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AN ANALYSIS OF CHANGES IN THRESHOLD LIMIT VALUES OVER TIME

by

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A technical report submitted to the Faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Science in Environmental Engineering in the Department of Environmental Sciences and Engineering.

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ABSTRACT

ROGER W. NELSON. An Analysis of Changes In Threshold Limit Values Over Time. (Under The Direction of Dr. STEPHEN M. RAPPAPORT)

Threshold Limit Values (TLVs) for industrial chemicals have been in existence since 1946. It has been proposed that the rate of change of TLVs over the years reflects the rate of change of exposure within industry (Roach and Rappaport, 1990). In this paper, a detailed analysis of TLVs as a whole, industry specific TLVs, and TLVs for known or suspected carcinogens was made to determine the rate of change of TLVs between 1946 and 1990. It was found that the median fold reduction for all TLVs was 2.0. For most industries in this analysis it was also 2.0-fold, and for known or suspected carcinogens it was 2.4-fold. The rate of change for all TLVs decreased with time (21.7% reductions per year in 1951 to 13.3% per year in 1990). For most industries the reduction rate was 13.3% reductions per year, while for known or suspected carcinogens it was 16% per year. It is postulated that the results of this analysis can be used to infer past exposures.

Key words: TLV, change of TLVs, exposure, history of reductions

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INTRODUCTION

Since 1946 the American Conference of Governmental Industrial Hygienists (ACGIH) has been setting Threshold Limit Values (TLVs) for chemicals used in industry. The TLVs are reviewed and updated annually by a Committee of health professionals who state that, "These values are based on the best available information from industrial experience, from experimental studies and, when possible, from the combination of both" (Board of Directors, ACGIH, 1990). In addition they state that these limits are set at a level to protect "nearly all workers" from adverse health effects over their working lifetimes (ACGIH, 1992). However, the documentation supporting this position is scanty (ACGIH, 1976 and 1986). What does "nearly all workers" mean? The ACGIH (1992) also states that "a small percentage of workers may experience discomfort from substances at concentrations at or below the threshold limit...". How small is this "small percentage"?

In recent years there have been a number of articles criticizing the ACGIH on their methods of arriving at the TLVs, (Castleman and Ziem, 1988; Ziem and Castleman, 1989; Roach and Rappaport, 1990). There has also been criticism regarding adoption of the TLVs as official limits by the Occupational Safety and Health Administration (OSHA) and other countries around the world (Castleman and Ziem, 1988). In addition there has been criticism that industry has played too important a role in the setting of TLVs (Castleman and Ziem, 1988; Ziem and Castleman, 1989; Roach and Rappaport, 1990; Rappaport, 1993). Roach and

Rappaport (1990) postulated that the limits were driven more by exposures in industry rather than by strict considerations of health. Thus, as the exposures in industry became lower, through improved technology or better work procedures, the TLVs got lower.

If Roach and Rappaport (1990) are correct, i.e., that TLVs reflect attainable exposures at the time they are set, then the history of the TLVs represents the history of exposures to industrial chemicals over the last 45 years. Since exposures have, by-and-large, been reduced during this period, analysis of the TLVs over time allows inferences to be made regarding the rates of reduction in exposure over time. This report will attempt to show the rate of change between 1946 and 1990 for the TLVs as a whole, for TLVs representing known or suspected carcinogens, and for TLVs used in selected industries.

BACKGROUND

Roach and Rappaport (1990) reviewed the 1976 and 1986 Documentation of the TLVs for Chemical Substances to determine the basis for the TLVs. Upon evaluating the Documentation they found that the TLV Committee has traditionally emphasized studies involving human exposures. In the 1976 Documentation, 225 of the 488 TLVs listed were at least partly based on human experience. In the 1986 Documentation 127 of the 600 chemicals listed were at least partly based on human experience at or below the 1986 TLV. After careful analysis of the data available from the original references cited by the TLV Committee, they found that 17% of employees exposed to a concentration at or below the 1976 TLV and 14% of employees exposed at or below the 1986 TLV were

adversely affected. These results suggest an overall risk of 1 in 6-7. This finding, according to Roach and Rappaport, clearly contradicts the official definition of TLVs as levels to protect "nearly all workers" from adverse health effects over their working lifetimes (ACGIH, 1992).

Roach and Rappaport (1990) also showed that the TLVs were significantly correlated with the levels of exposure reported in the studies cited by the TLV Committee in its documentation. From this, they concluded that the TLVs reflected the exposure levels at the time the limits were adopted. Such a conclusion would be consistent with the suggestion of Castleman and Zeim (1988) that corporations unduly influenced the setting of TLVs through personal communications with the ACGIH Committee. The ACGIH Board of Directors responded by stating that they solicited information from all possible sources through the Notice of Intended Changes (Board of Directors, ACGIH, 1990). They also stated that the analysis of Roach and Rappaport (1990) was biased because it was based on a "small nonrepresentative sample of TLVs ..." (Breysse, 1991). To this Rappaport and Roach (1991) countered that their samples were not biased merely because they were small. Indeed, because they had investigated all pertinent studies cited in the Documentation they saw no reason why their results could not be generalized to the TLVs as a whole.

In a recent paper, Rappaport (1993) studied reductions in TLVs as a function of time for 27 substances in the "Notice of Intended Changes (for 1991 - 1992)". The result of his analysis showed overall median fold reductions of 2.0 - 2.5 between 1946 and 1989. This investigation is intended to expand that work by analyzing TLVs to determine the history of reductions in exposure to all 630 substances on the list as well as for chemicals used in particular industries. The industry-specific

data will be obtained from a separate database developed by the National Institute for Occupational Safety and Health (NIOSH).

METHODS

Industry Specific Data

In order to show the rate of reduction of TLVs over time in various industries the chemicals listed in the TLV booklet were classified by industry using the National Occupational Exposure Survey-based Job Exposure Matrix (NOES-based JEM) that was developed at NIOSH. The JEM was developed on potential exposure data collected during the 1972-1974 National Occupational Hazard Survey (NOHS). The NOHS was intended to describe the health and safety conditions in the American workplace and to determine the extent of workers' exposure to chemical, physical, and biological agents. The survey sample covered non-agricultural businesses that were under the jurisdiction of the Occupational Safety and Health Act (OSHA) of 1970 and employed more than eight employees (Seiber et al., 1991).

The NOES is classified by industry and occupation and exposures within industry and occupation. The industries are coded using the Standard Industrial Classification (SIC) codes and occupations are coded by 1970 Bureau of the Census occupation codes. Included in the NOES are data on 8,342 different potential exposure agents in facilities representing 639 SIC codes and 442 occupations. Chemical agents are coded by the Chemical Abstracts Service (CAS) number and unique hazard codes assigned by NIOSH (Seiber et al., 1991).

Because the TLVs are also listed by CAS number, the files were merged by CAS number. Only those agents that matched exactly by CAS numbers were analyzed. If the agent in the TLV booklet did not have a CAS number it was disregarded. The industry was classified on a broad basis by using the two digit SIC code for those industries with 50 or more employees in the NOES database. Of these industries, only those with the highest number of employees and highest percentage of exposed workers (those without protection) were analyzed since it is likely that these industries had the most influence on the development of TLVs because they had the most to lose if they had to meet tougher standards (see Table I).

Fold Reductions

As mentioned above, a database of the agents listed in the ACGIH TLV booklet and their corresponding TLVs was established along with their associated CAS numbers for each year from 1946 to 1992. The data was entered into an EXCEL (Microsoft Corporation) spreadsheet using an IBM - PC. Only TLVs that have been adopted are included in this database. If a chemical was listed under the "Notice of Intended Changes" it was not included until actually adopted. Changes of TLVs were calculated as fold reductions. This calculation was accomplished by dividing the old TLV by the new TLV in the year the change occurred. (Note: A fold increase would be indicated by a "reduction" less than one). The number of fold reductions, median fold change, average fold change, maximum fold change, minimum fold change, and the predicted fold changes (for those series with a significant linear trend ($p \leq 0.05$)) were then calculated for all TLVs, for industry-specific TLVs, and for known or suspected carcinogens for each five year interval between 1946 and 1990. Initially, fold reductions were calculated for each year between 1946 and 1992. However, upon reviewing the results of the above values

there were no significant distinctions between the annual fold calculations and the five-year fold reductions. Therefore, to simplify presentation of results, the analysis concentrated on changes that occurred within each five year period from 1946 - 1990. If the TLV had a ceiling value it was divided by 6 to give an approximate eight-hour time weighted average (Rappaport, 1993).

Interval Between Reductions

Values for the interval between TLV Changes in five year intervals were calculated in the following manner. Each time a change occurred, the interval which elapsed between changes was calculated (in years) by subtracting the year in which the existing TLV was adopted from the year in which the change occurred. This process was repeated for each consecutive change. The intervals between changes were calculated from 1951 so the first five year interval (1946 - 1950) did not bias the results. Once the intervals between changes were calculated the median interval between changes, average interval between changes, maximum interval between changes, and minimum interval between changes were calculated for all TLVs, for industry-specific TLVs, and for known or suspected carcinogens. If there was a significant linear trend ($p \leq 0.05$) then the predicted interval between changes was calculated as well.

Carcinogens

In trying to compare the rate of change of TLVs for chemicals that are known or suspected carcinogens with those of all TLVs, a list of these carcinogens was extracted from the TLV booklet. Values for the fold change and the interval between reductions for these chemicals were calculated as described above.

Rate of Fold Reduction

The rate of reductions of TLVs was determined for all TLVs, for suspect or known carcinogens, and for TLVs by SIC code in the following manner. First, the time series of median fold reductions and median intervals were analyzed to determine whether there was a significant linear trend. This was done by doing a trend test on each set of median values. To check for significance ($p \leq 0.05$) a t - test was applied. Using the LINEST function of EXCEL to estimate regressions of median fold change over time and median interval between changes over time the estimated slopes and standard errors were computed as well as the degrees of freedom. The estimated slope (m) was divided by its standard error of the slope (se) and this value was compared to the critical value (CV) from the t-distribution with the (n-1) degrees of freedom (df). If the value was greater than the critical value then this set of data was considered to have a significant linear trend.

Those series with significant linear trends are shown in the respective tables with predicted intervals or predicted fold reductions for each five year interval. If a series had a significant trend in both the fold reductions and the interval between changes then the rate of reduction was calculated using the predicted values for both sets of data for each five year interval. If only the fold reduction or only the interval between changes showed a significant trend then the predicted value for the respective set of data was used in the calculation for the rate of reduction along with the overall median value for the non-significant set of data. However, if there were no significant trends in either the fold reductions or the interval between changes then the overall median values for all years for both sets of data were used to determine the rate of reduction for that series of data. The rate of reduction, or percent reduction per year, then was calculated by dividing the median fold reduction (in percent) by the median interval (in years) between

changes. To summarize, the predicted values were used when significant linear trends were identified and the overall median value was used if a significant trend was not identified in either the fold reductions or interval between changes.

RESULTS

Fold Reductions in TLVs

Twenty nine different industries were selected from the NOES database with chemicals that match those in the TLV booklet (see Table I). It is also noteworthy to mention that only 99 of the 630 chemicals, or 16 percent, listed in the TLV booklet are included in the industry-specific analysis (Table II). The results of the analysis for all TLVs and for each of the SIC codes are shown in Tables III and IV. The median reduction for all TLVs from 1946 to 1990 in five year intervals did not show a significant linear trend ($p>0.05$). This can be easily seen in Figure 1 from the scatter plot of the data. Therefore, because there was no significant linear trend, the fold reductions of the entire list of TLVs were looked at as a whole. The median reduction calculated from 1946 to 1990 was 2.0-fold.

Table IV gives the values for median, average, maximum, minimum, and number of fold reductions for each SIC in this study. For the various industries in this study, the results show a median fold reduction between 2.0 and 5.0 for the period 1946 - 1990, the majority being around 2.0-fold (see Table IV). Of these industries, most did not show a significant linear trend in fold reductions over time; however, there were some that did. These industries are SICs 23 (Apparel and Other Textile Products), 36 (Electric and Electronic Equipment), and 37 (Transportation

Equipment), all having a positive slope with time. This indicates that as time goes by the median fold reduction increases for the 3 industries mentioned above. Each SIC code that did not show a significant linear trend was analysed over the whole period in which changes occurred within that industry. (For a graphical representation of the individual SICs look at Figures 2 through 25.) It should be pointed out that some SIC codes were combined with other SIC codes to provide enough data to be analysed. Those SICs that were combined are: SICs 20 (Food and Kindered Products) and 21 (Tobacco Manufactures), SICs 40 (Railroad Transportation) and 45 (Transportation by Air), and SICs 49 (Electric, Gas, and Sanitary Services), 72 (Personal Services), 73 (Business Services), and 76 (Miscellaneous Repair Services).

The fold reductions for known or suspected carcinogens did not show a significant linear trend over time for five year intervals from 1946 - 1990. The median fold reduction for all known or suspected carcinogens was 2.4 (see Table V). There were 112 reductions between 1946 and 1990 for this category. A plot of the fold reductions is shown in Figure 26.

Interval Between Changes

The median interval between changes for all TLVs and for most SIC codes included in this study show definite trends. In most cases, the trend is towards longer intervals between changes. As can be seen from Table VI, the median interval between changes for the TLVs as a whole shows that there is a significant linear trend. The predicted median interval between changes for all the TLVs per five year interval ranges between 9.0 and 15.0 years (see Table VI). This information can also be seen in graphical form in Figure 27. The data for several

industries are generally similar to those for the entire list of TLVs. (See, for example, SICs 15 (General Building Contractors), 20 (Food and Kindred Products) and 21 (Tobacco Manufacturers), 24 (Lumber and Wood Products), 32 (Stone Clay and Glass Products), and 38 (Instruments and Related Products)). One industry, however, can be singled out as an exception. SIC 17 (Special Trade Contractors) has a negative slope and ranges from 21.0 years to 5.5 years between changes (see Table VII). This indicates that the years between changes have been decreasing with time. Graphs for each SIC code are provided in Figures 28 through 50. The information for the median, average, maximum, minimum, and number of intervals between changes for all SICs and for known or suspected carcinogens can be seen in Tables VII and VIII respectively. The median interval between changes for known or suspected carcinogens was 15.0 years. There was not a significant linear trend for this series of data. The graph of the median interval between changes is shown in Figure 51.

In looking at these graphs it is interesting to note the cyclical pattern observed in each SIC code. Each SIC code showed an increase in the interval between changes until 1966 - 1970 when there was a decrease in the interval until 1976 - 1980 when another decrease was observed, then the interval between changes began to increase again. This cycle appears to be typical of most SIC codes in this analysis. Even the TLVs for known or suspect carcinogens follow this cycle with the exception that the interval between changes began to decrease between 1980 and 1990.

Rate of Fold Reduction in TLVs

The rates of reduction in TLVs were calculated as described in the Methods section as Fold Reductions per year (or Percent Reduction per year) for all TLVs, for

known or suspected carcinogens, and for each SIC. Since there was not a significant linear trend in the fold reductions for all TLVs the entire list of TLVs was treated as a whole and the overall median fold reduction was 2.0 or 200%. The rate of reduction calculated for all TLVs ranged from 21.7 to 13.3 Percent Reduction per year between 1951 and 1990 (see Table IX). The graphical representation of this rate is shown in Figure 52. (Note that the interval is from 1951 since the first five year interval was disregarded in the calculation for the interval between changes.) The rate of reduction for known or suspected carcinogens was calculated using the overall interval and overall median fold reduction since there was not a significant linear trend observed in either the fold reductions or the interval between reductions. The rate of reduction for known or suspected carcinogens was calculated to be 16% per year (see Table IX). The rates for SICs with significant trends were calculated as described in the Methods section. The rates for SICs 15, 17, 20 and 21, 23, 24, 32, 36, 37, and 38 showed significant trends in either the interval between changes or fold reduction (see Table X). For a graphical representation of the rates of change over time for these SICs see Figures 53 through 61. The rest of the SICs in this study did not show significant trends and so their rates of reduction was calculated using the overall interval and the overall median fold reduction for the respective industry (see Table XI).

As can be seen from Figure 62 for the number of changes per five year interval, 39 changes occurred during the first five years (1946 - 1950) of observation. The number then dropped to 5 and later started increasing until about 1970 before it decreased again. Another upward cycle is characteristic of the next five year intervals until the last five years (1985 - 1990) when the number of changes decreased by more than 50 percent. The general behavior, however, is the increase

of the number of changes for the entire interval from 1946 to 1990 with predicted numbers of changes between 18 and 57 (see Figure 63).

DISCUSSION

This analysis is based upon the conjecture of Rappaport (1993) in which he analysed 27 TLVs for fold reductions over time. In this paper all TLVs, suspect and known carcinogens, and chemicals in selected industries were analysed to see if there were any particular industries that had significant influences on the rate of change of TLVs. In this effort an unbiased attempt was made to include all TLVs in the analysis by merging the entire list of TLVs with the NOES - based JEM database. The resultant database contained 29 SICs that used chemicals listed in the ACGIH-TLV booklet that matched by CAS number. Subsequently, there were only 99 chemicals from the TLV booklet that were included in this analysis as part of specific SICs.

Fold Reductions

The results of the fold reductions for most of the SICs did not differ significantly from the overall fold reduction for all TLVs. One possible reason for this is that the industries selected included similar chemicals. The overall median fold reduction for all TLVs was 2.0-fold (Table III) and most of the SICs in this study had a 2.0-fold reduction as well (Table IV). The known or suspected carcinogens had a slightly higher fold reduction of 2.4-fold (Table V) between 1946 and 1990 but this too was not significantly different from the overall fold reduction. In Rappaport's study of 27 agents in the 1992 to 1993 Notice of Intended Changes the

fold reduction was also 2.0-fold. It is clear from these results that TLVs have been decreasing by 2.0-fold since 1946, whenever there was a reduction. Therefore, from these results it is unlikely that the ACGIH paid strict attention to the health effects of chemicals used in industry when setting TLVs. It is more likely that the levels of exposures attainable within industry influenced the TLVs since, apparently, the level of toxicity of the chemical did not play as important a role. Hence, we can say that the levels of exposure within industry has steadily decreased with time.

From this basically constant decrease in all TLVs by a 2.0-fold reduction it seems likely that the ACGIH - TLV Committee has not changed their overall method of evaluating these chemicals in reaching exposure limits from 1946 to 1990.

However, if we were to take a closer look at individual agents such as those considered to be human carcinogens or potential human carcinogens we might find a much greater fold change in more recent years (Rappaport, 1993). For instance, in the 1992-1993 TLV booklet there were 12 new changes adopted. Of the 12 changes that were adopted those agents that were not considered to be carcinogenic had a median change of around a 2.0-fold reduction. However, the 3 agents that were considered to be carcinogenic had a much greater reduction namely, dinitrotoluene had a 10.0-fold reduction, ethylbromide had a 40.5-fold reduction, and formaldehyde had a 20.0-fold reduction. The median reduction for these three carcinogenic agents is 20.0-fold (Table XII). This may be due to a more conservative approach by the committee to assess the risks involved in working with these toxic agents and in an attempt to base their decisions more on health effects rather than on economic reasons (Rappaport, 1993). It might be noteworthy also to mention that the average age (the number of years since the last change occurred) of the 12 newly adopted TLVs was 24 years and that two of the oldest

TLVs are considered to be carcinogens (i.e. dinitrotoluene, 46 years, and ethylbromide, 45 years), see Table XII. This may lead us to ask how accurate the evaluations have been in the past 46 years. It appears from the 1992-1993 TLV changes that the committee is now placing an emphasis on greater reductions of carcinogenic agents. The non-carcinogenic agents, however, seem to reflect the past history of fold reductions with a median fold of around 2.0 (see Table XII).

Interval Between Changes

The results from the analysis of the interval between changes indicate that the intervals have been increasing with time for all TLVs. The predicted intervals ranged from 9.2 years to 15.0 years for all TLVs (see Table VI). There were 6 industries that had significant linear trends as follows: SIC 15, ranged from 7.7 to 20.8 years; SICs 20 and 21 ranged from 6.8 to 24.5; SIC 24 ranged from 7.8 to 26.2 years; SIC 32 ranged from 11.6 to 17.1 years and SIC 38 ranged from 9.7 to 19.6 years; SIC 17 decreased from 21.3 to 5.5 years. SIC 17 is Special Trade Contractors and it seems to have a wide range of chemicals. A number of the chemicals appear to be from welding operations and apparently have been experiencing shorter intervals between changes. All other SIC codes in this study had overall median intervals between 11.5 and 15.0 years, the majority being 15.0 years (see Table VII). The median interval between changes for known or suspected carcinogens was 15.0 years (see Table VIII). This value was surprising because one would expect greater attention would be paid to more harmful substances in an effort to reduce exposures. However, these results seem to be contrary to that opinion. This trend of longer intervals between changes suggest that it was much easier to reduce exposures (and, therefore, the TLVs) in the beginning when levels of exposure were much higher. Better technologies and improved work practices may also be a

contributing factor to the lower levels of exposure today making it more difficult to reduce exposures. It is interesting to note that many SIC codes showed an increase in the interval between changes until around 1970 when the OSH Act was passed. The passing of the Act, which required a safe environment for workers, may have contributed to the immediate decrease in the interval between changes but during the 1980's they began to increase again (see Figures 27 to 51). This pattern of events may be symbolic of the priorities of the government at the time.

Rate of Fold Reductions

As determined from this analysis the rate of reduction for all TLVs ranged from 21.7 % per year to 13.3 % per year (see Table IX). It is plain to see that the rates of reduction have been decreasing over time (see Figure 52). From the same argument given above for the interval between changes, it is much easier to reduce the TLVs at a faster rate in the beginning when exposures were much higher. Now that there is improved technology within the workplace and better work procedures, it is more difficult to attain the same rate of reduction as before.

If Roach and Rappaport were correct in speculating that the TLVs reflect exposures at the time they are set then the rate of reduction determined above is the rate of reduction of exposure over time. Given the fact that there is little evidence showing human exposures to chemicals in the workforce a possible application of the rate determined in this analysis is to infer levels of exposure in the past and in the future for occupational chemical exposures in general.

CONCLUSION

It has been suggested that Threshold Limit Values reflect exposures in industry at the time they were set (Roach and Rappaport, 1990). Therefore, the rate of reduction of the TLVs may be a reflection of the rate of reduction in exposure. All TLVs have been reducing by about 2.0-fold (median value) since 1946 and this level of reduction is evidenced in the various industries selected in this report from the NOES - based JEM database. Known and suspected carcinogens showed a 2.4 median fold reduction which is not significantly different from the overall value for all TLVs. The median interval between changes for all TLVs has been increasing over time and this too is evidenced in the various industries included in this report. The median interval between changes ranged from 9.2 to 15.0 years with most of the SIC codes being 15.0 years. The median interval between changes for carcinogens was also 15.0 years. The rate of change for all TLVs was between 21.7 and 13.3 % reduction per year indicating a steady decrease in the rate of exposure. The rate of exposure for the various industries in this study were between 13.3 and 15.4 % reduction per year and the rate for known or suspected carcinogens was 16.0 % reduction per year. These values reflect the exposure rate in industry over time and may be used as guides for inferring historical levels of exposure by epidemiologists and other health professionals.

REFERENCES

ACGIH, *Threshold Limit Values - Discussion And Thirty-Five Year Index With Recommendations*, Vol. 9, ACGIH, Cincinnati, 1984.

ACGIH, *Threshold Limit Values for Chemical Substances and Workroom Environment with Intended Changes for 1980*, ACGIH, Cincinnati, 1980.

ACGIH, *Threshold Limit Values for Chemical Substances and Workroom Environment with Intended Changes for 1981*, ACGIH, Cincinnati, 1981.

ACGIH, *Threshold Limit Values for Chemical Substances and Workroom Environment with Intended Changes for 1982*, ACGIH, Cincinnati, 1982.

ACGIH, *Threshold Limit Values for Chemical Substances and Workroom Environment with Intended Changes for 1983-1984*, ACGIH, Cincinnati, 1983.

ACGIH, *Threshold Limit Values for Chemical Substances and Workroom Environment with Intended Changes for 1984-1985*, ACGIH, Cincinnati, 1984.

ACGIH, *Threshold Limit Values and Biological Exposure Indices for 1985-1986*, ACGIH, Cincinnati, 1985.

ACGIH, *Threshold Limit Values and Biological Exposure Indices for 1986-1987*, ACGIH, Cincinnati, 1986.

ACGIH, *Threshold Limit Values and Biological Exposure Indices for 1987-1988*, ACGIH, Cincinnati, 1987.

ACGIH, *Threshold Limit Values and Biological Exposure Indices for 1988-1989*, ACGIH, Cincinnati, 1988.

ACGIH, *Threshold Limit Values and Biological Exposure Indices for 1989-1990*, ACGIH, Cincinnati, 1989.

ACGIH, *Threshold Limit Values and Biological Exposure Indices for 1990-1991*, ACGIH, Cincinnati, 1990.

ACGIH, *Threshold Limit Values and Biological Exposure Indices for 1991-1992*, ACGIH, Cincinnati, 1991.

ACGIH, *Threshold Limit Values and Biological Exposure Indices for 1992-1993*, ACGIH, Cincinnati, 1992.

ACGIH, Board of Directors, "Threshold Limit Values: A More Balanced Appraisal," *Applied Occupational and Environmental Hygiene*, Vol. 5(6), pp. 340-344, (June 1990).

ACGIH, *Documentation of the Threshold Limit Values*, 3rd ed., 3rd printing, ACGIH, Cincinnati, 1976.

ACGIH, *Documentation of the Threshold Limit Values*, 5th ed., ACGIH, Cincinnati, 1986.

Breyse, P. A., "ACGIH TLVs: A Critical Analysis of the Documentation," *American Journal of Industrial Medicine*, Vol. 20, pp. 423-428, (1991).

Castleman, B. I., Zeim, G. E., "Corporate Influence on Threshold Limit Values," *American Journal of Industrial Medicine*, Vol. 13, pp. 531-559, (1988).

Zeim, G. E., Castleman, B. I., "Threshold Limit Values: Historical Perspectives and Current Practice," *Journal of Occupational Medicine*, Vol. 31, pp. 910-918, (1989).

Rappaport, S. M., "Threshold Limit Values, Permissible Exposure Limits, and Feasibility: The Bases for Exposure Limits in the United States," *American Journal of Industrial Medicine*, Vol. 23, pp. 683-694, (1993).

Rappaport, S. M., Roach, S. A., "Response to ACGIH "Critical Analysis," *American Journal of Industrial Medicine*, Vol. 20, pp. 429-430, (1991).

Roach, S. A., Rappaport, S. M., "But They Are Not Thresholds: A Critical Analysis of the Documentation of Threshold Limit Values," *American Journal of Industrial Medicine*, Vol. 17, pp. 727-753, (1990).

Seiber, W. K. Jr., Sundin, D. S., Frazier, T. M., Robinson, C. F., "Development, Use, and Availability of a Job Exposure Matrix Based on National Occupational Hazard Survey Data," *American Journal of Industrial Medicine*, Vol. 20, pp. 163-174, (1991).

TABLES

Table I
List of Standard Industry Codes (SIC)

SIC	Name
15	General Building contractors
17	Special Trade Contractors
20	Food and Kindered Products
21	Tobacco Manufacturers
22	Textile Mill Products
23	Apperel and Other Textile Products
24	Lumber and Wood Products
25	Furniture and Fixtures
26	Paper and Allied Products
27	Printing and Publishing
28	Chemicals and Allied Products
29	Petroleum and Coal Products
30	Rubber and Miscellaneous Plastic Products
31	Leather and Leather Products
32	Stone, Clay, and Glass Products
33	Primary Metal Industries
34	Fabricated Metal Products
35	Machinery, Except Electrical
36	Electrical and Electronic Equipment
37	Transportation Equipment
38	Instruments and Related Products
39	Miscellaneous Manufacturing Industries
40	Railroad Transportation
45	Transportation By Air
49	Electric, gas, and Sanitary Services
72	Personal Services
73	Business Services
76	Miscellaneous Repair Services
80	Health Services

Table II

List of Chemicals in the Various Industries Selected

Chemical Name	Chemical Name
Acetaldehyde	Malathion
Acetone	2-Methoxyethanol
Acrylic acid	Methyl chloroform
Acrylonitrile	Methyl ethyl ketone (MEK)
Allyl glycidyl Ether (AGE)	Methyl isobutyl ketone
Ammonia	Methyl Mercaptan
n-Amyl acetate	Methyl n-amyl ketone
Aniline	Methyl n-butyl ketone (2-Hexanone)
Arsine	Methylene chloride
Benzene (benzol)	Nitrogen dioxide
Boron tribromide	Nitromethane
Boron oxide	Octane
Bromine	Ozone
Butane	Paraffin wax fume
2-Butoxyethanol (EGBE)	Pentane
n-Butyl acetate	Perchloroethylene
n-Butyl alcohol	Phenyl glycidyl ether (PGE)
sec-Butyl alcohol	Phthalic anhydride
n-Butyl Glycidyl Ether (BGE)	Propylene oxide
Cadmium dusts and salts	Sodium hydroxide
Calcium oxide	Stoddard solvent
Camphor, synthetic	Styrene, monomer
Carbon tetrachloride	Sulfur dioxide
Chlorine	Sulfur monochloride
Chlorobenzene	Sulfuric acid
Chloroform	Tantalum, metal & oxide dusts
Chromium Metal	Tetrasodium pyrophosphate
Chrysotile	Thiram
Cobalt Metal dust and fume	Titanium dioxide
Cyclohexanol	Toluene
Cyclohexanone	Toluene-2,4-diisocyanate (TDI)
o-Dichlorobenzene	Tributyl phosphate
Dichlorodifluoromethane	Trichloroethylene
Diisobutyl ketone	Trichlorofluoromethane
Dimethylformamide	Triethyl amine
Dioxane	Vinyl chloride
Epichlorohydrin	Xylene (o-,m-,p-isomers)
2-Ethoxyethanol (EGEE)	Zinc chromates
2-Ethoxyethyl acetate	
Ethyl benzene	
Ethyl silicate	
Ethyl Chloride	
Ethylene dichloride	
Ethylene glycol (vapor)	
Ethylene oxide	
Formaldehyde	
Furfural	
Furfuryl alcohol	
Gluteraldehyde	
Heptane	
Hexachloroethane	
Hexane (n-Hexane)	
Hydrogen chloride	
Hydrogen fluoride	
Hydrogen Sulfide	
Iodine	
Iron oxide fume	
Isobutyl alcohol	
Isophorone diisocyanate	
Lead, inorg. dust & fumes, as Pb	
Magnesium oxide fume	

Table III
Fold Reductions in All TLVs
(For 5-year intervals from 1946)

	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year	5	10	15	20	25	30	35	40	45	45
median	2.0	5.0	2.0	5.9	2.2	1.5	2.5	2.0	4.7	2.0
maximum	100.0	1000.0	10.6	10000.0	100.0	25.0	50.0	12.3	100.0	10000.0
minimum	0.1	0.5	0.8	0.2	0.2	0.1	0.02	0.1	0.2	0.02
average	6.6	203.5	3.3	235.5	6.2	3.4	6.9	3.3	8.3	36.7
number	39	5	12	41	31	44	50	80	35	337
pred. num	18	23	28	33	37	42	47	52	57	

Fold Change for All TLVs

m	-0.00513	3.223333 b
se	0.045142	1.27014
R2	0.001844	1.748341
F	0.012931	7 df
	0.039527	21.39687
m/se	-0.11372	
t - CV	1.89	

Number of changes for All TLVs

m	0.96	13.44444 b
se	0.477276	13.42892
R2	0.366274	18.48483
F	4.045786	7 df
	1382.4	2391.822
m/se	2.011414	
t - CV	1.89	

Definitions

m	slope
se	standard error of slope
R2	regression value of line
F	F-statistic
t - CV	Critical Value from t-distribution
b	y-intercept
df	degrees of freedom

Table IV
Fold Reductions Over Time By SIC Code

SIC		1951-1955 1956-1960 1961-1965 1976-1980 1981-1985 1951-1985									
15		1951-1955	1956-1960	1961-1965	1976-1980	1981-1985	1951-1985				
year		10	15	20	35	40	30				
median		5.0	1.9	6.0	2.5	6.3	3.8				
average		5.0	1.9	6.0	2.5	6.3	4.7				
maximum		5.0	1.9	6.0	2.5	12.3	12.3				
minimum		5.0	1.9	6.0	2.5	0.3	0.3				
number		1	1	1	1	2	6				
SIC		1966-1970 1971-1975 1976-1980 1981-1985 1966-1985									
17		1966-1970	1971-1975	1976-1980	1981-1985	1966-1985					
year		25	30	35	40	20					
median		2.0	1.5	2.2	7.2	2.0					
average		2.0	1.6	2.4	7.2	2.9					
maximum		2.5	1.9	5.0	12.3	12.3					
minimum		1.5	1.5	0.1	2.0	0.1					
number		2	3	5	2	12					
SIC		1946-1950 1951-1955 1956-1960 1961-1965 1966-1970 1971-1975 1976-1980 1981-1985 1986-1990 1946-1990									
20 & 21		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	10	15	20	25	30	35	40	45	
median		2.0	10.0	3.0	6.0	1.4	2.0	2.0	2.0	6.1	2.0
average		1.5	10.0	3.0	6.0	1.1	2.6	2.0	1.6	6.0	3.7
maximum		2.0	10.0	4.0	10.0	1.5	6.0	2.0	2.4	6.1	10.0
minimum		0.1	10.0	2.0	2.0	0.3	1.5	2.0	0.2	5.8	0.1
number		4	2	2	6	3	5	1	4	3	30
SIC		1946-1950 1951-1955 1956-1960 1961-1965 1966-1970 1971-1975 1976-1980 1981-1985 1986-1990 1946-1990									
22		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	10	15	20	25	30	35	40	45	
median		2.0	10.0	2.0	6.0	1.4	2.0	2.0	2.0	6.0	2.0
average		2.5	7.5	2.6	4.6	1.4	2.9	2.6	3.8	5.0	3.1
maximum		10.0	0.5	2.0	6.0	2.5	6.0	11.8	12.3	2.0	12.3
minimum		0.5	0.5	2.0	1.3	0.3	1.5	0.1	0.2	2.0	0.1
number		9	1	2	7	5	7	7	14	1	53
SIC		1946-1950 1951-1955 1961-1965 1966-1970 1971-1975 1976-1980 1981-1985 1986-1990									
23		1946-1950	1951-1955	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990		
year		5	10	20	25	30	35	40	45		
median		2.0	0.5	2.0	1.4	2.0	2.2	2.0	3.9		
average		1.5	0.5	3.6	1.4	2.7	3.5	4.5	3.9		
maximum		2.0	0.5	6.0	2.5	6.0	11.8	12.3	5.8		
minimum		0.5	0.5	2.0	0.3	1.5	0.1	0.8	2.0		
number		3	1	5	3	5	5	7	2		
pred. red.		1.0	1.3	1.7	1.9	2.2	2.4	2.6	2.8		
SIC		1946-1950 1951-1955 1961-1965 1966-1970 1971-1975 1976-1980 1981-1985 1986-1990 1946-1990									
24		1946-1950	1951-1955	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990	
year		5	10	20	25	30	35	40	45		
median		1.3	5.3	6.0	1.5	2.0	2.3	2.4	6.1	2.0	
average		1.3	5.3	4.4	1.5	2.9	4.6	5.3	6.1	3.5	
maximum		2.0	10.0	6.0	2.5	6.0	11.8	12.3	6.1	12.3	
minimum		0.5	0.5	1.3	0.3	1.5	2.0	1.4	6.1	0.3	
number		3	2	3	5	4	4	3	1	25	
SIC		1946-1950 1951-1955 1956-1960 1961-1965 1966-1970 1971-1975 1976-1980 1981-1985 1986-1990 1946-1990									
25		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	10	15	20	25	30	35	40	45	
median		1.6	0.5	4.0	2.0	1.4	2.0	2.2	2.0	1.2	2.0
average		1.4	0.5	4.0	3.5	1.4	2.5	3.7	3.1	1.2	2.6
maximum		2.0	0.5	4.0	6.0	2.5	6.0	11.8	12.3	2.0	12.3
minimum		0.5	0.5	4.0	1.3	0.3	1.5	0.1	1.4	0.3	0.1
number		4	1	1	5	5	6	7	9	2	40

SIC 26		1946-1950	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1946-1985
year		5	15	20	25	30	35	40	
median		2.0	3.0	6.0	1.5	2.0	2.3	2.4	2.0
average		1.8	3.0	4.8	1.5	2.7	1.9	5.8	3.0
maximum		2.0	4.0	6.0	3.4	6.0	2.5	12.3	12.3
minimum		1.3	1.9	1.3	0.3	1.5	0.1	2.0	0.1
number		3	2	4	6	5	6	5	31

SIC 27		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	10	15	20	25	30	35	40	45	
median		2.0	0.5	2.4	4.0	2.3	2.0	2.2	2.0	2.0	2.0
average		2.6	0.5	2.4	3.9	3.0	1.7	2.0	4.3	1.4	2.9
maximum		5.0	0.5	4.0	6.0	6.0	2.1	5.0	12.3	2.0	12.3
minimum		1.3	0.5	0.8	1.3	0.2	1.2	0.1	1.4	0.3	0.1
number		7	1	2	6	6	9	5	13	3	52

SIC 28		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	10	15	20	25	30	35	40	45	
median		2.0	0.5	2.0	4.0	1.4	2.0	2.5	2.0	2.0	2.0
average		2.1	0.5	2.2	3.9	1.9	1.7	4.7	3.8	3.0	2.9
maximum		5.0	0.5	4.0	6.0	6.0	2.1	11.8	12.3	4.9	12.3
minimum		0.5	0.5	0.8	1.3	0.2	1.2	2.0	0.2	2.0	0.2
number		9	1	4	8	6	9	5	16	3	61

SIC 29		1946-1950	1961-1965	1966-1970	1971-1975	1981-1985	1946-1985
year		5	20	25	30	40	
median		2.0	6.0	0.3	2.0	0.3	2.0
average		2.0	6.0	0.3	3.3	0.3	3.3
maximum		2.0	6.0	0.3	6.0	2.4	6.0
minimum		2.0	6.0	0.3	2.0	2.4	0.3
number		3	3	1	3	1	11

SIC 30		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	10	15	20	25	30	35	40	45	
median		2.0	1.3	3.0	2.2	1.5	1.5	2.3	2.0	3.5	2.0
average		4.1	1.3	3.0	3.3	1.5	2.1	5.8	3.1	3.5	3.4
maximum		10.0	2.0	4.0	6.0	2.5	6.0	39.2	12.3	5.0	39.2
minimum		1.3	0.5	2.0	1.3	0.3	1.2	0.1	0.2	2.0	0.1
number		5	2	2	6	5	9	10	11	2	52

SIC 31		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	10	15	20	25	30	35	40	45	
median		2.0	0.5	4.0	6.0	1.5	1.7	2.5	2.0	2.0	2.0
average		4.4	0.5	4.0	4.4	1.4	1.7	2.8	4.0	2.0	3.0
maximum		10.0	0.5	4.0	6.0	2.5	2.0	5.0	12.3	2.0	12.3
minimum		1.3	0.5	4.0	1.3	0.3	1.5	2.0	1.4	2.0	0.3
number		3	1	1	3	4	4	5	7	2	30

SIC 32		1946-1950	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	15	20	25	30	35	40	45	
median		2.0	4.0	6.0	0.9	1.7	2.6	2.0	2.0	2.0
average		1.9	5.6	4.3	2.0	2.1	3.0	3.8	2.0	3.0
maximum		2.0	10.6	6.0	6.0	6.0	5.0	12.3	2.0	12.3
minimum		1.3	2.0	1.3	0.2	0.1	2.0	2.0	2.0	0.1
number		5	3	5	4	8	4	6	1	36

SIC 33	1946-1950	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year	5	15	20	25	30	35	40	45	
median	1.8	2.4	6.0	1.5	2.0	2.1	2.2	2.0	2.0
average	1.5	2.4	4.3	2.0	3.3	2.0	3.1	3.3	2.7
maximum	2.0	4.0	6.0	6.0	10.0	2.5	12.3	5.8	12.3
minimum	0.2	0.8	1.3	0.2	1.3	0.8	0.2	2.0	0.2
number	8	2	5	7	8	6	10	3	49

SIC 34	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year	5	10	15	20	25	30	35	40	45	
median	2.0	0.5	1.4	4.0	1.5	2.0	2.5	2.0	5.0	2.0
average	1.8	0.5	2.1	3.9	1.5	3.7	5.7	2.8	4.3	3.4
maximum	4.0	0.5	4.0	6.0	2.5	16.9	39.2	10.3	5.8	39.2
minimum	0.5	0.5	0.8	1.3	0.3	1.3	0.2	0.2	2.0	0.2
number	11	1	3	6	6	12	14	16	3	72

SIC 35	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year	5	10	15	20	25	30	35	40	45	
median	2.0	0.5	4.0	2.0	1.5	2.0	2.1	2.0	2.0	2.0
average	2.7	0.5	5.1	3.6	1.5	2.6	3.0	3.4	2.0	2.9
maximum	10.0	0.5	10.6	6.0	2.5	10.0	11.8	12.3	2.0	12.3
minimum	0.5	0.5	0.8	1.3	0.3	0.2	0.1	0.2	2.0	0.1
number	11	1	3	7	6	13	10	18	1	70

SIC 36	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	
year	5	10	15	20	25	30	35	40	45	
median	2.0	0.5	2.0	2.0	1.4	1.5	2.5	2.0	5.8	
average	1.6	0.5	2.3	3.2	1.4	3.7	5.8	2.8	5.0	
maximum	2.0	0.5	4.0	6.0	2.5	25.0	39.2	12.3	6.1	
minimum	0.5	0.5	0.8	1.3	0.3	0.2	0.0	0.1	2.0	
number	9	1	3	9	5	13	15	16	5	
pred. red.	0.8	1.2	1.5	1.9	2.2	2.5	2.9	3.2	3.5	

SIC 37	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	
year	5	10	15	20	25	30	35	40	45	
median	2.0	1.4	2.0	2.2	1.5	2.0	2.5	2.0	5.0	
average	14.0	4.0	6.0	12.0	7.0	20.0	22.0	31.0	9.0	
maximum	10.0	10.0	4.0	6.1	5.2	25.0	39.2	12.3	6.5	
minimum	0.5	0.5	0.8	1.3	0.3	0.2	0.0	0.2	0.9	
number	14	4	6	12	7	20	22	31	9	
pred. red.	1.3	1.6	1.8	2.0	2.3	2.5	2.8	3.0	3.3	

SIC 38	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year	5	10	15	20	25	30	35	40	45	
median	1.8	0.5	2.4	4.0	1.4	1.7	2.5	2.0	3.9	2.0
average	2.3	0.5	2.4	3.9	1.4	2.1	3.0	3.3	3.9	2.7
maximum	10.0	0.5	4.0	6.0	2.5	6.0	11.8	12.3	5.8	12.3
minimum	0.2	0.5	0.8	1.3	0.3	1.2	0.1	0.8	2.0	0.1
number	10	1	2	6	5	10	12	13	2	61

SIC 39	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year	5	10	15	20	25	30	35	40	45	
median	1.5	0.5	2.4	6.0	0.9	1.7	2.2	2.0	2.0	2.0
average	1.5	0.5	2.4	4.3	0.9	2.4	4.1	2.7	2.0	2.6
maximum	2.0	0.5	4.0	6.0	1.4	6.0	11.8	10.0	2.0	11.8
minimum	0.5	0.5	0.8	1.3	0.3	1.3	0.1	0.2	2.0	0.1
number	7	1	2	5	2	6	4	9	1	37

SIC 40 & 45		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	10	15	20	25	30	35	40	45	
median		2.0	0.5	1.9	6.0	1.4	1.7	2.5	2.0	4.9	2.0
average		2.5	0.5	1.7	4.5	1.9	1.9	3.3	2.5	5.0	2.8
maximum		10.0	0.5	2.0	6.0	6.0	6.0	11.8	10.0	10.3	11.8
minimum		0.5	0.5	0.8	1.3	0.2	0.2	0.1	0.1	2.0	0.1
number		12	1	5	6	7	8	10	18	5	72

SIC 49,72,73,76		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	10	15	20	25	30	35	40	45	
median		2.1	0.5	2.0	6.0	1.5	2.0	2.0	2.0	2.0	2.0
average		2.4	0.5	2.3	4.4	2.0	3.0	2.1	3.6	2.0	2.9
maximum		5.0	0.5	4.0	6.0	6.0	6.0	2.2	12.3	2.0	12.3
minimum		2.0	0.5	0.8	2.0	0.2	1.3	2.0	0.2	2.0	0.2
number		7	1	3	5	6	10	3	10	1	46

SIC 80		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year		5	10	15	20	25	30	35	40	45	
median		2.0	0.5	2.0	6.0	1.4	2.0	2.3	2.0	2.0	2.0
average		3.1	0.5	2.5	5.4	2.0	2.4	3.2	3.6	2.0	3.1
maximum		10.0	0.5	4.0	10.0	6.0	6.0	11.8	12.3	2.0	12.3
minimum		0.1	0.5	2.0	2.0	0.2	1.5	0.1	0.2	2.0	0.1
number		10	1	4	7	7	8	8	15	2	62

Table V
Fold Reductions for All Carcinogens
(For 5-year intervals from 1946)

	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1946-1990
year	5	10	15	20	25	30	35	40	45	
median	2.0	2.0	2.0	5.0	5.7	1.5	2.5	2.2	4.7	2.4
average	4.3	334.3	1.6	781.1	6.7	1.7	8.9	3.5	15.2	104.8
maximum	25.0	1000.0	2.0	10000.0	12.8	6.0	50.0	11.1	100.0	10000.0
minimum	0.2	0.8	0.8	2.0	2.5	0.2	0.0	0.1	0.4	0.0
number	11.0	3.0	5.0	13.0	4.0	15.0	21.0	27.0	13.0	112

Median Fold Reductions for Carcinogens

m	0.029533	2.328333 b
se	0.042529	1.196632
R2	0.064449	1.647157
F	0.482221	7 df
	1.308327	18.99187
m/se	0.694422	
t - CV	1.89	

Table VI
Interval Between Changes in All TLVs
(For 5-year intervals from 1946)

	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
years	10	15	20	25	30	35	40	45
median	7	11	13	9	15	13.5	15	13
average	7.0	9.9	10.4	11.5	15.0	17.1	16.3	15.9
maximum	8	14	17	24	27	34	36	40
minimum	6	1	1	1	2	1	1	1
number	5	12	41	31	44	50	80	36
pred. inter	9.2	10.0	10.8	11.6	12.5	13.3	14.1	15.0

Median Interval change

m	0.165476	7.511905 b
se	0.067221	2.002566
r2	0.502484	2.178197
F	6.059906	6 df
	28.75149	28.46726
m/se	2.461688	
t - CV	1.94	

Table VII Interval Between Reductions By SIC Code

SIC 15	1951-1955	1956-1960	1961-1965	1976-1980	1981-1985
year	10	15	20	35	40
median	8.0	11.0	9.0	23.0	18.0
average	8.0	11.0	9.0	23.0	18.0
maximum	8.0	11.0	9.0	23.0	18.0
minimum	8.0	11.0	9.0	23.0	8.0
number	1	1	1	1	2
pred. inter	7.7	9.9	12.0	18.6	20.8

SIC 17	1966-1970	1971-1975	1976-1980	1981-1985
year	25	30	35	40
median	22.5	15.0	9.0	7.0
average	22.5	19.0	11.4	7.0
maximum	24.0	27.0	30.0	8.0
minimum	21.0	15.0	2.0	6.0
number	2	3	5	2
pred. inter.	21.3	16.0	10.8	5.5

SIC 20 & 21	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	2.0	8.0	10.5	14.5	15.0	15.0	9.0	18.5	35.0
average	1.8	8.0	10.5	13.0	13.3	13.0	9.0	15.5	36.7
maximum	2.0	8.0	11.0	17.0	21.0	15.0	9.0	24.0	40.0
minimum	1.0	8.0	10.0	2.0	4.0	9.0	9.0	1.0	35.0
number	4.0	2.0	2.0	6.0	3.0	5.0	1.0	4.0	3.0
pred. inter		6.8	9.4	11.9	14.4	17.0	19.5	22.0	24.5

SIC 22	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	2.0	6.0	11.0	15.0	21.0	19.0	7.0	10.5	7.0
average	1.8	6.0	11.0	15.4	17.2	17.5	12.5	15.0	7.0
maximum	4.0	6.0	11.0	17.0	24.0	27.0	30.0	34.0	7.0
minimum	1.0	1.0	11.0	13.0	4.0	9.0	2.0	1.0	7.0
number	9	1	2	7	5	7	7	14	1

SIC 23	1946-1950	1951-1955	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	20	25	30	35	40	45
median	2.0	6.0	16.0	15.0	15.0	6.0	13.0	23.5
average	2.7	6.0	16.0	14.3	15.4	13.4	16.4	23.5
maximum	4.0	6.0	17.0	24.0	27.0	30.0	34.0	40.0
minimum	2.0	6.0	15.0	4.0	9.0	2.0	5.0	7.0
number	3	1	5	3	5	5	7	2

SIC 24	1946-1950	1951-1955	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	20	25	30	35	40	45
median	2.0	6.0	15.0	21.0	18.0	17.5	13.0	35.0
average	2.0	6.0	15.0	18.4	16.5	18.8	16.7	35.0
maximum	2.0	8.0	17.0	24.0	27.0	34.0	29.0	35.0
minimum	2.0	4.0	13.0	4.0	9.0	6.0	8.0	35.0
number	3	2	3	5	4	4	3	1
pred. inter		7.8	13.1	15.7	18.3	20.9	23.5	26.2

