	1.10	1.10
	All Other	1.50	1.10	1.65
M229	Shafting	1.50	1.10	1.65
M230 to M234	Steam Turbines	0.94	1.10	1.03
	*Breakdown (Gen.)	0.87	1.10	.96
	*Breakdown (Not Gen.)	1.03	1.10	1.13
	*Limited Breakdown	0.75	1.10	.83
	Combined Coverage	1.09	1.10	1.20
	Explosion Coverage	1.31	1.10	1.44
M235 to M239	Water Turbines	1.30	1.10	1.43
	Breakdown (Gen.)	..	1.10	1.10
	Breakdown (Not Gen.)	1.50	1.10	1.65
	Limited Breakdown	..	1.10	1.10
	Combined Cov.	1.30	1.10	1.43
	Explosion Cov.	2.50	1.10	2.75
M240	Electric Generators	..	1.10	1.10
M241 & M242	Electric Motors	1.07	1.10	1.18
	5 H.P. or less	1.50	1.10	1.65
	6 to 25 H.P.	1.10	1.10	1.21
	26 to 100 H.P.	1.02	1.10	1.12
	Over 100 H.P.	..	1.10	1.10
M243	Rotary Converters	1.33	1.10	1.46
	100 K.W. or less	2.00	1.10	2.20
	101 to 1,000 K.W.	1.35	1.10	1.49
	Over 1,000 K.W.	0.80	1.10	.88

* Rate reductions (Breakdown & Ltd. Br.) about 25% over 9,000 kw. Rate increases on all sizes 100 kw. or less. The Multipliers shown are average for all sizes.

Exhibit E (Continued)

Manual Page No.	Classifications	Experience Adjustment	Manual Rate Multipliers: Premium Graduation Factor	Manual Rate Multipliers: Total (3) × (4)
(1)	(2)	(3)	(4)	(5)
	II. MACHINERY (continued)			
M244	Transformers	0.96	1.10	1.06
	25 K.W. or less	1.25	1.10	1.38
	26 to 200 K.W.	1.10	1.10	1.21
	201 to 1,000 K.W.	0.90	1.10	.99
	Over 1,000 K.W.	0.75	1.10	.83
M245	Motor Control Equip.	..	..	1.00
M246	Misc. Elect. Apparatus	..	1.10	1.10
M247	Small Refr. & Comp. Mchs.	..	1.10	1.10
M248	Deep-Well Pump Units	..	1.10	1.10
M249	Air Conditioners	..	1.10	1.10
M250	Personal Injury	0.50	..	0.50
ID122c to ID122f	Use and Occupancy			
	Fly-wheel Engine & Turbine	1.32	1.09	1.44
	Electrical Machinery	1.17	1.09	1.28
ID222	Consequential Damage	1.25	1.09	1.36
ID321 & 322	Power Interruption			
	*Loss of Use	2.00	1.09	2.18
	Spoilage	1.50	1.09	1.64
ID400	Expediting Charges	0.67	..	0.67
ID522	Outage	1.78	1.09	1.94

* Multipliers adjusted so that practically no increase for Group 1, up to 150% increase for Group 5.

At the time of the rate revision, the statistical plan was amended to provide for the reporting of experience on a full manual premium basis, with premium discounts to be reported separately. A size of risk code was provided to be used for all premium, exposure and loss records, and a policy count was set up. With this information available, the manual premium multiplier used to offset the effect of the premium discount may be accurately determined and adjusted when necessary on the basis of all company experience.

At the time of the introduction of graded expense for boiler and machinery insurance, there was some discussion as to whether or not there existed a loss ratio differential by size of risk. Some individuals felt that there probably was, since the large risks frequently employ full time experienced engineers to operate and maintain their equipment, and are also more apt to set up adequate depreciation reserves so that objects will be replaced before they become dangerously old and worn out. However, there was no unanimity on this point, and no statistical experience was available. The amendment

to the statistical plan will provide loss experience by size of risk which will show whether or not a differential exists, and if such be the case, whether such differential is great enough to receive recognition.

Points in the Rating Procedure Offering Possibilities for Further Investigation

1. A review of the indicated object charge adjustments shown in Exhibits B and C indicates the advisability of more frequent truing up of the Boiler and Machinery classification rates. The long intervals of time between complete manual revisions seems to indicate that although attention is paid to the overall rate levels there is not enough credibility assigned to indicated changes in the classification loss and inspection cost relativity. It would seem to be desirable to review the classification experience at regular intervals, every three years for example, and to have a definite formula for the adjustment of classification relativity. One possibility would be to use the five latest calendar years' experience for losses and to apply credibility to the indicated versus the underlying on the basis of a credibility table combining both the number of objects and the loss frequency. Such a table has been shown in a paper by Mr. Barber entitled "Suggested Method for Developing Automobile Rates." This table is shown on pages 219 to 222 of Volume XV of the Proceedings of the Casualty Actuarial Society. For inspection cost the two latest available calendar years combined might be used with 100% credibility applicable in all cases except where the number of earned objects is so small that the inspection cost may be unreliable. In those cases either additional years of experience might be used or else the indicated inspection cost might be modified by analogy to other objects. If such a regular program for the truing up of Boiler and Machinery classification rates were to be introduced, when changes are made, there would not occur the violent fluctuations in the manual premium for individual objects such as was occasioned by the recent manual revision.

