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TECHNICAL MANPOWER IN NEW YORK STATE. VOLUME I, SUPPLEMENT B, JOB PROJECTIONS IN TECHNICAL OCCUPATIONS.

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STARTING WITH 1962 FIGURES ON EMPLOYMENT IN TECHNICAL OCCUPATIONS, PROJECTIONS ARE MADE TO 1970 AND 1975 FOR MAJOR GROUPS AND SUBGROUPS ON A STATE-WIDE AND AREA BASES. IT WAS ESTIMATED THAT PRIVATE INDUSTRY AND GOVERNMENT IN NEW YORK STATE WILL PROVIDE A TOTAL OF 193,000 JOBS IN TECHNICAL OCCUPATIONS IN 1970 AND 227,600 IN 1975, COMPARED TO 148,700 IN 1962. THE NUMBER OF JOBS WILL BE UP 30 PERCENT BY 1970 AND 53 PERCENT BY 1975. THE GREATEST GROWTH IS PREDICTED FOR THE BIOLOGICAL, MEDICAL, AND DENTAL GROUP, MORE THAN 80 PERCENT BY 1975. TABULAR DATA INCLUDE (1) NUMBER OF JOBS IN SELECTED TECHNICAL OCCUPATIONS, ACTUAL 1962 AND PROJECTED 1970 AND 1975, (2) NUMBER OF JOBS IN SELECTED TECHNICAL OCCUPATIONS GROUPS, 1970 AND 1975, AND (3) ESTIMATE OF NET OCCUPATIONAL MOBILITY, BY TECHNICAL OCCUPATIONAL GROUP 1962-1970 AND 1962-1975. "TECHNICAL MANPOWER IN NEW YORK STATE," VOLUME I, SUPPLEMENT A, AND VOLUME II (VT 000 576 - 000 579) ARE RELATED DOCUMENTS. (FS)

# TECHNICAL MANPOWER IN NEW YORK STATE

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NEW YORK STATE • DEPARTMENT OF LABOR
DIVISION OF RESEARCH AND STATISTICS

*In cooperation with*

- *The State Education Department*
- *State University of New York*

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
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# TECHNICAL MANPOWER IN NEW YORK STATE

## VOLUME I, SUPPLEMENT B

## JOB PROJECTIONS IN TECHNICAL OCCUPATIONS

STATE OF NEW YORK
NELSON A. ROCKEFELLER, *Governor*

DEPARTMENT OF LABOR
M. P. CATHERWOOD, *Industrial Commissioner*

In cooperation

with

THE STATE EDUCATION DEPARTMENT
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NEW YORK STATE DEPARTMENT OF LABOR

Division of Research and Statistics

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## PREFACE

This supplementary volume contains projections of manpower requirements in technical occupations. Data as of 1962 are given in the rest of this report on "Technical Manpower in New York State," namely in volume 1, in supplement A to volume 1, and in volume 2. The present volume, starting with 1962 figures on employment in technical occupations, makes projections to 1970 and 1975. It makes them for the major groups of technical occupations on both a State-wide and an area basis. There are also projections for subgroups, shown for the State as a whole.

These employment projections give a picture of future demand that may be of assistance to manpower and educational planners, to guidance counselors in schools, to curriculum experts, and to industry. Elsewhere the report discusses supply factors, namely the schooling of technicians and technical specialists and on-the-job training practices (in chapters IV, V, and IX of volume 1 and throughout volume 2). However, the projections for 1970 and 1975 do not attempt to estimate whether some types of schooling will be more important than they were in 1962 or whether in the future industry will rely more or rely less on training by the employer.

Underlying the projections are the following basic assumptions:

- Maintenance of high levels of economic activity.
- Continuation of scientific and technological advance, affecting methods of production in industry and in medical, health, and educational services.
- Continued growth in expenditures for research and development.
- Continued high levels of defense expenditure.

Specific assumptions are stated at appropriate places in the report.

The figures for 1970 and 1975 should be viewed as projections for a prosperous year at the end of the 1960's and for a prosperous year around the middle of the 1970's. If a future year is one of depression, actual employment may for that reason be markedly different from the projections for that year.

The projections presented here are preliminary ones. The Division has underway a series of projections for all occupation groups, and these, as well as improvements in benchmark data, may result in modifications of the estimates contained in this report.

The report was prepared by Abraham J. Berman, with the assistance of Sheldon Dorfman and Rita Israel. Sol Swerdloff, Howard Stambler, and Neal Rosenthal, of the U. S. Bureau of Labor Statistics, made valuable suggestions, which are gratefully acknowledged.