SIC 25	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	2.5	6.0	11.0	15.0	21.0	15.0	9.0	14.0	23.5
average	2.3	6.0	11.0	15.2	17.2	15.4	15.9	17.1	23.5
maximum	4.0	6.0	11.0	17.0	24.0	27.0	30.0	34.0	40.0
minimum	1.0	6.0	11.0	13.0	4.0	9.0	2.0	5.0	7.0
number	4	1	1	5	5	6	7	9	2

SIC 26	1946-1950	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985
year	5	15	20	25	30	35	40
median	2.0	11.0	15.0	2.5	9.0	10.0	10.5
average	2.0	11.0	15.0	2.5	13.7	17.3	12.0
maximum	2.0	11.0	15.0	4.0	27.0	34.0	24.0
minimum	2.0	11.0	15.0	1.0	5.0	8.0	3.0
number	3	2	4	6	5	6	5

SIC 27	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	2.1	6.0	11.0	15.0	10.5	15.0	6.0	10.5	19.0
average	1.7	6.0	11.0	15.2	11.8	16.7	14.4	14.3	22.0
maximum	2.0	6.0	11.0	17.0	24.0	27.0	30.0	34.0	40.0
minimum	1.0	6.0	11.0	13.0	3.0	5.0	2.0	3.0	7.0
number	7	1	2	6	6	9	5	13	3

SIC 28	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	2.0	6.0	11.0	15.0	12.5	16.0	26.0	17.0	9.0
average	1.9	6.0	10.8	15.4	12.5	19.1	21.0	16.4	11.7
maximum	4.0	6.0	11.0	17.0	22.0	27.0	30.0	34.0	19.0
minimum	1.0	6.0	10.0	13.0	3.0	9.0	9.0	1.0	7.0
number	9	1	4	8	6	9	5	16	3

SIC 29	1946-1950	1961-1965	1966-1970	1971-1975	1981-1985
year	5	20	25	30	40
median	2.0	15.0	4.0	15.0	13.0
average	2.0	15.7	4.0	17.0	13.0
maximum	2.0	17.0	4.0	27.0	13.0
minimum	2.0	15.0	4.0	9.0	13.0
number	3	3	1	3	1

SIC 30	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	1.0	6.5	10.5	15.0	21.0	15.0	8.0	13.0	19.5
average	1.4	6.5	10.5	14.3	17.4	17.6	12.0	13.7	19.5
maximum	2.0	7.0	11.0	17.0	24.0	27.0	30.0	29.0	32.0
minimum	1.0	6.0	10.0	9.0	4.0	1.0	2.0	1.0	7.0
number	5	2	2	6	5	9	10	11	2

SIC 31	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	2.0	6.0	11.0	15.0	18.0	18.0	10.0	8.0	9.0
average	1.7	6.0	11.0	15.0	16.0	16.5	17.0	12.4	9.0
maximum	2.0	6.0	11.0	17.0	24.0	27.0	30.0	29.0	11.0
minimum	1.0	6.0	11.0	13.0	4.0	9.0	6.0	2.0	7.0
number	3	1	1	3	4	4	5	7	2

SIC 32	1946-1950	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	15	20	25	30	35	40	45
median	2.0	11.0	15.5	11.5	15.0	12.5	16.0	19.0
average	1.8	11.7	15.5	11.8	15.1	16.0	15.7	19.0
maximum	2.0	14.0	17.0	21.0	27.0	30.0	24.0	19.0
minimum	1.0	10.0	13.0	3.0	9.0	9.0	6.0	19.0
number	5	3	5	4	8	4	6	1
pred. inter		11.6	12.5	13.4	14.4	15.3	16.2	17.1

SIC 33	1946-1950	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	15	20	25	30	35	40	45
median	2.0	11.0	14.5	18.0	15.0	9.0	11.0	19.0
average	1.9	11.0	14.8	15.5	15.0	11.3	14.4	26.0
maximum	3.0	11.0	16.0	24.0	27.0	30.0	34.0	40.0
minimum	1.0	11.0	13.0	3.0	9.0	3.0	1.0	19.0
number	8	2	5	7	8	6	10	3

SIC 34	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	1.0	6.0	11.0	15.0	18.5	15.0	8.5	20.0	11.0
average	1.6	6.0	10.3	15.2	17.8	14.3	13.3	18.2	19.3
maximum	4.0	6.0	11.0	17.0	24.0	27.0	30.0	34.0	40.0
minimum	1.0	6.0	9.0	13.0	4.0	1.0	1.0	1.0	7.0
number	11	1	3	6	6	12	14	16	3

SIC 35	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	1.0	6.0	11.0	15.0	18.5	15.0	8.5	8.5	7.0
average	1.6	6.0	12.0	15.4	17.8	14.9	13.0	12.9	7.0
maximum	4.0	6.0	14.0	17.0	24.0	27.0	30.0	34.0	3
minimum	1.0	6.0	1.0	13.0	4.0	5.0	2.0	1.0	7.0
number	11	1	3	7	6	13	10	18	1

SIC 36	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	2.0	6.0	11.0	15.0	21.0	15.0	10.0	14.5	17.0
average	1.8	6.0	10.7	14.2	17.2	14.1	16.5	15.6	19.6
maximum	4.0	6.0	11.0	17.0	24.0	27.0	34.0	34.0	40.0
minimum	1.0	6.0	10.0	5.0	4.0	1.0	2.0	1.0	7.0
number	9	1	3	9	5	13	15	16	5

SIC 37	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	1.0	6.5	11.0	15.0	15.0	15.0	9.5	13.0	12.0
average	1.5	6.8	10.8	12.0	14.0	15.0	14.0	14.1	18.1
maximum	4.0	8.0	13.0	17.0	24.0	27.0	34.0	34.0	40.0
minimum	1.0	6.0	9.0	1.0	4.0	1.0	1.0	1.0	3.0
number	14	4	6	12	7	20	22	31	9

SIC 38	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	2.0	6.0	11.0	15.0	21.0	15.0	12.5	13.0	23.5
average	1.9	6.0	11.0	15.2	17.2	14.7	16.8	15.6	23.5
maximum	4.0	6.0	11.0	17.0	24.0	27.0	34.0	34.0	40.0
minimum	1.0	6.0	11.0	13.0	4.0	5.0	2.0	3.0	7.0
number	10	1	2	6	5	10	12	13	2
pred. inter		9.7	11.1	12.5	13.9	15.3	16.8	18.2	19.6

SIC 39	1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year	5	10	15	20	25	30	35	40	45
median	2.0	6.0	11.0	15.0	9.5	15.0	16.0	13.0	7.0
average	2.0	6.0	11.0	15.0	9.5	16.2	16.0	15.8	7.0
maximum	4.0	6.0	11.0	17.0	15.0	27.0	30.0	34.0	7.0
minimum	1.0	6.0	11.0	13.0	4.0	9.0	2.0	1.0	7.0
number	7	1	2	5	2	6	4	9	1

SIC 40 & 45		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year		5	10	15	20	25	30	35	40	45
median		1.5	6.0	11.0	15.0	19.0	15.0	16.0	15.0	9.0
average		1.7	6.0	10.8	15.6	15.4	13.1	16.5	17.6	16.4
maximum		4.0	6.0	11.0	17.0	24.0	27.0	30.0	37.0	40.0
minimum		1.0	6.0	10.0	13.0	3.0	2.0	2.0	1.0	7.0
number		12	1	5	6	7	8	10	18	5

SIC 49,72,73,76		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year		5	10	15	20	25	30	35	40	45
median		2.0	6.0	11.0	15.0	17.0	15.0	6.0	10.5	19.0
average		1.7	6.0	10.7	15.6	14.3	14.3	7.0	13.8	19.0
maximum		2.0	6.0	11.0	17.0	24.0	27.0	9.0	29.0	19.0
minimum		1.0	6.0	10.0	15.0	3.0	5.0	6.0	1.0	19.0
number		7	1	3	5	6	10	3	10	1

SIC 80		1946-1950	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990
year		5	10	15	20	25	30	35	40	45
median		2.0	6.0	11.5	14.7	19.0	15.0	5.0	7.0	13.0
average		1.8	6.0	11.3	13.6	15.4	18.3	13.1	11.6	13.0
maximum		4.0	6.0	13.0	17.0	24.0	27.0	30.0	29.0	19.0
minimum		1.0	6.0	10.0	2.0	3.0	9.0	2.0	1.0	7.0
number		10	1	4	7	7	8	8	15	2

Table VIII
Interval Between Reductions for All Carcinogens
(For 5-year intervals from 1951)

	1951-1955	1956-1960	1961-1965	1966-1970	1971-1975	1976-1980	1981-1985	1986-1990	1951-1990
year	10	15	20	25	30	35	40	45	
median	6.5	11.0	10.0	5.5	15.5	30.0	19.0	11.5	15.0
average	6.5	10.8	9.5	6.8	17.2	23.2	18.5	13.9	16.4
maximum	7.0	13.0	17.0	12.0	27.0	34.0	35.0	39.0	39.0
minimum	6.0	9.0	2.0	4.0	9.0	4.0	5.0	3.0	2.0
number	2.0	5.0	12.0	4.0	14.0	21.0	24.0	14.0	96

Median Interval between Reductions for Carcinogens

m	0.345238	4.130952 b
se	0.224219	6.679684
R2	0.283222	7.265514
F	2.370795	6 df
	125.1488	316.7262
m/se	1.539739	
t - CV	1.94	

Rate of Fold Reduction for all TLVs

Table IX

	median fold = 2		% change		200			
year	10	15	20	25	30	35	40	45
pred. inter	9.2	10.0	10.8	11.6	12.5	13.3	14.1	15.0
% per yr	21.7	20.0	18.5	17.2	16.0	15.0	14.2	13.3

% reduction per year = % fold change/predicted interval

example: 21.7 % per year = 200/9.2

Rate of Fold Reduction for Known or Suspected Carcinogens

	1951-1990	median fold = 2.4
total years	35	% change 240
med. inter.	15.0	
% per yr	16.0	

Table X
Rate of Fold Reductions Over Time By SIC Code
(For series with a significant linear trend)

SIC 15					median fold = 3.8		
year	10	15	20	35	40	% change 380	
interval	7.7	9.9	12	18.6	20.8		
% per yr	49.4	38.4	31.7	20.4	18.3		
SIC 17					median fold = 2		
year	25	30	35	40	% change 200		
interval	22.5	15	9	7			
% per yr	8.9	13.3	22.2	28.6			
SIC 20, 21					median fold = 2		
year	10	15	20	25	30	35	200
interval	6.8	9.4	11.9	14.4	17.0	19.5	40
% per yr	29.4	21.3	16.8	13.9	11.8	10.3	22.0
							9.1
							8.2
SIC 23							
year	10	20	25	30	35	40	45
pred. fold	130	170	190	220	240	260	280
interval	15.0	15.0	15.0	15.0	15.0	15.0	15.0
% per yr	8.7	11.3	12.7	14.7	16.0	17.3	18.7
SIC 24					median fold = 2		
year	10	20	25	30	35	40	200
interval	7.8	13.1	15.7	18.3	20.9	23.5	
% per yr	25.6	15.3	12.7	10.9	9.6	8.5	
SIC 32					median fold = 2		
year	15	20	25	30	35	40	200
interval	11.6	12.5	13.4	14.4	15.3	16.2	45
% per yr	17.2	16.0	14.9	13.9	13.1	12.3	17.1
							11.7
SIC 36							
year	10	15	20	25	30	35	40
pred. fold	120	150	190	220	250	290	320
interval	10.6	11.5	12.4	13.3	14.1	15.0	15.9
% per yr	11.3	13.0	15.3	16.5	17.7	19.3	20.1
							20.8
SIC 37							
year	10	15	20	25	30	35	40
Pred. fold	160	180	200	230	250	280	300
interval	13	13	13	13	13	13	13
% per yr	12.3	13.8	15.4	17.7	19.2	21.5	23.1
							25.4
SIC 38					median fold = 2		
year	10	15	20	25	30	35	200
interval	9.7	11.1	12.5	13.9	15.3	16.8	40
% per yr	20.6	18.0	16.0	14.4	13.1	11.9	18.2
							19.6
							10.2

Table XI
Rate of Fold Reductions Over Time By SIC Code
(For series without a significant linear trend)

SIC	22	25	26	27	28	29	30	31
year	1951-1990	1951-1990	1951-1985	1951-1990	1951-1990	1961-1985	1951-1990	1951-1990
med. fold	2	2	2	2	2	2	2	2
% fold	200	200	200	200	200	200	200	200
med. inter	15	15	11.5	13	15	15	15	15
% per yr	13.3	13.3	17.4	15.4	13.3	13.3	13.3	13.3

SIC	33	34	35	39	40 & 45	49,72,73,76	80
year	1956-1990	1951-1990	1951-1990	1951-1990	1951-1990	1951-1990	1951-1990
med. fold	2	2	2	2	2	2	2
% fold	200	200	200	200	200	200	200
med. inter	15	15	13	15	15	15	13
% per yr	13.3	13.3	15.4	13.3	13.3	13.3	15.4

Table XII**1992 Changes in TLVs**

Chemical	Fold	Age (y)	Carcinogen
Caprolatum	0.9	18	
Carbon monoxide	2.0	25	
o-Dichlorobenzene	0.3	29	
1,1 Dichloroethane	2.0	19	
Dimethylamine	2.0	26	
Dinitrotoluene	10.0	46	y
Ethylbromide	40.5	45	y
Formaldehyde	20.0	7	y
Kaolin	5.0	21	
Methylamine	2.0	25	
Toluene	2.0	19	
Trimethylamine	2.0	9	
median fold non-carc.	2.0		
median fold carc.	20.0		
median fold 12 TLVs	2.0		
average age carc.	32.7		
average age 12 TLVs	24.1		
average age non-carc	21.2		

FIGURES

Figure 1
Fold Reductions in All TLVs
(For 5-year intervals from 1946)

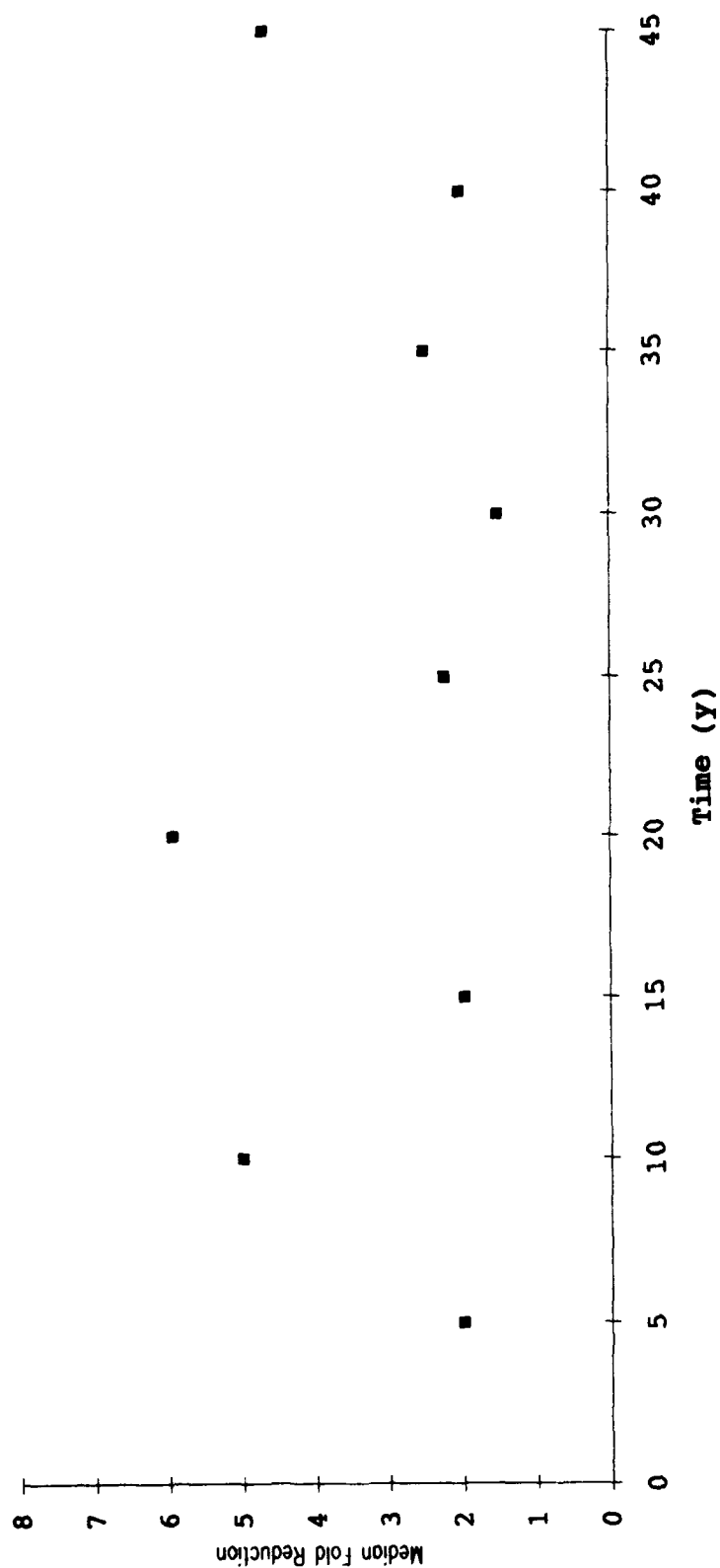


Figure 2
Fold Reductions in TLVs for SIC 15
(For 5 year intervals from 1946)

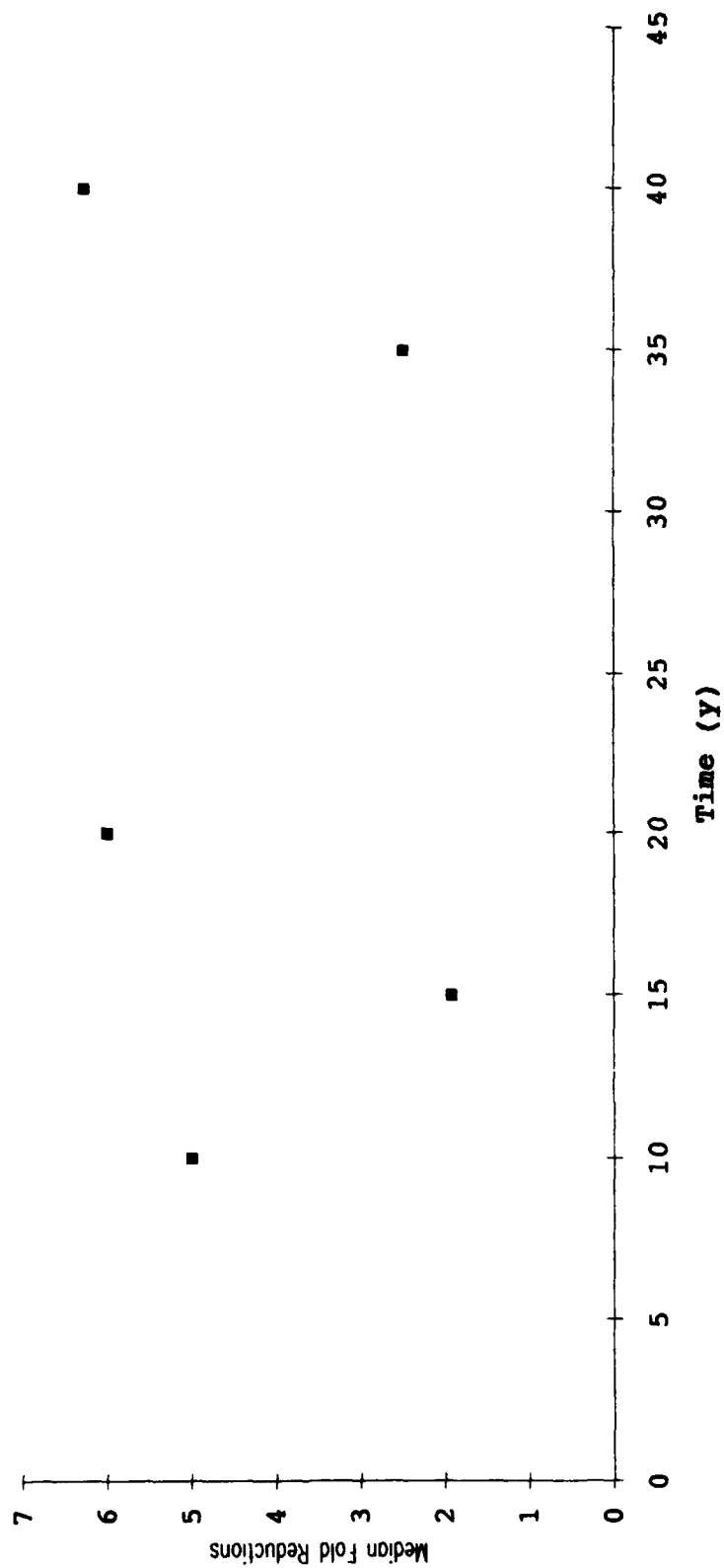


Figure 3
Fold Reductions in TLVs for SIC 17
(For 5 year intervals from 1946)

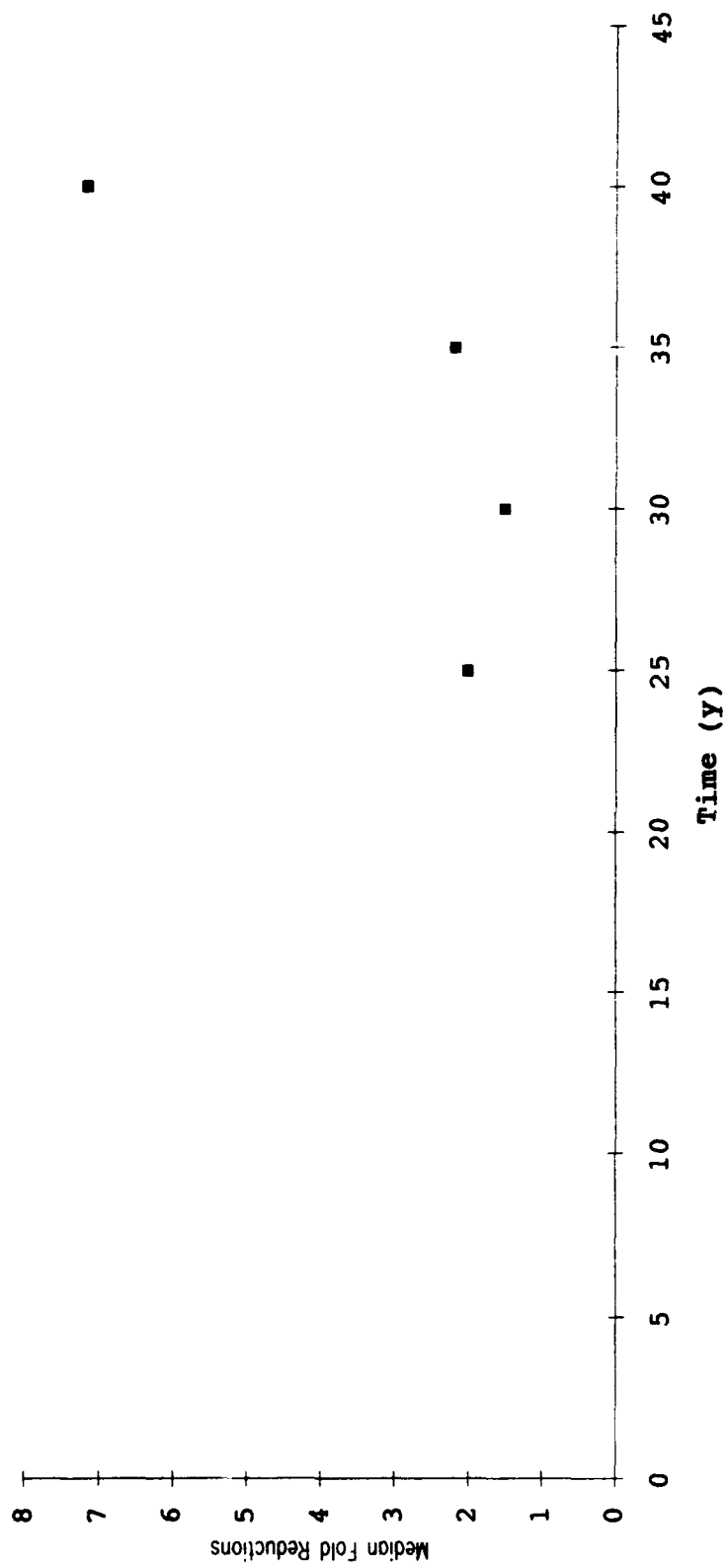


Figure 4
Fold reductions in TLVs for SICs 20 & 21
(For 5 year intervals from 1946)

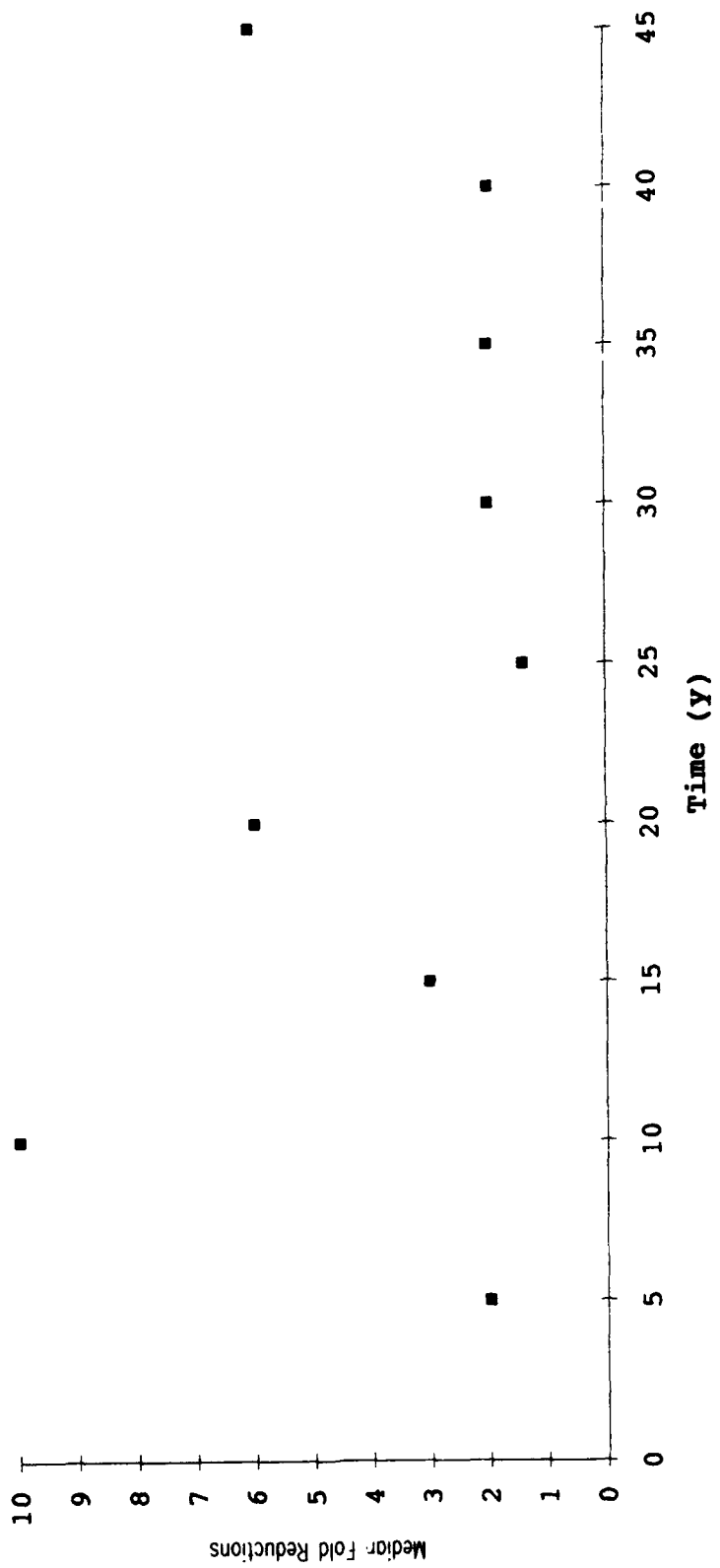


Figure 5
Fold Reductions in TLVs for SIC 22
(For 5 year intervals from 1946)

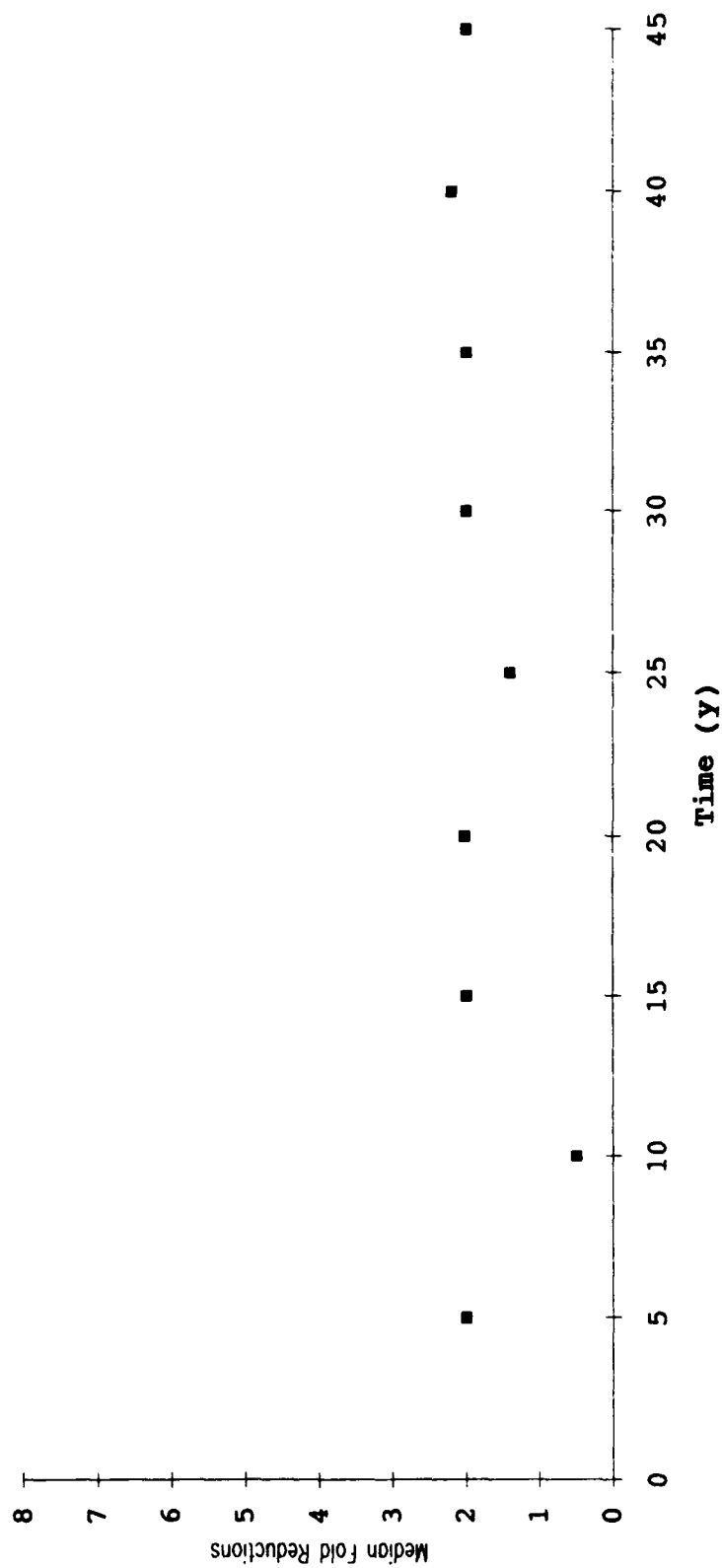


Figure 6
Fold Reductions in TLVs for SIC 23
(For 5 year intervals from 1946)

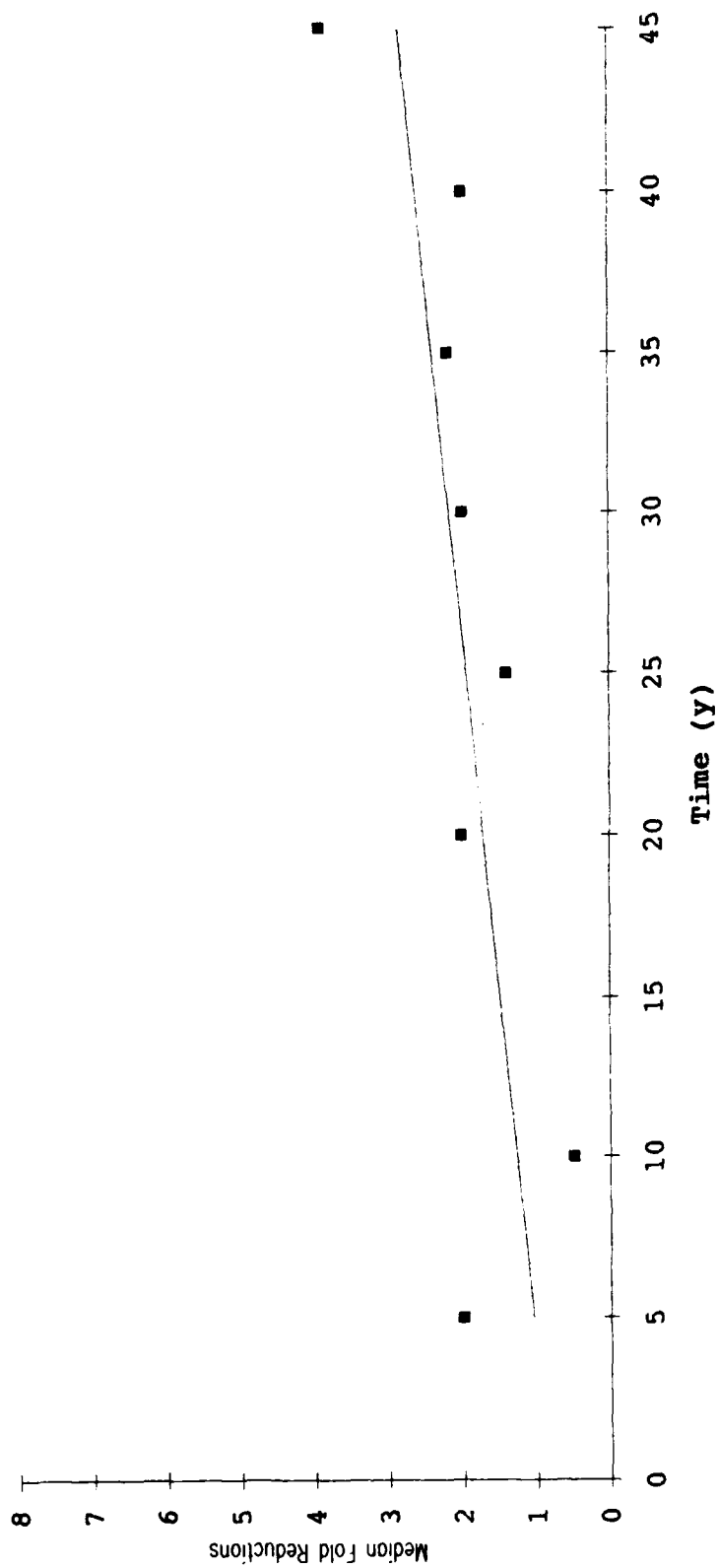


Figure 7
Fold Reductions in TLVs for SIC 24
(For 5 year intervals from 1946)

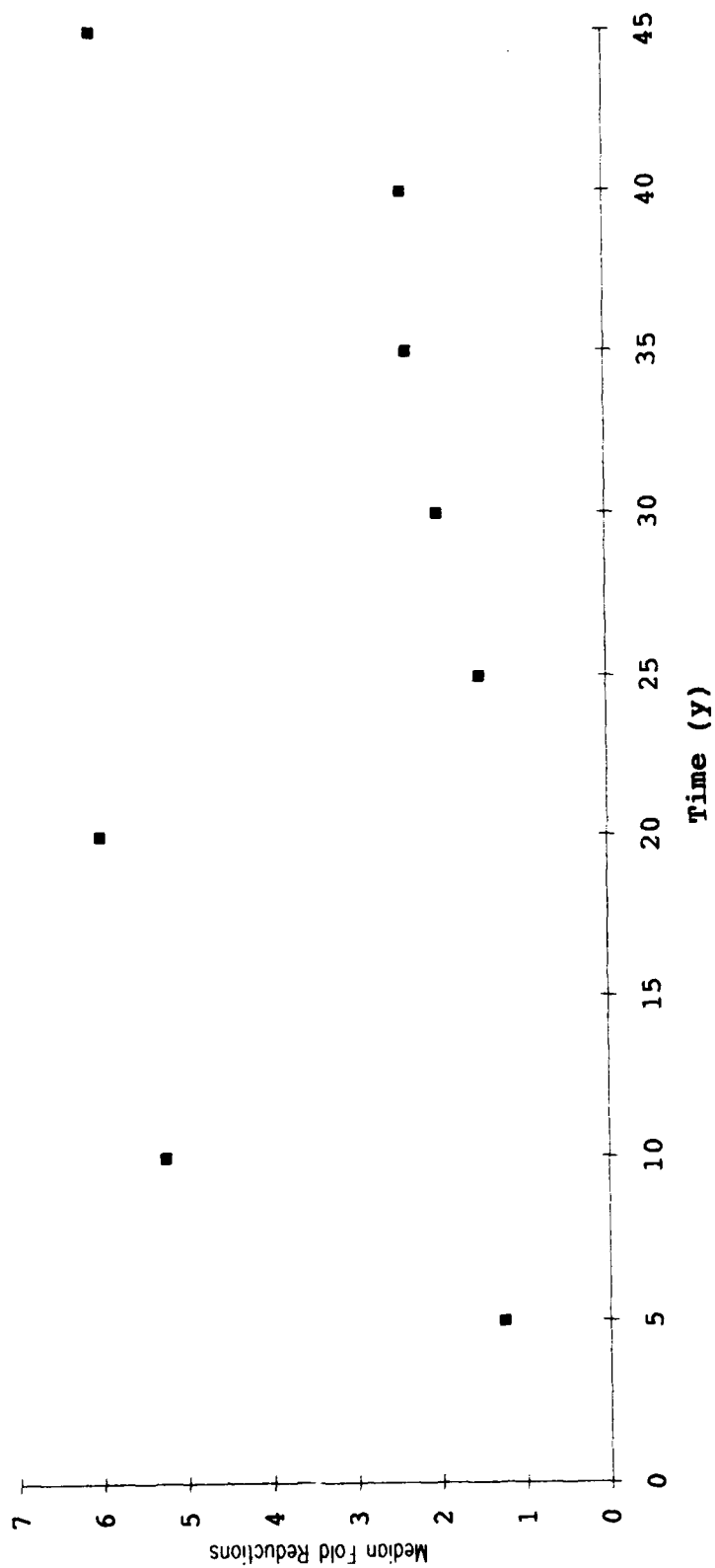


Figure 8
Fold Reductions in TLVs for SIC 25
(For 5 year intervals from 1946)

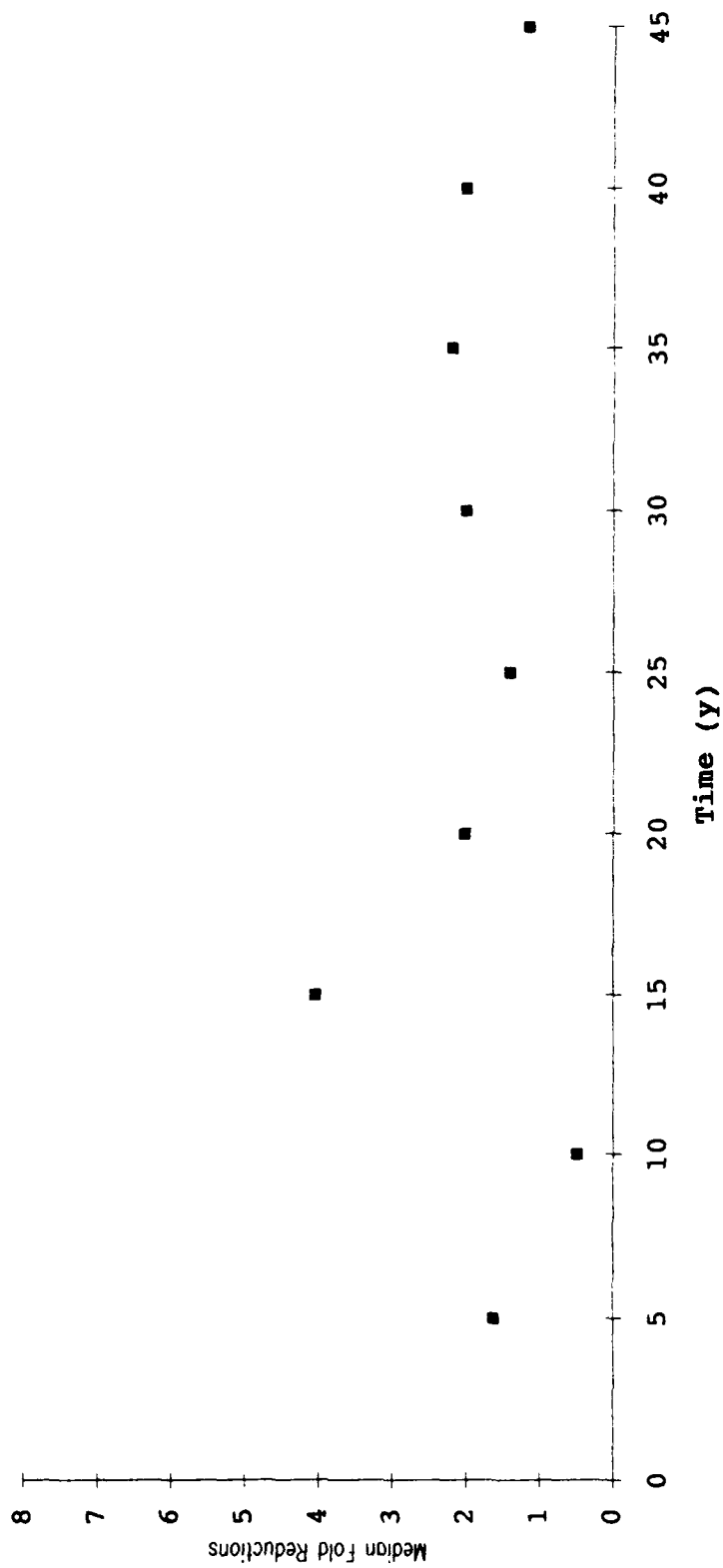


Figure 9
Fold Reductions in TLVs for SIC 26
(For 5 year intervals from 1946)

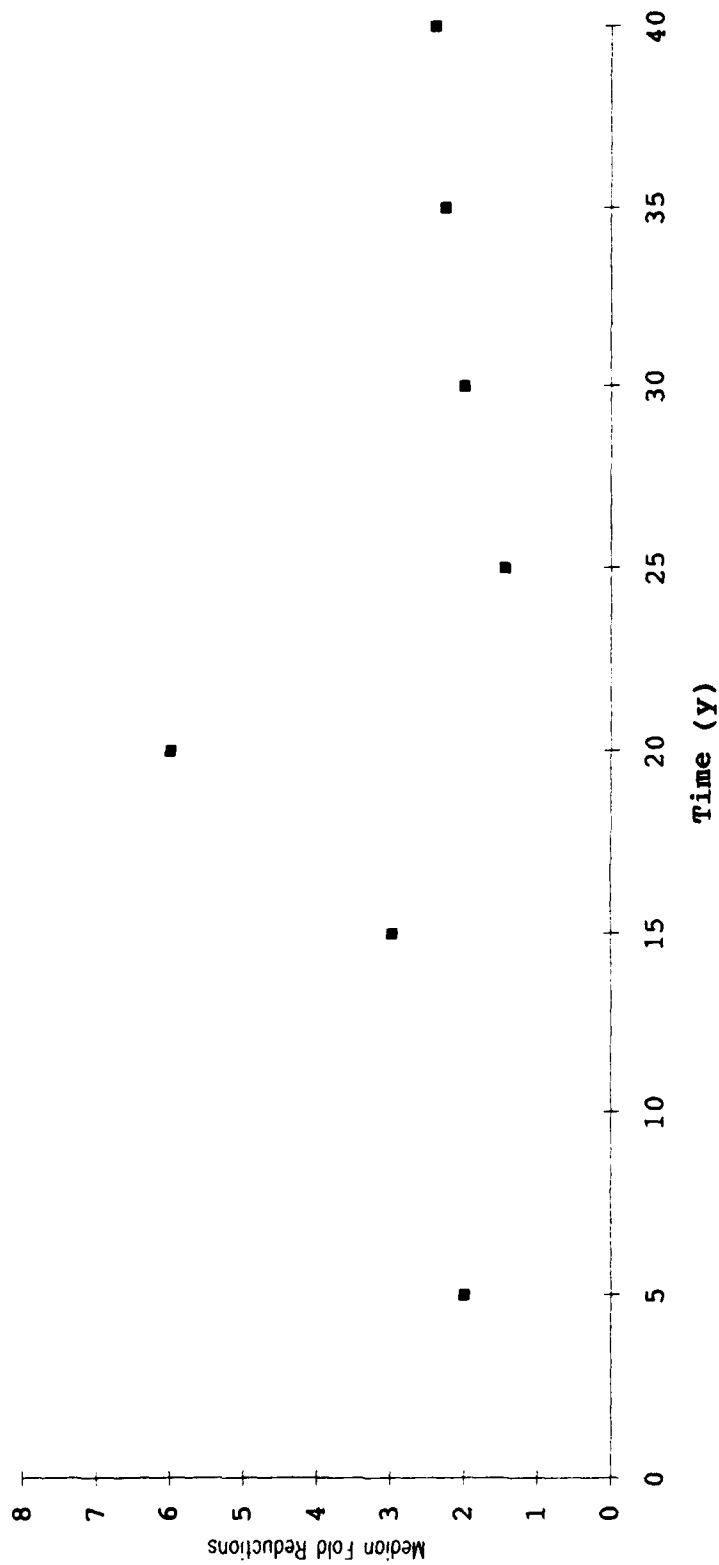


Figure 10
Fold Reductions in TLVs for SIC 27
(For 5 year intervals from 1946)

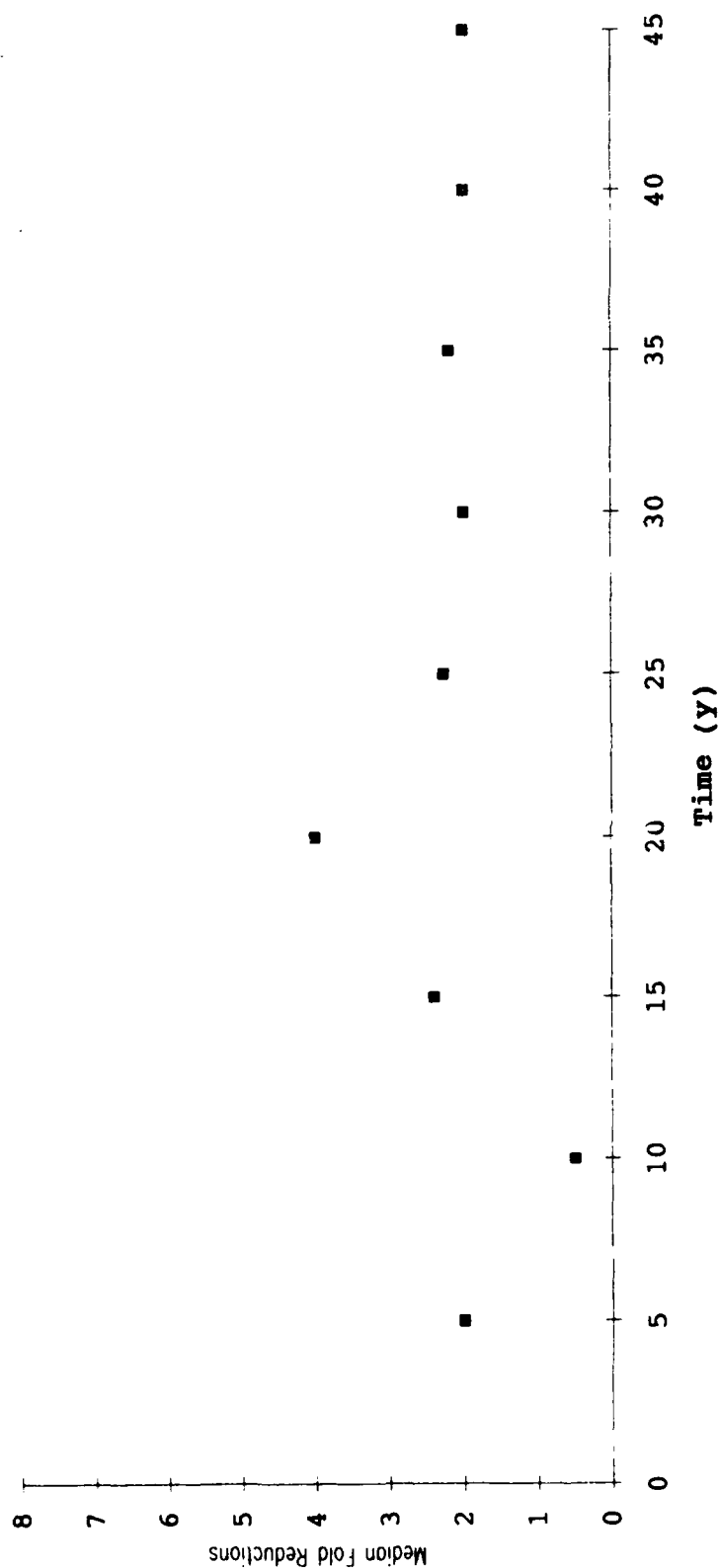


Figure 11
Fold Reductions in TLVs for SIC 28
(For 5 year intervals from 1946)