2. The second recommendation for possible investigation regards the large number of individual rates contained in the present manual. The small exposure involved in many classifications seems entirely inadequate to justify the great number of separate individual rates for every size and type of insurable object. A great many of these individual rates are based upon very slim loss data and by no inspection expense statistics at all. There may be a theoretical loss and inspection cost differential between all the various types and sizes of objects but considering the very small exposure it would seem to be much more desirable to extend the averaging process by combining many of the present individual objects into a smaller number of classifications for which rates can be justified by statistical data.

3. The third possibility for investigation is in the rates for certain extremely infrequent objects which are tailor-made to fit the power plant requirements of individual risks. An investigation into the cost and hazards involved might indicate that the use of "A" rating under the control of the Bureau, similar to that used in other casualty lines, might produce object premiums more closely akin to the actual risk requirements than that produced at present by the compulsory use of a manual rate. If this were found to be true and the change adopted, the manual would be relieved of a large number of classification rates for which the number of insurable objects is almost negligible and at the same time would produce a loss and inspection pure premium which would provide enough money to cover the object inspections required in the individual case and to cover the estimated loss hazard which would vary from risk to risk.

4. A review of the experience for the personal injury coverage for both Boiler and Machinery shows that the loss ratio is so low and the premium charge for this coverage so small for individual risks that it would probably be desirable to automatically include this coverage in all policies for no premium charge. In many instances the cost of providing this coverage on the policies is almost as much as the premium involved, and it would seem to be more practicable to automatically provide the coverage for all risks and to include the personal injury losses with the property damage losses for each individual classification for experience purposes.

5. Although the recent introduction of insurance charges to replace the old Boiler and Location charges represents a forward step, the present system still seems to offer the opportunity for critical review. It seems quite desirable that an investigation be made into this situation with the object in mind, if the investigation so justifies, of eliminating the present Boiler and Machinery insurance charges entirely and substituting therefor a single manual object premium to be charged for each object insured. This manual object rate would be for a definite standard limit per accident ($5,000 for example), and increase limits premium would be obtained by the application of factors from increased limits tables. The objects could be divided into several groups reflecting the relative seriousness of high limits hazard, with corresponding increased limits tables for each group. The additional inspection dollars on multiple location risks which now consist of a portion of the insurance charge collected for each location might be more appropriately charged through the application of a territorial differential reflecting the accessibility of the risk.

The reason for recommending an investigation as to the feasibility of this change is that in the author's opinion the following drawbacks exist under the present system of Boiler and Machinery insurance charges. The first

drawback is the present method of charges for increased limits. The net effect of current insurance charges is to give a flat dollar premium per location for excess limits regardless of the hazard involved. For certain objects the premium is unwontedly high and in other instances seems to be grossly inadequate, although for all classifications combined the net dollar income for increased limits is amply sufficient to pay for serious accidents when they occur. For example, a risk involving small air tanks spread over a large number of locations is required to pay for each location a charge of $33 for losses in excess of $1,000 per accident up to $50,000 per accident. On the other hand a risk with several large high pressure water tube boilers in one location is required to pay a single premium of only $33 for limits in excess of $1,000 up to $50,000 per accident. It seems patently absurd to charge a much greater premium in the first case where the possibility of an expensive loss is infinitely small compared to the possibility for the risk with the large high pressure boilers. For a great many objects the individual increased limits premium is far out of line with the actual hazard involved and the risk and the company frequently do not have the advantage of a blanket limit per accident since there is a material incentive for assureds to purchase varying limits per object, for separate locations, to avoid the discrimination in increased limits charges for the small objects with very little hazard.

The second drawback is in the collection of increased inspection dollars for multiple location risks. Since a large part of the additional inspection expense for risks of this type is in traveling time, consideration should be given to the accessibility of the risk and its location rather than just to the number of locations. Risks in rural districts or in certain western or southern states are frequently in locations far removed from any inspection office and require appreciably more money to service than the average, while on the other hand a large city school risk involving many locations might require only five or ten minutes traveling time between each location. Further, since the charge for each location also includes excess limits premium it is very difficult to determine overall just how much additional inspection expense provision the company does collect and whether the amount is inadequate or redundant.

The third drawback is in the basis for the determination of manual rates. The all company statistics compiled by the Bureau for the basis of rate making provide that the total dollar income from insurance charges shall be distributed pro rata over the object charge premiums. Although the present Boiler insurance charges are appreciably lower than the old basic and location charges they will still require approximately a 35% flat loading on the earned object premiums for all classifications. This result will produce experience indications for certain classifications that are at an appreciable

variance from the actual conditions. As extremes consider the case of a small air tank where the minimum insurance charge is 100% of the object charge and large high pressure water tube boilers where the insurance charge may be less than 10% of the object charge. Of course, this situation is offset to some degree by the fact that assureds as a rule purchase low limits for low rated objects and high limits for high rated objects, but appreciable distortion of the experience is still present.