C. A. Pearce, Director
Division of Research and Statistics

# JOB PROJECTIONS IN TECHNICAL OCCUPATIONS

It is estimated that private industry and government in New York State will provide a total of 193,000 jobs in technical occupations in 1970 and 227,600 in 1975 -- compared to the 148,700 found in 1962. That is, the number of jobs will be up 30 percent by 1970 and 53 percent by 1975.

These figures on future job openings are ones derived by projecting to 1970 and 1975 the past trends in employment and utilization of technicians and technical specialists, modified by employers' five-year estimates of future utilization. They are presented not as forecasts of what will take place in the future but rather as levels that will be reached if the trends of the post-war period continue into the future. To the extent these trends change, the projections will miss the mark. Because past trends rarely persist precisely, the projections presented here should be viewed as indicators, to be used along with any other evidence of probable future trends the reader may have. For example, a person well acquainted with a particular area may be aware of plans for the construction of industrial establishments or the expansion of a university or other institution that will materially pick up the rate of growth of technical manpower employment in the area; or he may have reason to suspect that major plant shut-downs will occur that will depress the rate of growth.

This volume presents projections for separate occupation groups in the technical field, and does so by area. Although the projections are shown as specific numbers and percentages, no significance should be attached to small differences in the figures shown. In using projections of this kind, some prefer to disregard exact figures and instead just indicate relative magnitudes of change. For example, projections for three different occupations of, say, +56 percent, +34 percent, and +75 percent may simply be characterized as "average," "below average," and "above

average" increases. The authors of this report believe that the projections justify somewhat more precise differentiation than this, while recognizing that for some purposes broad characterizations of change may suffice.

## State-wide Picture

The expected 53-percent increase in the number of technical occupation jobs between 1962 and 1975 is a figure that averages out rather wide differences in the expected growth of individual occupations (see table 1 at the end of this volume). Even when grouped they show wide differences (see table below).

PROJECTED GROWTH OF MAJOR TECHNICAL OCCUPATION GROUPS BETWEEN 1962 AND 1975
NEW YORK STATE

| Occupation group | Number of jobs | | Percent rise | Rank (percent rise) |
|---|---|---|---|---|
| | 1962 | 1975 | | |
| All occupations | 148,684 | 227,551 | 53 | |
| Biological, medical, dental, and related science technicians | 25,445 | 46,799 | 84 | 1 |
| Physical science technicians | 8,969 | 14,599 | 63 | 2 |
| Data-processing systems analysis and programming specialists | 6,153 | 9,848 | 60 | 3 |
| Civil engineering and construction technicians and specialists | 13,464 | 21,085 | 57 | 4 |
| Draftsmen | 20,972 | 32,526 | 55 | 5 |
| Structural design technicians and related specialists | 2,516 | 3,776 | 50 | 6 |
| Electro and mechanical engineering technicians | 42,031 | 61,615 | 47 | 7 |
| Technical writing and illustration specialists | 3,034 | 4,395 | 45 | 8 |
| Safety and sanitation inspectors and related specialists | 4,084 | 5,790 | 42 | 9 |
| Mathematics technicians | 831 | 1,082 | 30 | 10 |
| Sales and service technicians | 1,932 | 2,506 | 30 | 11 |
| Product testing and inspection specialists | 8,059 | 10,246 | 27 | 12 |
| Industrial engineering technicians and related specialists | 6,901 | 8,632 | 25 | 13 |
| Airway tower specialists and flight dispatchers | 1,373 | 1,584 | 15 | 14 |
| Broadcasting, motion picture and recording studio specialists | 2,920 | 3,068 | 5 | 15 |

The greatest growth by far is that projected for the biological, medical, and dental group -- more than 80 percent. Some individual occupations within this broad group, such as general medical assistants in doctors' offices, are expected to show even larger increases. The 1962-1975 increases in the physical science technician and data-processing specialist groups also are expected to be well above the average. (See table 1 for occupational detail.)

Relatively small changes, on the other hand, are projected for broadcasting and motion picture specialists and for airway tower specialists. Increases substantially below average are indicated also in the case of product testing and inspection specialists, industrial engineering technicians, and sales and service technicians.

Two factors lie behind the projections by occupation: (1) the rate at which various industries are expected to expand their total employment, and (2) the change in the ratio of various sorts of technician and technical specialist to total employment in each industry. Of the projected over-all increase of 53 percent between 1962 and 1975, 22 percentage points are attributed to the former and the other 31 to the latter.

An illustration of industry growth is hospital services. Its expected expansion explains a major part of the anticipated rise in the number of biological and medical technicians.