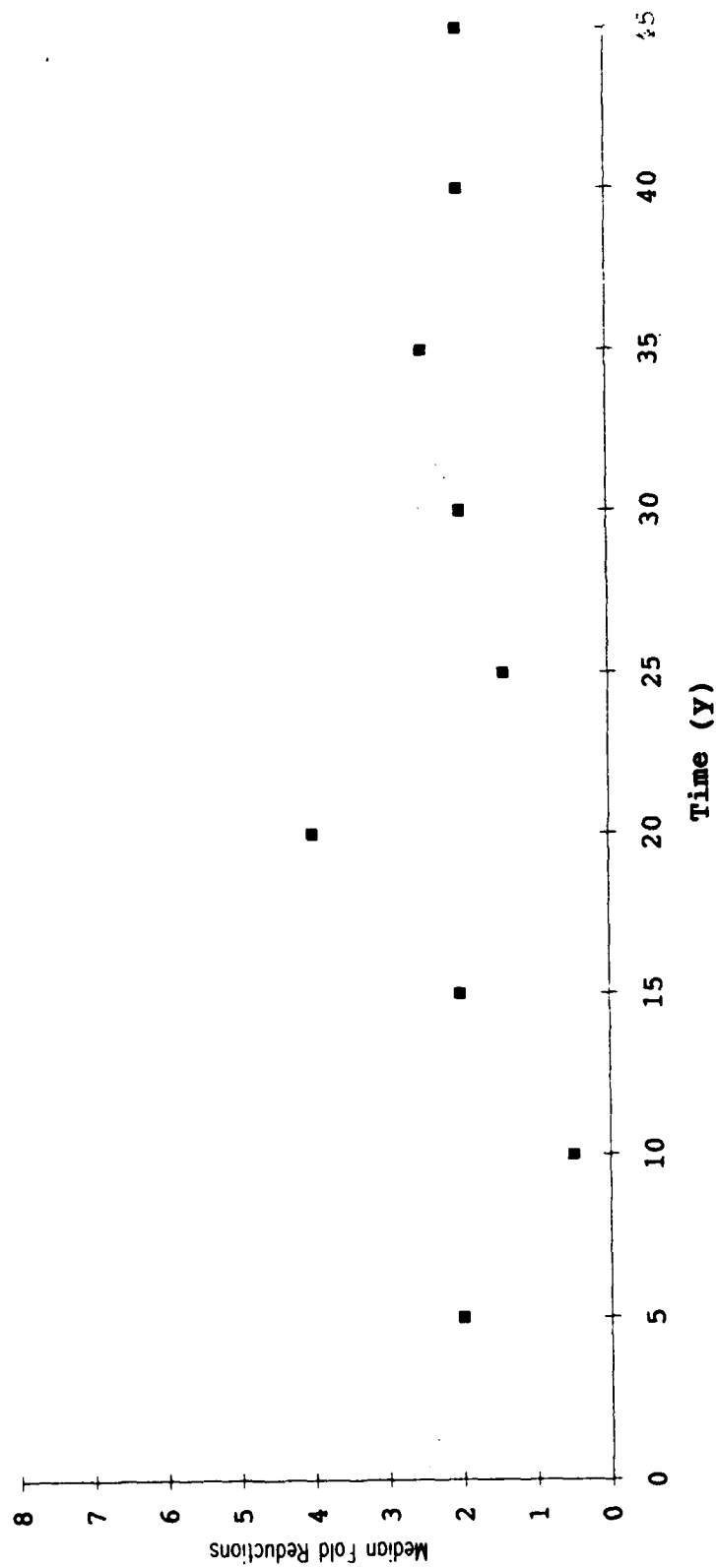


Figure 12
Fold Reductions in TLVs for SIC 29
(For 5 year intervals from 1946)

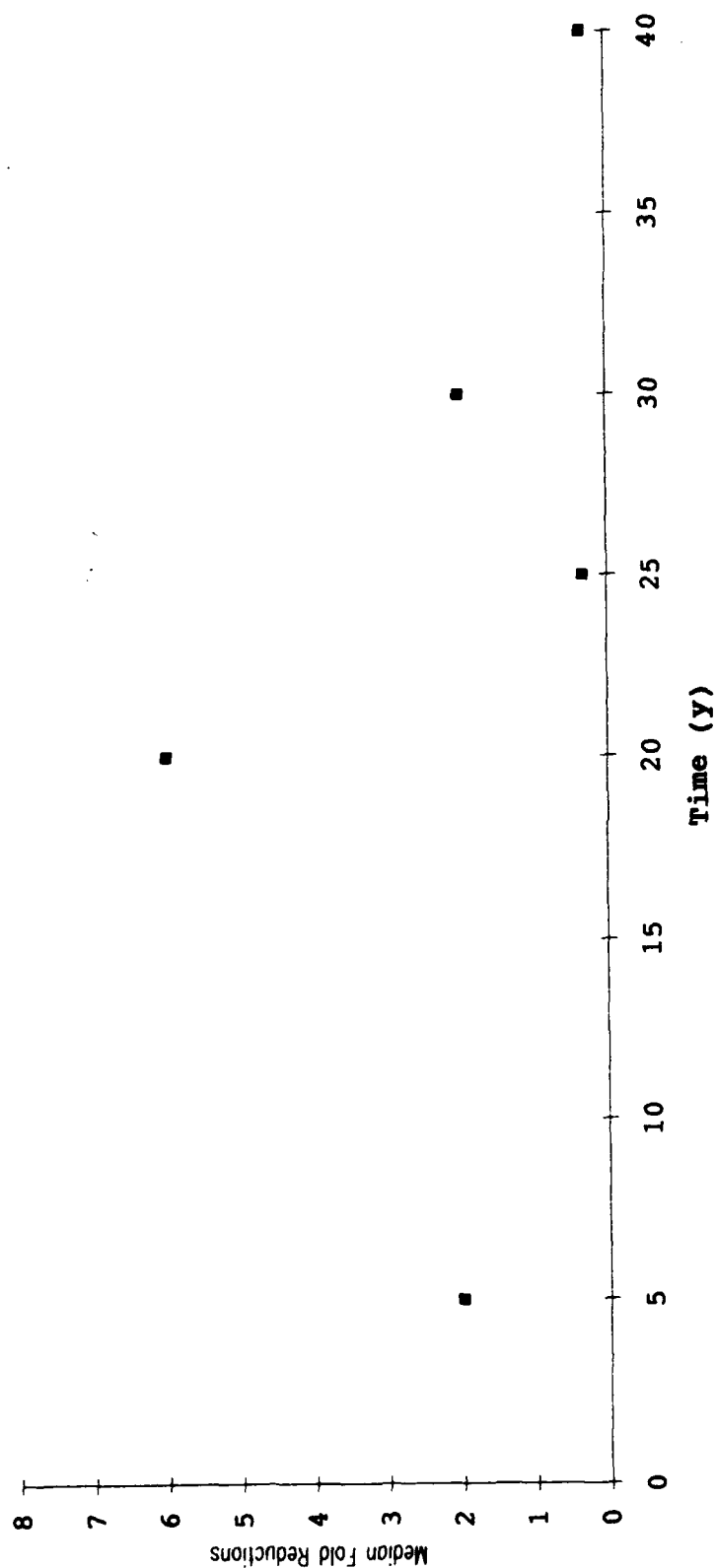


Figure 14
Fold Reductions in TLVs for SIC 31
(For 5 year intervals from 1946)

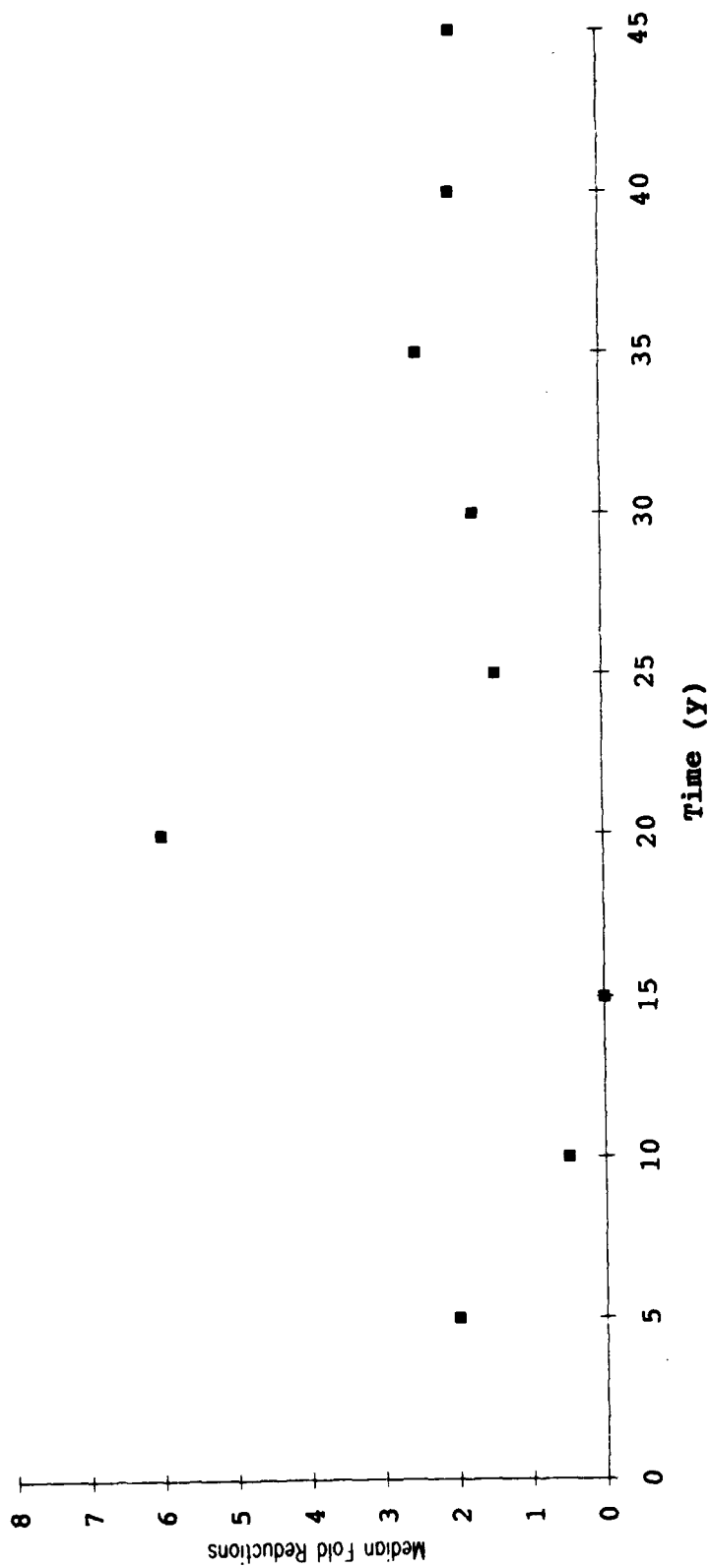


Figure 15
Fold Reductions in TLVs for SIC 32
(For 5 year intervals from 1946)

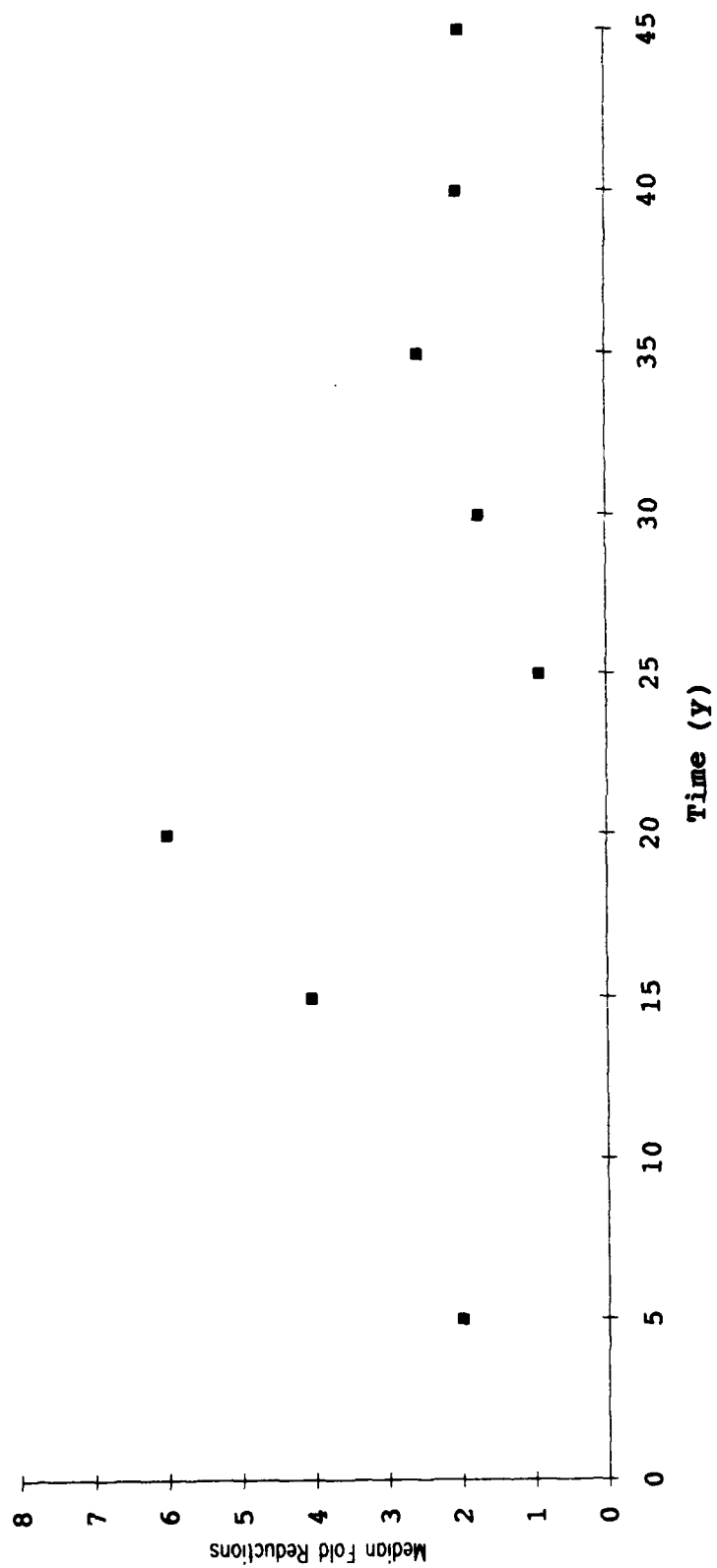


Figure 16
Fold Reductions in TLVs for SIC 33
(For 5 year intervals from 1946)

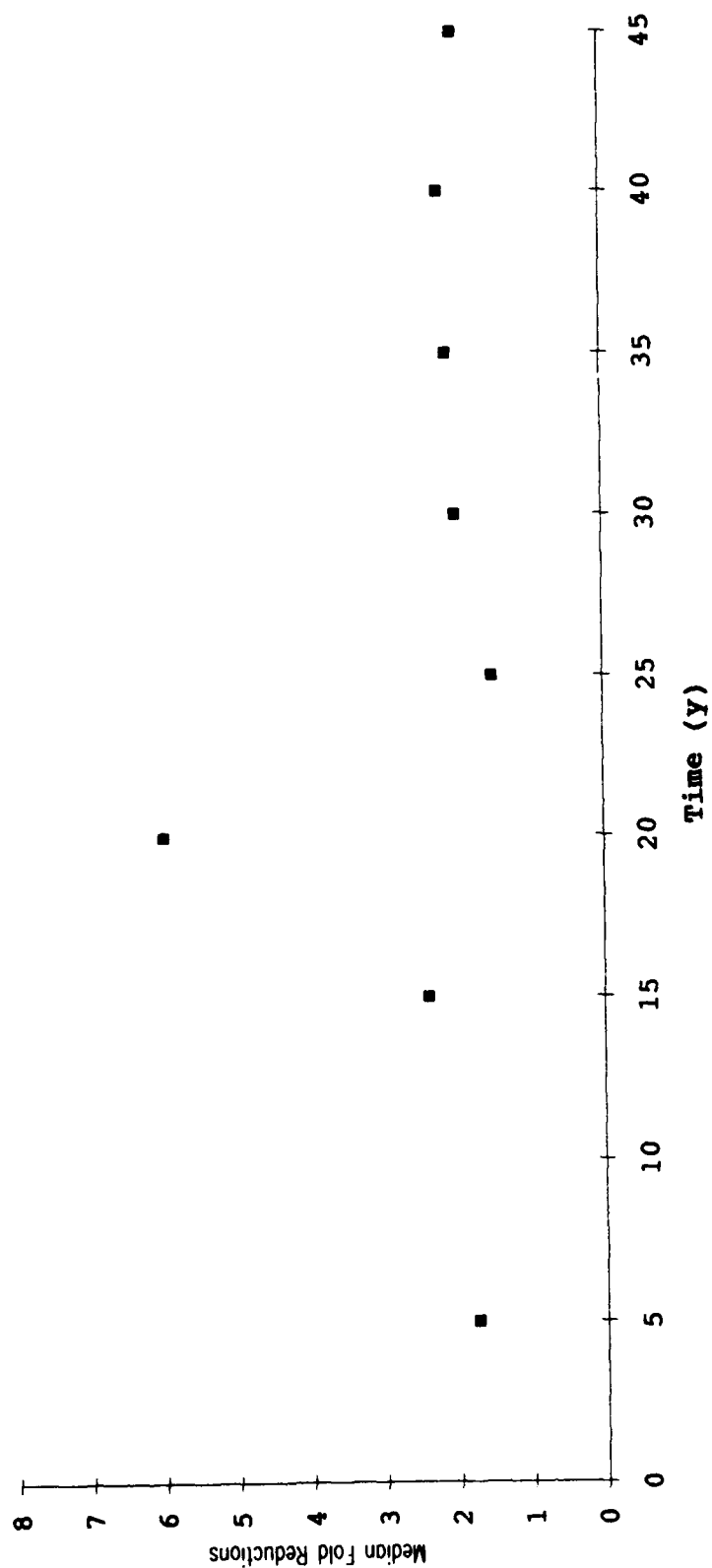


Figure 17
Fold Reductions in TLVs for SIC 34
(For 5 year intervals from 1946)

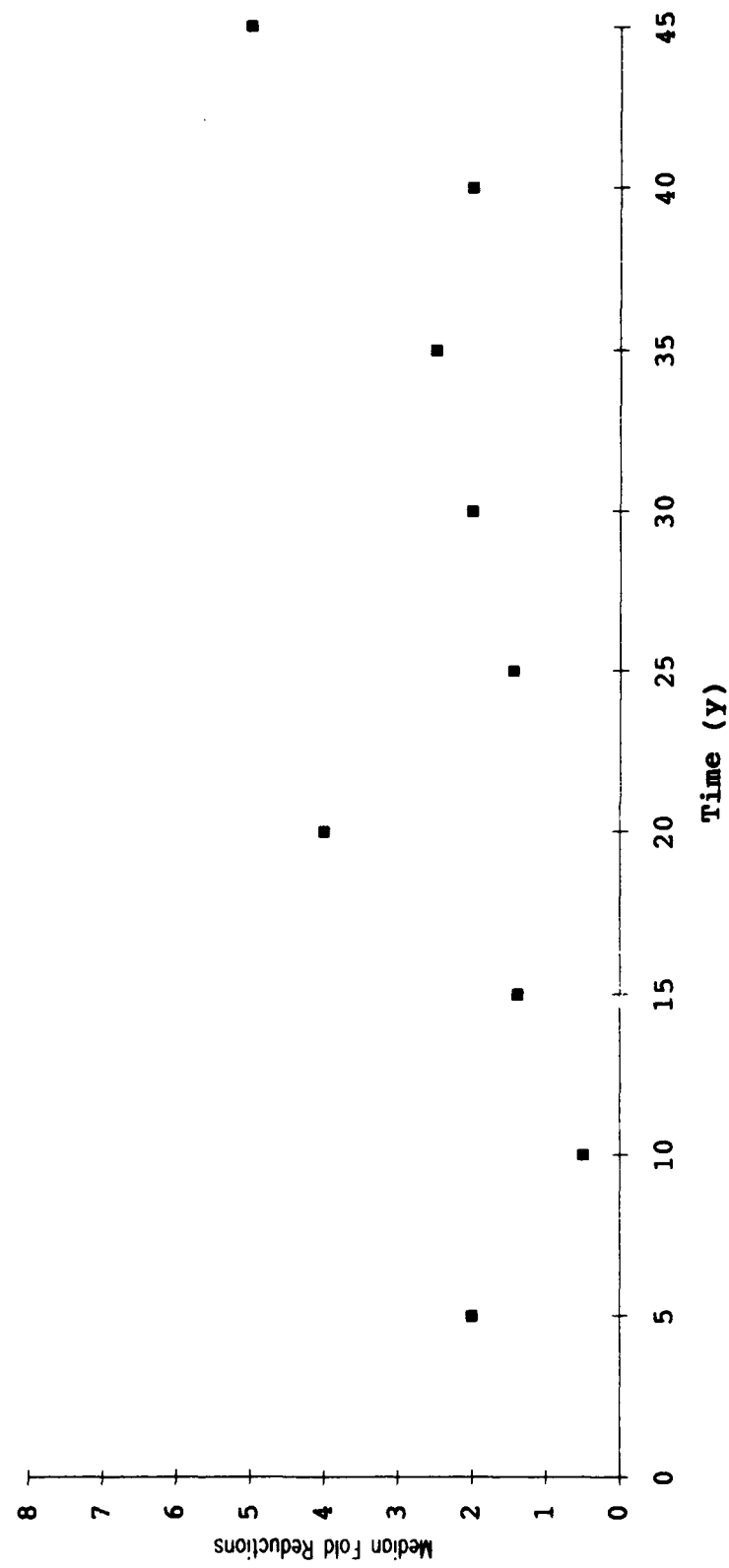


Figure 18
Fold Reductions in TLVs for SIC 35
(For 5 year intervals from 1946)

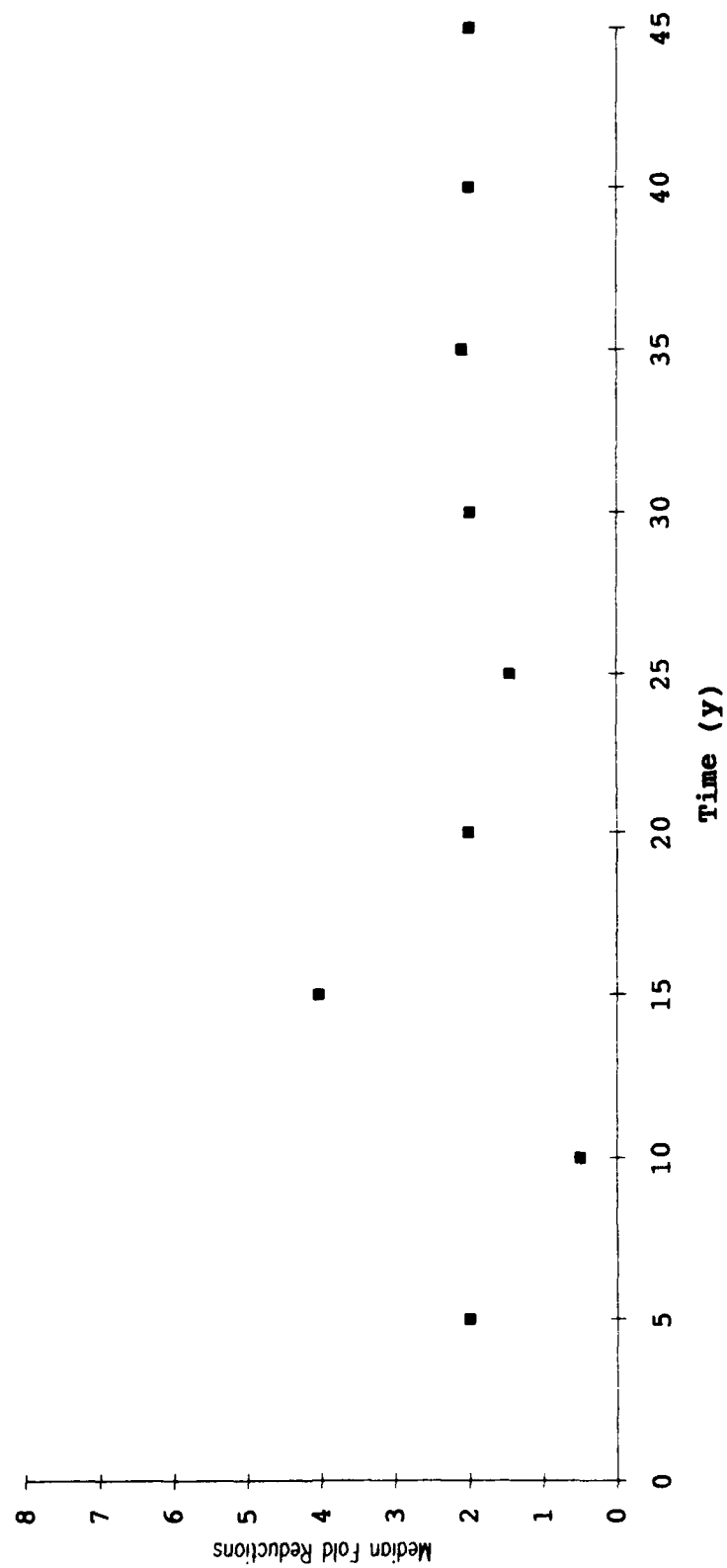


Figure 19
Fold Reductions in TLVs for SIC 36
(For 5 year intervals from 1946)

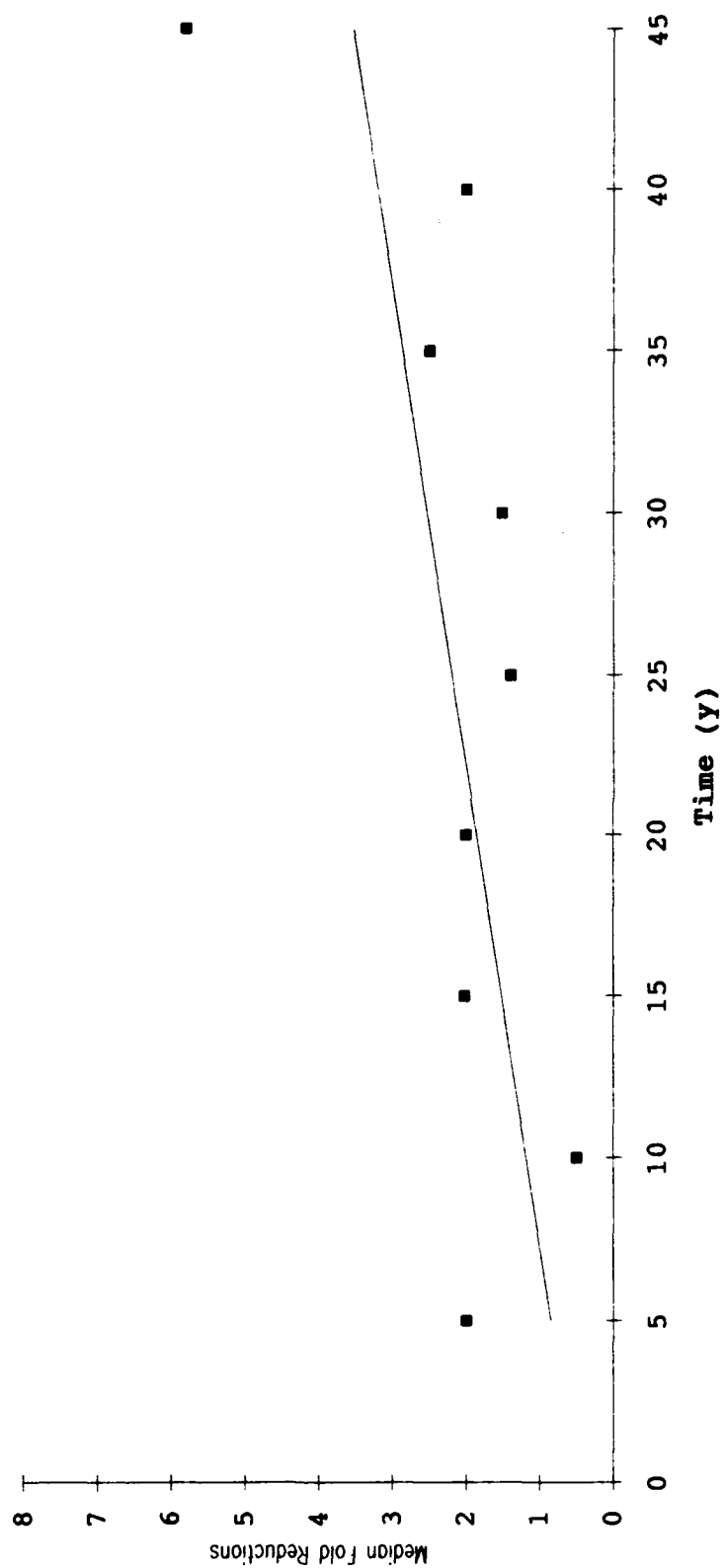


Figure 20
Fold Reductions in TLVs for SIC 37
(For 5 year intervals from 1946)

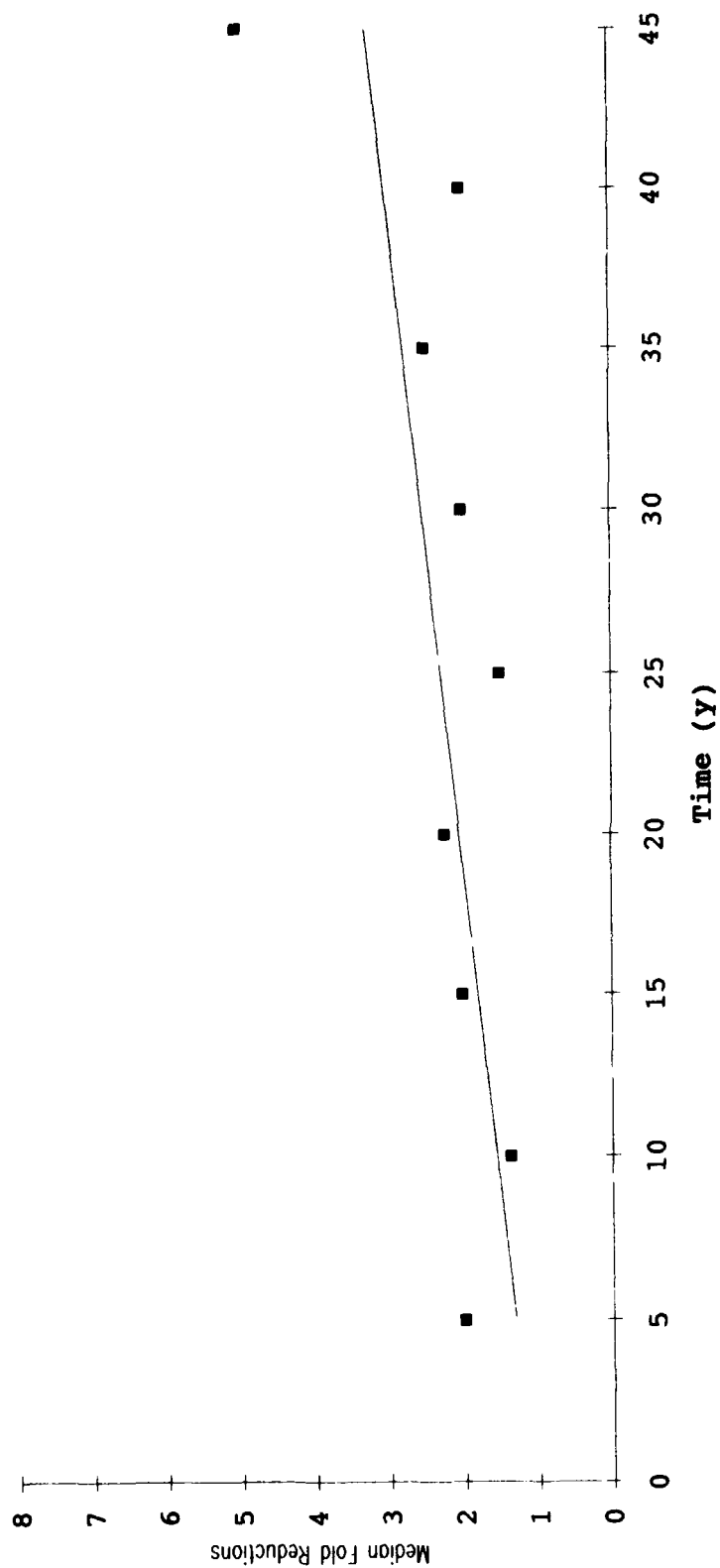


Figure 21
Fold Reductions in TLVs for SIC 38
(For 5 year intervals from 1946)

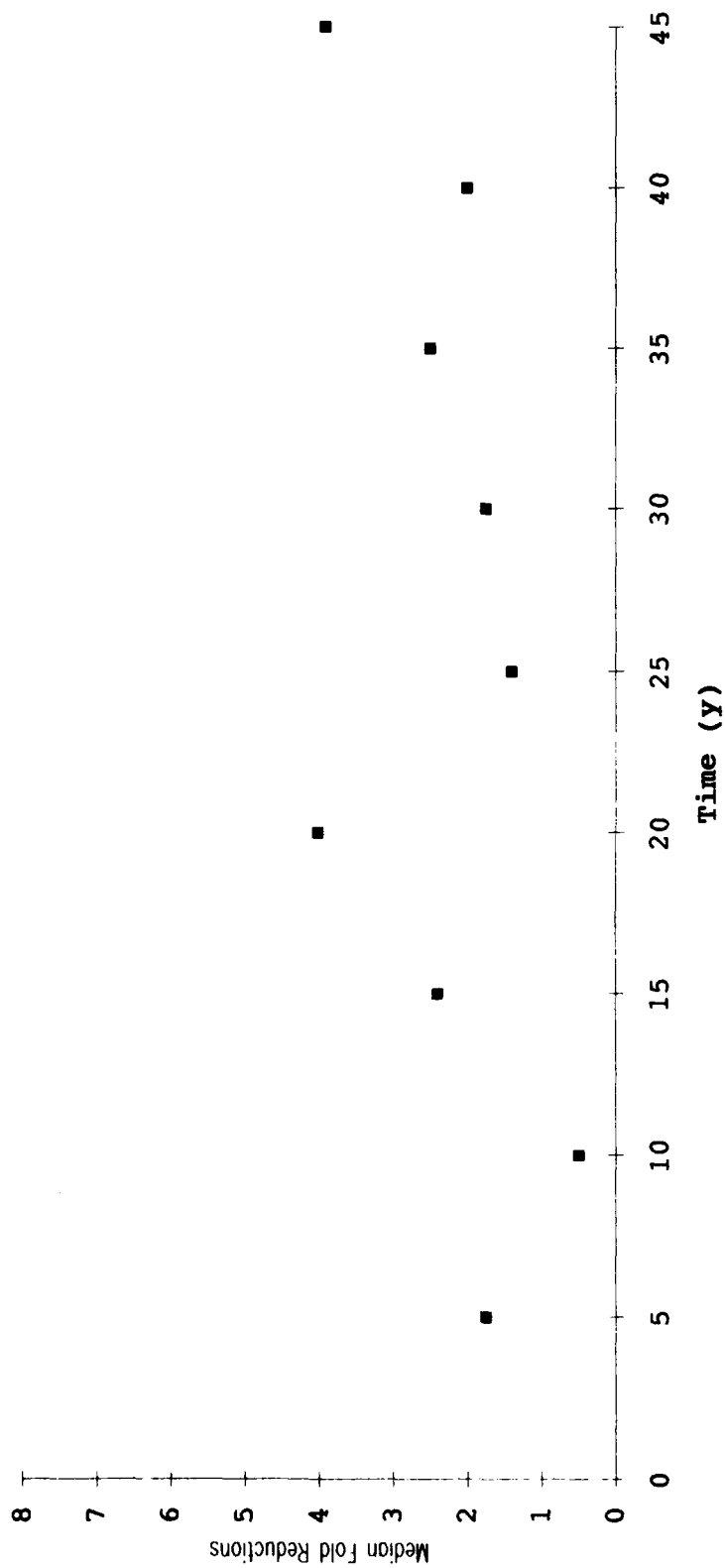


Figure 22
Fold Reductions in TLVs for SIC 39
(For 5 year intervals from 1946)

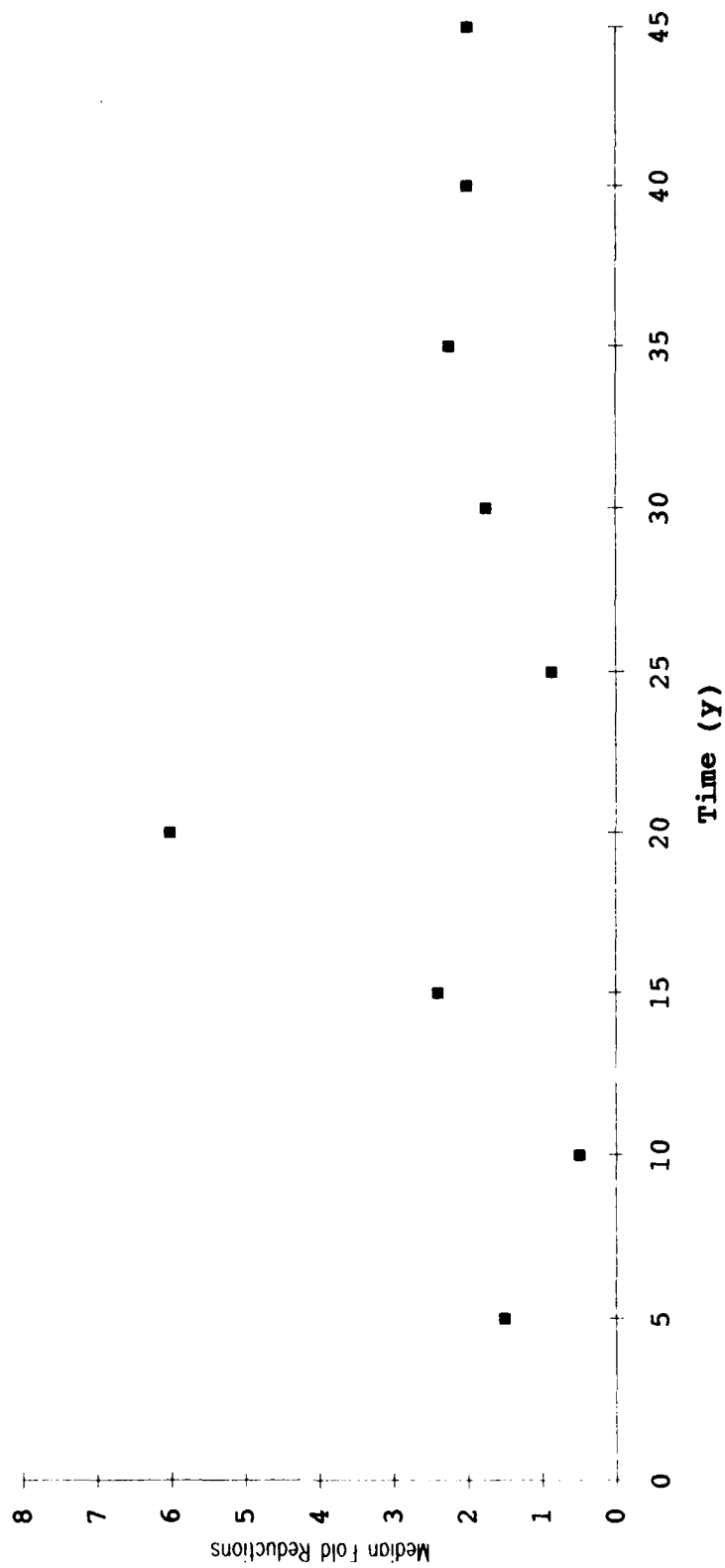


Figure 23
Fold Reductions in TLVs for SICs 40 & 45
(For 5 year intervals from 1946)

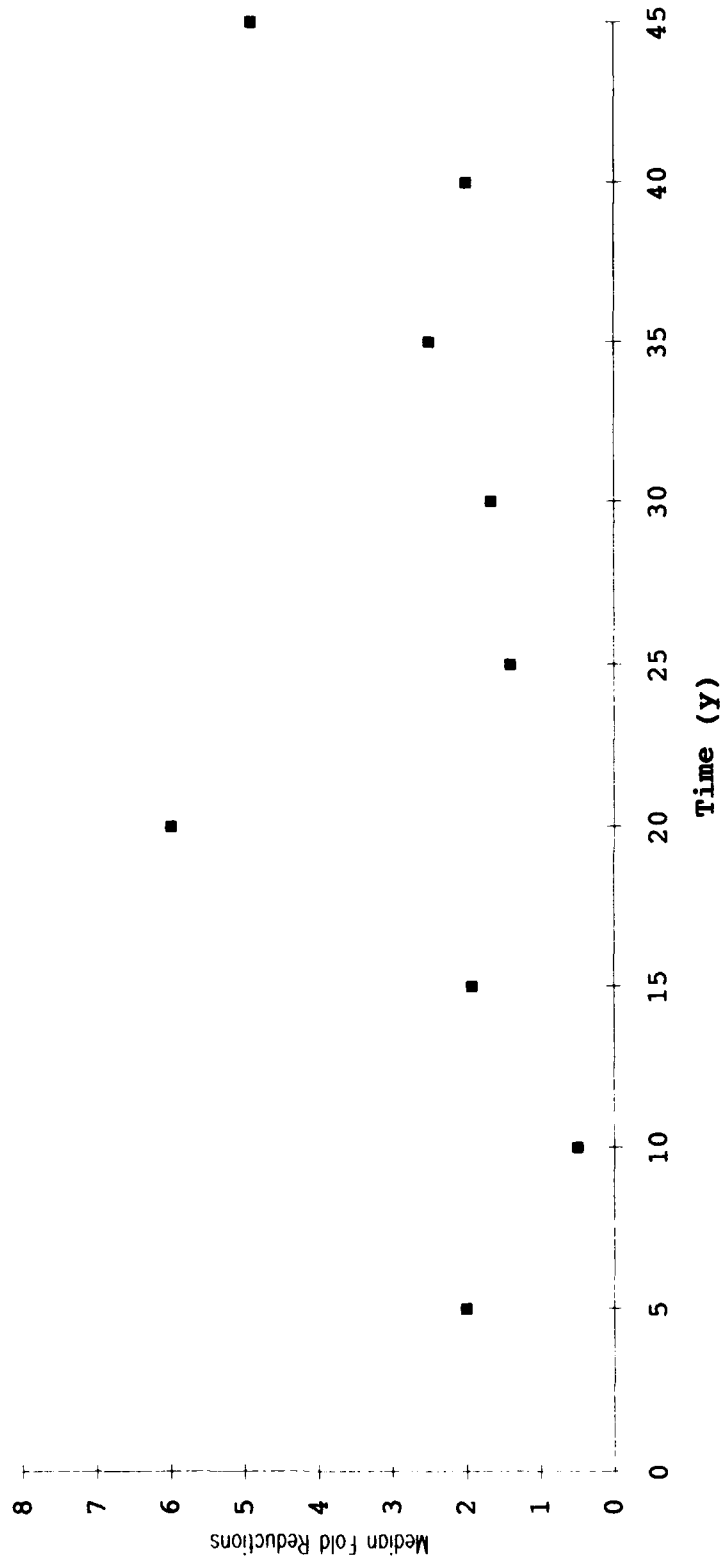


Figure 24
Fold Reductions in TLVs for SICs 49, 72, 73, & 76
(For 5 year intervals from 1946)

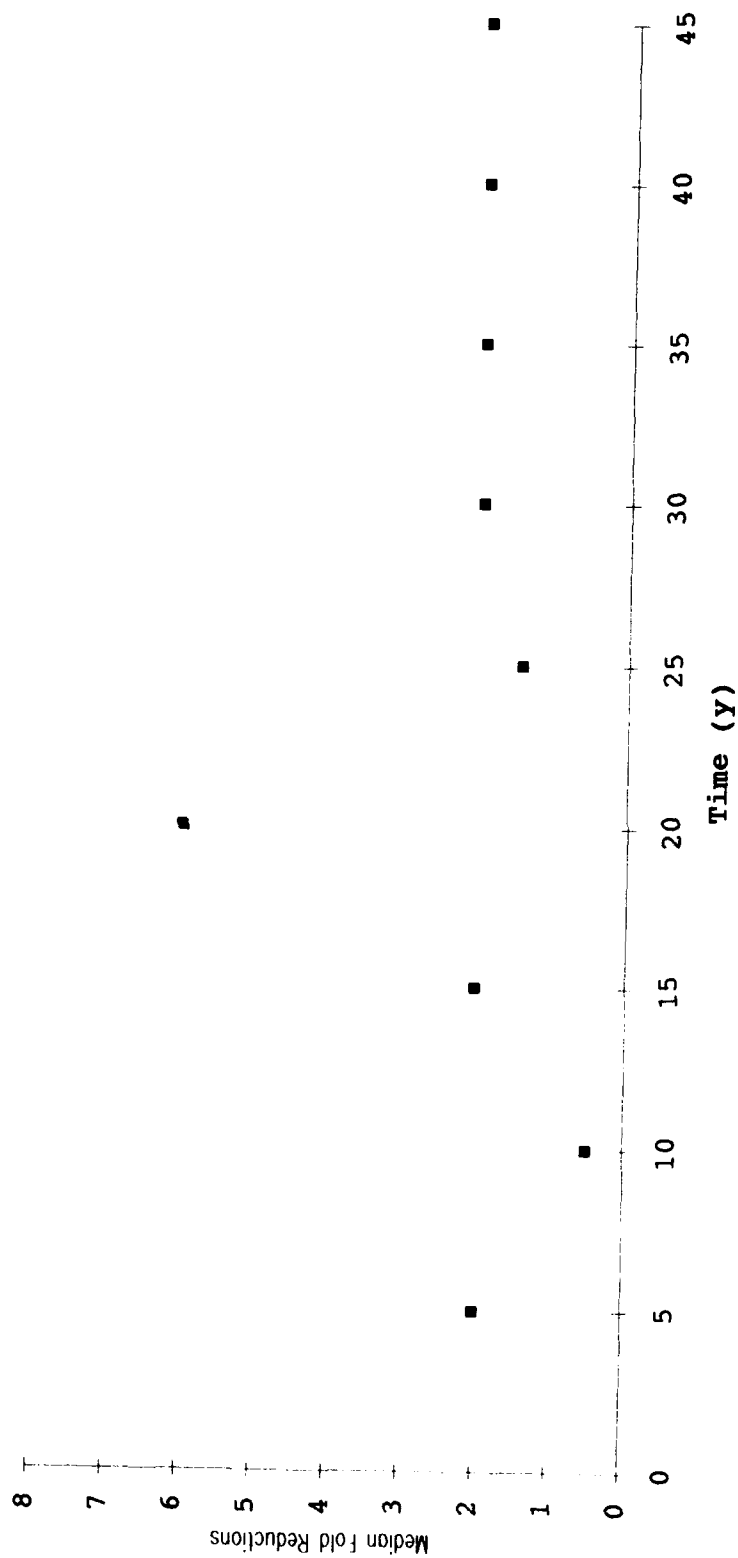


Figure 25
Fold Reductions in TLVs for SIC 80
(For 5 year intervals from 1946)

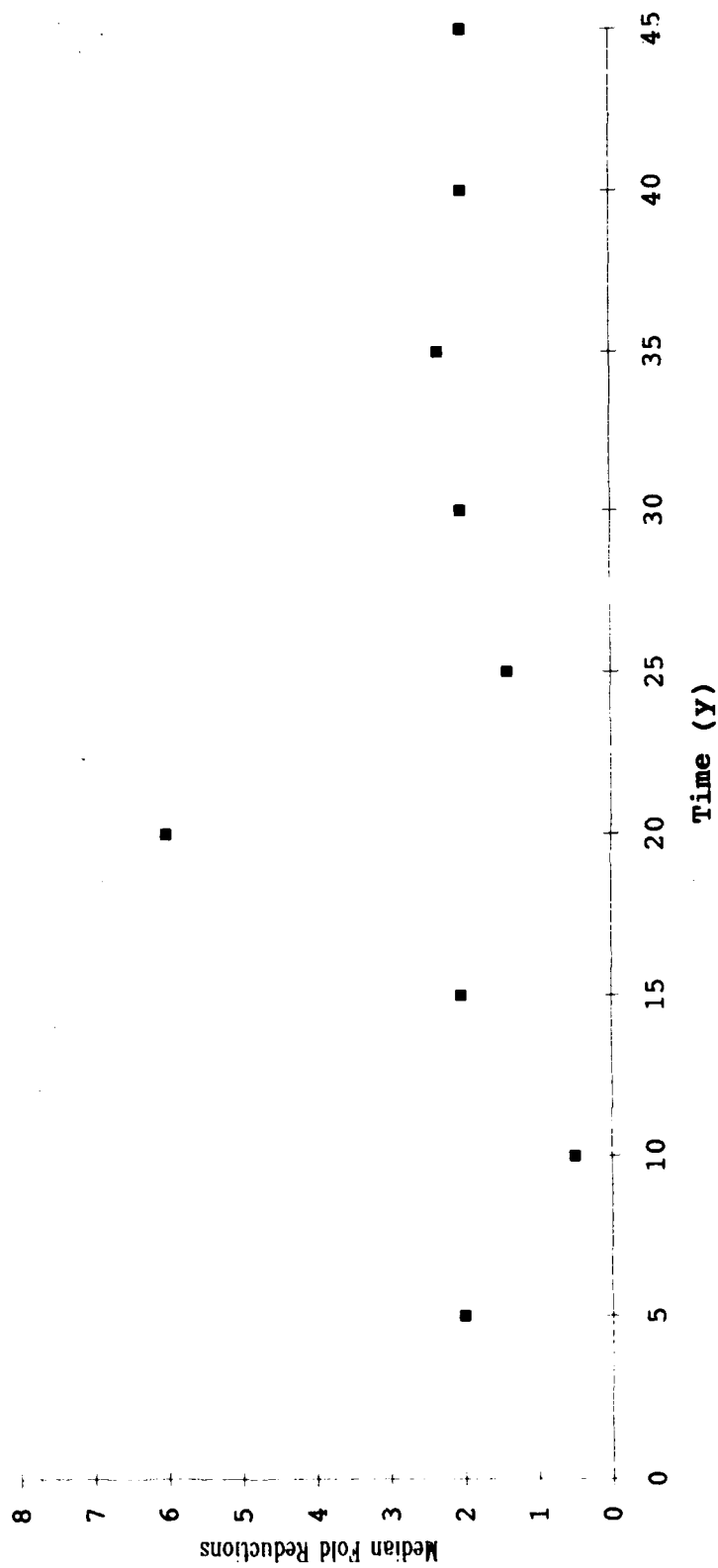


Figure 26
Fold Reductions in TLVs for Known or Suspected Carcinogens
(For 5 year intervals from 1946)

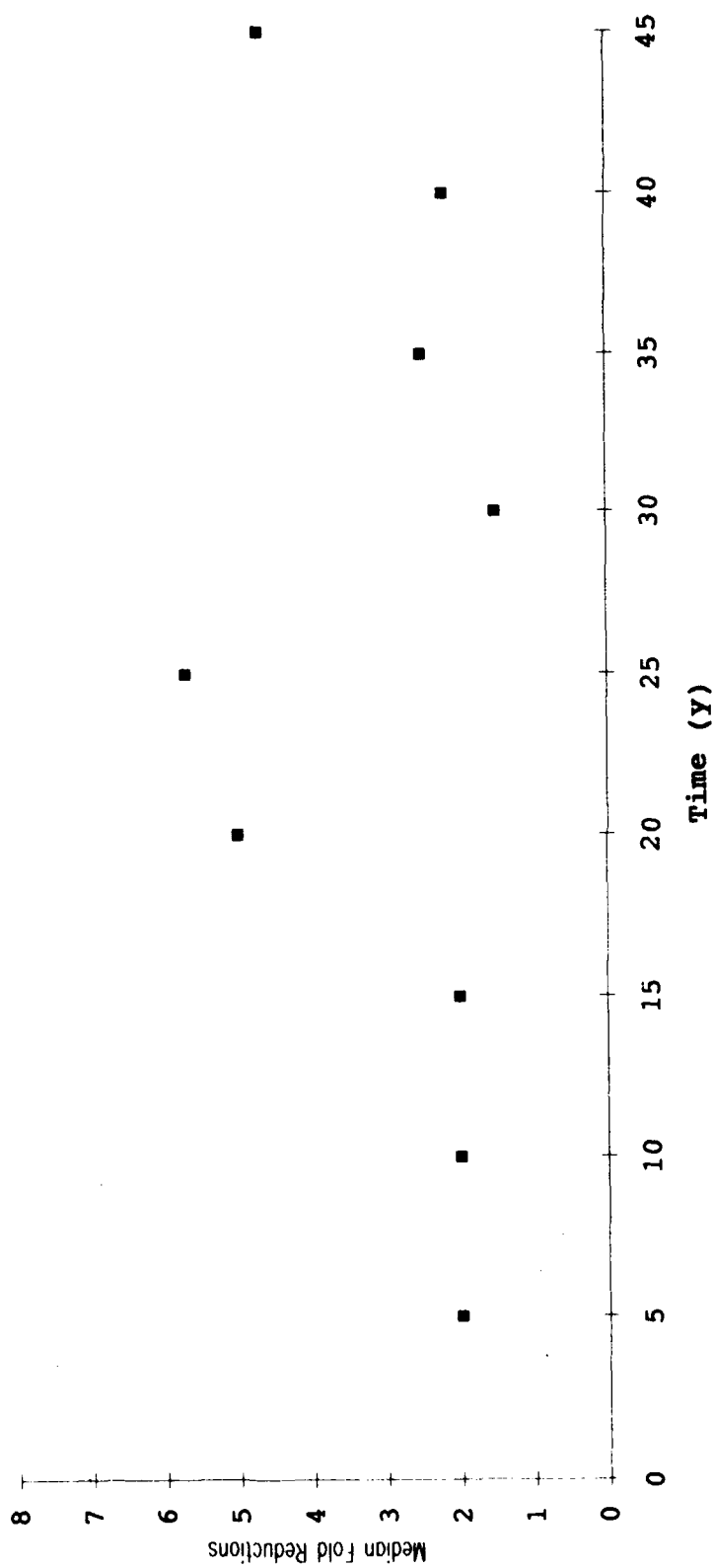


Figure 27
Interval Between Changes in All TLVs
(For 5 year intervals from 1946)

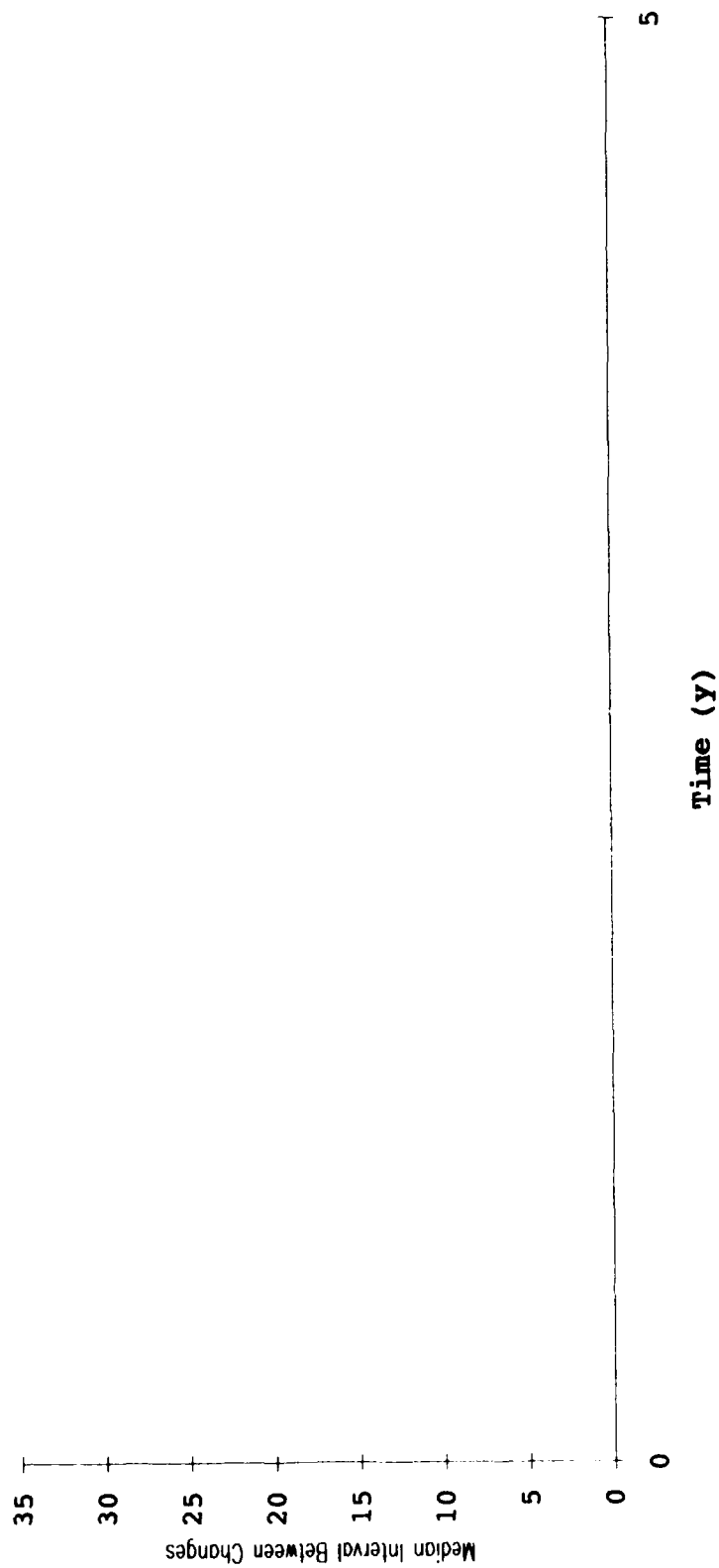


Figure 28
Interval Between Changes in TLVs for SIC 15
(For 5 year intervals from 1946)

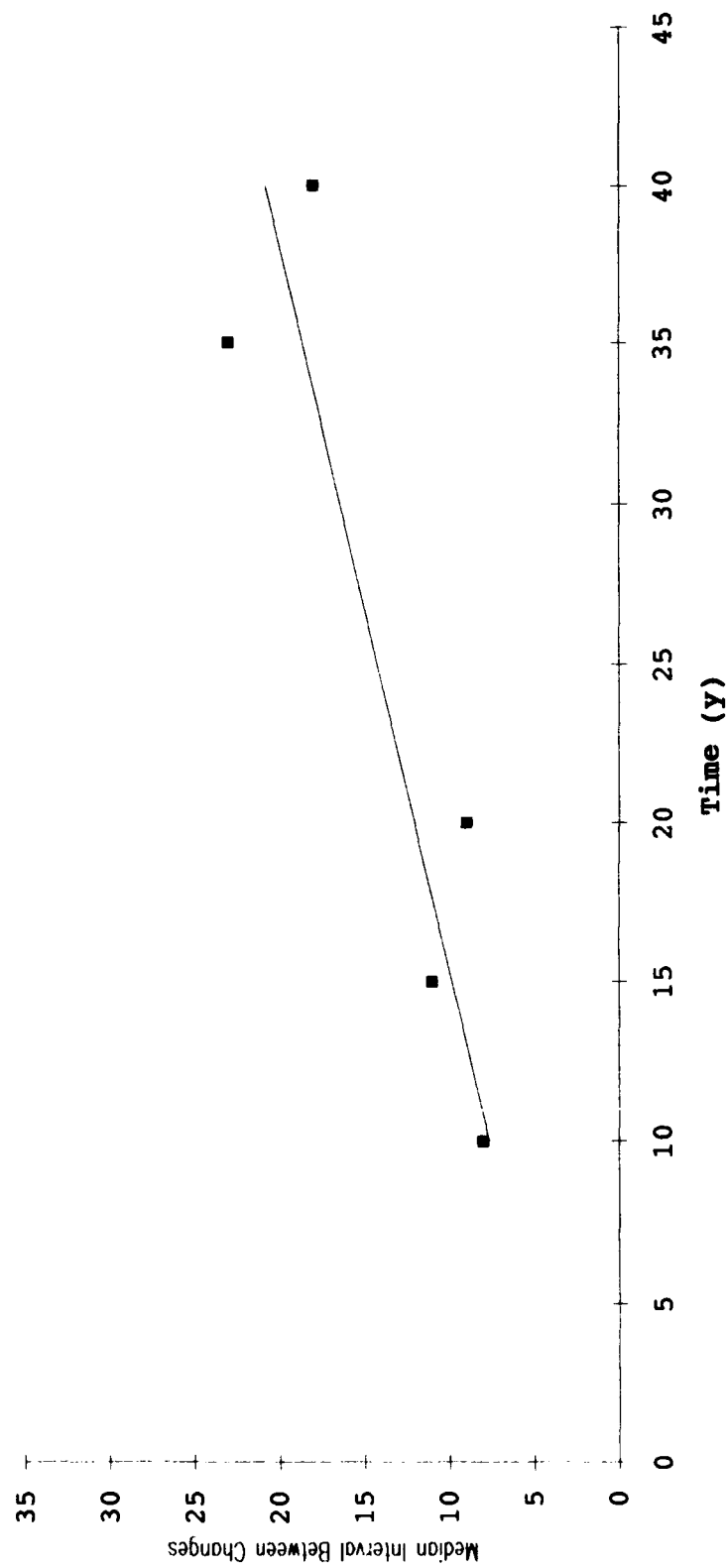


Figure 29
Interval Between Changes in TLVs for SIC 17
(For 5 year intervals from 1946)

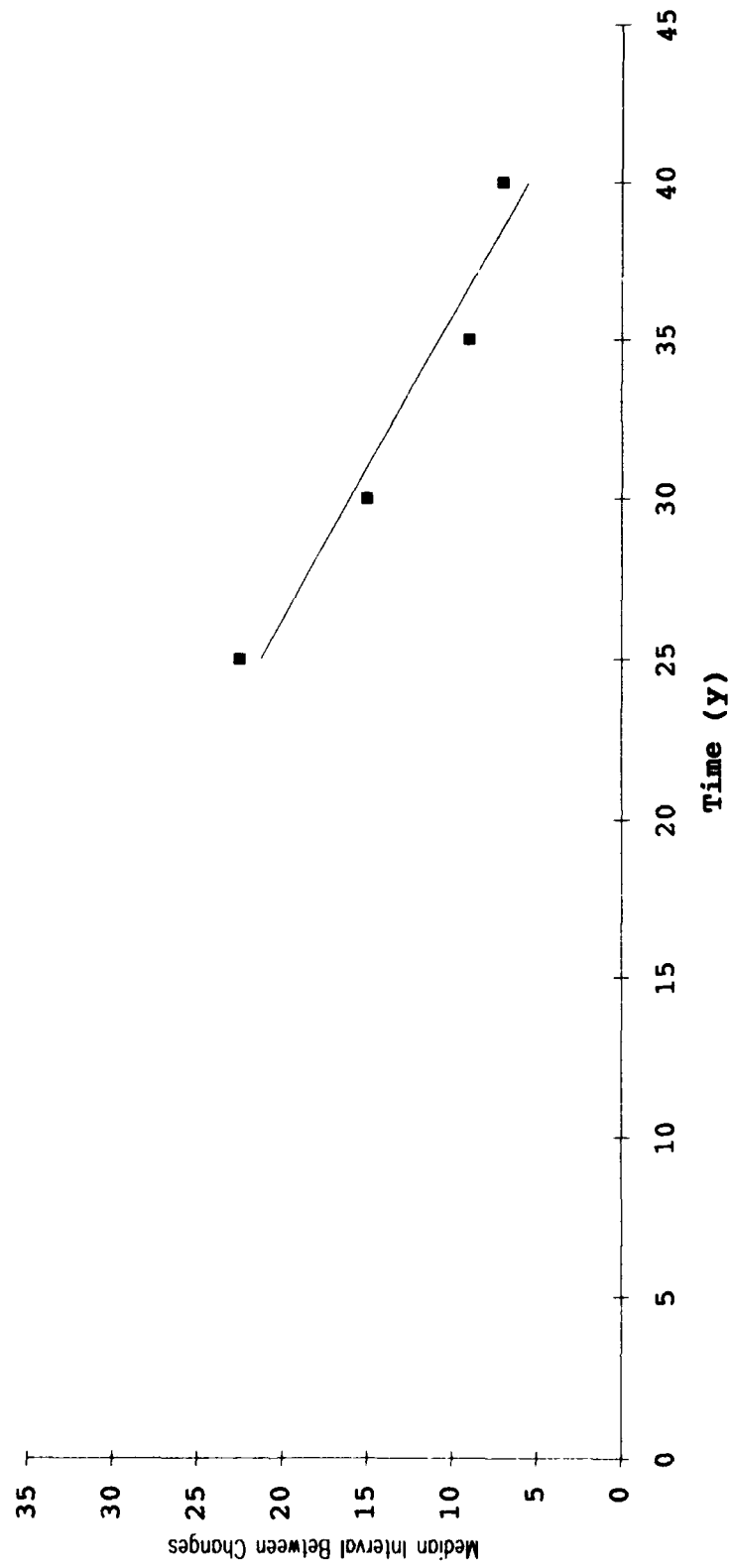


Figure 30
Interval Between Changes in TLVs for SICs 20 & 21
(For 5 year intervals from 1946)

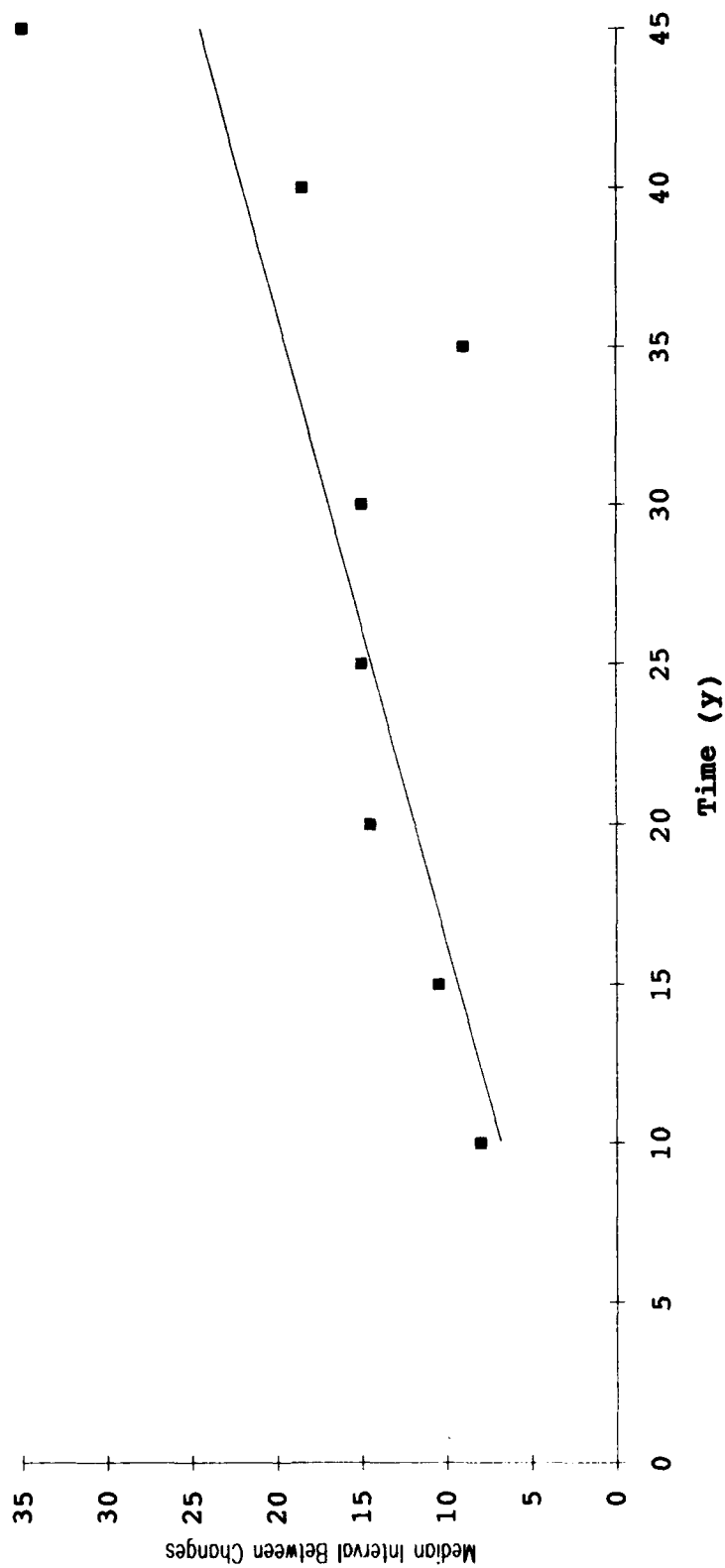


Figure 31
Interval Between Changes in TLVs for SIC 22
(For 5 year intervals from 1946)

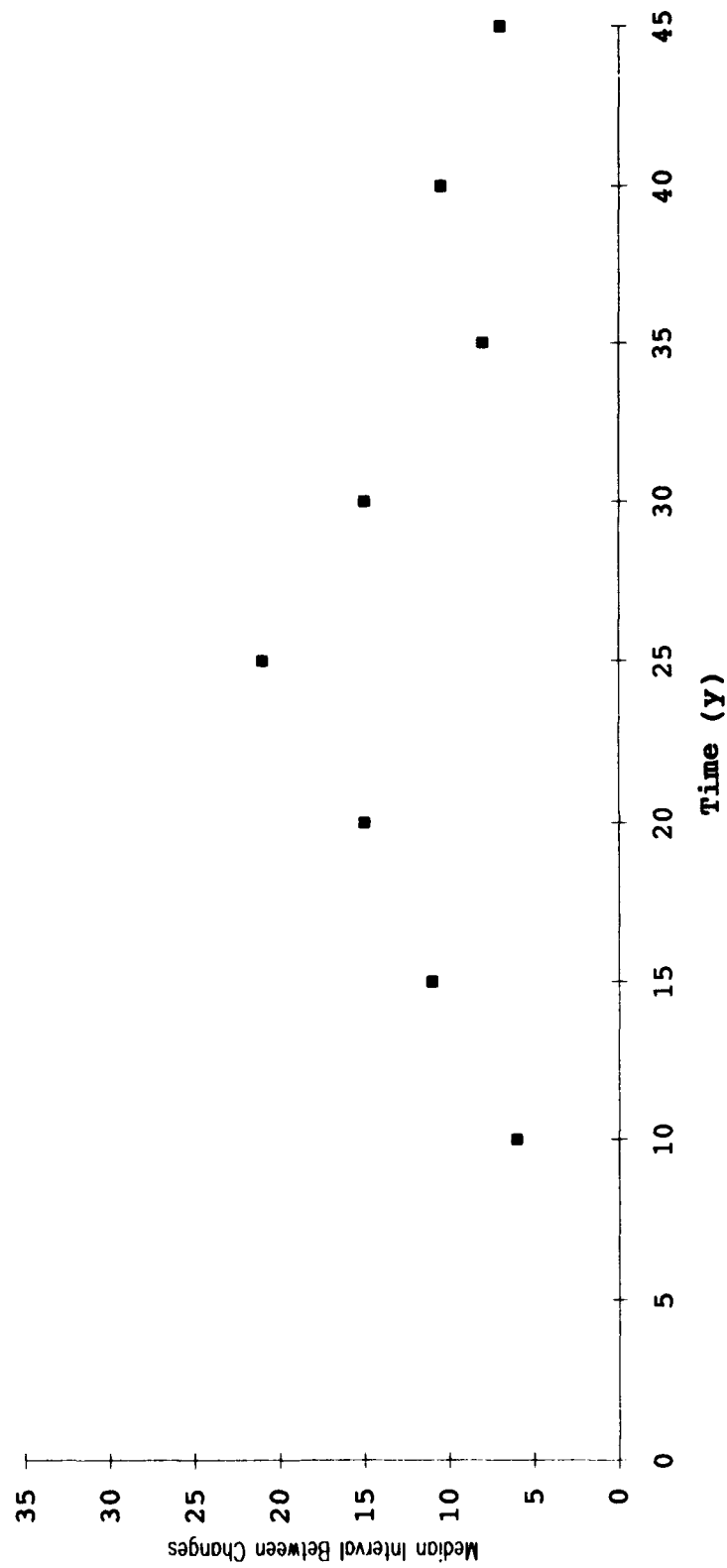


Figure 32
Interval Between Changes in TLVs for SIC 23
(For 5 year intervals from 1946)

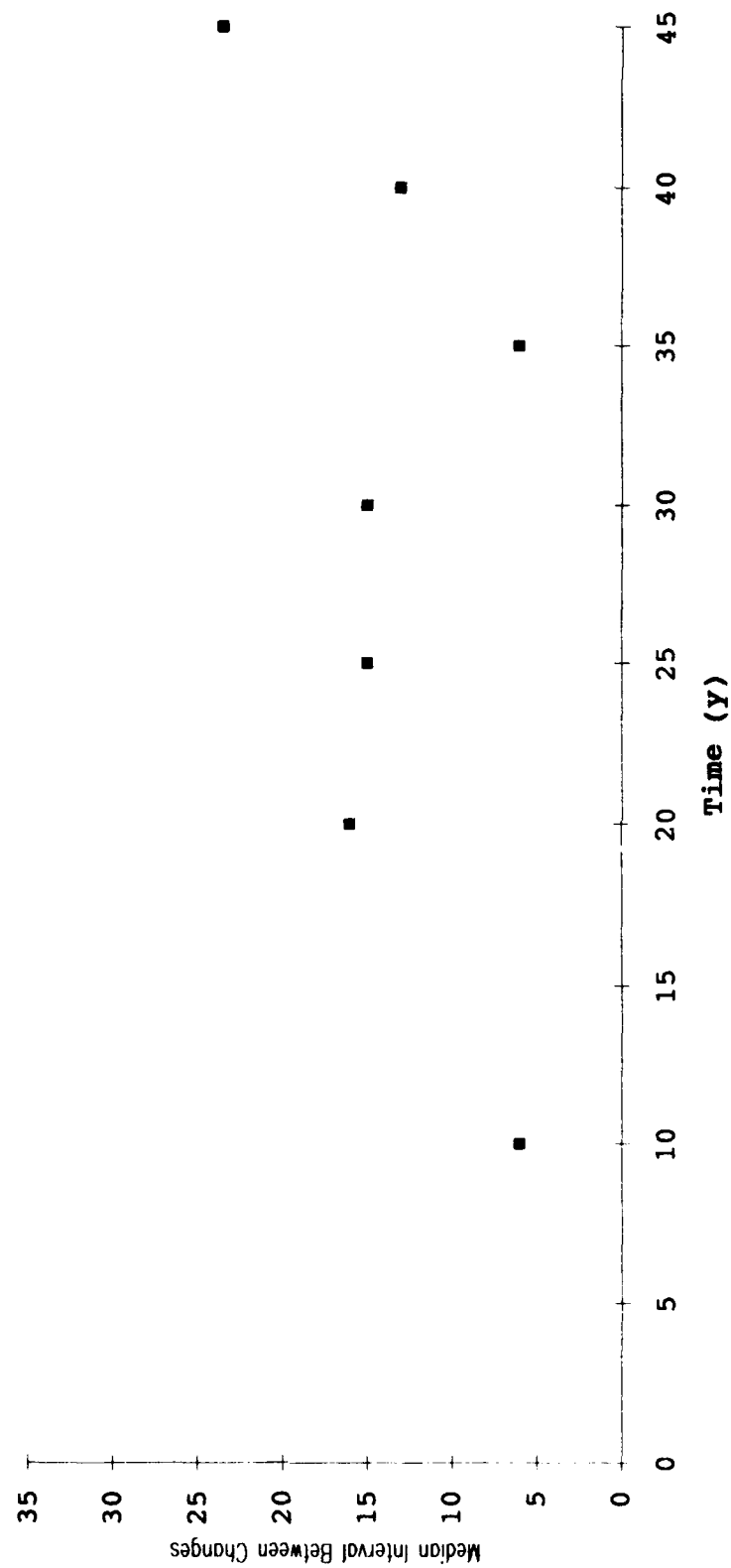


Figure 33
Interval Between Changes in TLVs for SIC 24
(For 5 year intervals from 1946)

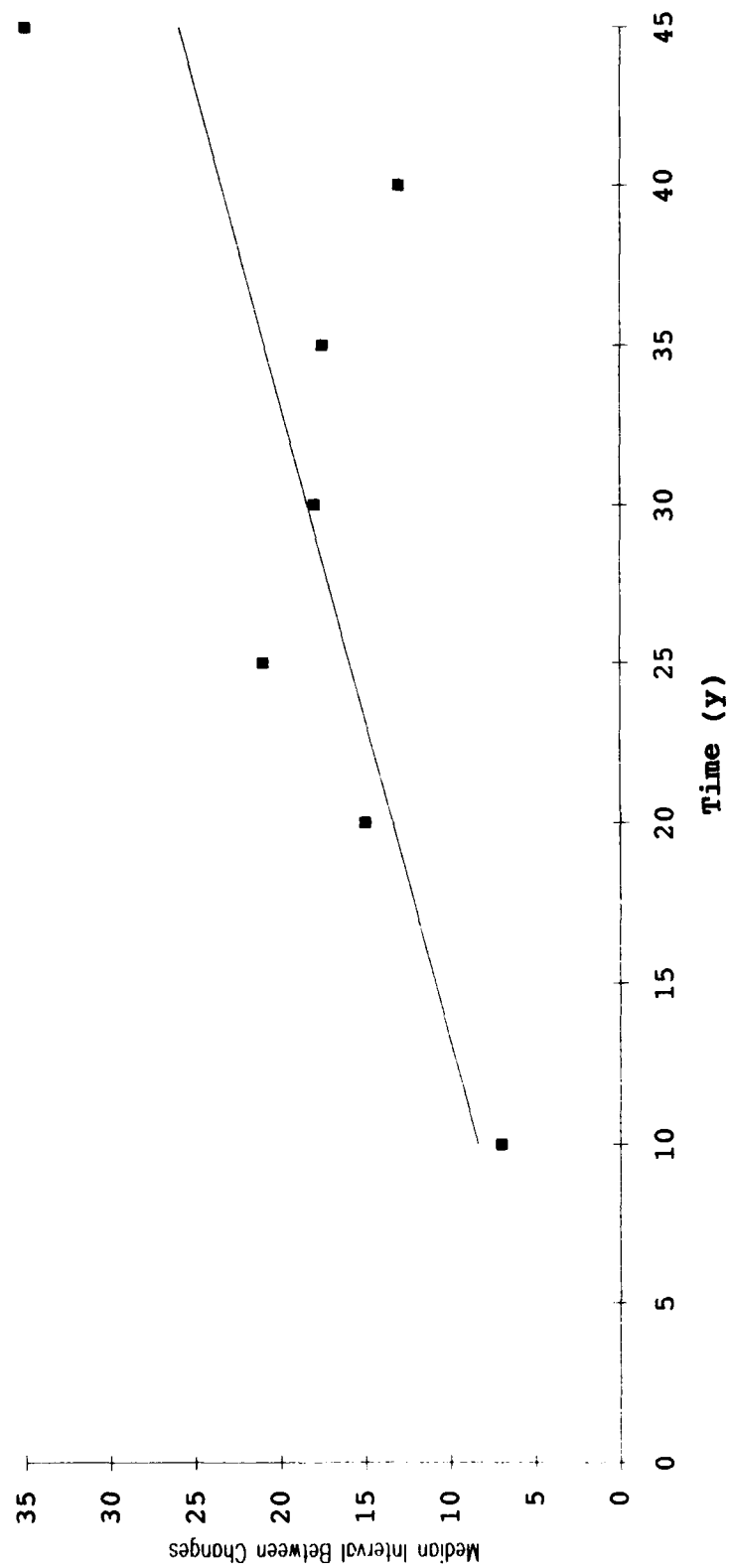


Figure 34
Interval Between Changes in TLVs for SIC 25
(For 5 year intervals from 1946)

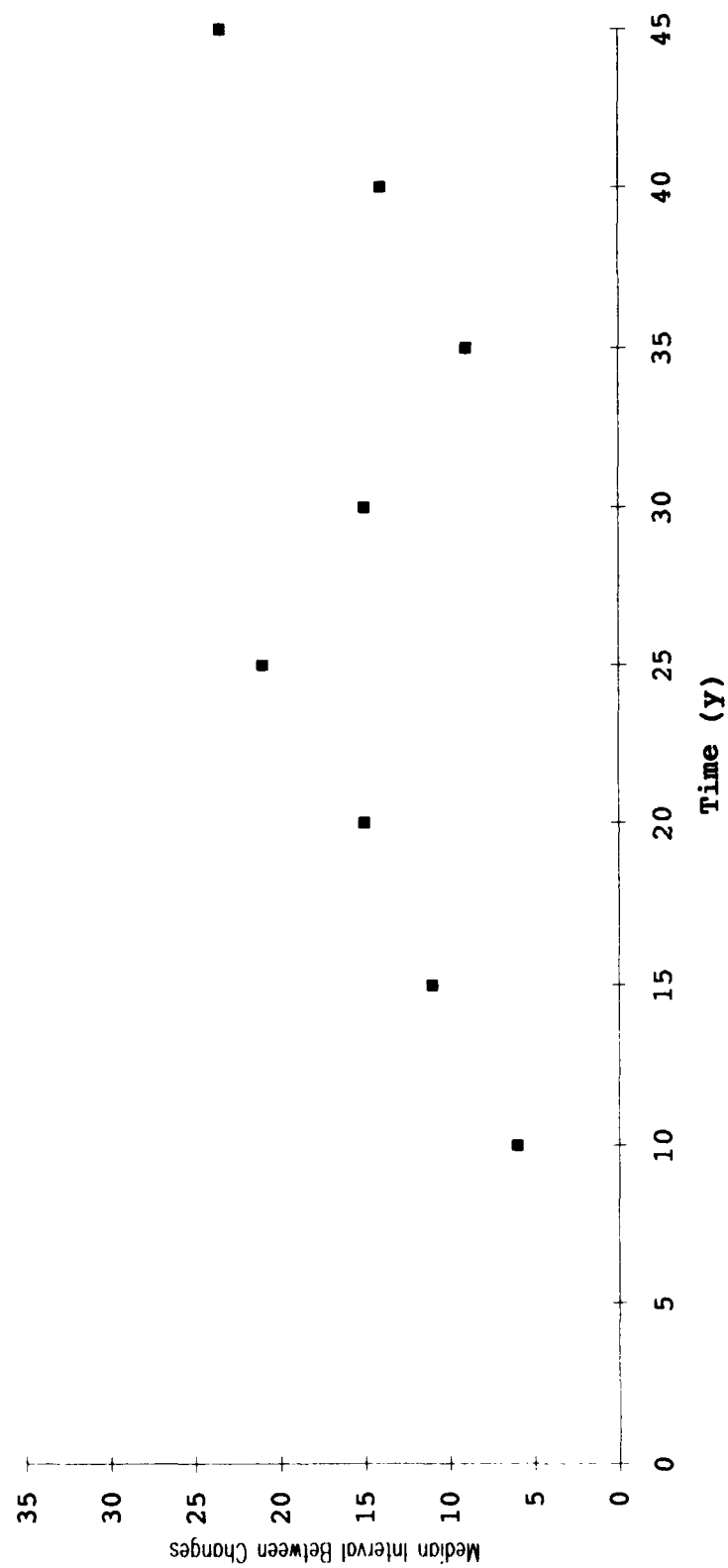


Figure 35
Interval Between Changes in TLVs for SIC 26
(For 5 year intervals from 1946)

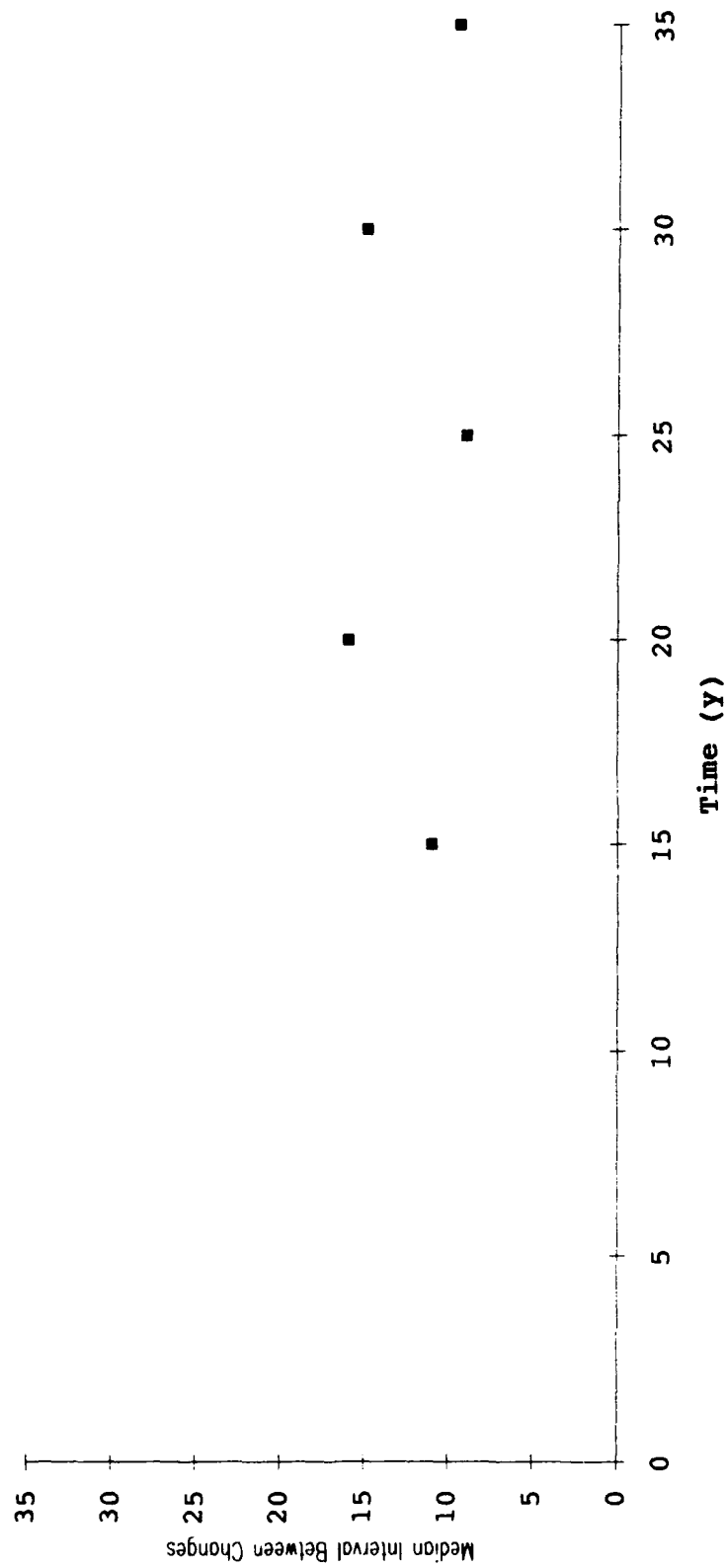


Figure 36
Interval Between Changes in TLVs for SIC 27
(For 5 year intervals from 1946)

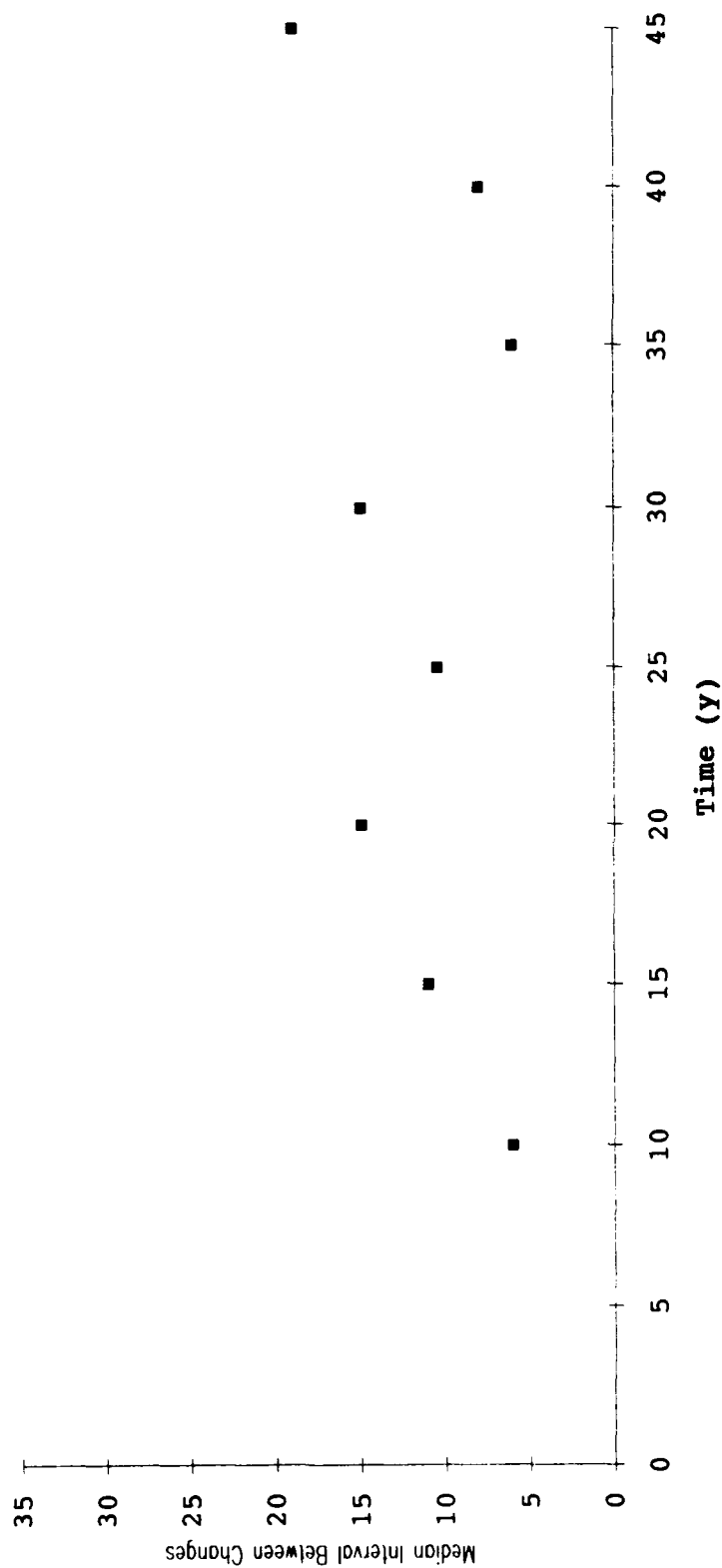


Figure 37
Interval Between Changes in TLVs for SIC 28
(For 5 year intervals from 1946)

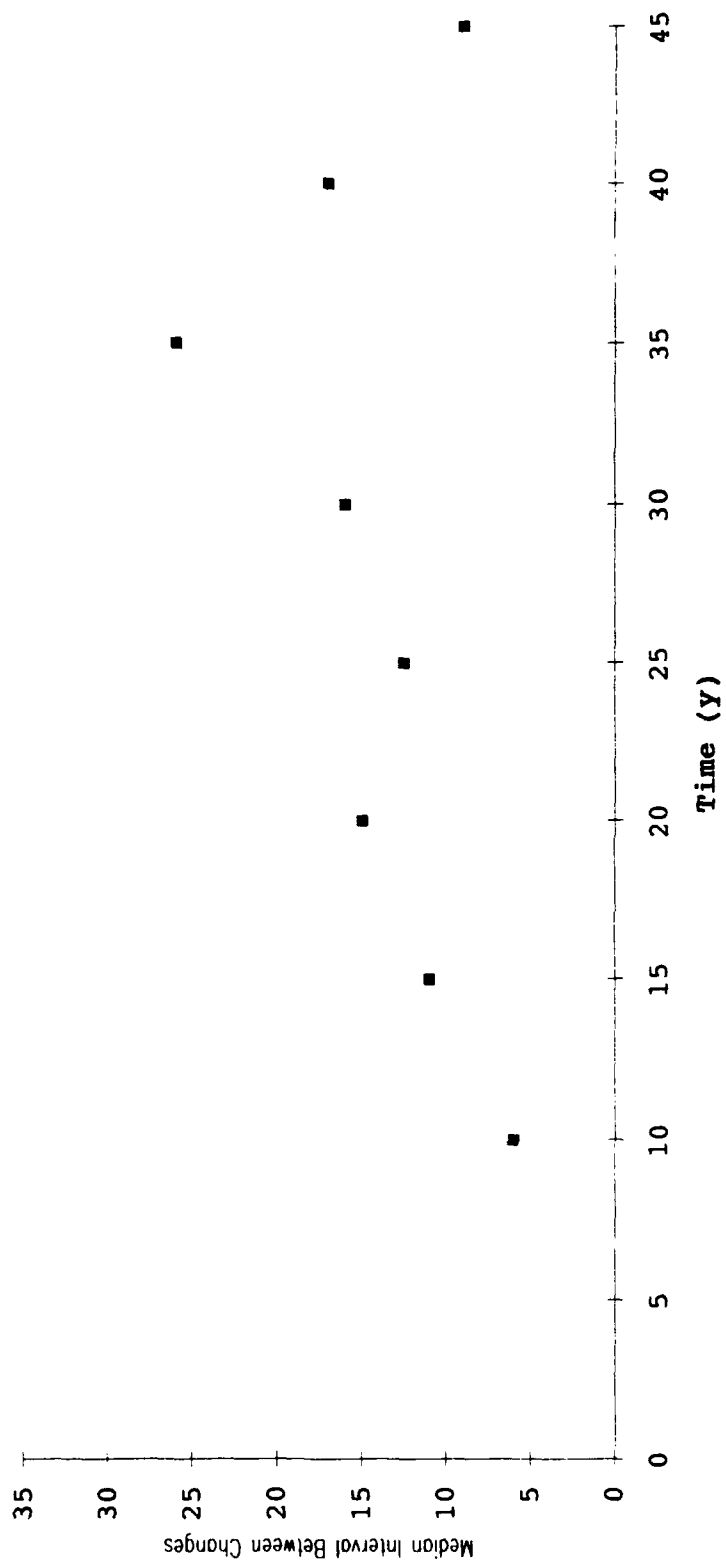


Figure 38
Interval Between Changes in TLVs for SIC 29
(For 5 year intervals from 1946)

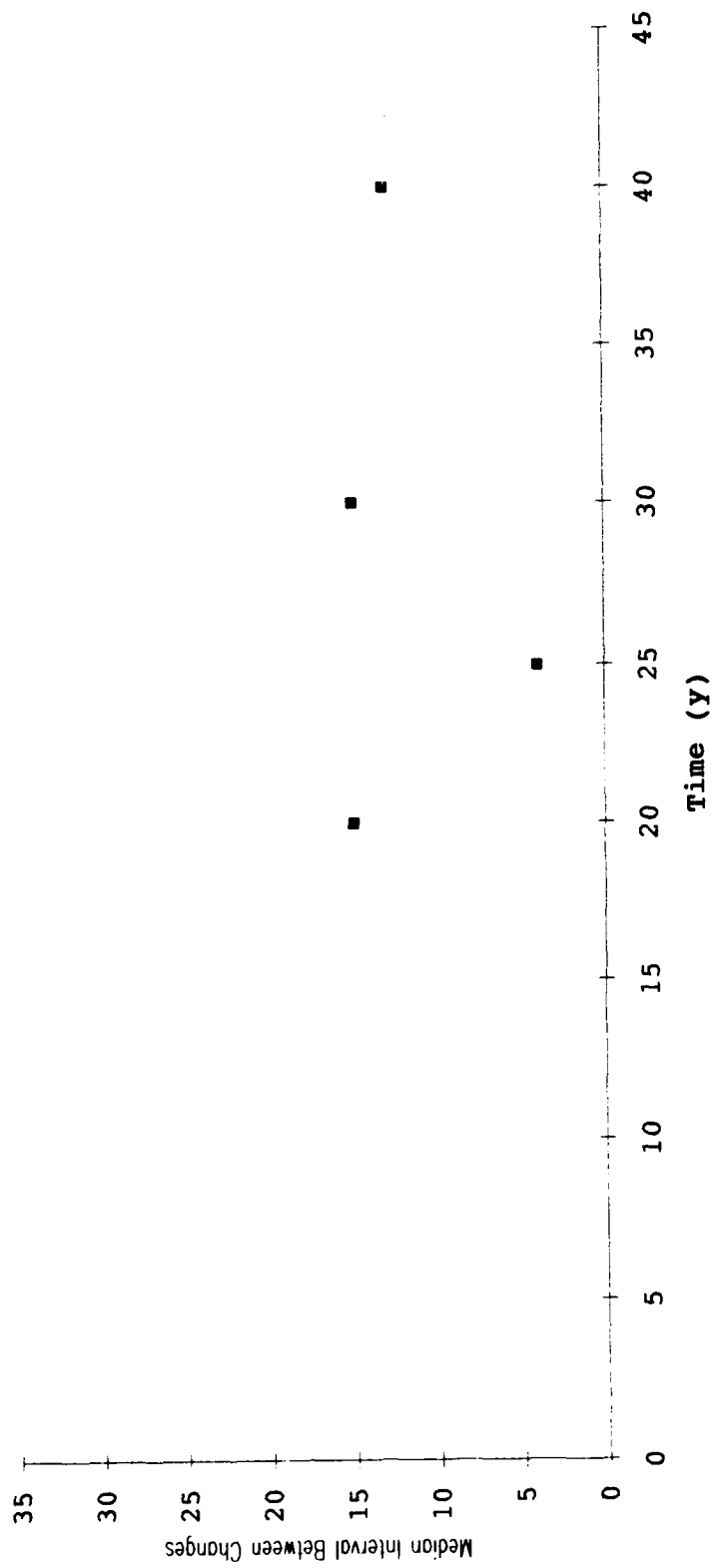


Figure 39
Interval Between Changes in TLVs for SIC 30
(For 5 year intervals from 1946)

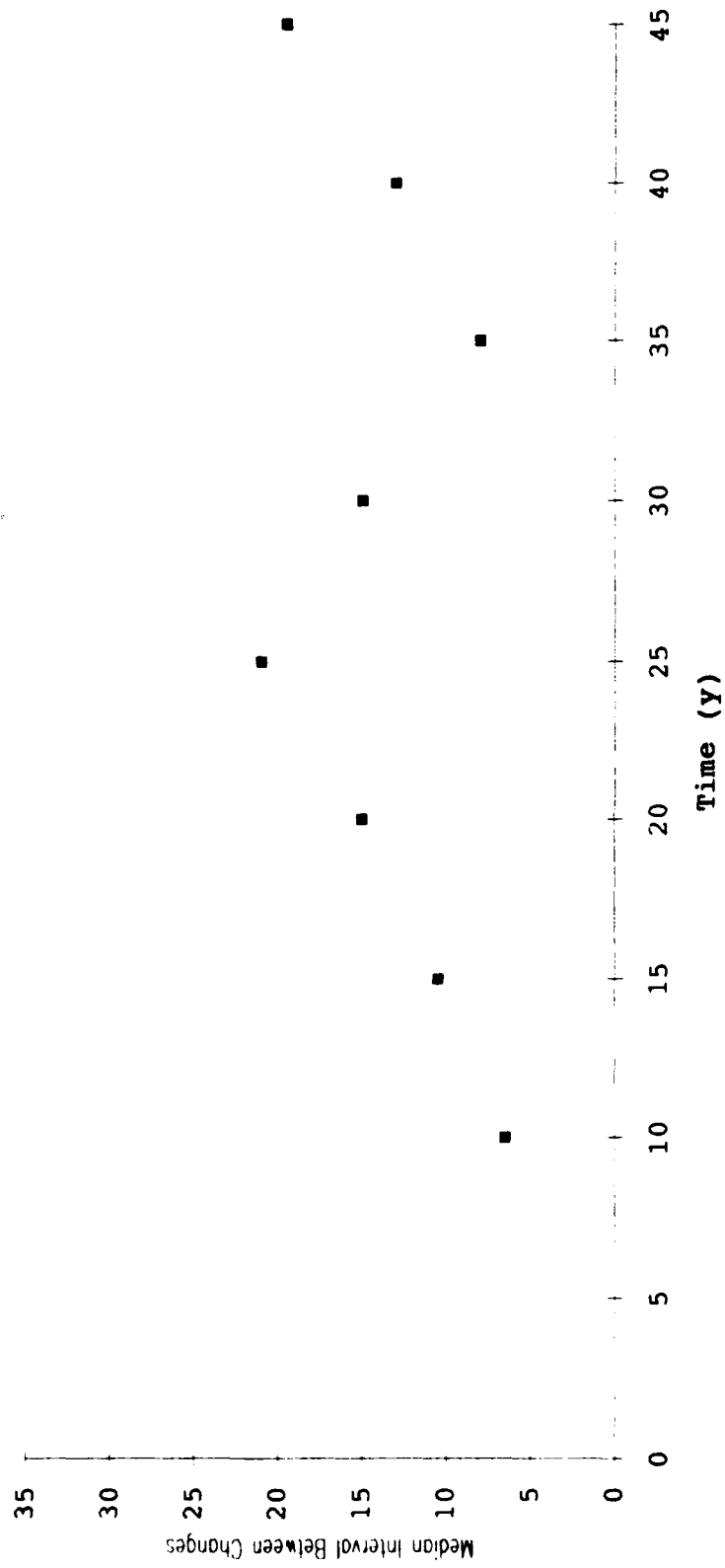


Figure 40
Interval Between Changes in TLVs for SIC 31
(For 5 year intervals from 1946)

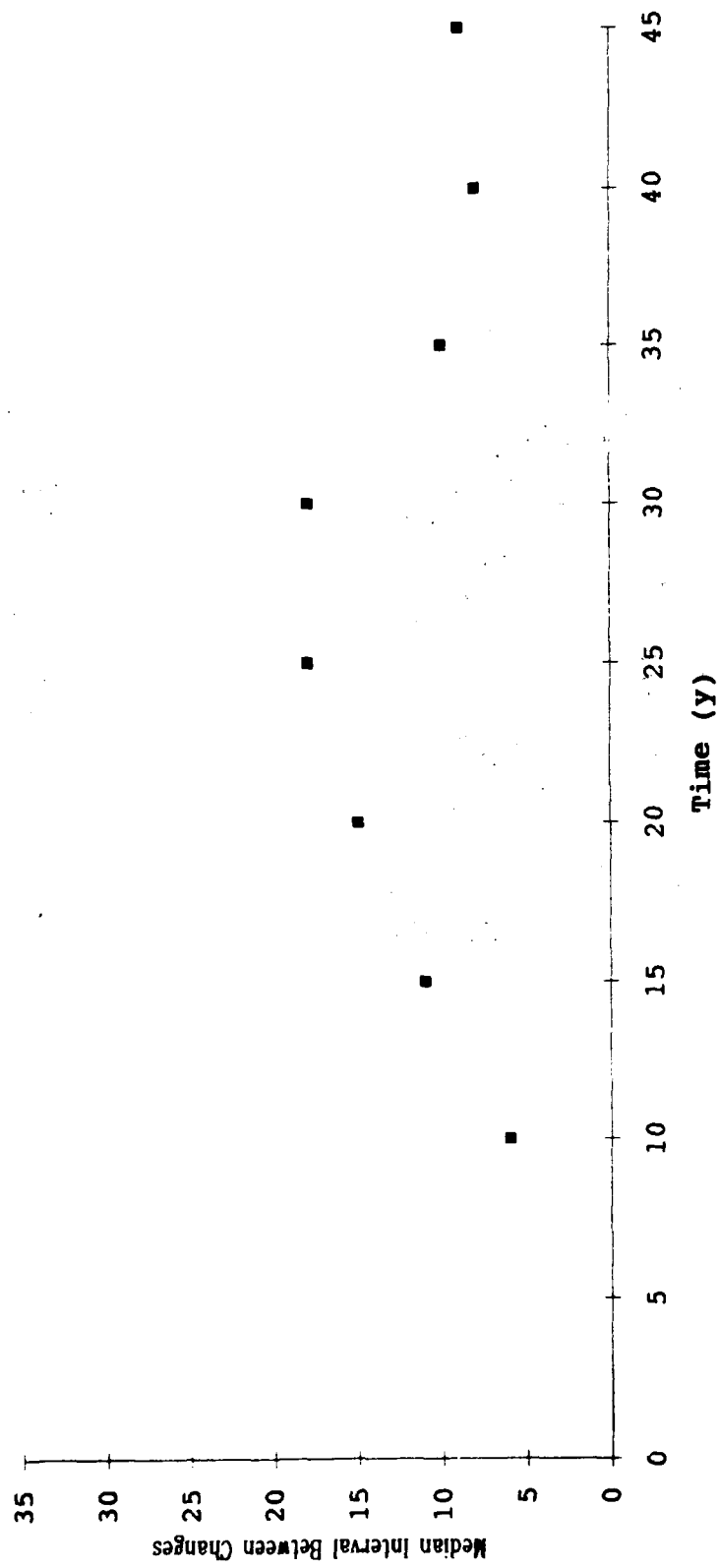


Figure 41
Interval Between Changes in TLVs for SIC 32
(For 5 year intervals from 1946)

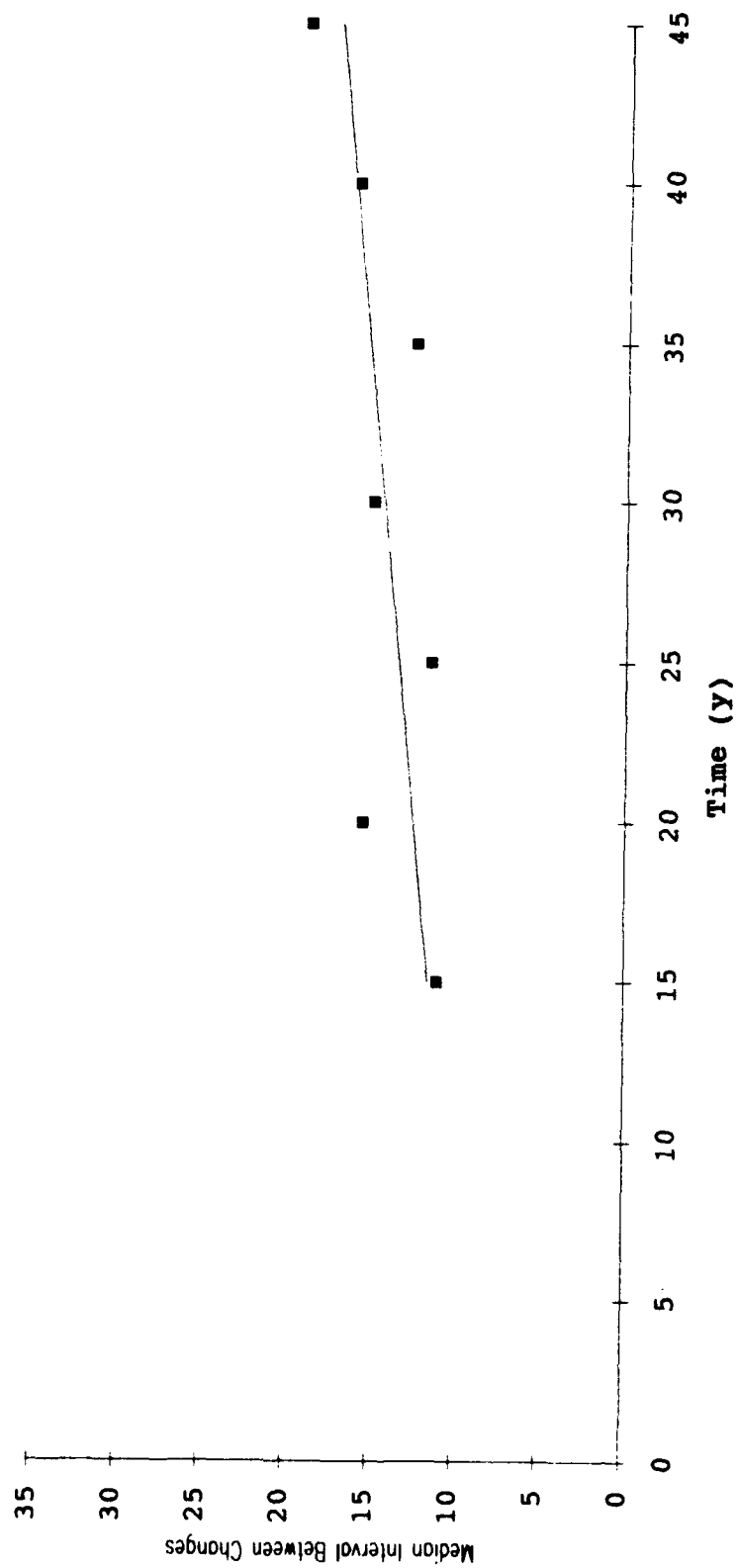


Figure 42
Interval Between Changes in TLVs for SIC 33
(For 5 year intervals from 1946)

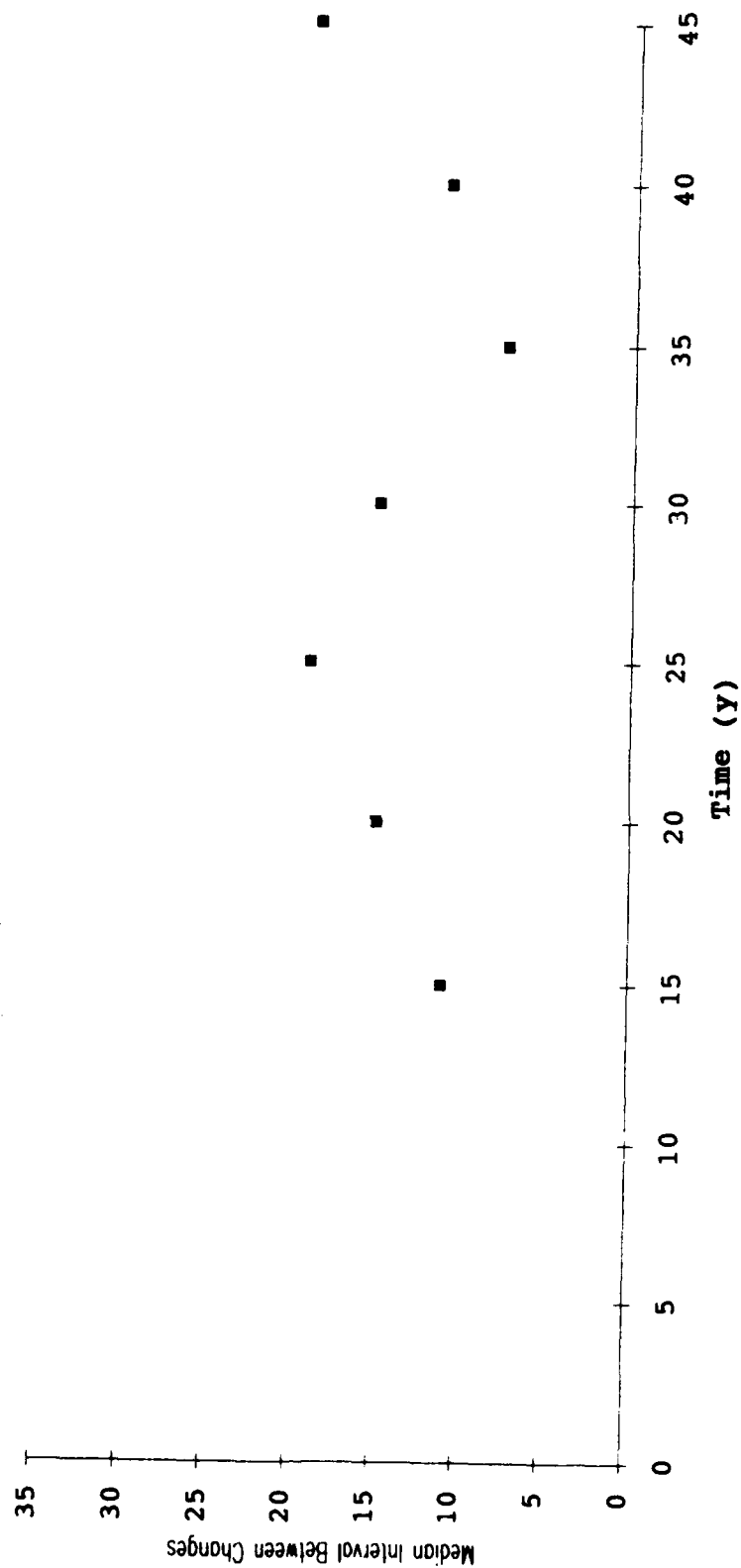


Figure 44
Interval Between Changes in TLVs for SIC 35
(For 5 year intervals from 1946)

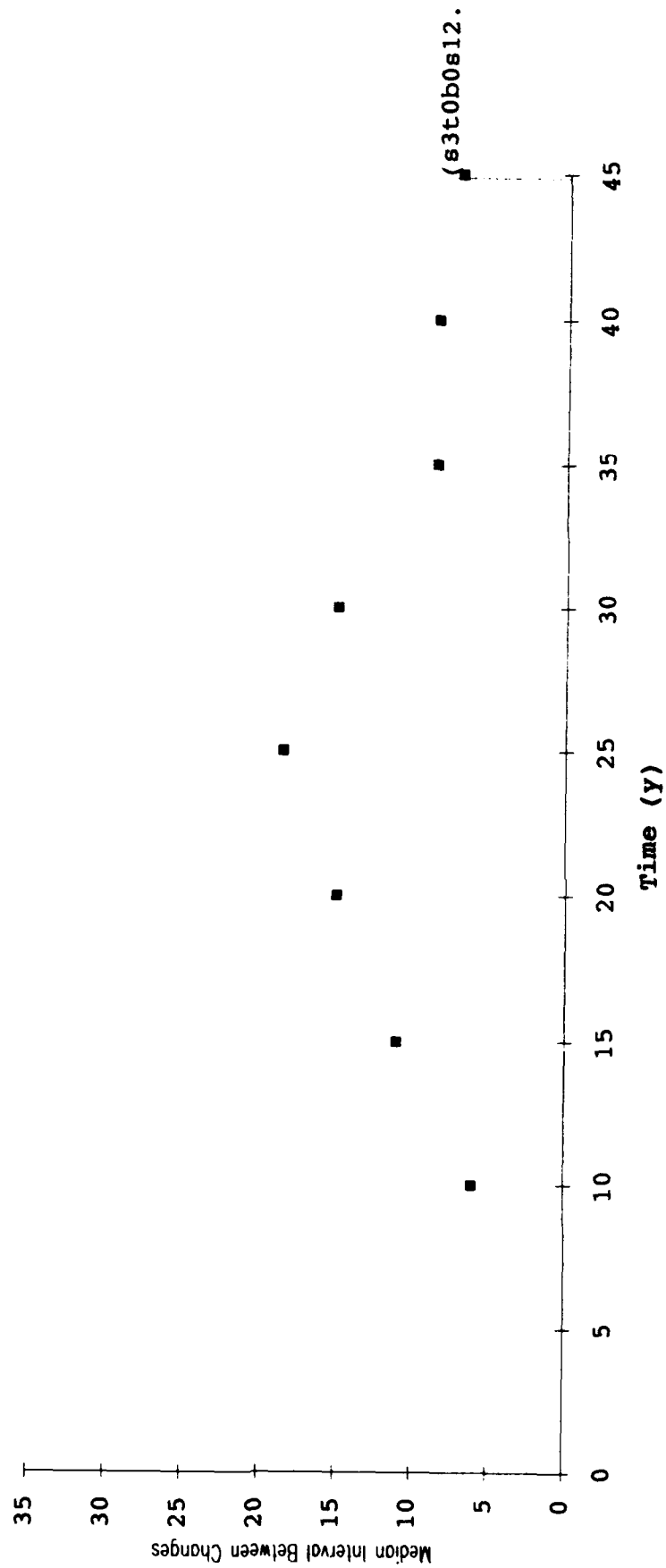


Figure 43
Interval Between Changes in TLVs for SIC 34
(For 5 year intervals from 1946)

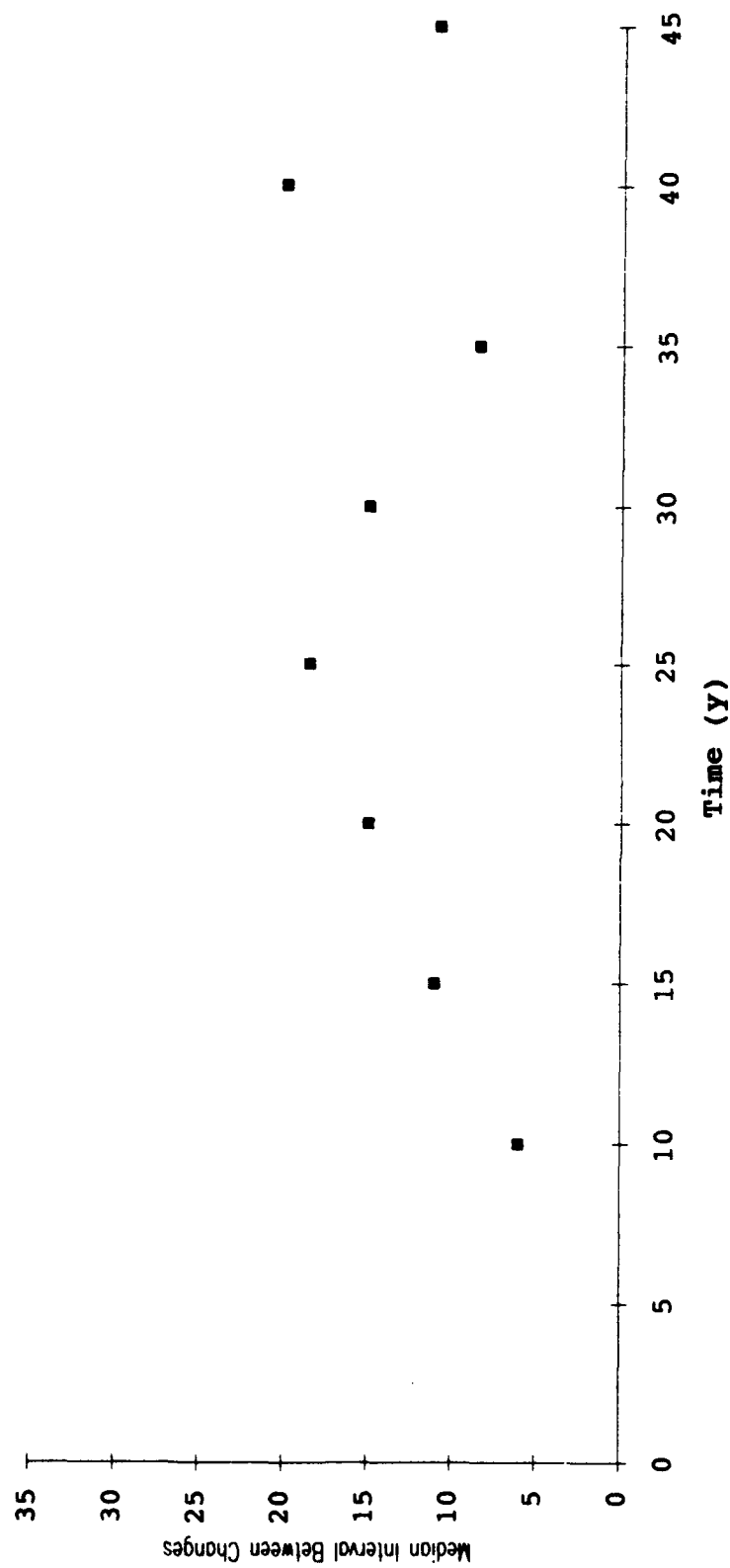


Figure 45
Interval Between Changes in TLVs for SIC 36
(For 5 year intervals from 1946)

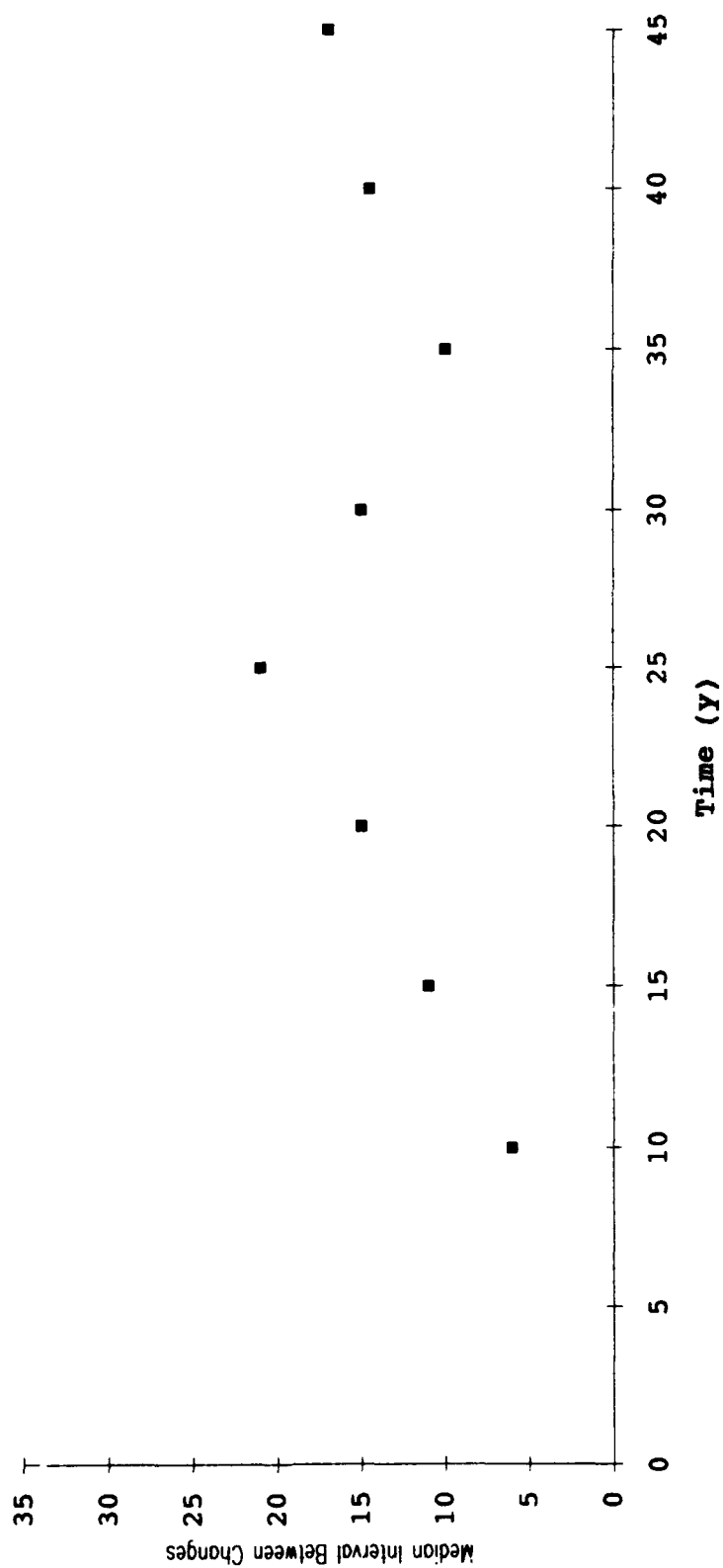


Figure 46
Interval Between Changes in TLVs for SIC 37
(For 5 year intervals from 1946)

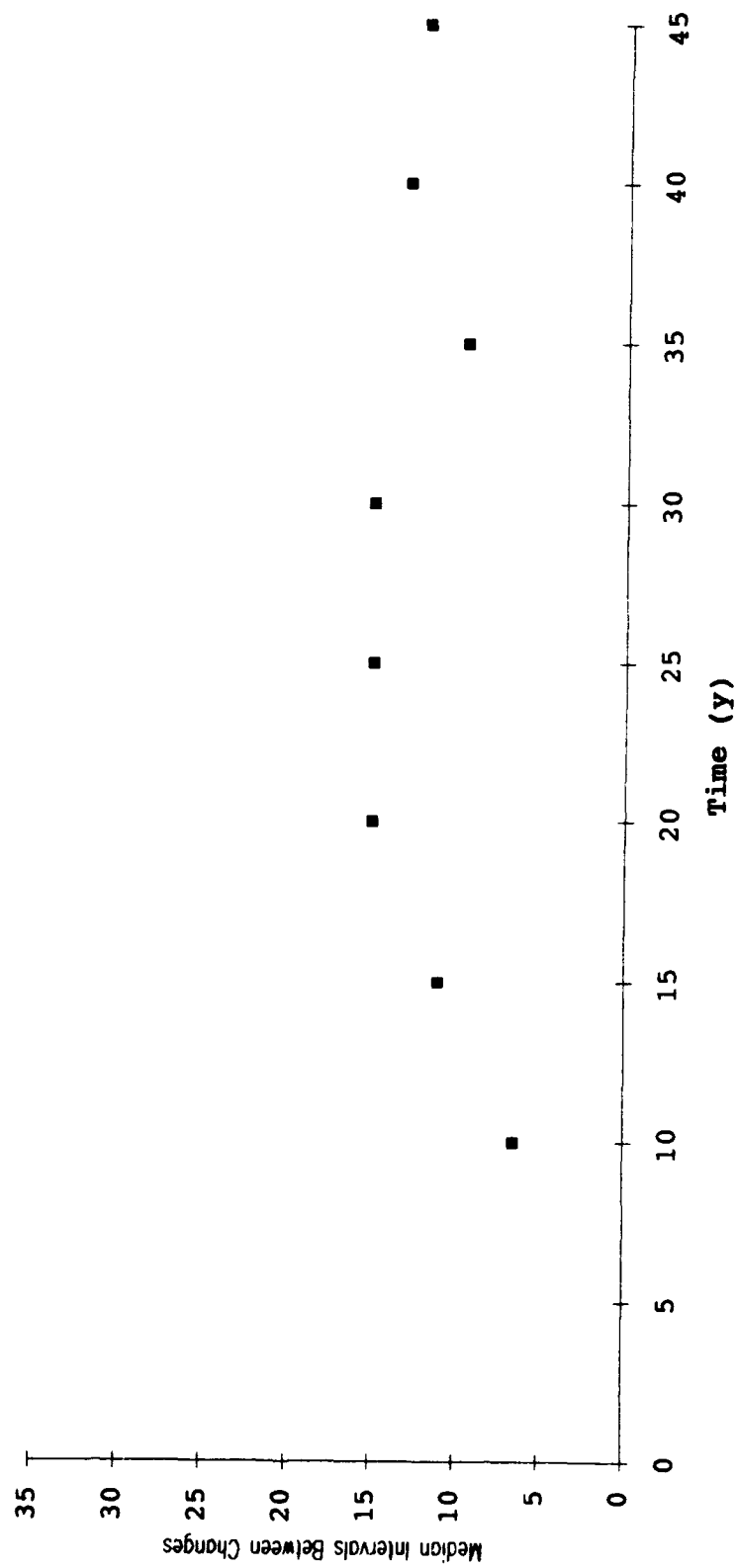


Figure 47
Interval Between Changes in TLVs for SIC 38
(For 5 year intervals from 1946)

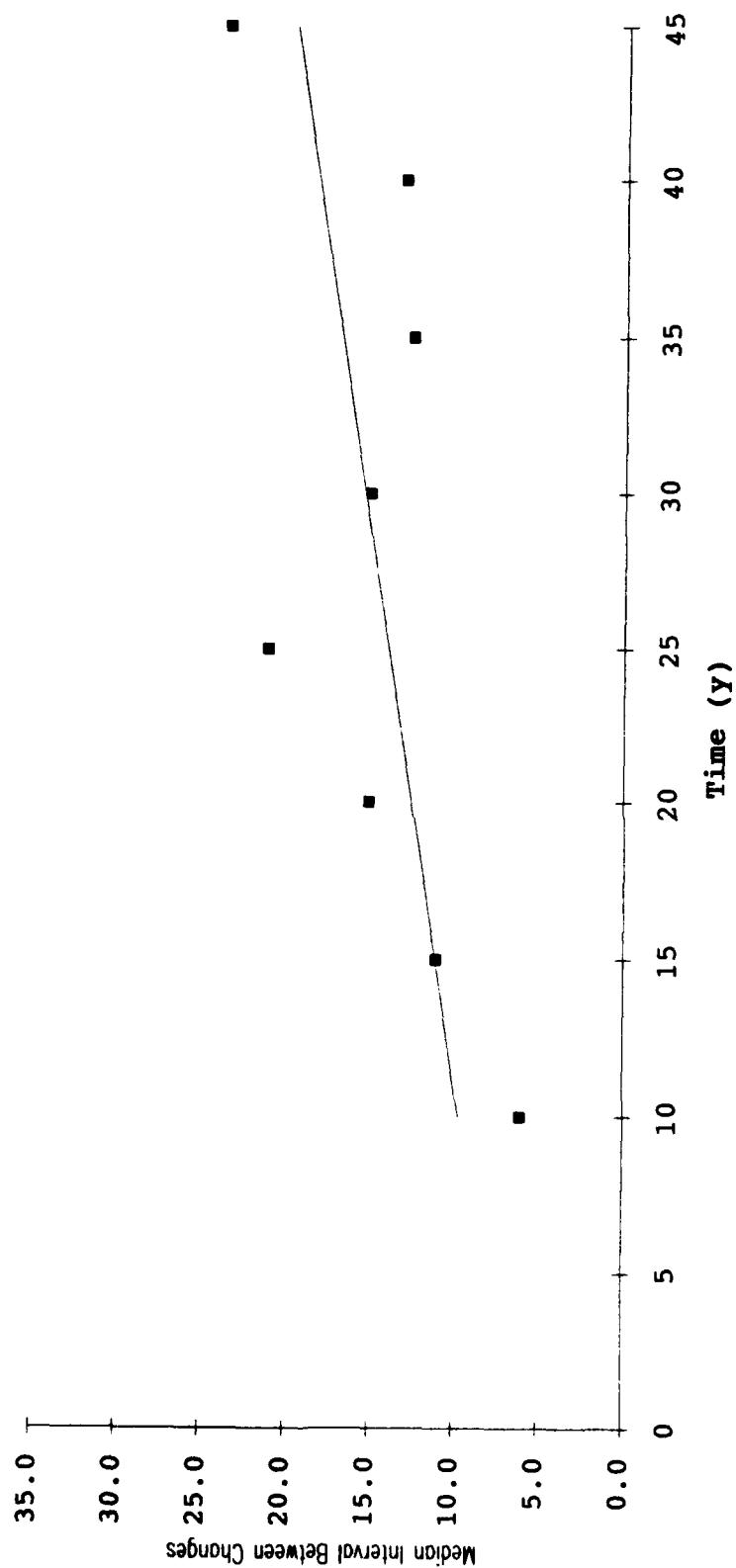


Figure 48
Interval Between Changes in TLVs for SIC 39
(For 5 year intervals from 1946)

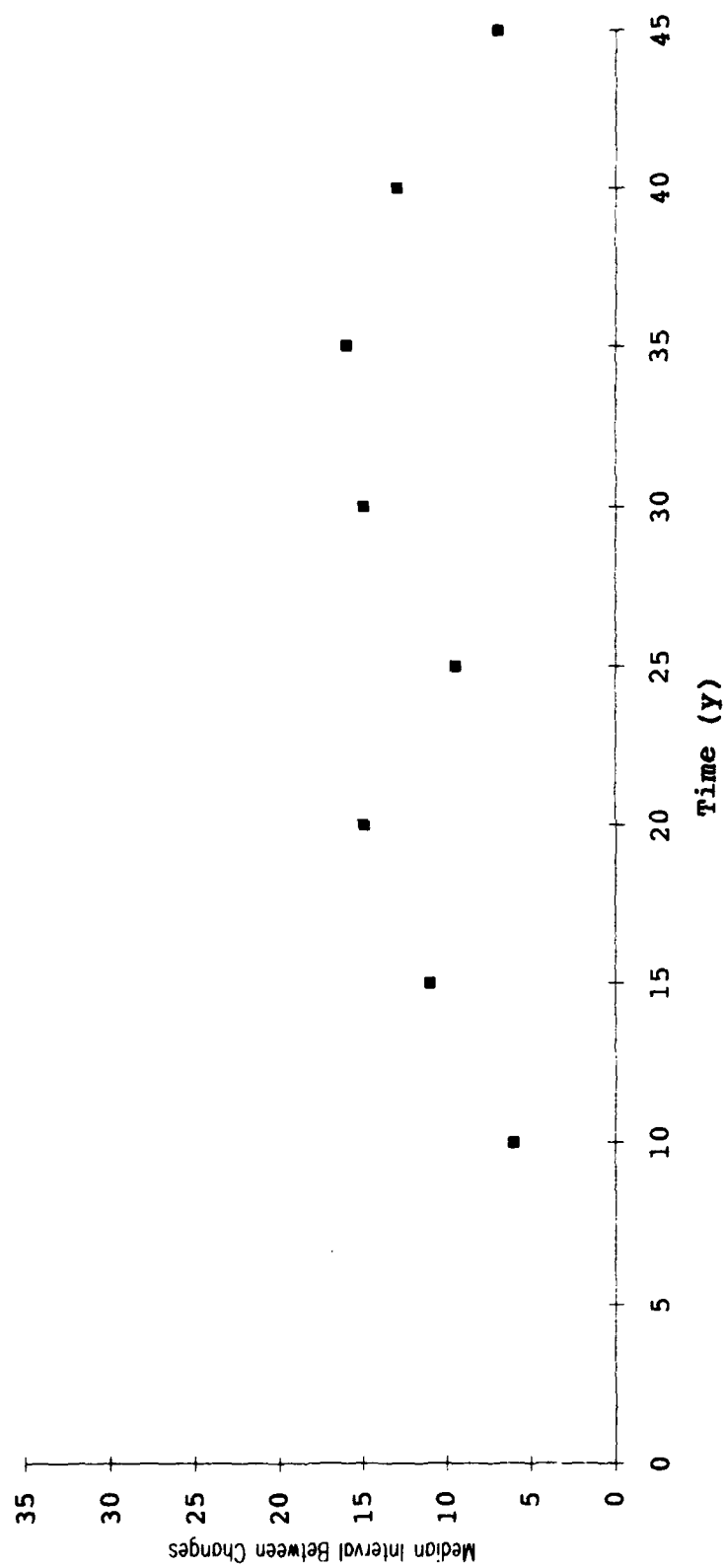


Figure 49
Interval Between Changes in TLVs for SICs 40 & 45
(For 5 year intervals from 1946)

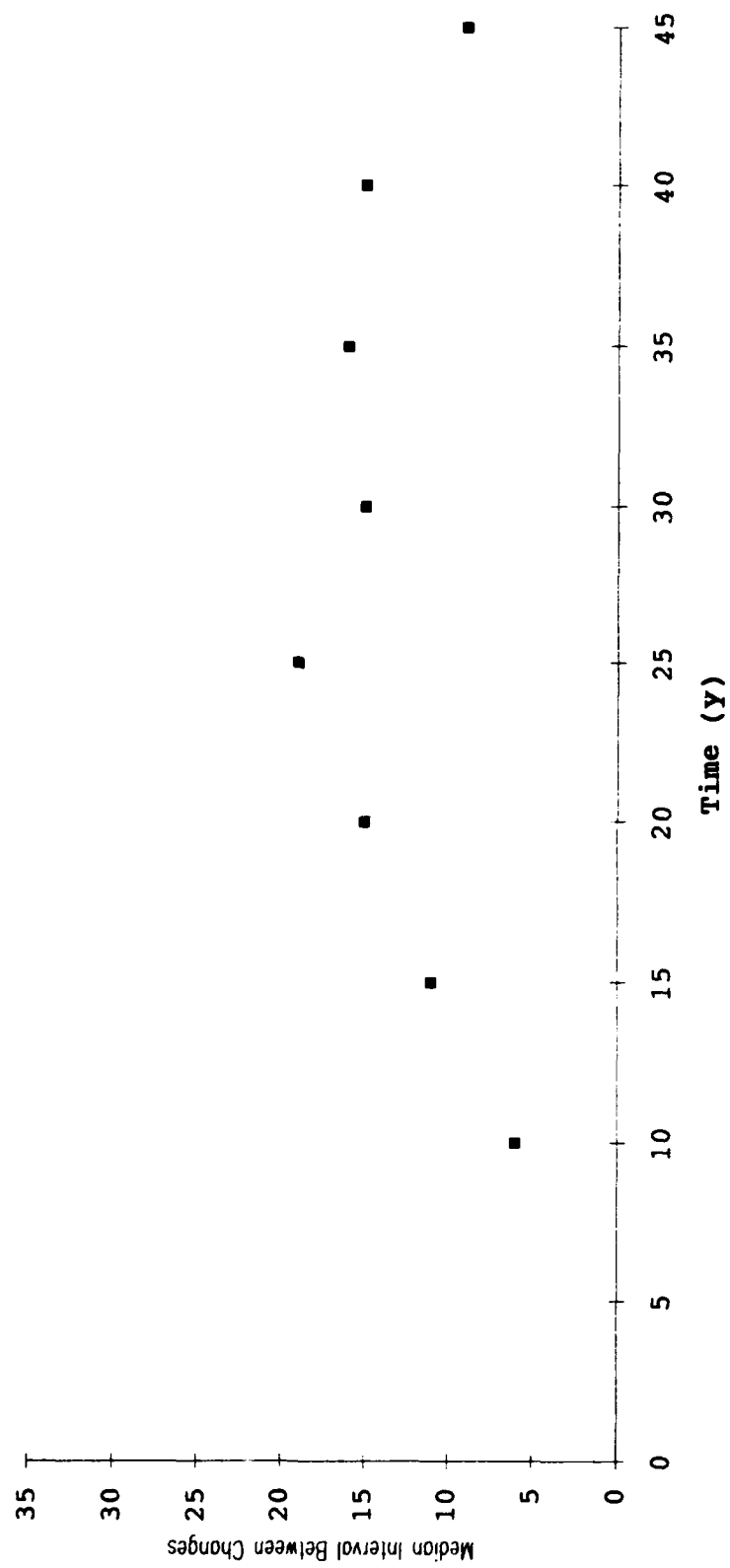


Figure 50
Interval Between Changes in TLVs for SICs 49, 72, 73 & 76
(For 5 year intervals from 1946)

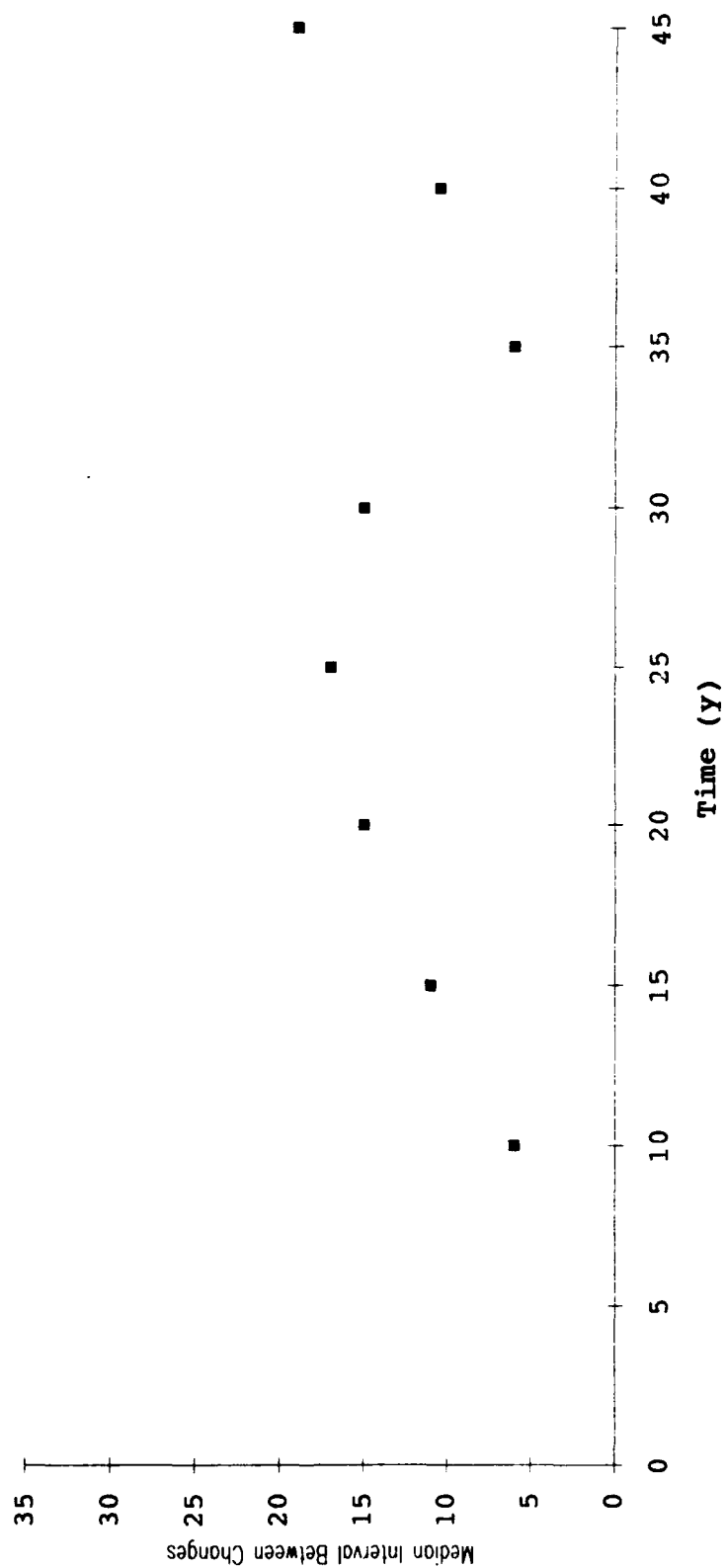


Figure 51
Interval Between Changes in TLVs for SIC 80
(For 5 year intervals from 1946)

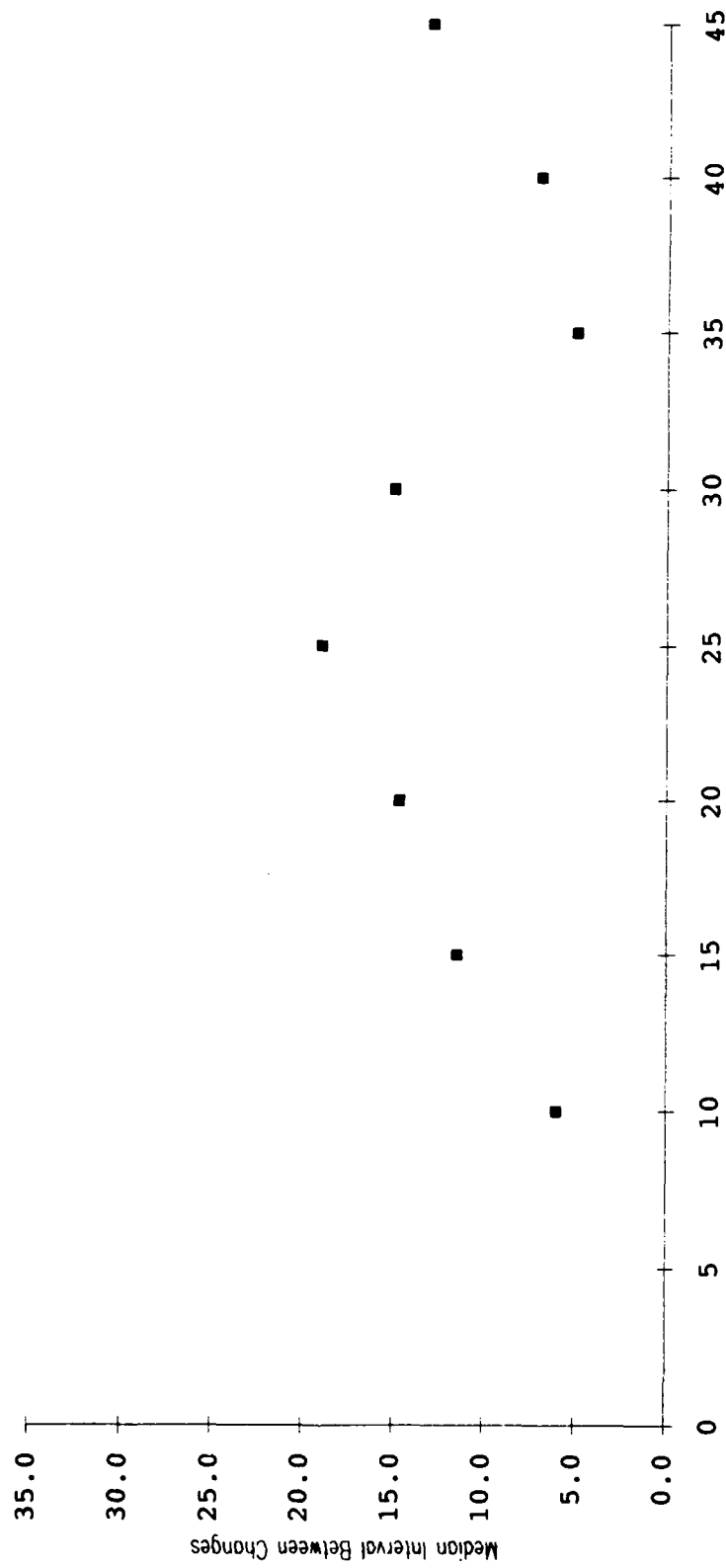


Figure 52
Interval Between Changes in TLVs for Known or Suspected Carcinogens
(For 5 year intervals from 1946)

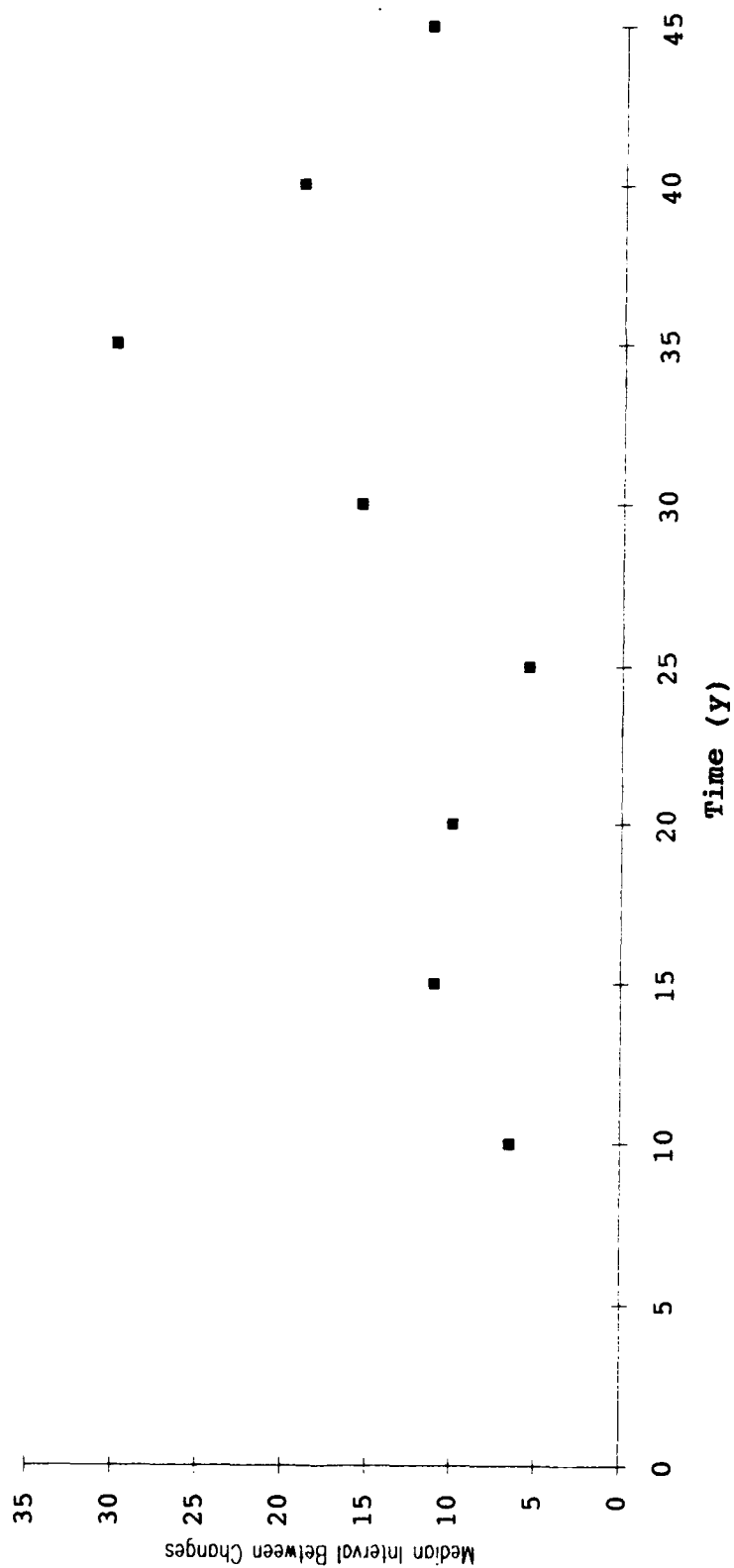


Figure 53
Rate of Reduction for All TLVs
(For 5-year intervals from 1946)

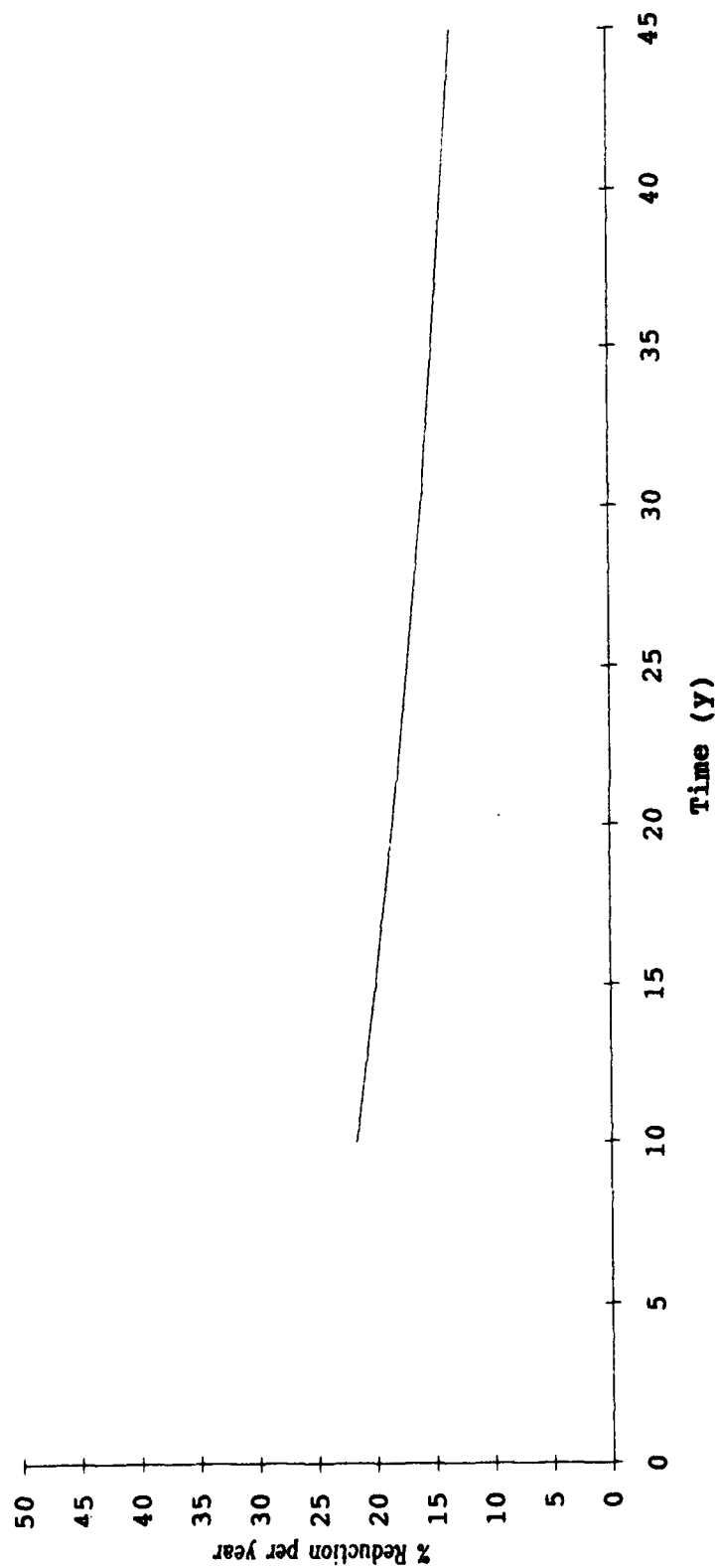


Figure 54
Rate of Reduction for SIC 15
(For 5 year intervals from 1946)

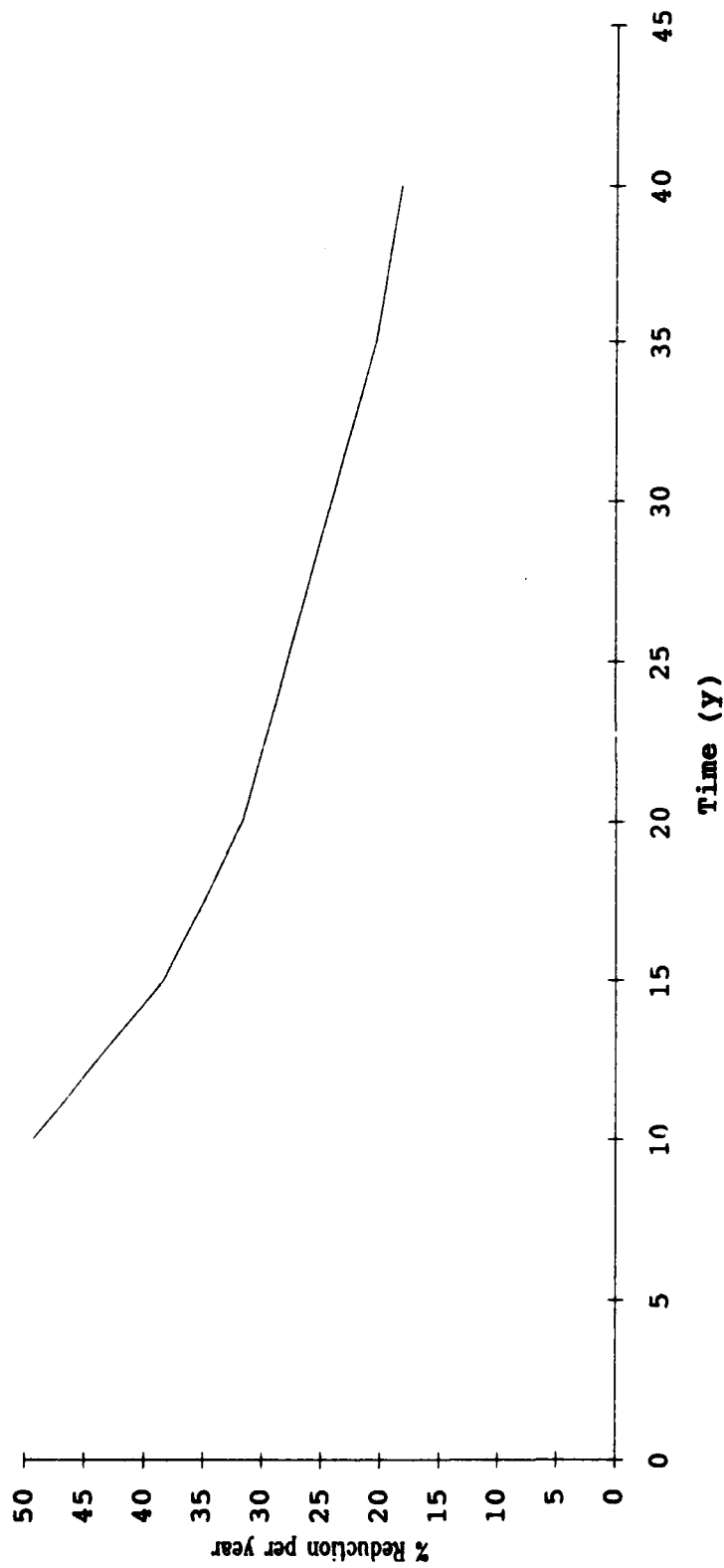


Figure 55
Rate of Reduction for SIC 17
(For 5 year intervals from 1946)

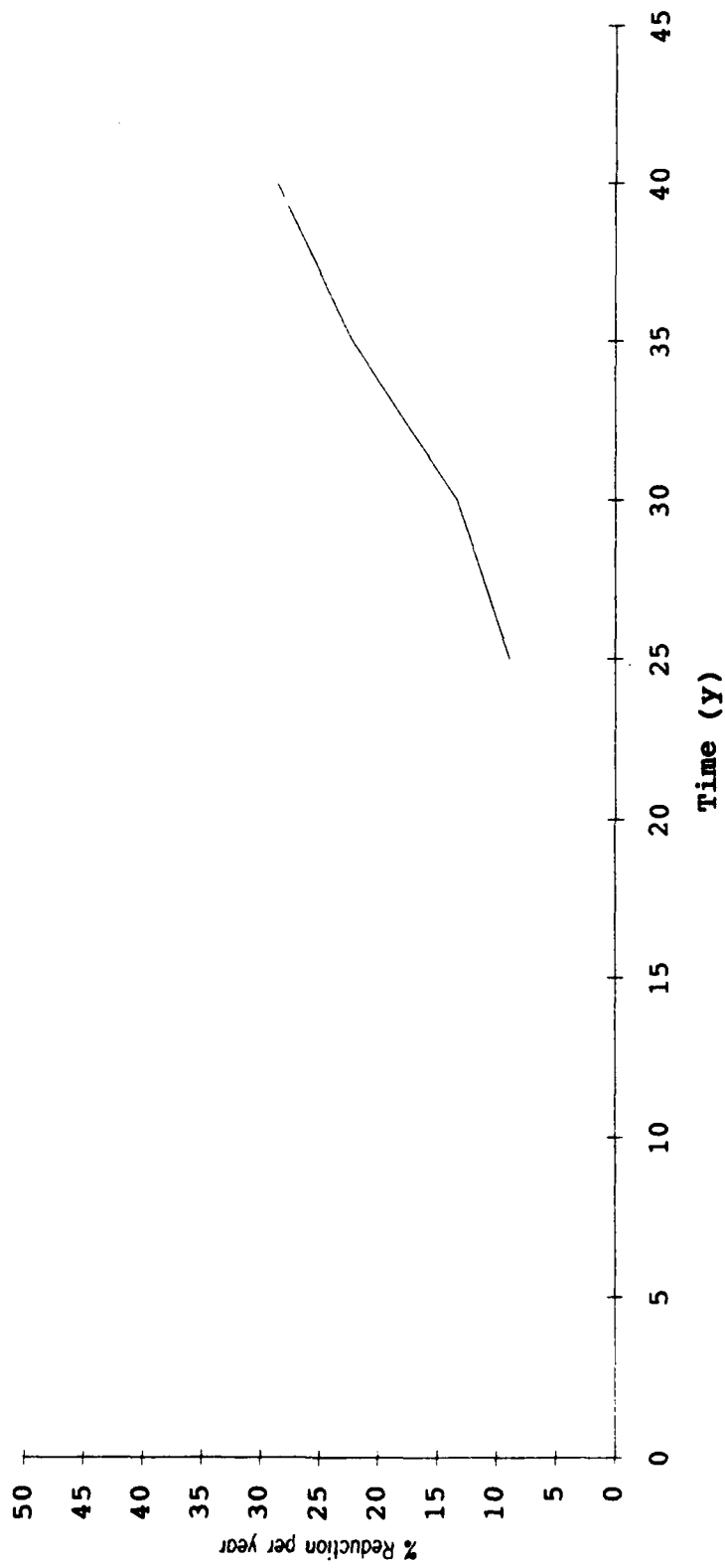


Figure 56
Rate of Reduction for SICs 20 & 21
(For 5 year intervals from 1946)

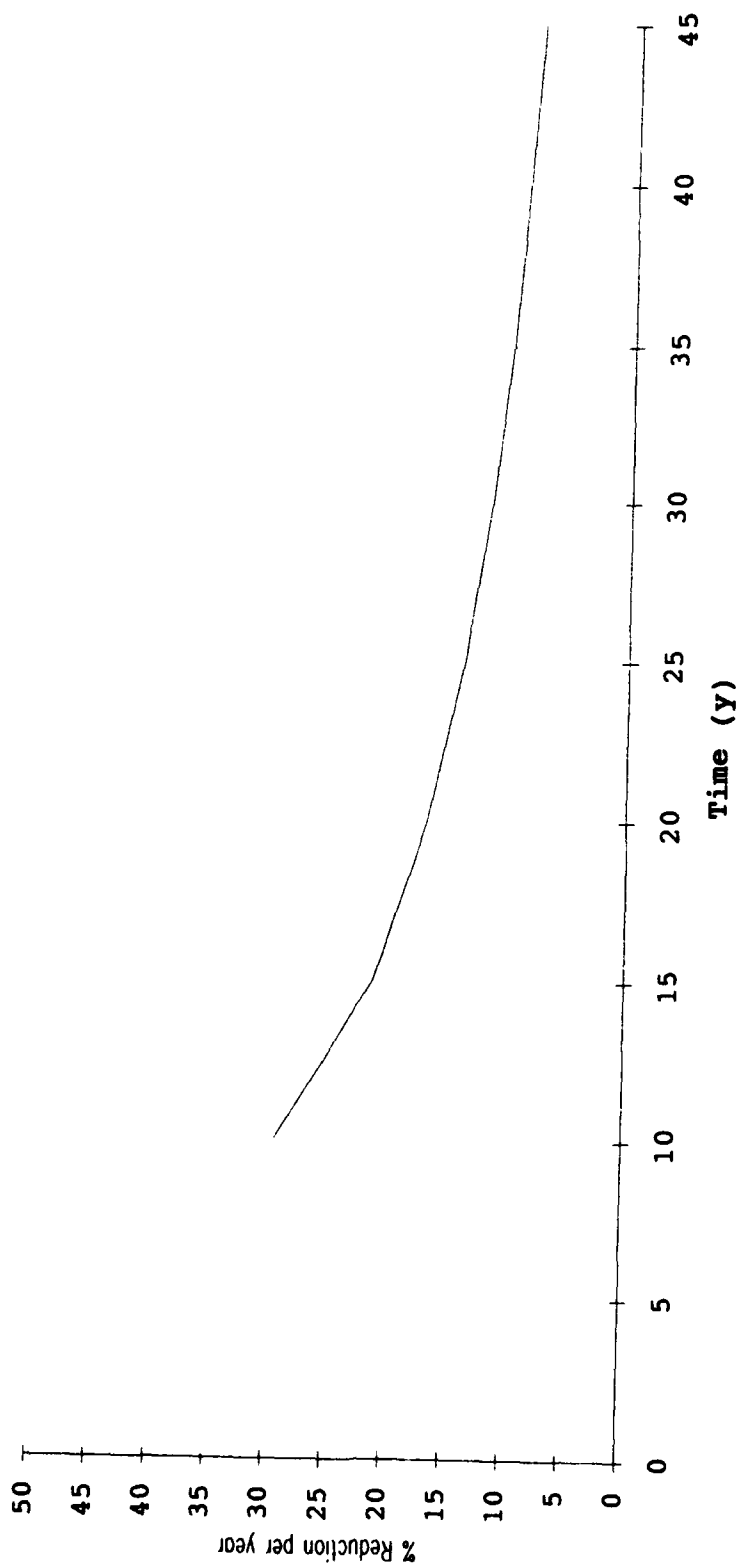


Figure 57
Rate of Reduction for SIC 23
(For 5 year intervals from 1946)

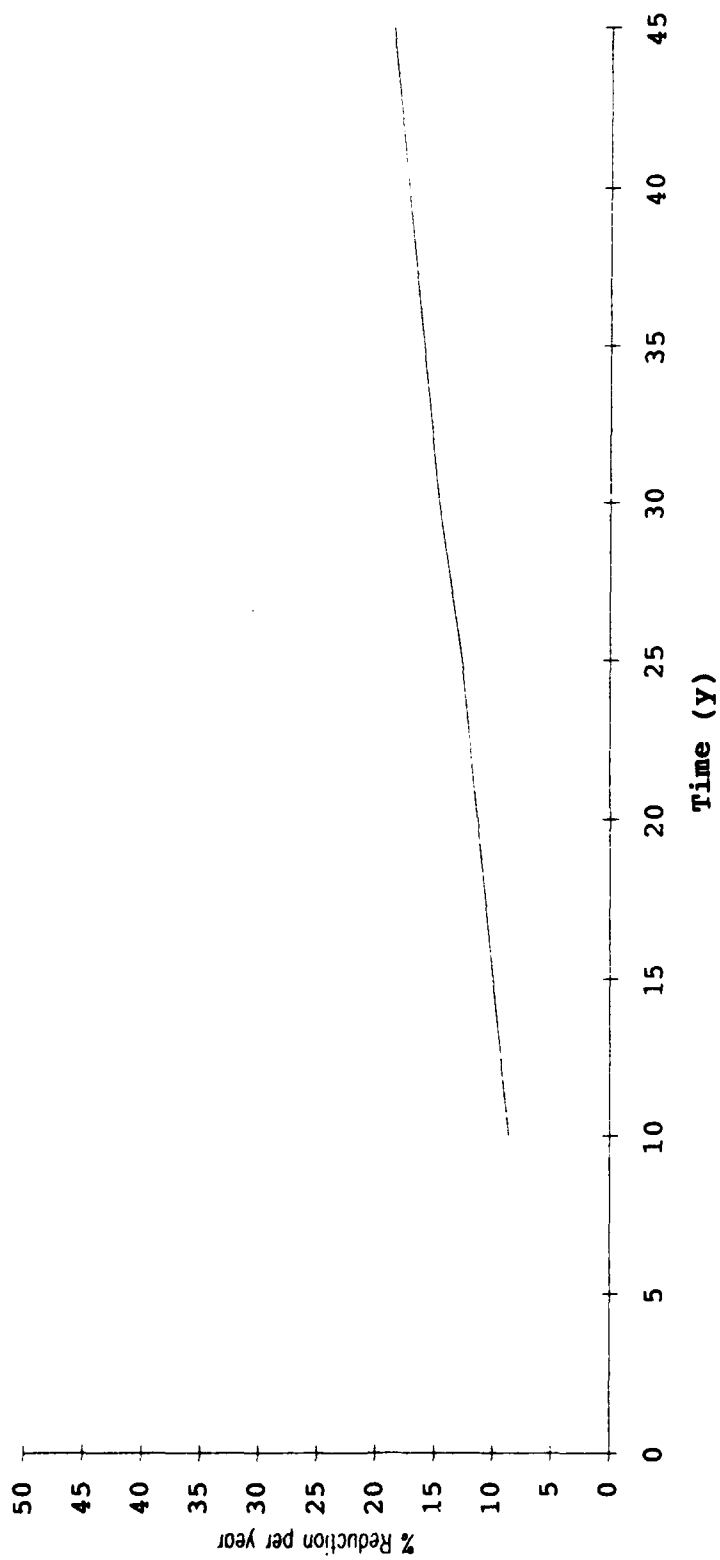


Figure 58
Rate of Reduction for SIC 24
(For 5 year intervals from 1946)

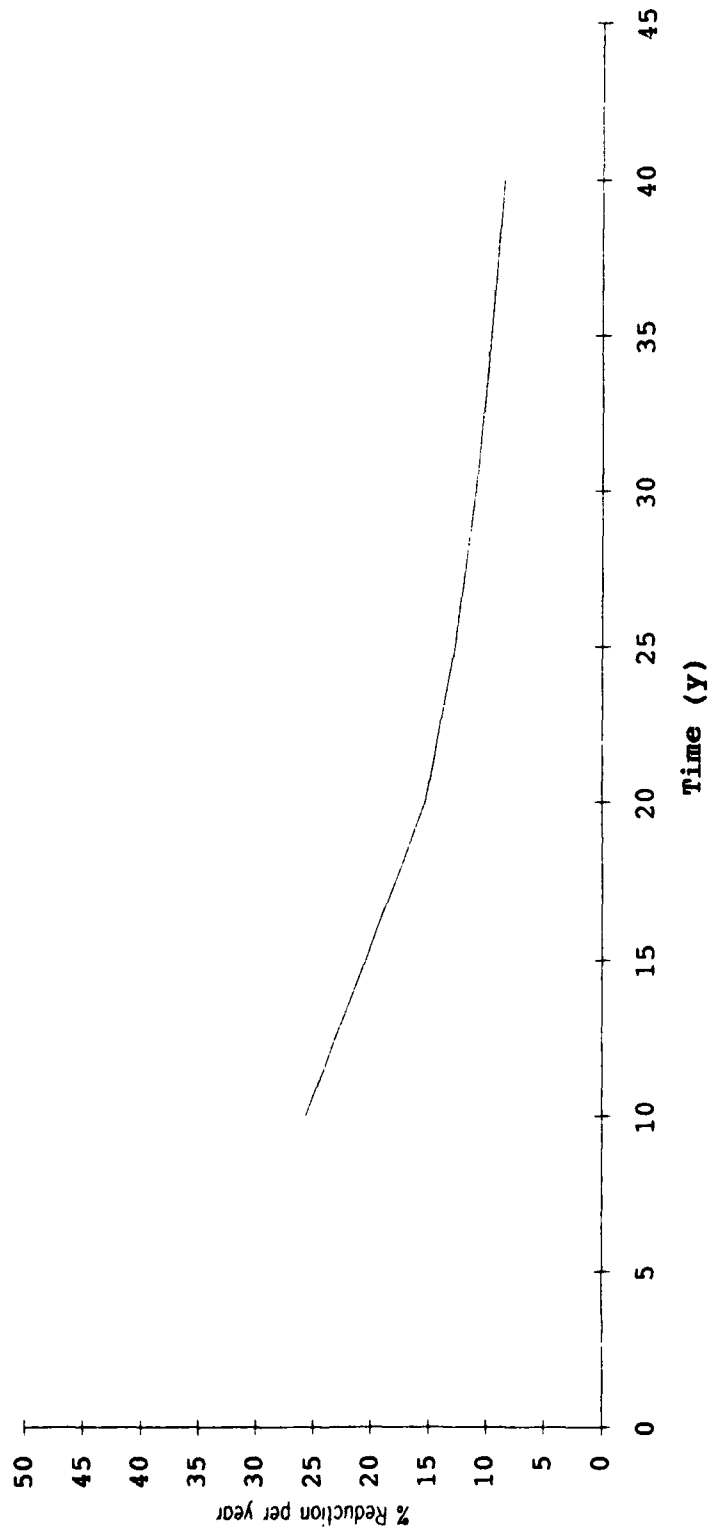


Figure 59
Rate of Reduction for SIC 32
(For 5 year intervals from 1946)

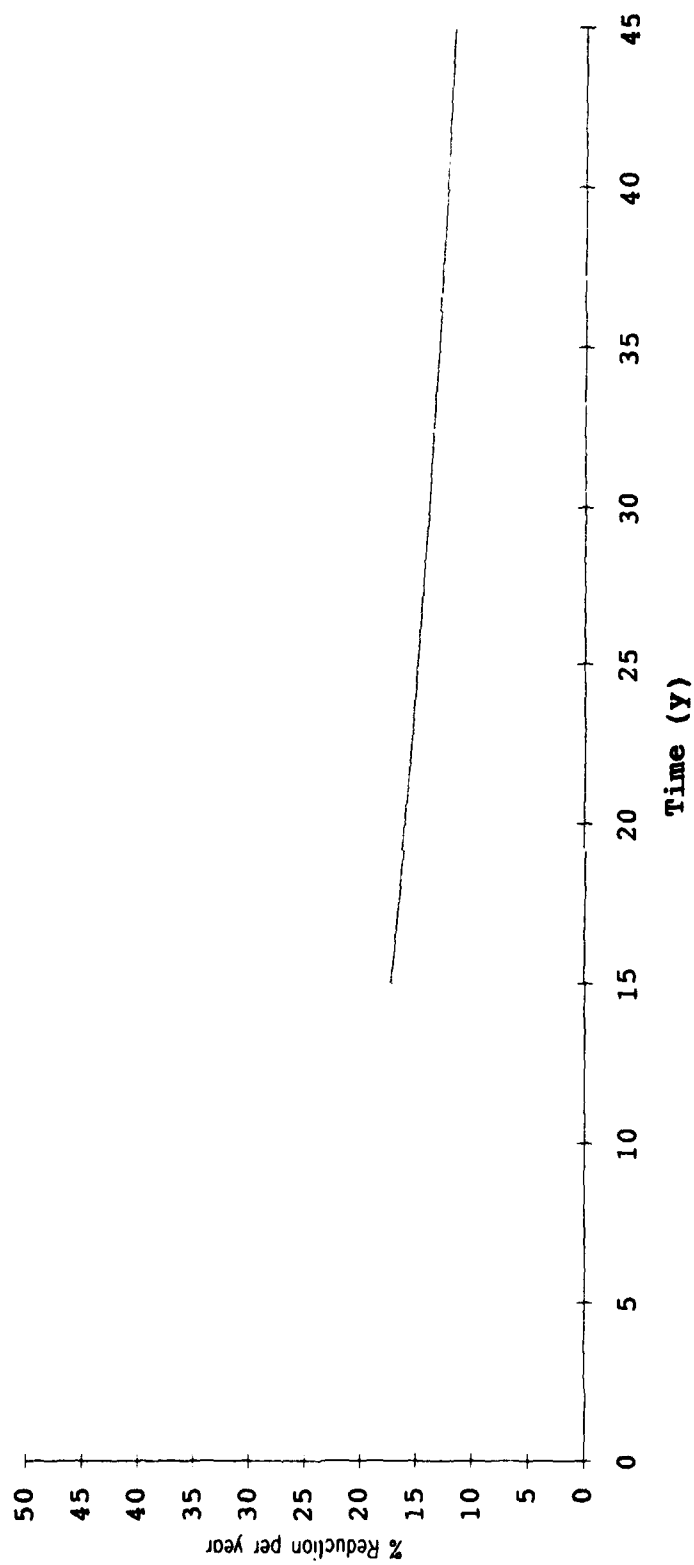


Figure 60
Rate of Reduction for SIC 36
(For 5 year intervals from 1946)

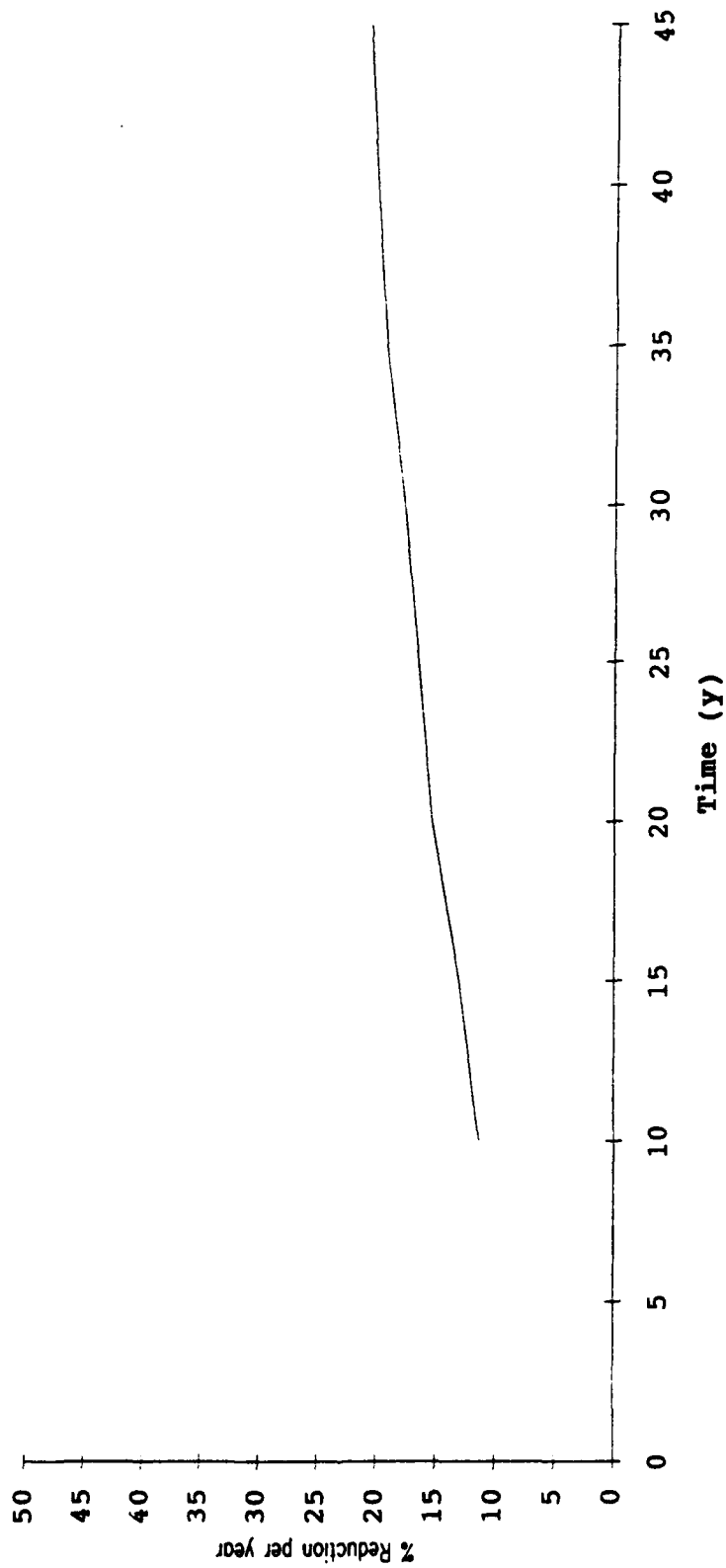


Figure 61
Rate of Reduction for SIC 37
(For 5 year intervals from 1946)

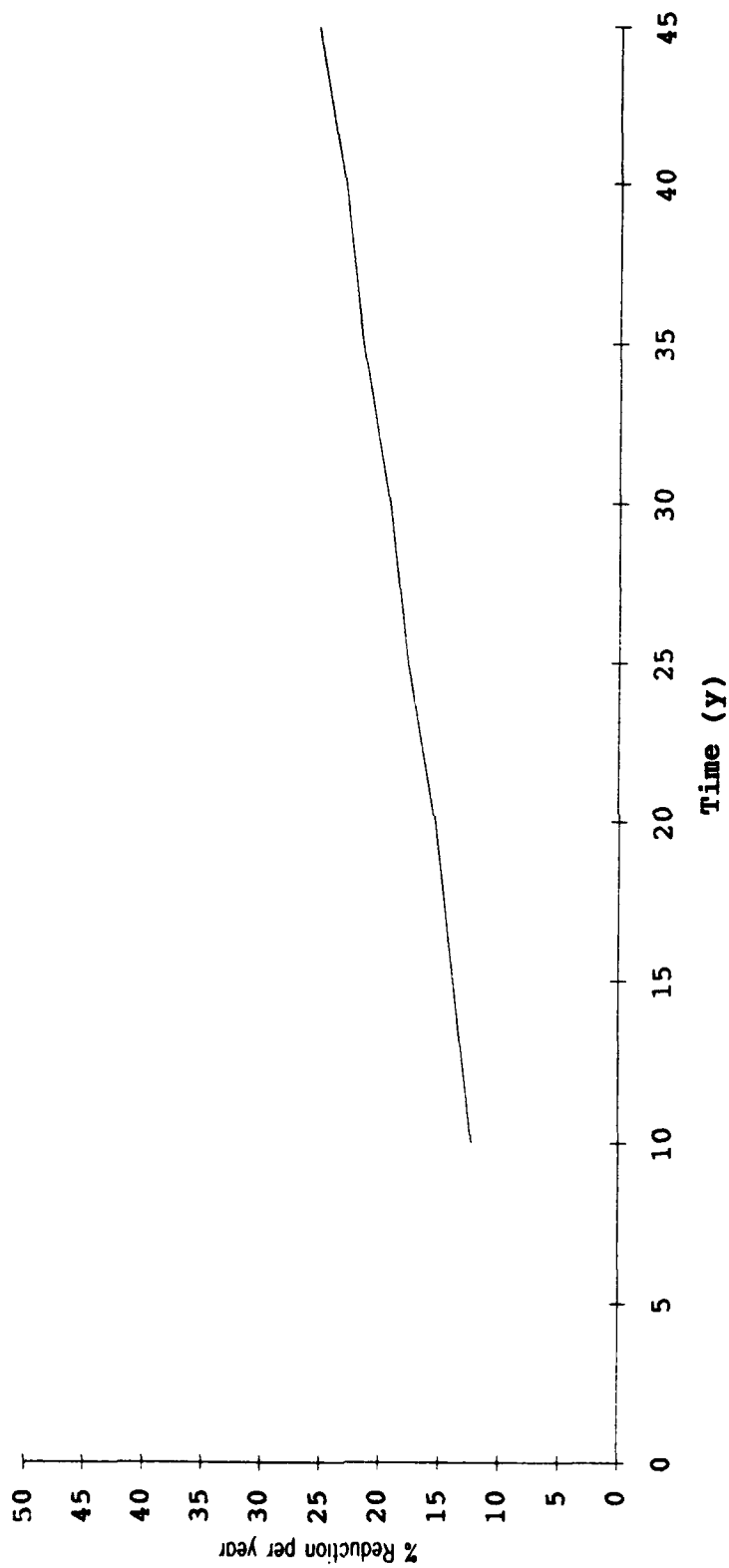


Figure 62
Rate of Reduction for SIC 38
(For 5 year intervals from 1946)

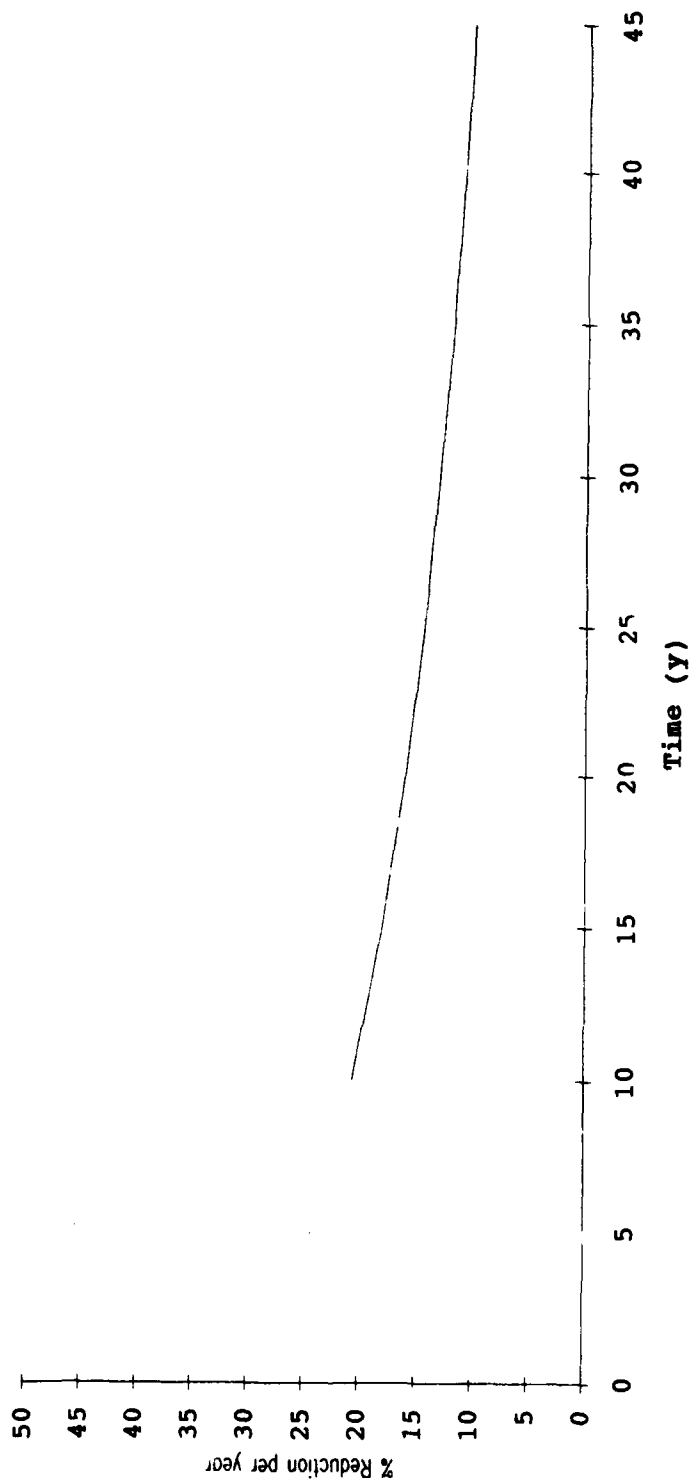


Figure 63
Number of Changes of All TLVs
(For 5 year intervals from 1946)

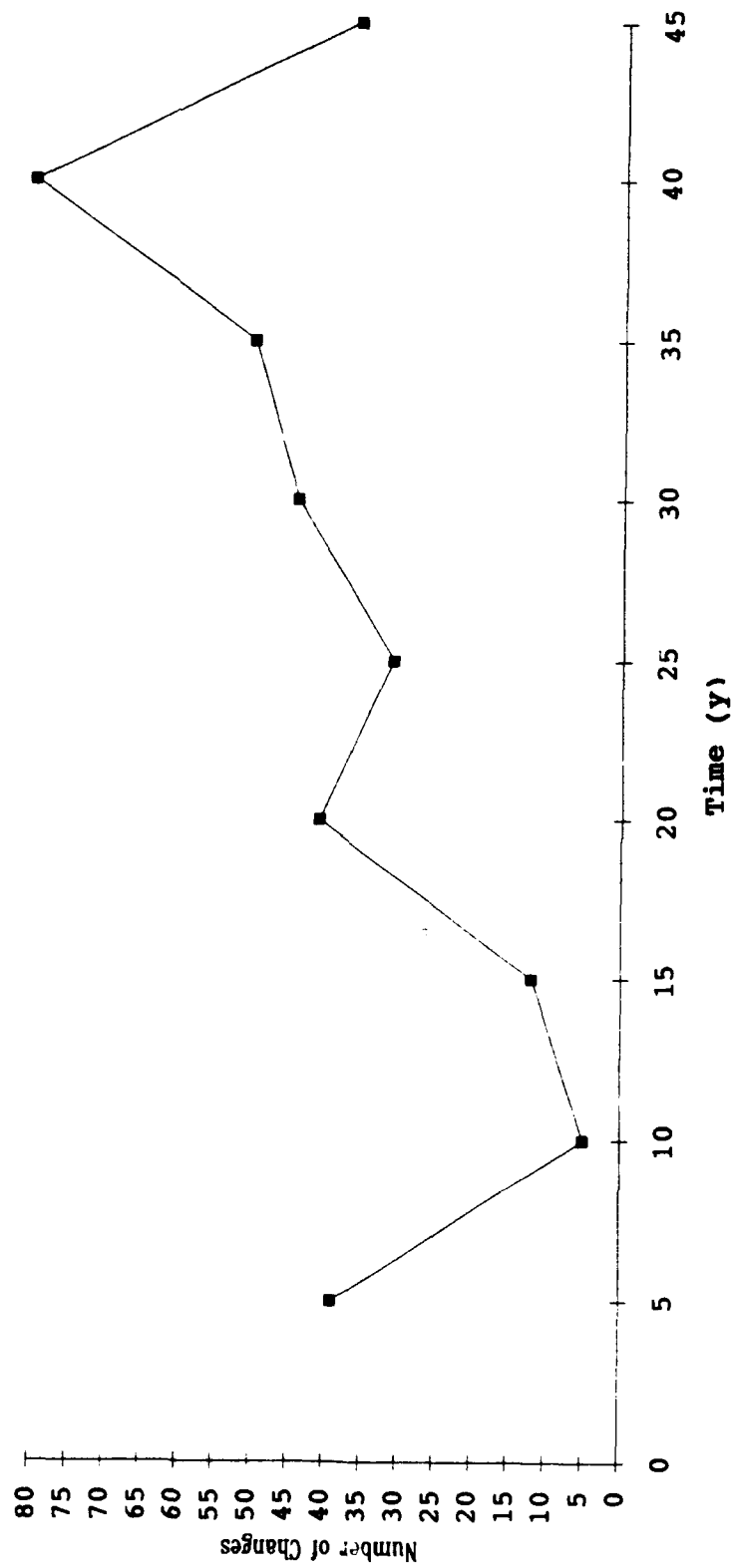
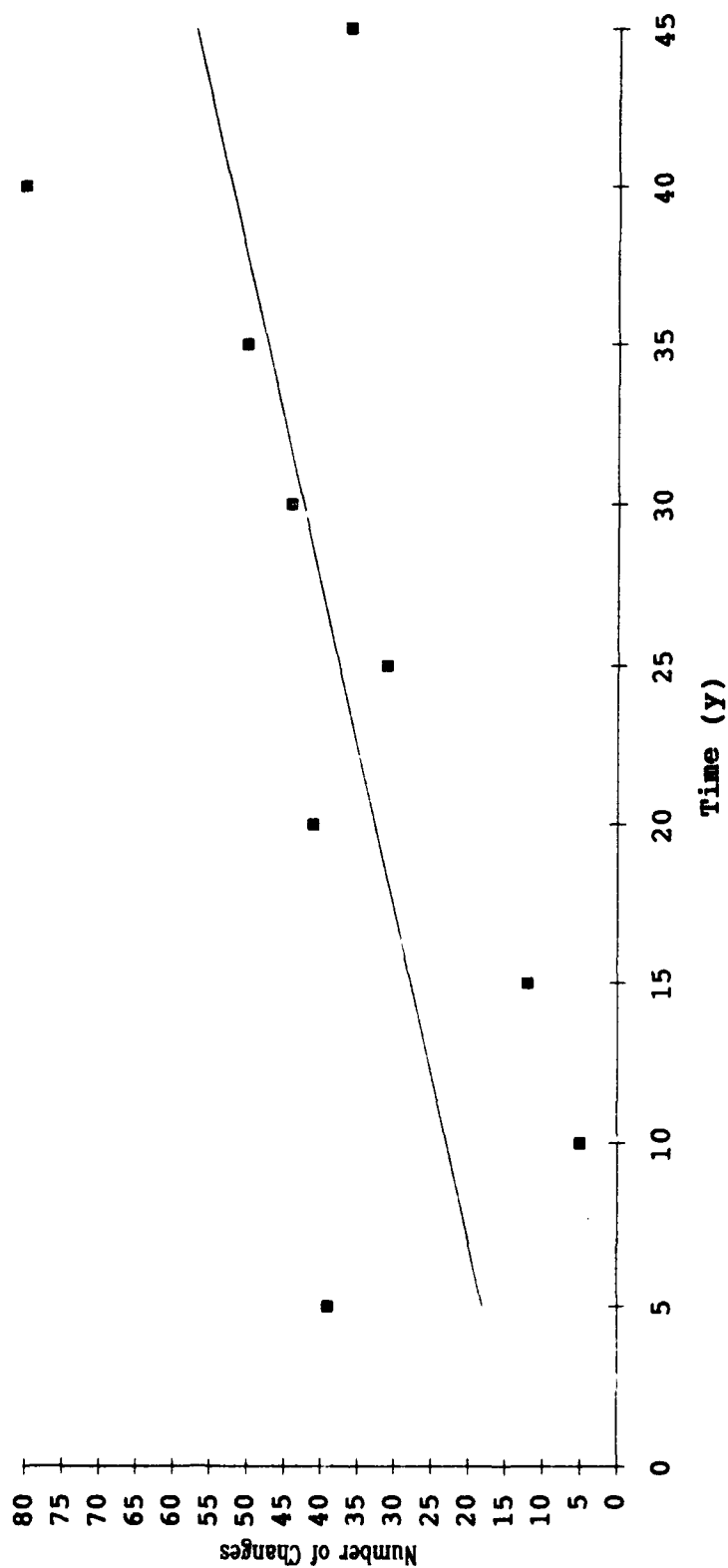


Figure 64
Number of Changes of All TLVs
(For 5 year intervals from 1946)



APPENDICES

APPENDIX A

All chemicals listed in the TLV booklet with their corresponding fold reductions
and interval between reductions by year.

Substance	CAS #	APPENDIX A		carcinogen	yr change	fold	yr change
		yr intr	yr cur tlv				
Abate		1969	deleted				
Acetaldehyde	75-07-0	1946	1973	y			
Acetic acid	64-19-7	1946	1946				
Acetic anhydride	108-24-7	1947	1973				
Acetone	67-64-1	1947	1982				
Acetonitrile	75-05-8	1962	1962				
Acetylene tetrabromide	79-27-6	1959	1959				
Acetylsalicylic acid (Aspirin)	50-78-2	1980	1980				
Acrolein	107-02-8	1946	1963				
Acrylamide	79-06-1	1967	1987	y			
Acrylic acid	79-10-7	1981	1990				
Acrylonitrile	107-13-1	1947	1981	y			
Aldrin	309-00-2	1956	1956	y			
Allyl alcohol	107-18-6	1956	1961				
Allyl chloride	107-05-1	1957	1968	y			
Allyl glycidyl ether (AGE)	106-92-3	1971	1973				
Allyl propyl disulfide	2179-59-1	1956	1956				
Aluminum as Al	7429-90-5						
Metal dust		1979	1979				
Pyro powders		1979	1979				
Welding fumes		1979	1979				
Soluble salts		1979	1979				
Alkyls (NOC)		1979	1979				
Aluminum oxide as Al	1344-28-1	1960	1968				
2-Aminopyridine	504-29-0	1967	1967				
Amitrole	61-82-5	1983	1983	y			
Ammonia	7664-41-7	1946	1973				
Ammonium chloride fume	12125-02-9	1972	1972				
Ammonium perfluorooctanoate	3825-26-1	1988	1988				
Ammonium sulfamate	7773-06-0	1956	1971				
n-Amyl acetate	628-63-7	1946	1963				
sec-Amyl acetate	626-38-0	1967	1967				
Aniline	62-53-3	1946	1980	y			
Anisidine	29191-52-4	1966	1966	y			
Antimony	7440-36-0	1947	1950				
Antimony trioxide	1309-64-4			y			
Handling and use		1977	1977	y			
ANTU	86-88-4	1957	1957				
Arsenic	7440-38-2	1947	1980	y			
Arsine	7784-42-1	1946	1947	y			
Asbestos		1946		y			
Amosite	12172-73-5	1980	1980	y			
Chrysotile	12001-29-5	1980	1980	y			
Crocidolite	12001-28-4	1980	1980	y			
Other forms		1980	1980	y			
Asphalt (petroleum) fumes	8052-42-4	1971	1971	y			
Atrazine	1912-24-9	1978	1983				
Azinphos-methyl	86-50-0	1967	1967				
Barium, soluble compounds	7440-39-3	1946	1946				
Barium sulfate	7727-43-7	1987	1937				
Benomyl	17804-35-2	1979	1979				
Benzene (benzol)	71-43-2	1946	1977	y	1947	2	1948
Benzoyl peroxide	94-36-0	1966	1966				
Benzyl chloride	100-44-7	1956	1956				
Beryllium	7440-41-7	1959	1961	y			
Biphenyl	92-52-4	1968	1968				
Bismuth telluride							
Undoped	1304-82-1	1973	1973				
Se-doped		1973	1973				
Borates, tetra, sodium salts	1303-96-4						
Anhydrous		1977	1977				
Decahydrate		1977	1977				
Pentahydrate		1977	1977				
Boron oxide	1303-86-2	1962	1971				
Boron tribromide	10294-33-4	1969	1986				

Substance	fold	yr change	fold	yr change	fold	yr change	fold
Abate						1971	1.5
Acetaldehyde							
Acetic acid							
Acetic anhydride							
Acetone						1953	0.5
Acetonitrile							
Acetylene tetrabromide							
Acetylsalicylic acid (Aspirin)							
Acrolein							
Acrylamide							
Acrylic acid							
Acrylonitrile							
Aldrin							
Allyl alcohol							
Allyl chloride						1963	3
Allyl glycidyl ether (AGE)							
Allyl propyl disulfide							
Aluminum as Al							
Metal dust							
Pyro powders							
Welding fumes							
Soluble salts							
Alkyls (NOC)							
Aluminum oxide as Al							
2-Aminopyridine							
Amitrole							
Ammonia						1962	2
Ammonium chloride fume							
Ammonium perfluorooctanoate							
Ammonium sulfamate							
n-Amyl acetate							
sec-Amyl acetate							
Aniline							
Anisidine							
Antimony							
Antimony trioxide							
Handling and use							
ANTU							
Arsenic						1950	0.2
Arsine							
Asbestos							
Amosite							
Chrysotile							
Crocidolite							
Other forms							
Asphalt (petroleum) fumes							
Atrazine							
Azinphos-methyl							
Barium, soluble compounds							
Barium sulfate							
Benomyl							
Benzene (benzol)	1.43	1957	1.375	1971	6	1976	2.5
Benzoyl peroxide							
Benzyl chloride							
Beryllium							
Biphenyl							
Bismuth telluride							
Undoped							
Se-doped							
Borates, tetra, sodium salts							
Anhydrous							
Decahydrate							
Pentahydrate							
Boron oxide							
Boron tribromide							

Substance	fold	y bet ch1	y bet ch2	y bet ch3	y bet ch4	y bet ch5	y bet ch6
Abate		2					
Acetaldehyde	2	27					
Acetic acid	0	0					
Acetic anhydride	5.7	26					
Acetone	1.35	6	29				
Acetonitrile	0	0					
Acetylene tetrabromide	0	0					
Acetylsalicylic acid (Aspirin)	0	0					
Acrolein	5.21	7					
Acrylamide	10	20					
Acrylic acid	4.9	9					
Acrylonitrile	10.47	34					
Aldrin	0	0					
Allyl alcohol	2.5	5					
Allyl chloride	2.5	6	5				
Allyl glycidyl ether (AGE)	0.33	2					
Allyl propyl disulfide	0	0					
Aluminum as Al							
Metal dust	0	0					
Pyro powders	0	0					
Welding fumes	0	0					
Soluble salts	0	0					
Alkyls (NOC)	0	0					
Aluminum oxide as Al	5	8					
2-Aminopyridine	0	0					
Amitrole	0	0					
Ammonia	2.06	16	11				
Ammonium chloride fume	0	0					
Ammonium perfluorooctanoate	0	0					
Ammonium sulfamate	1.5	15					
n-Amyl acetate	1.97	17					
sec-Amyl acetate	0	0					
Aniline	2.5	34					
Anisidine	0	0					
Antimony	0.2	3					
Antimony trioxide							
Handling and use	0	0					
ANTU	0	0					
Arsenic	2.5	3	30				
Arsine	25	1					
Asbestos							
Amosite	10	34					
Chrysotile	2.5	34					
Crocidolite	25	34					
Other forms	2.5	34					
Asphalt (petroleum) fumes	0	0					
Atrazine	2	5					
Azinphos-methyl	0	0					
Barium, soluble compounds	0	0					
Barium sulfate	0	0					
Benomyl	0	0					
Benzene (benzol)	0.167	1	1	9	14	5	1
Benzoyl peroxide	0	0					
Benzyl chloride	0	0					
Beryllium	10000	2					
Biphenyl	0	0					
Bismuth telluride							
Undoped	0	0					
Se-doped	0	0					
Borates, tetra, sodium salts							
Anhydrous	0	0					
Decahydrate	0	0					
Pentahydrate	0	0					
Boron oxide	1.5	9					
Boron tribromide	5.99	17					

Boron trifluoride	7637-07-2	1960	1963			
Bromacil	314-40-9	1979	1979			
Bromine	7726-95-6	1946	1959			
Bromine pentafluoride	7789-30-2	1969	1969			
Bromoform	75-25-2	1967	1967			
1,3-Butadiene	106-99-0	1946	1986	y		
Butane	106-97-8	1973	1981			
2-Butoxyethanol (EGBE)	111-76-2	1946	1981			
n-Butyl acetate	123-86-4	1946	1968			
sec-Butyl acetate	105-46-4	1967	1967			
tert-Butyl acetate	540-88-5	1967	1967			
n-Butyl acrylate	141-32-2	1978	1978			
n-Butyl alcohol	71-36-3	1946	1976			
sec-Butyl alcohol	78-92-2	1968	1981			
tert-Butyl alcohol	75-65-0	1961	1961			
n-Butylamine	109-73-9	1956	1963			
tert-Butyl Chromate as CrO3	1189-85-1	1964	1968	y		
n-Butylglycidyl ether (BGE)	2426-08-6	1962	1981			
n-Butyl lactate	138-22-7	1976	1976			
Butyl mercaptan	109-79-5	1954	1970			
o-sec-Butylphenol	89-72-5	1980	1980			
p-tert-Butyltoluene	98-51-1	1956	1956			
Cadmium dusts and salts	7440-43-9	1946	1976	y		
Cadmium oxide	1306-19-0					
Fume, as Cd		1956	1974			
Production		1983	1988			
Calcium carbonate (Limestone)	1317-65-3	1971	1971			
Calcium chromate	13765-19-0	1991	1991			
Calcium cyanamide	156-62-7	1976	1976			
Calcium hydroxide	1305-62-0	1976	1976			
Calcium oxide	1305-78-8	1968	1978			
Calcium silicate (synthetic)	1344-95-2	1981	1981			
Calcium sulfate	13397-24-5	1986	1986			
Camphor, synthetic	76-22-2	1964	1972			
Caprolactam	105-60-2					
Dust		1974	1974			
Vapor		1974	1974			
Captan	2425-06-1	1977	1977	y		
Captan	133-06-2	1976	1976	y		
Carbaryl	63-25-2	1966	1966			
Carbofuran	1563-66-2	1976	1976			
Carbon black	1333-86-4	1967	1967	y		
Carbon dioxide	124-38-9	1946	1946			
Carbon disulfide	75-15-0	1946	1980	y		
Carbon monoxide	630-08-0	1946	1967			
Carbon tetrabromide	558-13-4	1975	1975			
Carbon tetrachloride	56-23-5	1946	1981	y		
Carbonyl fluoride	353-50-4	1978	1981			
Catechol	120-80-9	1977	1977			
Cellulose	9004-34-6	1971	1971			
Cesium hydroxide	21351-79-1	1975	1975			
Chlordane	57-74-9	1956	1962	y		
Chlorinated camphene	8001-35-2	1957	1957	y		
Chlorinated diphenyl oxide	55720-99-5	1956	1956			
Chlorine	7782-50-5	1946	1989			
Chlorine dioxide	10049-04-4	1960	1960			
Chlorine trifluoride	7790-91-2	1956	1963			
Chloroacetaldehyde	107-20-0	1962	1963			
Chloroacetone	78-95-5	1989	1989			
a-Chloroacetophenone	532-27-4	1968	1968			
Chloroacetyl chloride	74-04-9	1980	1980			
Chlorobenzene	108-90-7	1950	1991			
o-Chlorobenzylidene malononitrile	2698-41-1	1967	1982			
Chlorobromomethane	74-97-5	1968	1968			
Chlorodifluoromethane	75-45-6	1975	1975			
Chlorodiphenyl (42% chlorine)	53469-21-9	1946	1946	y		
Chlorodiphenyl (54% chlorine)	11097-69-1	1957	1957	y		

Boron trifluoride							
Bromacil							
Bromine							
Bromine pentafluoride							
Bromoform							
1,3-Butadiene					1947	5	
Butane					1976	0.84	
2-Butoxyethanol (EGBE)					1957	4.04	
n-Butyl acetate							
sec-Butyl acetate							
tert-Butyl acetate							
n-Butyl acrylate							
n-Butyl alcohol					1950	0.5	
sec-Butyl alcohol							
tert-Butyl alcohol							
n-Butylamine							
tert-Butyl Chromate as CrO3							
n-Butylglycidyl ether (BGE)							
n-Butyl lactate							
Butyl mercaptan							
o-sec-Butylphenol							
p-tert-Butyltoluene							
Cadmium dusts and salts							
Cadmium oxide							
Fume, as Cd					1969	5.98	
Production							
Calcium carbonate (Limestone)							
Calcium chromate							
Calcium cyanamide							
Calcium hydroxide							
Calcium oxide							
Calcium silicate (synthetic)							
Calcium sulfate							
Camphor, synthetic							
Caprolactam							
Dust							
Vapor							
Captan							
Carbaryl							
Carbofuran							
Carbon black							
Carbon dioxide							
Carbon disulfide							
Carbon monoxide							
Carbon tetrabromide							
Carbon tetrachloride			1953	2		1962	2.46
Carbonyl fluoride							
Catechol							
Cellulose							
Cesium hydroxide							
Chlordane							
Chlorinated camphene							
Chlorinated diphenyl oxide							
Chlorine	1948	2		1967	6		1970 0.167
Chlorine dioxide							
Chlorine trifluoride							
Chloroacetaldehyde							
Chloroacetone							
a-Chloroacetophenone							
Chloroacetyl chloride							
Chlorobenzene							
o-Chlorobenzylidene malononitrile							
Chlorobromomethane							
Chlorodifluoromethane							
Chlorodiphenyl (42% chlorine)							
Chlorodiphenyl (54% chlorine)							

Boron trifluoride	5.99	3			
Bromacil	0	0			
Bromine	10.6	14			
Bromine pentafluoride	0	0			
Bromoform	0	0			
1,3-Butadiene	100	1	39		
Butane	0.75	3	5		
2-Butoxyethanol (EGBE)	1.98	11	24		
n-Butyl acetate	1.33	22			
sec-Butyl acetate	0	0			
tert-Butyl acetate	0	0			
n-Butyl acrylate	0	0			
n-Butyl alcohol	11.84	1	26		
sec-Butyl alcohol	1.48	13			
tert-Butyl alcohol	0	0			
n-Butylamine	6	7			
tert-Butyl Chromate as CrO3	6.25	4			
n-Butylglycidyl ether (BGE)	2.03	19			
n-Butyl lactate	0	0			
Butyl mercaptan	19.4	16			
o-sec-Butylphenol	0	0			
p-tert-Butyltoluene	0	0			
Cadmium dusts and salts	4	30			
Cadmium oxide					
Fume, as Cd	2	13	5		
Production	6	5			
Calcium carbonate (Limestone)	0	0			
Calcium chromate					
Calcium cyanamide	0	0			
Calcium hydroxide	0	0			
Calcium oxide	2.5	10			
Calcium silicate (synthetic)	0	0			
Calcium sulfate	0	0			
Camphor, synthetic	0.167	8			
Caprolactam					
Dust	0	0			
Vapor	0	0			
Captafol	0	0			
Captan	0	0			
Carbaryl	0	0			
Carbofuran	0	0			
Carbon black	0	0			
Carbon dioxide	0	0			
Carbon disulfide	1.94	34			
Carbon monoxide	1.93	21			
Carbon tetrabromide	0	0			
Carbon tetrachloride	2.09	7	9	19	
Carbonyl fluoride	2.77	3			
Catechol	0	0			
Cellulose	0	0			
Cesium hydroxide	0	0			
Chlordane	4	6			
Chlorinated camphene	0	0			
Chlorinated diphenyl oxide	0	0			
Chlorine	2	2	19	3	19
Chlorine dioxide	0	0			
Chlorine trifluoride	6	7			
Chloroacetaldehyde	6	1			
Chloroacetone	0	0			
a-Chloroacetophenone	0	0			
Chloroacetyl chloride	0	0			
Chlorobenzene	7.5	41			
o-Chlorobenzylidene malonitrile	6.15	15			
Chlorobromomethane	0	0			
Chlorodifluoromethane	0	0			
Chlorodiphenyl (42% chlorine)	0	0			
Chlorodiphenyl (54% chlorine)	0	0			

Chloroform	67-66-3	1946	1978	y
bis(Chloromethyl) ether	542-88-1	1974	1974	y
1-Chloro-1-nitropropane	600-25-9	1946	1981	
Chloropentafluoroethane	76-15-3	1981	1981	
Chloropicrin	76-06-2	1957	1959	
beta-Chloroprene	126-99-8	1961	1985	y
2-Chloropropionic acid	598-78-7	1988	1988	
o-Chlorostyrene	2039-87-4	1975	1975	
o-Chlorotoluene	95-49-8	1974	1974	
Chlorpyrifos	2921-88-2	1975	1975	
Chromite ore processing (Cr)		1978	1978	
Chromium Metal	7440-47-3	1974	1980	
Chromium (II) compounds		1981	1981	
Chromium (III) compounds		1981	1981	
Chromium (VI) compounds				y
Water soluble		1981	1981	y
Certain water insoluble		1981	1981	y
Chromyl chloride	14977-61-8	1981	1981	y
Clopidol	2971-90-6	1975	1975	
Coal dust		1985	1985	
Coal tar pitch volatiles	65996-93-2	1967	1967	y
Cobalt Metal dust and fume	7440-48-4	1968	1987	y
Cobalt carbonyl	10210-68-1	1983	1983	
Cobalt hydrocarbonyl	16842-03-8	1983	1983	
Copper	7440-50-8			
Fume		1965	1975	
Dusts and mists		1968	1968	
Cotton dust, raw		1966	1976	
Cresol all isomers	1319-77-3	1952	1952	
Crotonaldehyde	4170-30-3	1967	1967	y
Crufomate	299-86-5	1975	1976	
Cumene	98-82-8	1967	1967	
Cyanamide	420-04-2	1977	1977	
Cyanides		1947	1947	
Cyanogen	460-19-5	1969	1969	
Cyanogen chloride	506-77-4	1981	1981	
Cyclohexane	110-82-7	1946	1967	
Cyclohexanol	108-93-0	1946	1961	
Cyclohexanone	108-94-1	1946	1981	
Cyclohexene	110-83-8	1946	1967	
Cyclohexylamine	108-91-8	1974	1974	
Cyclonite	121-82-4	1980	1980	
Cyclopentadiene	542-92-7	1966	1966	
Cyclopentane	287-92-3	1981	1981	
Cyhexatin	13121-70-5	1982	1982	
2,4-D	94-75-7	1956	1956	
DDT	50-29-3	1957	1957	y
Decaborane	17702-41-9	1957	1957	
Demeton	8065-48-3	1968	1968	
Diacetone alcohol	123-42-2	1956	1956	
Diazinon	333-41-5	1972	1972	
Diazomethane	334-88-3	1967	1967	y
Diborane	19287-45-7	1956	1956	
Dibrom				
2-N-Dibutylaminoethanol	102-81-8	1968	1968	
Dibutyl phenol phosphate	2528-36-1	1990	1990	
Dibutyl phosate	107-66-4	1968	1968	
Dibutyl phthalate	84-74-2	1968	1968	
Dichloroacetylene	7572-29-4	1970	1970	y
o-Dichlorobenzene	95-50-1	1946	1963	
p-Dichlorobenzene	106-46-7	1961	1961	
Dichlorodifluoromethane	75-71-8	1946	1947	
1,3-Dichloro-5,5-dimethyl hydantoin	118-52-5	1966	1966	
1,1-Dichloroethane	75-34-3	1946	1973	
1,2-Dichloroethylene	540-59-0	1946	1946	
Dichloroethyl ether	111-44-4	1946	1973	y

Chloroform	1959	2.04	1974	2
bis(Chloromethyl) ether				
1-Chloro-1-nitropropane				
Chloropentafluoroethane				
Chloropicrin				
beta-Chloroprene			1980	2
2-Chloropropionic acid				
o-Chlorostyrene				
o-Chlorotoluene				
Chlorpyrifos				
Chromite ore processing (Cr)				
Chromium Metal				
Chromium (II) compounds				
Chromium (III) compounds				
Chromium (VI) compounds			1976	2
Water soluble				
Certain water insoluble				
Chromyl chloride				
Clopidol				
Coal dust				
Coal tar pitch volatiles				
Cobalt Metal dust and fume				
Cobalt carbonyl				
Cobalt hydrocarbonyl				
Copper				
Fume			1973	0.1
Dusts and mists				
Cotton dust, raw				
Cresol all isomers				
Crotonaldehyde				
Cruformate				
Cumene				
Cyanamide				
Cyanides				
Cyanogen				
Cyanogen chloride				
Cyclohexane				
Cyclohexanol				
Cyclohexanone			1961	2
Cyclohexene				
Cyclohexylamine				
Cyclonite				
Cyclopentadiene				
Cyclopentane				
Cyhexatin				
2,4-D				
DDT				
Decaborane				
Demeton				
Diacetone alcohol				
Diazinon				
Diazomethane				
Diborane				
Dibrom				
2-N-Dibutylaminoethanol				
Dibutyl phenol phosphate				
Dibutyl phosate				
Dibutyl phthalate				
Dichloroacetylene				
o-Dichlorobenzene				
p-Dichlorobenzene				
Dichlorodifluoromethane				
1,3-Dichloro-5,5-dimethyl hydantoin				
1,1-Dichloroethane				
1,2-Dichloroethylene				
Dichloroethyl ether			1963	6

Chloroform	2.45	13	15	4
bis(Chloromethyl) ether				
1-Chloro-1-nitropropane	10	35		
Chloropentafluoroethane	0	0		
Chloropicrin	10.45	2		
beta-Chloroprene	1.25	19	5	
2-Chloropropionic acid	0	0		
o-Chlorostyrene	0	0		
o-Chlorotoluene	0	0		
Chlorpyrifos	0	0		
Chromite ore processing (Cr)	0	0		
Chromium Metal	2	6		
Chromium (II) compounds	0	0		
Chromium (III) compounds	0	0		
Chromium (VI) compounds				
Water soluble	0	0		
Certain water insoluble	0	0		
Chromyl chloride	0	0		
Clopidol	0	0		
Coal dust	0	0		
Coal tar pitch volatiles	0	0		
Cobalt Metal dust and fume	2	19		
Cobalt carbonyl	0	0		
Cobalt hydrocarbonyl	0	0		
Copper				
Fume	5	8	2	
Dusts and mists	0	0		
Cotton dust, raw	5	10		
Cresol all isomers	0	0		
Crotonaldehyde	0	0		
Cruformate	10	1		
Cumene	0	0		
Cyanamide	0	0		
Cyanides	0	0		
Cyanogen	0	0		
Cyanogen chloride	0	0		
Cyclohexane	1.36	21		
Cyclohexanol	1.99	15		
Cyclohexanone	2	15	20	
Cyclohexene	1.34	21		
Cyclohexylamine	0	0		
Cyclonite	0	0		
Cyclopentadiene	0	0		
Cyclopentane	0	0		
Cyhexatin	0	0		
2,4-D	0	0		
DDT	0	0		
Decaborane	0	0		
Demeton	0	0		
Diacetone alcohol	0	0		
Diazinon	0	0		
Diazomethane	0	0		
Diborane	0	0		
Dibrom				
2-N-Dibutylaminoethanol	0	0		
Dibutyl phenol phosphate	0	0		
Dibutyl phosate	0	0		
Dibutyl phthalate	0	0		
Dichloroacetylene	0	0		
o-Dichlorobenzene	5.98	17		
p-Dichlorobenzene	0	0		
Dichlorodifluoromethane	10	1		
1,3-Dichloro-5,5-dimethyl				
hydantoin	0	0		
1,1-Dichloroethane	2.03	27		
1,2-Dichloroethylene	0	0		
Dichloroethyl ether	0.52	17	10	

Dichlorofluoromethane	75-43-4	1946	1980				
1,1-Dichloro-1-nitroethane	594-72-9	1946	1981				
Dichloropropene	542-75-6	1980	1980	y			
2,2-Dichloropropionic acid	75-99-0	1980	1980				
Dichlorotetrafluoroethane	76-14-2	1946	1947				
Dichlorvos	62-73-7	1964	1964				
Dicrotophos	141-66-2	1977	1977				
Dicyclopentadiene	77-73-6	1976	1976				
Dicyclopentadienyl iron	102-54-5	1975	1975				
Dieldrin	60-57-1	1956	1956	y			
Diethanolamine	111-42-2	1981	1981				
Diethylamine	109-89-7	1952	1981				
2-Diethylaminoethanol	100-37-8	1967	1967				
Diethylene triamine	111-40-0	1969	1972				
Diethyl ketone	96-22-0	1981	1981				
Diethyl phthalate	84-66-2	1975	1975				
Diffuorodibromomethane	75-61-6	1956	1956				
Diglycidyl ether (DGE)	2238-07-5	1961	1981	y			
Diisobutyl ketone	108-83-8	1956	1988				
Diisopropylamine	108-18-9	1968	1968				
N,N-Dimethyl acetamide	127-19-5	1961	1963				
Dimethylamine	124-40-3	1966	1966				
Dimethylaniline	121-69-7	1946	1946				
Dimethylformamide	68-12-2	1960	1966				
1,1-Dimethylhydrazine	57-14-7	1960	1960	y			
Dimethylphthalate	131-11-3	1968	1968				
Dimethyl sulfate	77-78-1	1946	1976	y			
Dinitolmide ('3,5-Dinitro-o-toluam	148-01-6	1976	1976				
Dinitrobenzene	528-29-0	1957	1957				
Dinitro-o-cresol	534-52-1	1950	1950				
Dinitrotoluene	25321-14-6	1946	1946	y			
Dioxane	123-91-1	1946	1981	y			
Dioxathion	78-34-2	1977	1977				
Diphenylamine	122-39-4	1969	1969				
Dipropylene glycol methyl ether	34590-94-8	1960	1960				
Dipropyl ketone	123-19-3	1981	1981				
Diquat	231-36-7	1973	1973				
Di-sec-octyl phthalate	117-81-7	1966	1966	y			
Disulfiram	97-77-8	1976	1976				
Disulfoton (Disyston)	298-04-4	1974	1974				
2,6-Di-tert-butyl-p-cresol	128-37-0	1975	1975				
Diuron	330-54-1	1977	1977				
Divinyl benzene	1321-74-0	1980	1980				
Emery	1302-74-5	1971	1971				
Endosulfan	115-29-7	1970	1970				
Endrin	72-20-8	1964	1964				
Enflurane	13838-16-9	1988	1988				
Epichlorohydrin	106-89-8	1965	1980	y			
EPN	2104-64-5	1956	1956				
Ethanolamine	141-43-5	1965	1965				
Ethion	563-12-2	1976	1976				
2-Ethoxyethanol (EGEE)	110-80-5	1968	1984				
2-Ethoxyethyl acetate	111-15-9	1968	1984				
Ethyl acetate	141-78-6	1946	1946				
Ethyl acrylate	140-88-5	1957	1981	y			
Ethyl alcohol	64-17-5	1946	1946				
Ethylamine	75-04-7	1952	1967				
Ethyl amyl ketone	541-85-5	1967	1967				
Ethyl benzene	100-41-4	1946	1967				
Ethyl bromide	74-96-4	1946	1947				
Ethyl butyl ketone	106-35-4	1967	1967				
Ethyl chloride	75-00-3	1946	1947				
Ethylene chlorohydrin	107-07-3	1946	1976				
Ethylenediamine	107-15-3	1956	1956				
Ethylene dichloride	107-06-2	1946	1980	y			
Ethylene glycol (vapor)	107-21-1	1973	1981				
Ethylene glycol dinitrate (Nitroglycer	628-96-6	1946	1983				

Dichlorofluoromethane			1947	5	1977	2
1,1-Dichloro-1-nitroethane					1963	6
Dichloropropene						
2,2-Dichloropropionic acid						
Dichlorotetrafluoroethane						
Dichlorvos						
Dicrotophos						
Dicyclopentadiene						
Dicyclopentadienyl iron						
Dieldrin						
Diethanolamine						
Diethylamine						
2-Diethylaminoethanol						
Diethylene triamine						
Diethyl ketone						
Diethyl phthalate						
Diffuorodibromomethane						
Diglycidyl ether (DGE)					1963	110
Diisobutyl ketone			1973	1.93	1985	0.6
Diisopropylamine						
N,N-Dimethyl acetamide						
Dimethylamine						
Dimethylaniline						
Dimethylformamide						
1,1-Dimethylhydrazine						
Dimethylphthalate						
Dimethyl sulfate						
Dinitolmide ('3,5-Dinitro-o-toluamide)						
Dinitrobenzene						
Dinitro-o-cresol						
Dinitrotoluene						
Dioxane			1947	5	1974	2
Dioxathion						
Diphenylamine						
Dipropylene glycol methyl ether						
Dipropyl ketone						
Diquat						
Di-sec-octyl phthalate						
Disulfiram						
Disulfoton (Disyston)						
2,6-Di-tert-butyl-p-cresol						
Diuron						
Divinyl benzene						
Emery						
Endosulfan						
Endrin						
Enflurane						
Epichlorohydrin						
EPN						
Ethanolamine						
Ethion						
2-Ethoxyethanol (EGEE)			1973	2	1981	2
2-Ethoxyethyl acetate					1981	2
Ethyl acetate						
Ethyl acrylate						
Ethyl alcohol						
Ethylamine						
Ethyl amyl ketone						
Ethyl benzene						
Ethyl bromide						
Ethyl butyl ketone						
Ethyl chloride						
Ethylene chlorohydrin					1947	2
Ethylenediamine						
Ethylene dichloride	1947	1.33	1953	0.75	1962	2
Ethylene glycol (vapor)						
Ethylene glycol dinitrate (Nitroglern)	1962	2.5	1963	6	1981	3.33

Dichlorofluoromethane	50	1	30	3		
1,1-Dichloro-1-nitroethane	1.2	17	18			
Dichloropropene	0	0				
2,2-Dichloropropionic acid	0	0				
Dichlorotetrafluoroethane	10	1				
Dichlorvos	0	0				
Dicrotophos	0	0				
Dicyclopentadiene	0	0				
Dicyclopentadienyl iron	0	0				
Dieldrin	0	0				
Diethanolamine	0	0				
Diethylamine	2.5	29				
2-Diethylaminoethanol	0	0				
Diethylene triamine	0	0				
Diethyl ketone	0	0				
Diethyl phthalate	0	0				
Diffuorodibromomethane	0	0				
Diglycidyl ether (DGE)	1.06	2	18			
Diisobutyl ketone	1.72	17	12	3		
Diisopropylamine	0	0				
N,N-Dimethyl acetamide	0	0				
Dimethylamine	0	0				
Dimethylaniline	0	0				
Dimethylformamide	2	6				
1,1-Dimethylhydrazine	0	0				
Dimethylphthalate	0	0				
Dimethyl sulfate	9.62	30				
Dinitolmide ('3,5-Dinitro-o-toluam	0	0				
Dinitrobenzene	0	0				
Dinitro-o-cresol	0	0				
Dinitrotoluene	0	0				
Dioxane	2	1	27	7		
Dioxathion	0	0				
Diphenylamine	0	0				
Dipropylene glycol methyl ether	0	0				
Dipropyl ketone	0	0				
Diquat	0	0				
Di-sec-octyl phthalate	0	0				
Disulfiram	0	0				
Disulfoton (Disyston)	0	0				
2,6-Di-tert-butyl-p-cresol	0	0				
Diuron	0	0				
Divinyl benzene	0	0				
Emery	0	0				
Endosulfan	0	0				
Endrin	0	0				
Enflurane	0	0				
Epichlorohydrin	2.63	15				
EPN	0	0				
Ethanolamine	0	0				
Ethion	0	0				
2-Ethoxyethanol (EGEE)	10.27	5	8	3		
2-Ethoxyethyl acetate	10	13	3			
Ethyl acetate	0	0				
Ethyl acrylate	5	24				
Ethyl alcohol	0	0				
Ethylamine	2.5	15				
Ethyl amyl ketone	0	0				
Ethyl benzene	2	21				
Ethyl bromide	2	1				
Ethyl butyl ketone	0	0				
Ethyl chloride	5	1				
Ethylene chlorohydrin	29.09	1	29			
Ethylenediamine	0	0				
Ethylene dichloride	5	1	6	9	18	
Ethylene glycol (vapor)	12.28	8				
Ethylene glycol dinitrate (Nitroglycer	0.32	16	1	18	2	

Ethylene oxide	75-21-8	1946	1984	y			
Ethylenimine	151-36-4	1971	1971	y			
Ethyl ether	60-29-7	1946	1946				
Ethyl formate	109-94-4	1946	1947				
Ethylidene norbornene	16219-75-3	1976	1976				
Ethyl mercaptan	75-08-1	1962	1971				
N-Ethylmorpholine	100-74-3	1967	1982				
Ethyl silicate	78-10-4	1946	1979				
Fenamiphos	22224-92-6	1984	1984				
Fensulfotion	115-90-2	1976	1976				
Fenthion	55-38-9	1980	1983				
Ferbam	14484-64-1	1957	1971				
Ferrovandium dust	12604-58-9	1956	1956				
Fibrous glass dust		1971	1971				
Fluorides, as F		1946	1946				
Fluorine	7782-41-4	1953	1973				
Fonofos	944-22-9	1982	1982				
Formaldehyde	50-00-0	1946	1983	y			
Formamide	75-12-7	1975	1988				
Formic acid	64-18-6	1967	1967				
Furfural	98-01-1	1957	1981				
Furfuryl alcohol	98-00-0	1961	1982				
Gasoline	8006-61-9	1946	1981	y			
Germanium tetrahydride	7782-65-2	1971	1971				
Glutaraldehyde	111-30-8	1976	1980				
Glycerin mist	56-81-5	1971	1971				
Glycidol	556-52-5	1962	1981				
Graphite dust		1987	1988				
Graphite (natural)	7882-42-5	1987	1991				
Graphite (synthetic)							
Gypsum (see calcium sulfate)	10101-4-4						
Hafnium	7440-58-6	1965	1965				
Halothane	151-67-7	1988	1988				
Heptachlor	76-44-8	1964	1964	y			
Heptane	142-82-5	1946	1971				
Hexachlorobutadiene	87-68-3	1982	1982	y			
Hexachlorocyclopentadiene	77-47-4	1974	1974				
Hexachloroethane	67-72-1	1966	1989	y			
Hexachloronaphthalene	1335-87-1	1968	1968				
Hexafluoroacetone	684-16-2	1973	1973				
Hexamethylene diisocyanate	822-06-0	1988	1988				
Hexane (n-Hexane)	110-54-3	1946	1982				
Other isomers		1982	1982				
sec-Hexyl acetate	108-84-9	1968	1968				
Hexylene glycol	107-41-5	1977	1977				
Hydrazine	302-01-2	1956	1977	y			
Hydrogenated terphenyls	61788-32-7	1976	1976				
Hydrogen bromide	10035-10-6	1956	1986				
Hydrogen chloride	7647-01-0	1946	1963				
Hydrogen cyanide	74-90-8	1946	1980				
Hydrogen fluoride	7664-39-3	1946	1986				
Hydrogen peroxide	7722-84-1	1956	1956				
Hydrogen selenide	7783-07-5	1946	1948				
Hydrogen sulfide	7783-06-4	1946	1966				
Hydroquinone	123-31-9	1956	1956				
2-Hydroxypropyl acrylate	999-61-1	1980	1980				
Indene	95-13-6	1970	1970				
Indium & compounds, as In	7440-74-6	1969	1969				
Iodine	7553-56-2	1946	1963				
Iodoform	75-47-8	1976	1977				
Iron oxide fume	1309-37-1	1946	1976				
Iron pentacarbonyl	13463-40-6	1972	1989				
Iron salts, soluble, as Fe		1969	1969				
Isoamyl acetate	123-92-2	1967	1967				
Isoamyl alcohol	123-51-3	1969	1969				
Isobutyl acetate	110-19-0	1967	1967				
Isobutyl alcohol	78-83-1	1968	1976				

Ethylene oxide			1957	2	1981	4.5
Ethylenimine						
Ethyl ether						
Ethyl formate						
Ethylidene norbornene						
Ethyl mercaptan			1963	73.84	1967	0.35
N-Ethylmorpholine						
Ethyl silicate						
Fenamiphos						
Fensulfothion						
Fenthion						
Ferbam						
Ferrovanadium dust						
Fibrous glass dust						
Fluorides, as F						
Fluorine						
Fonofos						
Formaldehyde	1948	2	1963	6	1972	2
Formamide						
Formic acid						
Furfural						
Furfuryl alcohol					1973	10
Gasoline						
Germanium tetrahydride						
Gluteraldehyde						
Glycerin mist						
Glycidol						
Grain dust						
Graphite (natural)						
Graphite (synthetic)						
Gypsum (see calcium sulfate)						
Hafnium						
Halothane						
Heptachlor						
Heptane						
Hexachlorobutadiene						
Hexachlorocyclopentadiene						
Hexachloroethane					1982	0.1
Hexachloronaphthalene						
Hexafluoroacetone						
Hexamethylene diisocyanate						
Hexane (n-Hexane)					1976	5
Other isomers						
sec-Hexyl acetate						
Hexylene glycol						
Hydrazine						
Hydrogenated terphenyls						
Hydrogen bromide					1961	1.7
Hydrogen chloride					1948	2
Hydrogen cyanide					1948	2
Hydrogen fluoride						
Hydrogen peroxide						
Hydrogen selenide						
Hydrogen sulfide					1963	6
Hydroquinone						
2-Hydroxypropyl acrylate						
Indene						
Indium & compounds, as In						
Iodine			1948	0.1	1961	10
Iodoform						
Iron oxide fume					1967	1.5
Iron pentacarbonyl					1982	10
Iron salts, soluble, as Fe						
Isoamyl acetate						
Isoamyl alcohol						
Isobutyl acetate						
Isobutyl alcohol						

Ethylene oxide	11.1	11	24	3		
Ethylenimine	0	0				
Ethyl ether	0	0				
Ethyl formate	2	1				
Ethylidene norbornene	0	0				
Ethyl mercaptan	19.23	1	4	4		
N-Ethylmorpholine	3.96	15				
Ethyl silicate	10	33				
Fenamiphos	0	0				
Fensulfothion	0	0				
Fenthion	0.5	3				
Ferbam	1.5	14				
Ferrovandium dust	0	0				
Fibrous glass dust	0	0				
Fluorides, as F	0	0				
Fluorine	0.125	20				
Fonofos	0	0				
Formaldehyde	2.4	2	15	9	13	
Formamide	1.67	13				
Formic acid	0	0				
Furfural	2.53	24				
Furfuryl alcohol	0.5	12	9			
Gasoline	2.2	35				
Germanium tetrahydride	0	0				
Gluteraldehyde	0.285	4				
Glycerin mist	0	0				
Glycidol	1.97	19				
Grain dust	2.5	1				
Graphite (natural)	1.25	4				
Graphite (synthetic)						
Gypsum (see calcium sulfate)						
Hafnium	0	0				
Halothane	0	0				
Heptachlor	0	0				
Heptane	1.22	25				
Hexachlorobutadiene	0	0				
Hexachlorocyclopentadiene	0	0				
Hexachloroethane	10.3	16	7			
Hexachloronaphthalene	0					
Hexafluoroacetone	0					
Hexamethylene diisocyanate	0					
Hexane (n-Hexane)	2.04	30	6			
Other isomers	0					
sec-Hexyl acetate	0					
Hexylene glycol	0					
Hydrazine	10	21				
Hydrogenated terphenyls	0					
Hydrogen bromide	6.06	5	25			
Hydrogen chloride	6	2	15			
Hydrogen cyanide	6.01	2	32			
Hydrogen fluoride	5.81	40				
Hydrogen peroxide						
Hydrogen selenide	2	2				
Hydrogen sulfide	0.36	17	3			
Hydroquinone	0					
2-Hydroxypropyl acrylate	0					
Indene	0					
Indium & compounds, as In	0					
Iodine	5.88	2	13	2		
Iodoform	3.33	1				
Iron oxide fume	2	21	9			
Iron pentacarbonyl	3.48	10	7			
Iron salts, soluble, as Fe	0					
Isoamyl acetate	0					
Isoamyl alcohol	0					
Isobutyl acetate	0					
Isobutyl alcohol	1.97	8				

Isocetyl alcohol	26952-21-6	1981	1981				
Isophorone	78-59-1	1946	1976				
Isophorone diisocyanate	4098-71-9	1977	1988				
Isopropoxyethanol	109-59-1	1981	1981				
Isopropyl acetate	108-21-4	1967	1967				
Isopropyl alcohol	67-63-0	1968	1968				
Isopropylamine	75-31-0	1956	1956				
N-Isopropylaniline	768-52-5	1980	1980				
Isopropyl ether	108-20-3	1973	1973				
Isopropyl glycidyl ether (IGE)	4016-14-2	1962	1962				
Kaolin	1332-58-7	1971	1971				
Ketene	463-51-4	1963	1968				
Lead, inorg. dust & fumes, as Pb	7439-92-1	1946	1973	y			
Lead arsenate	7784-40-9	1957	1957				
Lead chromate	7758-97-6			y			
as Pb		1991	1991	y			
as Cr (18454-12-1) (1983)		1977	1989	y			
Lindane	58-89-9	1956	1956	y			
Lithium hydride	7580-67-8	1960	1960				
L.P.G (Liquified petroleum gas)	68476-85-7	1966	1966				
Magnesite	546-93-0	1971	1971				
Magnesium oxide fume	1309-48-4	1946	1971				
Malathion	121-75-5	1956	1971				
Maleic anhydride	108-31-6	1968	1968				
Manganese	7439-96-5						
Dust		1946	1988				
Fume		1946	1980				
Manganese cyclopentadienyl							
tricarbonyl	12079-65-1	1974	1974				
Manganese tetroxide	1317-35-7						
Mercury as Hg	7439-97-6	1946					
Alkyl compounds		1956	1956				
All forms except alkyl vapor		1971	1971				
Aryl & inorganic compounds		1982	1982				
Mesityl oxide	141-79-7	1946	1981				
Methacrylic acid	79-41-4	1981	1981				
Methomyl	16752-77-5	1977	1977				
Methoxychlor	72-43-5	1956	1971	y			
2-Methoxyethanol (methyl cellosolve)	109-86-4	1946	1984				
2-Methoxyethyl acetate (EGMEA)	110-49-6	1946	1984				
4-Methoxyphenol	150-76-5	1982	1982				
Methyl acetate	79-20-9	1946	1947				
Methyl acetylene	74-99-7	1956	1956				
Methyl acetylene-propadiene							
mixture (MAPP)		1966	1989				
Methyl acrylate	96-33-3	1957	1957				
Methylacrylonitrile	126-98-7	1973	1973				
Methylal	109-87-5	1952	1952				
Methyl alcohol (methanol)	67-56-1	1946	1946				
Methyl amine	74-89-5	1967	1967				
Methyl n-amyl ketone	110-43-0	1967	1981				
N-Methyl aniline	100-61-8	1958	1982				
Methyl bromide	74-83-9	1946	1981	y			
Methyl n-butyl ketone (2-Hexanon)	591-78-6	1961	1981				
Methyl chloride	74-87-3	1946	1981	y			
Methyl chloroform	71-55-6	1953	1968				
Methyl 2-cyanoacrylate	137-05-3	1971	1971				
Methylcyclohexane	108-87-2	1946	1976				
Methylcyclohexanol	25639-42-3	1946	1973				
o-Methylcyclohexanone	583-60-8	1946	1973				
2-Methylcyclopentadienyl							
manganese tricarbonyl, as Mn	12108-13-3	1971	1971				
Methyl demeton	8022-00-2	1971	1971				
Methylene bisphenyl isocyanate	101-68-8	1965	1988				
Methylene chloride	75-09-2	1946	1988	y			
4,4'-Methylene bis(2-chloroaniline)	101-14-4	1974	1974	y			
Methylene bis(4-cyclohexy-							

Isocetyl alcohol							
Isophorone					1973	16.87	
Isophorone diisocyanate							
Isopropoxyethanol							
Isopropyl acetate							
Isopropyl alcohol							
Isopropylamine							
N-Isopropylaniline							
Isopropyl ether							
Isopropyl glycidyl ether (IGE)							
Kaolin							
Ketene							
Lead, inorg. dust & fumes, as Pb					1957	0.75	
Lead arsenate							
Lead chromate							
as Pb							
as Cr (18454-12-1) (1983)							
Lindane							
Lithium hydride							
L.P.G (Liquified petroleum gas)							
Magnesite							
Magnesium oxide fume							
Malathion							
Maleic anhydride							
Manganese							
Dust			1960	1.2	1963	6.02	
Fume							
Manganese cyclopentadienyl tricarbonyl							
Manganese tetroxide							
Mercury as Hg							
Alkyl compounds							
All forms except alkyl vapor							
Aryl & inorganic compounds							
Mesityl oxide					1958	2	
Methacrylic acid							
Methomyl							
Methoxychlor							
2-Methoxyethanol (methyl cellosolve)					1947	4	
2-Methoxyethyl acetate (EGMEA)					1947	4	
4-Methoxyphenol							
Methyl acetate							
Methyl acetylene							
Methyl acetylene-propadiene mixture (MAPP)							
Methyl acrylate							
Methylacrylonitrile							
Methylal							
Methyl alcohol (methanol)							
Methyl amine							
Methyl n-amyl ketone							
N-Methyl aniline							
Methyl bromide					1973	1.33	
Methyl n-butyl ketone (2-Hexanone)					1976	4.1	
Methyl chloride			1963	6	1973	0.167	
Methyl chloroform							
Methyl 2-cyanoacrylate							
Methylcyclohexane							
Methylcyclohexanol							
o-Methylcyclohexanone							
2-Methylcyclopentadienyl manganese tricarbonyl, as Mn							
Methyl demeton							
Methylene bisphenyl isocyanate							
Methylene chloride			1976	2.49	1981	2	
4,4'-Methylene bis(2-chloroaniline)							
Methylene bis(4-cyclohexy-							

Isooctyl alcohol	0				
Isophorone	1.78	17	3		
Isophorone diisocyanate	2	11			
Isopropoxyethanol	0				
Isopropyl acetate	0				
Isopropyl alcohol	0				
Isopropylamine	0				
N-Isopropylaniline	0				
Isopropyl ether	0				
Isopropyl glycidyl ether (IGE)	0				
Kaolin	0				
Ketene	0				
Lead, inorg. dust & fumes, as Pb	1.33	11	16		
Lead arsenate	0				
Lead chromate					
as Pb	0				
as Cr (18454-12-1) (1983)	4.167	12			
Lindane	0				
Lithium hydride	0				
L.P.G (Liquified petroleum gas)	0				
Magnesite	0				
Magnesium oxide fume	1.5	15			
Malathion	1.5	15			
Maleic anhydride	0				
Manganese					
Dust	0.166	14	3	25	
Fume	0				
Manganese cyclopentadienyl					
tricarbonyl	0				
Manganese tetroxide					
Mercury as Hg					
Alkyl compounds	0				
All forms except alkyl vapor	0				
Aryl & inorganic compounds	0				
Mesityl oxide	1.67	12	23		
Methacrylic acid	0				
Methomyl	0				
Methoxychlor	1.5	15			
2-Methoxyethanol (methyl cellosolv)	5	1	37		
2-Methoxyethyl acetate (EGMEA)	5	1	37		
4-Methoxyphenol	0				
Methyl acetate	0.5	1			
Methyl acetylene	0				
Methyl acetylene-propadiene					
mixture (MAPP)	1.09	23			
Methyl acrylate	0	0			
Methylacrylonitrile	0	0			
Methylal	0	0			
Methyl alcohol (methanol)	0	0			
Methyl amine	0	0			
Methyl n-amyl ketone	1.99	14			
N-Methyl aniline	4.09	24			
Methyl bromide	3.16	27	8		
Methyl n-butyl ketone (2-Hexanon)	5	15	5		
Methyl chloride	2.04	17	10	8	
Methyl chloroform	1.4	15			
Methyl 2-cyanoacrylate	0	0			
Methylcyclohexane	1.24	30			
Methylcyclohexanol	2	17			
o-Methylcyclohexanone	2	17			
2-Methylcyclopentadienyl					
manganese tricarbonyl, as Mn	0	0			
Methyl demeton	0	0			
Methylene bisphenyl isocyanate	0.59	23			
Methylene chloride	2	30	5	7	
4,4'-Methylene bis(2-chloroaniline)	0	0			
Methylene bis(4-cyclohexy-					

isocyanate)	5124-30-1	1974	1988				
4,4'-Methylene dianiline	101-77-9	1980	1980	y			
Methyl ethyl ketone (MEK)	78-93-3	1946	1961				
Methyl ethyl ketone peroxide	1338-23-4	1974	1974				
Methyl formate	107-31-3	1946	1947				
Methyl hydrazine	60-34-4	1967	1967	y			
Methyl iodide	74-88-4	1967	1981	y			
Methyl isoamyl ketone	110-12-3	1970	1982				
Methyl isobutyl carbinol	108-11-2	1956	1956				
Methyl isobutyl ketone	108-10-1	1946	1981				
Methyl isocyanate	624-83-9	1967	1967				
Methyl isopropyl ketone	563-80-4	1981	1981				
Methyl mercaptan	74-93-1	1966	1970				
Methyl methacrylate	80-62-6	1966	1966				
Methyl parathion	298-00-0	1971	1971				
Methyl propyl ketone	107-87-9	1946	1946				
Methyl silicate	681-84-5	1969	1981				
alpha-Methyl styrene	98-83-9	1959	1981				
Metribuzin	21087-64-9	1984	1984				
Mevinphos	7786-34-7	1982	1982				
Mica	12001-26-2	1987	1987				
Mineral wool fiber		1987	1987				
Molybdenum as Mo	7439-98-7						
Soluble compounds		1956	1956				
Insoluble compounds		1961	1971				
Monocrotophos	6923-22-4	1977	1977				
Morpholine	110-91-8	1966	1966				
Naled	300-76-5	1982	1982				
Naphthalene	91-20-3	1966	1966				
Nickel	7440-02-0			y			
Metal		1966	1966				
Insoluble compounds		1986	1986				
Soluble compounds		1966	1976	y			
Nickel carbonyl	13463-39-3	1947	1988	y			
Nickel sulfide roasting, fume & dust, as Ni		1978	1978	y			
Nicotine	54-11-5	1957	1957				
Nitrapyrin	1929-82-4	1981	1981				
Nitric acid	7697-37-2	1957	1966				
Nitric oxide	10102-43-9	1968	1968				
p-Nitroaniline	100-01-6	1956	1982				
Nitrobenzene	98-95-3	1946	1947				
p-Nitrochlorobenzene	100-00-5	1966	1988	y			
Nitroethane	79-24-3	1947	1947				
Nitrogen dioxide	10102-44-0	1946	1981				
Nitrogen trifluoride	7783-54-2	1966	1966				
Nitroglycerin (NG)	55-63-0	1946	1983		1962	2.5	1963
Nitromethane	75-52-5	1946	1947				
1-Nitropropane	108-03-2	1963	1963				
2-Nitropropane	79-46-9	1947	1987	y			
Nitrotoluene	99-08-1	1950	1982				
Nitrous oxide	10024-97-2	1989	1989				
Nonane	111-84-2	1976	1976				
Octachloronaphthalene	2234-13-1	1968	1968				
Octane	111-65-9	1946	1976				
Oil mist, mineral		1964	1964				
Osmium tetroxide	20816-12-0	1968	1968				
Oxalic acid	144-62-7	1967	1967				
Oxygen difluoride	7783-41-7	1966	1986				
Ozone	10028-15-6	1946	1989				
Paraffin wax fume	8002-74-2	1974	1976				
Paraquat	4685-14-7						
total dust		1989	1989				
respirable fraction		1968	1978				
Parathion	56-38-2	1953	1961				
Particulates Not Otherwise Classified		1986	1986				

isocyanate)							
4,4'-Methylene dianiline							
Methyl ethyl ketone (MEK)					1948	1.25	
Methyl ethyl ketone peroxide							
Methyl formate							
Methyl hydrazine							
Methyl iodide							
Methyl isoamyl ketone							
Methyl isobutyl carbinol							
Methyl isobutyl ketone					1947	2	
Methyl isocyanate							
Methyl isopropyl ketone							
Methyl mercaptan					1967	2	
Methyl methacrylate							
Methyl parathion							
Methyl propyl ketone							
Methyl silicate							
alpha-Methyl styrene					1968	6	
Metribuzin							
Mevinphos							
Mica							
Mineral wool fiber							
Molybdenum as Mo							
Soluble compounds							
Insoluble compounds							
Monocrotophos							
Morpholine							
Naled							
Naphthalene							
Nickel							
Metal							
Insoluble compounds							
Soluble compounds							
Nickel carbonyl				1954	1000	1976	0.02
Nickel sulfide roasting, fume & dust, as Ni							
Nicotine							
Nitrapyrin							
Nitric acid							
Nitric oxide							
p-Nitroaniline							
Nitrobenzene							
p-Nitrochlorobenzene						1985	0.33
Nitroethane							
Nitrogen dioxide				1954	5	1963	6
Nitrogen trifluoride							
Nitroglycerin (NG)	6	1970	0.167	1978	6	1981	1.67
Nitromethane							
1-Nitropropane							
2-Nitropropane				1961	2	1981	6
Nitrotoluene							
Nitrous oxide							
Nonane							
Octachloronaphthalene							
Octane						1971	1.24
Oil mist, mineral							
Osmium tetroxide							
Oxalic acid							
Oxygen difluoride							
Ozone						1954	10
Parafin wax fume							
Paraquat							
total dust							
respirable fraction							
Parathion							
Particulates Not Otherwise Classified							

isocyanate)	0.37	14					
4,4'-Methylene dianiline	0	0					
Methyl ethyl ketone (MEK)	1.27	2	13				
Methyl ethyl ketone peroxide	0	0					
Methyl formate	4	1					
Methyl hydrazine	0	0					
Methyl iodide	2.33	14					
Methyl isoamyl ketone	2.03	12					
Methyl isobutyl carbinol	0	0					
Methyl isobutyl ketone	2	1	34				
Methyl isocyanate	0	0					
Methyl isopropyl ketone	0	0					
Methyl mercaptan	3.4	1	4				
Methyl methacrylate	0	0					
Methyl parathion	0	0					
Methyl propyl ketone	0	0					
Methyl silicate	0.83	12					
alpha-Methyl styrene	0.33	9	13				
Metribuzin	0	0					
Mevinphos	0	0					
Mica	0	0					
Mineral wool fiber	0	0					
Molybdenum as Mo							
Soluble compounds	0	0					
Insoluble compounds	1.5	10					
Monocrotophos	0	0					
Morpholine	0	0					
Naled	0	0					
Naphthalene	0	0					
Nickel							
Metal	0	0					
Insoluble compounds	0	0					
Soluble compounds	10	10					
Nickel carbonyl	2.92	7	22	12			
Nickel sulfide roasting, fume & dust, as Ni	0	0					
Nicotine	0	0					
Nitrapyrin	0	0					
Nitric acid	5	9					
Nitric oxide	0	0					
p-Nitroaniline	2	26					
Nitrobenzene	5	1					
p-Nitrochlorobenzene	4.69	19	3				
Nitroethane	2	1					
Nitrogen dioxide	0.27	8	9	18			
Nitrogen trifluoride	0	0					
Nitroglycerin (NG)	0.43	16	1	7	8	3	2
Nitromethane	2	1					
1-Nitropropane	0	0					
2-Nitropropane	0.42	14	20	6			
Nitrotoluene	2.73	32					
Nitrous oxide	0	0					
Nonane	0	0					
Octachloronaphthalene	0	0					
Octane	1.36	25	5				
Oil mist, mineral	0	0					
Osmium tetroxide	0	0					
Oxalic acid	0	0					
Oxygen difluoride	6	20					
Ozone	6.06	8	35				
Paraffin wax fume	0.1	2					
Paraquat							
total dust	0	0					
respirable fraction	5	10					
Parathion	0	0					
Particulates Not Otherwise Classified	0	0					

Pentaborane	19624-22-7	1963	1963		
Pentachloronaphthalene	1321-64-8	1946	1946		
Pentachloronitrobenzene	82-68-8	1988	1988		
Pentachlorophenol	87-86-5	1947	1947	y	
Pentaerythritol	115-77-5	1962	1962		
Pentane	109-66-0	1946	1976		
Perchloroethylene	127-18-4	1946	1982	y	
Perchloromethyl mercaptan	594-42-3	1962	1962		
Perchloryl fluoride	7616-94-6	1963	1963		
Perlite	93763-70-3	1987	1987		
Phenol	108-95-2	1952	1961		
Phenothiazine	92-84-2	1968	1968		
o-Phenylenediamine	95-54-5	1991	1991		
m-Phenylenediamine	108-45-2	1991	1991		
p-Phenylenediamine	106-50-3	1966	1966		
Phenyl ether vapor	101-84-8	1967	1967		
Phenyl glycidyl ether (PGE)	122-60-1	1962	1982	y	
Phenylhydrazine	100-63-0	1956	1990	y	
Phenyl mercaptan	108-98-5	1978	1978		
Phenylphosphine	638-21-1	1973	1973		
Phorate	298-02-2	1974	1974		
Phosgene	75-44-5	1946	1962		
Phosphine	7803-51-2	1946	1963		
Phosphoric acid	7664-38-2	1960	1960		
Phosphorus (yellow)	7723-14-0	1947	1947		
Phosphorus oxychloride	10025-87-3	1982	1982		
Phosphorus pentachloride	10026-13-8	1947	1947		
Phosphorus pentasulfide	1314-80-3	1947	1947		
Phosphorus trichloride	7719-12-2	1946	1982		
Phthalic anhydride	85-44-9	1966	1976		
m-Phthalodinitrile	626-17-5	1977	1977		
Picloram	1918-02-1	1975	1975		
Picric acid	88-89-1	1956	1956		
Pindone	83-26-1	1981	1981		
Piperazine dihydrochloride	142-64-3	1981	1981		
Platinum	7440-06-4				
Metal		1981	1981		
Soluble salts, as Pt		1963	1963		
Portland cement	65997-15-1	1946	1972		
Potassium hydroxide	1310-58-3	1974	1974		
Propargyl alcohol	107-19-7	1969	1969		
beta-Propiolactone	57-57-8	1981	1981	y	
Propionic acid	79-09-4	1971	1971		
Propoxur	114-26-1	1969	1969		
n-Propyl acetate	109-60-4	1946	1946		
n-Propyl alcohol	71-23-8	1968	1968		
Propylene dichloride	78-87-5	1961	1961	y	
Propylene glycol dinitrate	6423-43-4	1978	1983		
Propylene glycol monomethyl ether	107-98-2	1972	1972		
Propylene imine	75-55-8	1956	1967	y	
Propylene oxide	75-56-9	1959	1981	y	
n-Propyl nitrate	627-13-4	1962	1962		
Pyrethrum	8003-34-7	1957	1962		
Pyridine	110-86-1	1956	1961		
Quinone	106-51-4	1961	1961		
Resorcinol	108-46-3	1976	1976		
Rhodium	7440-16-6				
Metal		1967	1982		
Insoluble compounds		1983	1983		
Soluble compounds		1982	1984		
Ronnel	299-84-3	1968	1971		
Rosin core solder pyrolysis products, as formaldehyde		1972	1972	y	
Rotenone (commercial)	83-79-4	1957	1957		
Rouge		1971	1971		
Rubber solvent (Naphtha)		1977	1977		

Pentaborane						
Pentachloronaphthalene						
Pentachloronitrobenzene						
Pentachlorophenol						
Pentaerythritol						
Pentane		1947	5	1970	1.97	
Perchloroethylene				1961	2.01	
Perchloromethyl mercaptan						
Perchloryl fluoride						
Perlite						
Phenol						
Phenothiazine						
o-Phenylenediamine						
m-Phenylenediamine						
p-Phenylenediamine						
Phenyl ether vapor						
Phenyl glycidyl ether (PGE)				1968	5.17	
Phenyldiazine						
Phenyl mercaptan						
Phenylphosphine						
Phorate						
Phosgene						
Phosphine				1947	20	
Phosphoric acid						
Phosphorus (yellow)						
Phosphorus oxychloride						
Phosphorus pentachloride						
Phosphorus pentasulfide						
Phosphorus trichloride						
Phthalic anhydride						
m-Phthalodinitrile						
Picloram						
Picric acid						
Pindone						
Piperazine dihydrochloride						
Platinum						
Metal						
Soluble salts, as Pt						
Portland cement						
Potassium hydroxide						
Propargyl alcohol						
beta-Propiolactone						
Propionic acid						
Propoxur						
n-Propyl acetate						
n-Propyl alcohol						
Propylene dichloride						
Propylene glycol dinitrate				1981	3.3	
Propylene glycol monomethyl ether						
Propylene imine						
Propylene oxide						
n-Propyl nitrate						
Pyrethrum						
Pyridine						
Quinone						
Resorcinol						
Rhodium						
Metal				1968	100	
Insoluble compounds						
Soluble compounds						
Ronnel						
Rosin core solder pyrolysis products, as formaldehyde						
Rotenone (commercial)						
Rouge						
Rubber solvent (Naphtha)						

Selenium and compounds	7782-49-2	1947	1966		
Selenium hexafluoride	7783-79-1	1967	1981		
Sesone	136-78-7	1981	1981		
Silica - Amorphous		1946		y	
Diatomeaceous earth (uncalcined)	61790-53-2	1987	1987		
Precipitated silica	112926-00-	1987	1987		
Silica gel	112926-00-	1987	1987		
Silica - Crystalline Cristobalite	14464-46-1	1987	1987	y	
Quartz	14808-60-7	1987	1987		
Silica, fused	60676-86-0	1987	1987		
Tridymite	15468-32-3	1987	1987		
Tripoli	1317-95-9	1987	1987		
Silicon	7440-21-3	1973	1973		
Silicon carbide	409-21-2	1971	1971		
Silicon tetrahydride	7803-62-5	1974	1983		
Silver	7440-22-4				
Metal		1966	1981		
Soluble compounds, as Ag		1966	1966		
Soapstone					
Respirable dust		1987	1987		
Total dust		1987	1987		
Sodium azide	26628-22-8	1976	1976		
Sodium bisulfite	7631-90-5	1980	1980		
Sodium fluoroacetate	62-74-8	1957	1962		
Sodium hydroxide	1310-73-2	1956	1971		
Sodium metabisulfite	7681-57-4	1980	1980		
Starch	9005-25-8	1976	1976		
Stearates		1987	1987		
Stibine	7803-52-3	1946	1947		
Stoddard solvent	8052-41-3	1946	1976		
Strychnine	57-24-9	1957	1957		
Styrene, monomer	100-42-5	1946	1981	y	
Subtilisins	1395-21-7	1975	1975		
Sucrose	57-50-1	1971	1971		
Sulfotep	3689-24-5	1982	1982		
Sulfur dioxide	7446-09-5	1946	1980		
Sulfur hexafluoride	2551-62-4	1956	1956		
Sulfuric acid	7664-93-9	1946	1948		
Sulfur monochloride	10025-67-9	1982	1986		
Sulfur pentafluoride	5714-22-7	1956	1986		
Sulfur tetrafluoride	7783-60-0	1973	1986		
Sulfuryl fluoride	2699-79-8	1968	1968		
Sulprofos	35400-43-2	1984	1984		
2,4,5-T	93-76-5	1963	1963		
Talc (no asbestos)	14807-96-6	1983	1983		
Talc (containing asbestos)		1985	1985	y	
Tantalum, metal & oxide dusts	7440-25-7	1965	1976		
Tellurium & compounds	13494-80-9	1946	1947		
Tellurium hexafluoride	7783-80-4	1968	1968		
Temephos	3383-96-8	1982	1982		
TEPP	107-49-3	1956	1956		
Terphenyls	26140-60-3	1968	1980		
1,1,1,2-Tetrachloro-2,2-difluoroethane	76-11-9	1966	1966		
1,1,2,2-Tetrachloro-1,2-difluoroethane	76-12-0	1968	1968		
1,1,2,2-Tetrachloroethane	79-34-5	1946	1982	y	
Tetrachloronaphthalene	1335-88-2	1968	1968		
Tetraethyl lead	78-00-2	1965	1970		
Tetrahydrofuran	109-99-9	1957	1957		
Tetramethyl lead	75-74-1	1967	1970		
Tetramethyl succinonitrile	3333-52-6	1967	1967		
Tetranitromethane	509-14-8	1956	1956		
Tetrasodium pyrophosphate	7722-88-5	1980	1981		
Tetryl	479-45-8	1946	1946		
Thallium	7440-28-0	1956	1957		
4,4'-Thiobis(6-tert-butyl-m-cresol)	96-69-5	1976	1976		

Selenium and compounds					
Selenium hexafluoride					
Sesone					
Silica - Amorphous					
Diatomeaceous earth (uncalcined)					
Precipitated silica					
Silica gel					
Silica - Crystalline Cristobalite					
Quartz					
Silica, fused					
Tridymite					
Tripoli					
Silicon					
Silicon carbide					
Silicon tetrahydride					
Silver					
Metal					
Soluble compounds, as Ag					
Soapstone					
Respirable dust					
Total dust					
Sodium azide					
Sodium bisulfite					
Sodium fluoroacetate					
Sodium hydroxide					
Sodium metabisulfite					
Starch					
Stearates					
Stibine					
Stoddard solvent				1970	2.52
Strychnine					
Styrene, monomer		1947	2	1957	2.02
Subtilisins					
Sucrose					
Sulfotep					
Sulfur dioxide				1957	1.92
Sulfur hexafluoride					
Sulfuric acid					
Sulfur monochloride					
Sulfur pentafluoride					
Sulfur tetrafluoride					
Sulfuryl fluoride					
Sulprofos					
2,4,5-T					
Talc (nc asbestos)					
Talc (containing asbestos)					
Tantalum, metal & oxide dusts				1971	25
Tellurium & compounds					
Tellurium hexafluoride					
Temephos					
TEPP					
Terphenyls					
1,1,1,2-Tetrachloro-2,2-difluoroethane					
1,1,2,2-Tetrachloro-1,2-difluoroethane					
1,1,2,2-Tetrachloroethane				1947	2
Tetrachloronaphthalene					
Tetraethyl lead					
Tetrahydrofuran					
Tetramethyl lead					
Tetramethyl succinonitrile					
Tetranitromethane					
Tetrasodium pyrophosphate					
Tetryl					
Thallium					
4,4'-Thiobis[6-tert-butyl-m-cresol]					

Selenium and compounds	2	19		
Selenium hexafluoride	2.5	14		
Sesone	0	0		
Silica - Amorphous				
Diatomeceous earth (uncalcined)	0	0		
Precipitated silica	0	0		
Silica gel	0	0		
Silica - Crystalline Cristobalite	0	0		
Quartz	0	0		
Silica, fused	0	0		
Tridymite	0	0		
Tripoli	0	0		
Silicon	0	0		
Silicon carbide	0	0		
Silicon tetrahydride	0.106	9		
Silver				
Metal	0.1	15		
Soluble compounds, as Ag	0	0		
Soapstone				
Respirable dust	0	0		
Total dust	0	0		
Sodium azide	0	0		
Sodium bisulfite	0	0		
Sodium fluoroacetate	2	5		
Sodium hydroxide	6	15		
Sodium metabisulfite	0	0		
Starch	0	0		
Stearates	0	0		
Stibine	100	1		
Stoddard solvent	2.19	24	6	
Strychnine	0	0		
Styrene, monomer	1.97	1	10	24
Subtilisins	0	0		
Sucrose	0	0		
Sulfotep	0	0		
Sulfur dioxide	2.5	11	23	
Sulfur hexafluoride	0	0		
Sulfuric acid	2	2		
Sulfur monochloride	6.5	4		
Sulfur pentafluoride	14.97	30		
Sulfur tetrafluoride	5.48	13		
Sulfuryl fluoride	0	0		
Sulprofos	0	0		
2,4,5-T	0	0		
Talc (no asbestos)	0	0		
Talc (containing asbestos)	0	0		
Tantalum, metal & oxide dusts	0.04	6	5	
Tellurium & compounds	0.1	1		
Tellurium hexafluoride	0	0		
Temephos	0	0		
TEPP	0	0		
Terphenyls	1.92	12		
1,1,1,2-Tetrachloro-2,2-difluoroethane	0	0		
1,1,2,2-Tetrachloro-1,2-difluoroethane	0	0		
1,1,2,2-Tetrachloroethane	5.07	1	35	
Tetrachloronaphthalene	0	0	0	
Tetraethyl lead	0.75	5		
Tetrahydrofuran	0	0		
Tetramethyl lead	0.5	3		
Tetramethyl succinonitrile	0	0		
Tetranitromethane	0	0		
Tetrasodium pyrophosphate	0.2	1		
Tetryl	0	0		
Thallium	1.5	1		
4,4'-Thiobis(6-tert-butyl-m-cresol)	0	0		

Thioglycolic acid	68-11-1	1978	1984				
Thionyl chloride	7719-09-7	1986	1986				
Thiram	137-26-8	1957	1989				
Tin	7440-31-3						
Metal		1982	1982				
Oxide & inorganic compounds except SnH ₄ , as Sn		1965	1965				
Organic compounds as Sn		1968	1968				
Titanium dioxide	13463-67-7	1956	1971	y			
Toluene	108-88-3	1946	1973				
Toluene-2,4-diisocyanate (TDI)	584-84-9	1959	1983	y			
o-Toluidine	95-53-4	1946	1982	y			
m-Toluidine	108-44-1	1985	1985				
p-Toluidine	106-49-0	1985	1985	y			
Tributyl phosphate	126-73-8	1968	1981				
Trichloroacetic acid	76-03-9	1980	1981				
1,2,4-Trichlorobenzene	120-82-1	1978	1983				
1,1,2-Trichloroethane	79-00-5	1982	1989	y			
Trichloroethylene	79-01-6	1946	1982	y			
Trichlorofluoromethane	75-69-4	1980	1982				
Trichloronaphthalene	1321-65-9	1946	1946				
1,2,3-Trichloropropane	96-18-4	1982	1987	y			
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1962	1962				
Triethylamine	121-44-8	1959	1983				
Trifluoromonomobromo methane	75-63-8	1956	1956				
Trimellitic anhydride	552-30-7	1981	1981				
Trimethylamine	75-50-3	1983	1983				
Trimethyl benzene	25551-13-7	1971	1971				
Trimethyl phosphite	121-45-9	1979	1982				
2,4,6-Trinitrotoluene (TNT)	118-96-7	1946	1980	y			
Triorthocresyl phosphate	78-30-8	1962	1962				
Triphenyl amine		1980	1980				
Triphenyl phosphate	115-86-6	1962	1962				
Tungsten	7440-33-7						
Insoluble compounds		1969	1969				
Soluble compounds		1969	1969				
Turpentine	8006-64-2	1946	1946				
Uranium (natural) soluble	7440-61-1	1953	1971	y			
insoluble compounds		1953	1971	y			
n-Valeraldehyde	110-62-3	1978	1978				
Vanadium, as V ₂ O ₅ dust	1314-62-1	1956	1982				
fume		1956	1982				
Vegetable oil mists		1982	1982				
Vinyl acetate	108-05-4	1968	1968				
Vinyl bromide	593-60-2	1972	1980	y			
Vinyl chloride	75-01-4	1946	1980	y			
Vinyl cyclohexene dioxide	106-87-6	1977	1977	y			
Vinylidene chloride	75-35-4	1975	1984	y			
Vinyl toluene	25013-15-4	1959	1981				
VM & P Naphtha	8032-32-4	1979	1979				
Warfarin	81-81-2	1957	1968				
Welding fumes (NOC)		1976	1976	y			
Wood dust (certain hard woods as beech & oak)		1972	1981	y			
Soft wood		1972	1972	y			
Xylene (o-, m-, p-isomers)	1330-20-7	1946	1967				
m-Xylene alpha, alpha'-diamine	1477-55-0	1976	1976				
Xylidine	1300-73-8	1959	1990				
Yttrium metal & compounds, as Y	7440-65-5	1960	1966				
Zinc chloride fume	7646-85-7	1968	1968				
Zinc chromates	13530-65-9	1977	1988	y			
Zinc oxide	1314-13-2						
Fume		1946	1962				
Dust		1982	1982				
Zinc stearate	557-05-1	1974					
Zirconium and compounds	7440-67-7	1956	1956				

Thioglycolic acid					
Thionyl chloride					
Thiram					
Tin					
Metal					
Oxide & inorganic compounds except SnH ₄ , as Sn					
Organic compounds as Sn					
Titanium dioxide					
Toluene					
Toluene-2,4-diisocyanate (TDI)	1961	5	1962	6.09	
o-Toluidine					
m-Toluidine					
p-Toluidine					
Tributyl phosphate					
Trichloroacetic acid					
1,2,4-Trichlorobenzene			1979	0.167	
1,1,2-Trichloroethane					
Trichloroethylene	1947	1.33	1948	1.5	
Trichlorofluoromethane					
Trichloronaphthalene					
1,2,3-Trichloropropane					
1,1,2-Trichloro-1,2,2-trifluoroethane					
Triethylamine					
Trifluoromono-bromo methane					
Trimellitic anhydride					
Trimethylamine					
Trimethyl benzene					
Trimethyl phosphite					
2,4,6-Trinitrotoluene (TNT)					
Triorthocresyl phosphate					
Triphenyl amine					
Triphenyl phosphate					
Tungsten					
Insoluble compounds					
Soluble compounds					
Turpentine					
Uranium (natural) soluble insoluble compounds					
n-Valeraldehyde					
Vanadium, as V ₂ O ₅ dust fume			1973	12.05	
Vegetable oil mists					
Vinyl acetate					
Vinyl bromide					
Vinyl chloride	1972	1.69	1973	1.51	
Vinyl cyclohexene dioxide					
Vinylidene chloride					
Vinyl toluene					
VM & P Naphtha					
Warfarin					
Welding fumes (NOC)					
Wood dust (certain hard woods as beech & oak)					
Soft wood					
Xylene (o-,m-,p-isomers)			1963	6	
m-Xylene alpha, alpha'-diamine					
Xylidine			1982	2.52	
Yttrium metal & compounds, as Y					
Zinc chloride fume					
Zinc chromates					
Zinc oxide					
Fume					
Dust					
Zinc stearate					
Zirconium and compounds					

Thioglycolic acid	1.3	6		
Thionyl chloride	0	0		
Thiram	5	32		
Tin				
Metal	0	0		
Oxide & inorganic compounds				
except SnH ₄ , as Sn	0	0		
Organic compounds as Sn	0	0		
Titanium dioxide	1.5	15		
Toluene	1.99	27		
Toluene-2,4-diisocyanate (TDI)	0.64	2	1	21
o-Toluidine	2.5	36		
m-Toluidine	0	0		
p-Toluidine	0	0		
Tributyl phosphate	2.27	13		
Trichloroacetic acid	0.15	1		
1,2,4-Trichlorobenzene	6.49	1	4	
1,1,2-Trichloroethane	0.82	7		
Trichloroethylene	1.99	1	1	34
Trichlorofluoromethane	5.99	2		
Trichloronaphthalene	0	0		
1,2,3-Trichloropropane	5	5		
1,1,2-Trichloro-1,2,2-trifluoroethane	0	0		
Triethylamine	2.43	24		
Trifluoromonobromo methane	0	0		
Trimellitic anhydride	0	0		
Trimethylamine	0	0		
Trimethyl benzene	0	0		
Trimethyl phosphite	0.26	3		
2,4,6-Trinitrotoluene (TNT)	3	34		
Triorthocresyl phosphate	0	0		
Triphenyl amine	0	0		
Triphenyl phosphate	0	0		
Tungsten				
Insoluble compounds	0	0		
Soluble compounds	0	0		
Turpentine	0	0		
Uranium (natural) soluble	0.25	18		
insoluble compounds	1.25	18		
n-Valeraldehyde	0	0		
Vanadium, as V ₂ O ₅ dust	10	26		
fume	0.16	17	9	
Vegetable oil mists	0	0		
Vinyl acetate	0	0		
Vinyl bromide	50	8		
Vinyl chloride	39.23	26	1	7
Vinyl cyclohexene dioxide	0	0		
Vinylidene chloride	2	9		
Vinyl toluene	1.98	22		
VM & P Naphtha	0	0		
Warfarin	5	11		
Welding fumes (NOC)	0	0		
Wood dust (certain hard woods as beech & oak)	5	9		
Soft wood	0	0		
Xylene (o-, m-, p- isomers)	0.33	17	4	
m-Xylene alpha, alpha'-diamine	0	0		
Xylidine	3.96	23	8	
Yttrium metal & compounds, as Y	5	6		
Zinc chloride fume	0	0		
Zinc chromates	5	11		
Zinc oxide				
Fume	3	16		
Dust	0	0		
Zinc stearate				
Zirconium and compounds	0	0		

APPENDIX B

List of chemicals by industry.

APPENDIX B
LIST OF CHEMICALS BY INDUSTRY

SIC	SIC TITLE	CHEMICAL NAME
15	GENERAL BUILDING CONTRACTORS	Ethylene glycol (vapor) Sulfur dioxide Nitrogen dioxide
17	SPECIAL TRADE CONTRACTORS	Ethylene glycol (vapor) Toluene Hexane (n-Hexane) Calcium oxide Iron oxide fume Magnesium oxide fume Paraffin wax fume Stoddard solvent Titanium dioxide
20	FOOD AND KINDRED PRODUCTS	Formaldehyde Methyl chloroform Styrene, monomer 2-Butoxyethanol (EGBE) Iron oxide fume Magnesium oxide fume Sodium hydroxide Xylene (o-,m-,p-isomers) Iodine Hydrogen chloride Hydrogen fluoride Ammonia Tetrasodium pyrophosphate Ozone Titanium dioxide Ozone
21	TOBACCO MANUFACTURES	
22	TEXTILE MILL PRODUCTS	Formaldehyde Acetone n-Butyl alcohol Methyl chloroform Acetaldehyde Methylene chloride Ethylene oxide Trichlorofluoromethane Dichlorodifluoromethane Isobutyl alcohol Methyl ethyl ketone (MEK) Trichloroethylene Butane Acrylonitrile Ethylene glycol (vapor) Toluene 2-Butoxyethanol (EGBE) n-Butyl acetate Dioxane Perchloroethylene n-Amyl acetate Iron oxide fume Sodium hydroxide Xylene (o-,m-,p-isomers) Hydrogen chloride Ammonia Sulfuric acid Tetrasodium pyrophosphate Paraffin wax fume Stoddard solvent Titanium dioxide

SIC SIC TITLE
23 APPAREL AND OTHER TEXTILE PRODUCTS

CHEMICAL NAME
 Formaldehyde
 Acetone
 n-Butyl alcohol
 Methyl chloroform
 Methylene chloride
 Butane
 Acrylonitrile
 Ethylene glycol (vapor)
 Toluene
 Perchloroethylene
 n-Amyl acetate
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 Hydrogen fluoride
 Ammonia
 Sulfuric acid
 Parafin wax fume
 Stoddard solvent
 Titanium dioxide

24 LUMBER AND WOOD PRODUCTS

Formaldehyde
 Acetone
 n-Butyl alcohol
 Methyl ethyl ketone (MEK)
 Ethyl benzene
 Ethylene glycol (vapor)
 Toluene
 n-Butyl acetate
 Iron oxide fume
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 Stoddard solvent
 Ozone
 Chrysotile
 Titanium dioxide

25 FURNITURE AND FIXTURES

Formaldehyde
 Acetone
 n-Butyl alcohol
 Methyl chloroform
 Methylene chloride
 Isobutyl alcohol
 Methyl ethyl ketone (MEK)
 Ethylene glycol (vapor)
 Methyl isobutyl ketone
 Toluene
 Methyl n-amyl ketone
 Hexane (n-Hexane)
 2-Butoxyethanol (EGBE)
 Malathion
 n-Butyl acetate
 Perchloroethylene
 Iron oxide fume
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 Ammonia
 Parafin wax fume
 Stoddard solvent
 Titanium dioxide

SIC SIC TITLE
26 PAPER AND ALLIED PRODUCTS

CHEMICAL NAME
 Formaldehyde
 Aniline
 Methyl chloroform
 Methyl mercaptan
 Isobutyl alcohol
 Methyl ethyl ketone (MEK)
 Ethylene glycol (vapor)
 Toluene
 2-Ethoxyethanol (EGEE)
 2-Butoxyethanol (EGBE)
 Calcium oxide
 Iron oxide fume
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 Sulfur dioxide
 Sulfuric acid
 Hydrogen sulfide
 Parafin wax fume
 Titanium dioxide

27 PRINTING AND PUBLISHING

Formaldehyde
 Acetone
 Dimethylformamide
 Methyl chloroform
 Methylene chloride
 Methyl ethyl ketone (MEK)
 Ethylene glycol (vapor)
 Toluene
 2-Methoxyethanol (methyl cellosolve)
 Hexane (n-Hexane)
 2-Ethoxyethanol (EGEE)
 2-Ethoxyethanol (EGEE)
 2-Ethoxyethyl acetate
 Gluteraldehyde
 2-Butoxyethanol (EGBE)
 Dioxane
 Perchloroethylene
 Heptane
 Magnesium oxide fume
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 Lead, inorg. dust & fumes, as Pb
 Hydrogen chloride
 Ammonia
 Sulfuric acid
 Chlorine
 Parafin wax fume
 Stoddard solvent
 Titanium dioxide

28 CHEMICALS AND ALLIED PRODUCTS

Formaldehyde
 Acetone
 Dimethylformamide
 n-Butyl alcohol
 Acetaldehyde
 Methylene chloride
 Ethylene oxide
 Methyl ethyl ketone (MEK)
 Acrylic acid
 Phthalic anhydride
 Styrene, monomer
 Ethylene glycol (vapor)
 Methyl isobutyl ketone
 Methyl isobutyl ketone
 Toluene

SIC SIC TITLE
28 CHEMICALS AND ALLIED PRODUCTS

CHEMICAL NAME
 Cyclohexanol
 Cyclohexanone
 Methyl *n*-amyl ketone
 Hexane (*n*-Hexane)
 2-Butoxyethanol (EGBE)
 Triethylamine
n-Butyl acetate
 Dioxane
 Heptane
 Iron oxide fume
 Magnesium oxide fume
 Sodium hydroxide
 Vanadium, as V2O5 dust
 Xylene (*o*-,*m*-,*p*-isomers)
 Lead, inorg. dust & fumes, as Pb
 Hydrogen chloride
 Ammonia
 Sulfuric acid
 Tetrasodium pyrophosphate
 Chlorine
 Titanium dioxide

29 PETROLEUM AND COAL PRODUCTS

Formaldehyde
 Toluene
 Sodium hydroxide
 Xylene (*o*-,*m*-,*p*-isomers)
 Hydrogen chloride
 Sulfuric acid

30 RUBBER AND MISC. PLASTICS PRODUCTS

Formaldehyde
 Carbon tetrachloride
 Acetone
 Methyl chloroform
 Vinyl chloride
 Methylene chloride
 Trichlorofluoromethane
 Dichlorodifluoromethane
 Methyl ethyl ketone (MEK)
 Styrene, monomer
 Epichlorohydrin
 Ethylene glycol (vapor)
 Toluene
 Chlorobenzene
 Cyclohexanone
 Pentane
 Hexane (*n*-Hexane)
 Octane
 2-Butoxyethanol (EGBE)
 Thiram
 Heptane
n-Amyl acetate
 Calcium oxide
 Iron oxide fume
 Magnesium oxide fume
 Sodium hydroxide
 Xylene (*o*-,*m*-,*p*-isomers)
 Tetrasodium pyrophosphate
 Paraffin wax fume
 Stoddard solvent
 Titanium dioxide

SIC SIC TITLE
31 LEATHER AND LEATHER PRODUCTS

CHEMICAL NAME
 Formaldehyde
 Acetone
 Methyl chloroform
 Methylene chloride
 Trichlorofluoromethane
 Dichlorodifluoromethane
 Methyl ethyl ketone (MEK)
 Ethylene glycol (vapor)
 Toluene
 Hexane (n-Hexane)
 2-Butoxyethanol (EGBE)
 Calcium oxide
 Iron oxide fume
 Magnesium oxide fume
 Xylene (o-,m-,p-isomers)
 Isophorone diisocyanate
 Stoddard solvent
 Titanium dioxide

32 STONE, CLAY, AND GLASS PRODUCTS

Formaldehyde
 Methyl ethyl ketone (MEK)
 Styrene, monomer
 Epichlorohydrin
 Ethylene glycol (vapor)
 Toluene
 Hexane (n-Hexane)
 2-Butoxyethanol (EGBE)
 Boron oxide
 Calcium oxide
 Iron oxide fume
 Magnesium oxide fume
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 n-Butylglycidyl ether (BGE)
 Hydrogen chloride
 Ammonia
 Bromine
 Fluorine
 Chlorine
 Titanium dioxide

33 PRIMARY METAL INDUSTRIES

Formaldehyde
 Methyl chloroform
 Trichlorofluoromethane
 Methyl ethyl ketone (MEK)
 Trichloroethylene
 Furfuryl alcohol
 Furfural
 Butane
 Ethylene glycol (vapor)
 Toluene
 2-Butoxyethanol (EGBE)
 Triethylamine
 Carbon monoxide
 Calcium oxide
 Iron oxide fume
 Magnesium oxide fume
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 Lead, inorg. dust & fumes, as Pb
 Arsenic
 Chromium Metal
 Cobalt Metal dust and fume

SIC SIC TITLE
33 PRIMARY METAL INDUSTRIES

CHEMICAL NAME
Hydrogen chloride
Hydrogen fluoride
Ammonia
Sulfuric acid
Tetrasodium pyrophosphate
Chlorine
Stoddard solvent
Titanium dioxide

34 FABRICATED METAL PRODUCTS

Formaldehyde
Acetone
n-Butyl alcohol
Benzene (benzol)
Methyl chloroform
Vinyl chloride
Methylene chloride
Methylene chloride
Propylene oxide
Isophorone
Isobutyl alcohol
Methyl ethyl ketone (MEK)
Trichloroethylene
Ethyl benzene
Epichlorohydrin
Methyl isobutyl ketone
Toluene
2-Methoxyethanol (methyl cellosolve)
Methyl n-amyl ketone
Hexane (n-Hexane)
2-Ethoxyethanol (EGEE)
2-Butoxyethanol (EGBE)
Triethylamine
n-Butyl acetate
Perchloroethylene
Calcium oxide
Iron oxide fume
Magnesium oxide fume
Sodium hydroxide
Xylene (o-,m-,p-isomers)
n-Butylglycidyl ether (BGE)
Lead, inorg. dust & fumes, as Pb
Cadmium dusts and salts
Chromium Metal
Hydrogen chloride
Hydrogen fluoride
Ammonia
Sulfuric acid
Tetrasodium pyrophosphate
Stoddard solvent
Titanium dioxide
Zinc chromates

35 MACHINERY, EXCEPT ELECTRICAL

Formaldehyde
Acetone
n-Butyl alcohol
Methyl chloroform
Methylene chloride
Nitromethane
Trichlorofluoromethane
Dichlorodifluoromethane
Camphor, synthetic
Isobutyl alcohol
sec-Butyl alcohol
Methyl ethyl ketone (MEK)
Trichloroethylene

SIC SIC TITLE
35 MACHINERY, EXCEPT ELECTRICAL

CHEMICAL NAME
 Furfuryl alcohol
 Butane
 Ethylene glycol (vapor)
 Methyl isobutyl ketone
 Toluene
 2-Ethoxyethanol (EGEE)
 2-Ethoxyethyl acetate
 2-Butoxyethanol (EGBE)
 n-Butyl acetate
 Dioxane
 Perchloroethylene
 Heptane
 n-Amyl acetate
 Carbon monoxide
 Boron oxide
 Calcium oxide
 Iron oxide fume
 Magnesium oxide fume
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 Lead, inorg. dust & fumes, as Pb
 Cadmium dusts and salts
 Chromium Metal
 Hydrogen chloride
 Ammonia
 Sulfuric acid
 Tetrasodium pyrophosphate
 Bromine
 Parafin wax fume
 Stoddard solvent
 Titanium dioxide

36 ELECTRIC AND ELECTRONIC EQUIPMENT

Formaldehyde
 Acetone
 n-Butyl alcohol
 Methyl chloroform
 Vinyl chloride
 Methylene chloride
 Camphor, synthetic
 Ethyl silicate
 Isobutyl alcohol
 Methyl ethyl ketone (MEK)
 Trichloroethylene
 Acrylic acid
 Styrene, monomer
 Epichlorohydrin
 Butane
 Ethylene glycol (vapor)
 Methyl isobutyl ketone
 Toluene
 Cyclohexanone
 Hexane (n-Hexane)
 2-Ethoxyethyl acetate
 2-Butoxyethanol (EGBE)
 n-Butyl acetate
 Perchloroethylene
 Heptane
 n-Amyl acetate
 Boron oxide
 Calcium oxide
 Iron oxide fume
 Magnesium oxide fume
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 Lead, inorg. dust & fumes, as Pb

SIC SIC TITLE
36 ELECTRIC AND ELECTRONIC EQUIPMENT

CHEMICAL NAME
Tantalum, metal & oxide dusts
Cadmium dusts and salts
Hydrogen chloride
Hydrogen fluoride
Ammonia
Sulfuric acid
Tetrasodium pyrophosphate
Silicon tetrahydride
Paraffin wax fume
Stoddard solvent
Hydrogen bromide
Boron tribromide
Chrysotile
Titanium dioxide

37 TRANSPORTATION EQUIPMENT

Formaldehyde
Carbon tetrachloride
Acetone
Chloroform
Dimethylformamide
n-Butyl alcohol
Benzene (benzol)
Methyl chloroform
Vinyl chloride
Acetaldehyde
Methylene chloride
Ethylene oxide
Trichlorofluoromethane
Dichlorodifluoromethane
Camphor, synthetic
Ethyl silicate
Isobutyl alcohol
sec-Butyl alcohol
Methyl ethyl ketone (MEK)
Trichloroethylene
Phthalic anhydride
Furfuryl alcohol
Furfural
Styrene, monomer
Epichlorohydrin
Butane
Ethylene dichloride
Ethylene glycol (vapor)
Methyl isobutyl ketone
Diisobutyl ketone
Toluene
Cyclohexanone
Methyl n-amyl ketone
Hexane (n-Hexane)
2-Ethoxyethanol (EGEE)
2-Ethoxyethyl acetate
2-Butoxyethanol (EGBE)
Phenyl glycidyl ether (PGE)
n-Butyl acetate
Dioxane
Tributyl phosphate
Perchloroethylene
Thiram
Heptane
Toluene-2,4-diisocyanate (TDI)
Methyl n-butyl ketone (2-Hexanone)
n-Amyl acetate
Boron oxide
Calcium oxide
Iron oxide fume

SIC SIC TITLE
37 TRANSPORTATION EQUIPMENT

CHEMICAL NAME
 Magnesium oxide fume
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 n-Butylglycidyl ether (BGE)
 Lead, inorg. dust & fumes, as Pb
 Tantalum, metal & oxide dusts
 Cadmium dusts and salts
 Chromium Metal
 Cobalt Metal dust and fume
 Hydrogen chloride
 Hydrogen fluoride
 Ammonia
 Sulfuric acid
 Tetrasodium pyrophosphate
 Paraffin wax fume
 Stoddard solvent
 Sulfur monochloride
 Ozone
 Chrysotile
 Titanium dioxide
 Zinc chromates

38 INSTRUMENTS AND RELATED PRODUCTS

Formaldehyde
 Aniline
 Acetone
 n-Butyl alcohol
 Methyl chloroform
 Methylene chloride
 Dichlorodifluoromethane
 Methyl ethyl ketone (MEK)
 Trichloroethylene
 Epichlorohydrin
 Butane
 Ethylene glycol (vapor)
 Methyl isobutyl ketone
 Toluene
 Hexane (n-Hexane)
 2-Ethoxyethanol (EGEE)
 2-Butoxyethanol (EGBE)
 n-Butyl acetate
 Tributyl phosphate
 Perchloroethylene
 Heptane
 Boron oxide
 Calcium oxide
 Iron oxide fume
 Magnesium oxide fume
 Sodium hydroxide
 Xylene (o-,m-,p-isomers)
 Lead, inorg. dust & fumes, as Pb
 Arsenic
 Chromium Metal
 Hydrogen chloride
 Hydrogen fluoride
 Ammonia
 Sulfuric acid
 Paraffin wax fume
 Stoddard solvent
 Titanium dioxide

SIC	SIC TITLE	CHEMICAL NAME
39	MISCELLANEOUS MANUFACTURING INDUSTRIES	Formaldehyde
		Acetone
		n-Butyl alcohol
		Methyl chloroform
		Methylene chloride
		Methyl ethyl ketone (MEK)
		Trichloroethylene
		Toluene
		Cyclohexanone
		2-Ethoxyethyl acetate
		2-Butoxyethanol (EGBE)
		Magnesium oxide fume
		Sodium hydroxide
		Xylene (o-,m-,p-isomers)
		Lead, inorg. dust & fumes, as Pb
		Chromium Metal
		Hydrogen chloride
		Sulfuric acid
		Tetrasodium pyrophosphate
		Paraffin wax fume
		Titanium dioxide
40	RAILROAD TRANSPORTATION	Sulfur dioxide
45	TRANSPORTATION BY AIR	Formaldehyde
		Acetone
		Hexachloroethane
		n-Butyl alcohol
		Methyl chloroform
		Methylene chloride
		Propylene oxide
		Dichlorodifluoromethane
		Camphor, synthetic
		Methyl ethyl ketone (MEK)
		Trichloroethylene
		Acrylic acid
		o-Dichlorobenzene
		Styrene, monomer
		Allyl glycidyl ether (AGE)
		Butane
		Methyl isobutyl ketone
		Toluene
		Cyclohexanol
		2-Methoxyethanol (methyl cellosolve)
		Methyl n-amyl ketone
		Hexane (n-Hexane)
		2-Ethoxyethyl acetate
		2-Butoxyethanol (EGBE)
		n-Butyl acetate
		Tributyl phosphate
		Iron oxide fume
		Magnesium oxide fume
		Sodium hydroxide
		Xylene (o-,m-,p-isomers)
		Lead, inorg. dust & fumes, as Pb
		Cadmium dusts and salts
		Chromium Metal
		Sulfur dioxide
		Hydrogen chloride
		Hydrogen fluoride
		Sulfuric acid
		Tetrasodium pyrophosphate
		Chlorine
		Paraffin wax fume
		Stoddard solvent
		Titanium dioxide

SIC SIC TITLE
49 ELECTRIC, GAS, AND SANITARY SERVICES

CHEMICAL NAME

Sodium hydroxide
Sulfuric acid
Chlorine

72 PERSONAL SERVICES

Perchloroethylene
Sodium hydroxide
Stoddard solvent

73 BUSINESS SERVICES

Formaldehyde
Acetone
Methyl chloroform
Styrene, monomer
Ethylene glycol (vapor)
2-Ethoxyethanol (EOEE)
2-Butoxyethanol (EOBE)
Dioxane
Iron oxide fume
Magnesium oxide fume
Sodium hydroxide
Xylene (o-,m-,p-isomers)
Lead, inorg. dust & fumes, as Pb
Hydrogen chloride
Ammonia
Sulfuric acid
Tetrasodium pyrophosphate

76 MISCELLANEOUS REPAIR SERVICES

Chromium Metal
Titanium dioxide

80 HEALTH SERVICES

Formaldehyde
Acetone
Chloroform
n-Butyl alcohol
Methyl chloroform
Ethyl chloride
Acetaldehyde
Methylene chloride
Ethylene oxide
Propylene oxide
Trichlorofluoromethane
Dichlorodifluoromethane
Trichloroacetic acid
Ethyl benzene
Styrene, monomer
Butane
Ethylene glycol (vapor)
Toluene
Hexane (n-Hexane)
Gluteraldehyde
2-Butoxyethanol (EOBE)
n-Butyl acetate
Dioxane
n-Amyl acetate
Sodium hydroxide
Xylene (o-,m-,p-isomers)
Iodine
Hydrogen chloride
Ammonia
Sulfuric acid
Tetrasodium pyrophosphate
Chlorine
Paraffin wax fume
Stoddard solvent
Titanium dioxide

APPENDIX C

Test for significance of fold reductions in TLVs.

APPENDIX C

t-test For Significance of Fold Reductions (for Table IV)

SIC 15

m	0.024806	3.743657 b
se	0.088563	2.359827
R2	0.025485	2.292389
F	0.078453	3 df
	0.412275	15.76514
m/se	0.280095	
t - CV	2.3	

17		
m	0.3228	-7.276 b
se	0.178683	5.892483
R2	0.620033	1.997739
F	3.263621	2 df
	13.02498	7.98192
m/se	1.806549	
t - CV	2.9	

20, 21		
m	-0.04632	4.987361 b
se	0.078416	2.206362
R2	0.047473	3.037044
F	0.34887	7 df
	3.21785	64.56547
m/se	-0.59065	
t - CV	1.89	

22		
m	-0.04041	4.719907 b
se	0.080083	2.253257
R2	0.0351	3.101596
F	0.254637	7 df
	2.449586	67.33929
m/se	-0.50462	
t - CV	1.89	

23		
m	0.045005	0.819257 b
se	0.020401	0.599152
R2	0.447833	0.759931
F	4.866273	6 df
	2.91025	3.464972
m/se	2.205963	
t - CV	1.94	

24		
m	0.016847	2.90777 b
se	0.059188	1.738241
R2	0.013323	2.204686
F	0.081017	6 df
	0.393795	29.16385
m/se	0.284635	
t - CV	1.94	

25		
m	-0.00352	1.968472 b
se	0.026724	0.751917
R2	0.002468	1.03501
F	0.017317	7 df
	0.01855	7.498722
m/se	-0.13159	
t - CV	1.89	

SIC
26
 m -0.02028 3.218197 b
 se 0.05554 1.484368
 R2 0.02597 1.639538
 F 0.133312 5 df
 0.358353 13.44042
 m/se -0.36512
 t - CV 2.01

27
 m 0.006917 1.975972 b
 se 0.024414 0.686933
 R2 0.011336 0.945559
 F 0.080262 7 df
 0.07176 6.258578
 m/se 0.283305
 t - CV 1.89

28
 m 0.0115 1.7575 b
 se 0.025102 0.706272
 R2 0.029112 0.972179
 F 0.209891 7 df
 0.198375 6.615925
 m/se 0.458139
 t - CV 1.89

29
 m -0.06625 3.72209 b
 se 0.096066 2.55976
 R2 0.13685 2.486609
 F 0.475642 3 df
 2.941003 18.54968
 m/se -0.68967
 t - CV 2.35

30
 m 0.0205 1.638611 b
 se 0.018762 0.527897
 R2 0.145701 0.726647
 F 1.193855 7 df
 0.630375 3.696114
 m/se 1.092637
 t - CV 1.89

31
 m -0.00912 2.701806 b
 se 0.044588 1.254556
 R2 0.005937 1.726889
 F 0.041806 7 df
 0.12467 20.87502
 m/se -0.20446
 t - CV 1.89

32
 m -0.03644 3.641855 b
 se 0.047044 1.394072
 R2 0.090912 1.661187
 F 0.600024 6 df
 1.655793 16.55726
 m/se -0.77461
 t - CV 1.94

SIC
33
m -0.01802 2.975539 b
se 0.043536 1.290122
R2 0.027761 1.537319
F 0.17132 6 df
0.404888 14.1801
m/se -0.41391
t - CV 1.94

34
m 0.055733 0.920556 b
se 0.031857 0.896339
R2 0.304227 1.233806
F 3.06075 7 df
4.659307 10.65593
m/se 1.7495
t - CV 1.89

35
m 0.001967 1.960278 b
se 0.025292 0.711632
R2 0.000863 0.979557
F 0.006046 7 df
0.005802 6.716721
m/se 0.077758
t - CV 1.89

36
m 0.067317 0.509861 b
se 0.0316 0.889115
R2 0.393313 1.223861
F 4.538079 7 df
6.7973 10.48486
m/se 2.130277
t - CV 1.89

37
m 0.048683 1.072917 b
se 0.023154 0.651467
R2 0.387093 0.89674
F 4.420981 7 df
3.5551 5.629
m/se 2.102613
t - CV 1.89

38
m 0.036867 1.322222 b
se 0.027969 0.786941
R2 0.198856 1.08322
F 1.737503 7 df
2.038727 8.213562
m/se 1.318144
t - CV 1.89

39
m 0.006483 1.976806 b
se 0.043461 1.222832
R2 0.003169 1.683221
F 0.022254 7 df
0.06305 19.83264
m/se 0.149177
t - CV 1.89

SIC

40, 45

m	0.043067	1.463889 b
se	0.045665	1.284846
R2	0.112739	1.768584
F	0.889452	7 df
	2.782107	21.89522
m/se	0.943108	
t - CV	1.89	

49,72,73,76

m	-0.00042	2.243722 b
	0.041499	1.167632
R2	1.46E-05	1.607239
F	0.000102	7 df
	0.000265	18.98252
m/se	-0.01012	
t - CV	1.89	

80

m	0.003683	2.160694 b
se	0.04154	1.168793
R2	0.001122	1.608837
F	0.007862	7 df
	0.02035	18.11851
m/se	0.08867	
t - CV	1.89	

APPENDIX D

Test for significance of interval between changes.

APPENDIX D

t-test For Significance of Interval Between Changes (for Table VII)

SIC
15
m 0.438806 3.268657 b
se 0.137119 3.653639
R2 0.773435 3.549227
F 10.24123 3 df
129.009 37.79104
m/se 3.200193
t - CV 2.35

17
m -1.05 47.5 b
se 0.177482 5.852884
R2 0.945946 1.984313
F 35 2 df
137.8125 7.875
m/se -5.91608
t - CV 2.92

20 & 21
m 0.505952 1.77381 b
se 0.197276 5.877029
R2 0.522964 6.392464
F 6.57767 6 df
268.7872 245.1815
m/se 2.564697
t - CV 1.94

22
m -0.05119 13.47024 b
se 0.189178 5.635801
R2 0.012056 6.13008
F 0.073221 6 df
2.751488 225.4673
m/se -0.27059
t - CV 1.94

23
m 0.258197 5.938525 b
se 0.194838 6.106069
R2 0.25993 5.751621
F 1.756114 5 df
58.09426 165.4057
m/se 1.325184
t - CV 2.01

24
m 0.52459 2.565574 b
se 0.232929 7.299812
R2 0.503581 6.876069
F 5.072144 5 df
239.8126 236.4016
m/se 2.252142
t - CV 2.01

25
m 0.270238 6.880952 b
se 0.160252 4.774061
R2 0.321552 5.192762
F 2.843711 6 df
76.68006 161.7887
m/se 1.686331

SIC

26

m -0.06286 11.39524 b
 se 0.21528 6.199049
 R2 0.020868 4.502909
 F 0.085251 4 df
 1.728571 81.10476
 m/se -0.29198
 t - CV 2.13

27

m 0.157143 7.303571
 SE 0.136537 4.067559
 R2 0.180844 4.424297
 F 1.324616 6
 25.92857 117.4464
 m/se 1.15092
 t - CV 1.94

28

m 0.208333 8.333333 b
 se 0.183721 5.473213
 R2 0.17649 5.953232
 F 1.285882 6 df
 45.57292 212.6458
 m/se 1.133967
 t - CV 1.94

29

m 0.085714 9.285714 b
 se 0.430662 12.78456
 R2 0.019422 6.369571
 F 0.039613 2 df
 1.607143 81.14286
 m/se 0.199029
 t - CV 2.92

30

m 0.182143 8.553571 b
 se 0.154501 4.602721
 R2 0.188074 5.006395
 F 1.389836 6 df
 34.83482 150.3839
 m/se 1.178913
 t - CV 1.94

31

m -0.02143 12.46429 b
 se 0.152437 4.541234
 R2 0.003283 4.939515
 F 0.019761 6 df
 0.482143 146.3929
 m/se -0.14057
 t - CV 1.94

32

m 0.185714 8.785714 b
 se 0.084031 2.657296
 R2 0.494152 2.223254
 F 4.884393 5 df
 24.14286 24.71429
 m/se 2.210066
 t - CV 2.01

SIC
33
m 0.057143 12.21429 b
se 0.153928 4.867636
R2 0.026823 4.072556
F 0.137812 5 df
2.285714 82.92857
m/se 0.371231
t - CV 2.01

34
m 0.135714 9.392857 b
se 0.151729 4.520135
R2 0.117653 4.916566
F 0.800049 6 df
19.33929 145.0357
m/se 0.894455
t - CV 1.94

35
m -0.06786 13.05357 b
se 0.147268 4.387258
R2 0.034176 4.772035
F 0.212311 6 df
4.834821 136.6339
m/se -0.46077
t - CV 1.94

36
m 0.175 8.875 b
se 0.135876 4.047875
R2 0.216586 4.402887
F 1.658786 6 df
32.15625 116.3125
m/se 1.287939
t - CV 1.94

37
m 0.07619 10.02976 b
se 0.097003 2.889796
R2 0.093235 3.14324
F 0.616929 6 df
6.095238 59.27976
m/se 0.785449
t - CV 1.94

38
m 0.283333 6.833333 b
se 0.143695 4.280798
R2 0.393197 4.656238
F 3.887892 6 df
84.29167 130.0833
m/se 1.971774
t - CV 1.94

39
m 0.060714 9.892857 b
se 0.124625 3.712704
R2 0.038051 4.038321
F 0.237339 6 df
3.870536 97.84821
m/se 0.487175
t - CV 1.94

SIC

40,45

m	0.095238	10.63095 b
se	0.135679	4.042019
R2	0.075887	4.396517
F	0.492712	6 df
	9.52381	115.9762
m/se	0.701934	
t - CV	1.94	

49,72,73,76

m	0.141667	8.541667 b
se	0.151524	4.514055
R2	0.127161	4.909953
F	0.874118	6 df
	21.07292	144.6458
m/se	0.934943	
t - CV	1.94	

80

m	-0.01567	11.83036 b
se	0.165886	4.941913
R2	0.001486	5.375335
F	0.008928	6 df
	0.257978	173.3654
m/se	-0.09449	
t - CV	1.94	