As to the second factor, changes in the functions performed by technicians and specialists affect the number and kinds of jobs that will become available in the future. The needs of an industry for technicians may change as a result of developments in technology, production methods, office procedures, form of industry organization, and so on. The rapid expansion in the use of electronic data-processing computers, for example, is enlarging the importance of the data-processing programmer -- that is it is increasing the ratio of programmers to total

personnel in many industries. The use of technicians to take over some of the design and development functions formerly performed by engineers has a similar effect.1/

The ratio of persons in technical occupations to total employment in the various industries was projected for each major technical occupation group, on the basis of information supplied by employers as part of the 1962 survey. Increases expected to result from changes in the ratio are greatest in the case of physical science technicians and data-processing specialists. As mentioned earlier, the over-all expansion of medical services is expected to be especially important in increasing the number of biological and medical technicians. (For details, see table 3.)

## Area Picture

The projections indicate that the largest percent growth in technical-occupation employment between 1962 and 1975 will be in the Rochester and Westchester areas, while the least growth will be in the New York City and Buffalo areas:

| Percent growth | Area | Counties |
|---|---|---|
| 53 | State average | |
| 77 | Rochester | Monroe |
| 70 | Westchester | Westchester |
| 60 | Binghamton | Broome |
| 59 | Albany-Schenectady-Troy | Albany, Rensselaer, Saratoga, and Schenectady |
| 58 | Nassau-Suffolk | Nassau and Suffolk |
| 54 | Utica | Herkimer and Oneida |
| 51 | Syracuse | Madison, Onondaga, and Oswego |
| 46 | New York City | Bronx, Kings, New York, Queens, and Richmond |
| 41 | Buffalo | Erie and Niagara |
| 63 | All other areas | All other counties |

As to each area, projections for each group of technical occupations will be found in table 2, at the end of this volume.

1. See volume 1, chapters VI and VII.

## Replacement Needs Arising From Deaths and Retirements

The number of technicians and specialists who will die or retire in the thirteen years between 1962 and 1975 is estimated to be 36,500 or one-quarter of the 1962 technician employment. People will be needed to replace them -- in addition to the new workers needed to take care of the expected 53-percent increase in the number of jobs above the 1962 level.

Corresponding replacement-need figures for each of the fifteen groups of technical occupations are shown in table 4. These are on a State-wide basis; replacement needs for the different areas of the State were not computed, but the reader may estimate roughly about how they would work out in an area by applying the State-wide relation between employment in technical occupations and jobs made vacant by deaths and retirements. 1/

## Jobs Vacated and Filled by Occupational Shifts

Workers shift out of technical occupations into other sorts of jobs, and in doing so they create vacancies in this field, just as deaths and retirements do. But technical-occupation jobs are also filled by occupational shifts, notably when a worker is upgraded from a nontechnical job. This section indicates the relative importance of these two movements, on the basis of rough estimates of the numbers they are likely to involve between 1962 and 1975. 1/

(1) Shifting out of technical occupations: There is no very good basis for estimating its extent, but the information that is available suggests that it will total 86,600 in the thirteen years between 1962 and 1975; in any event, it seems likely that it will be a far more important cause of job openings in 1962-1975 than deaths and retirements will be.

(2) Shifting into technical occupations: An employer fills technical-occupation jobs, as he does others, in two ways. One is to shift from other occu-

1. The appendix of this volume contains a statement of the estimating method used.

pations, primarily by upgrading them, persons who are already employed in the establishment. The other method is to recruit persons from sources outside the establishment, some of whom will be shifting from a different job in the process.

Persons recruited outside the firm who come from other employers or from the ranks of the unemployed may have been doing the same job or may be shifting from a different job. Others come from a school or college -- an armed services school, a high school, a technical institute, a community college, a four-year college. Those who come from schools and colleges may be either graduates or persons who have dropped out before graduation.

Whether these sources will be adequate to meet New York State's needs for technical personnel depends mainly on how many will be trained by the schools and colleges (including technical institutes and the armed forces) and on how many will be upgraded from other occupations (whether through shifts within an establishment or between establishments).

The question of how many should be trained by the schools and colleges to meet manpower needs may be approached in several ways: (a) One can estimate on the basis of past experience how much of the need will be met by upgrading 1/ from other occupations and then assume that the remaining need is the need that will have to be met by the schools and colleges. Or (b) one can say that the schools and colleges should reduce the dependence of employers on upgrading by making available relatively more school and college trained people than in the past -- on the theory that persons trained in this manner usually are superior to those who learn through the processes of upgrading. Or (c) one can say that an effort should be made both to increase the proportion of school-trained and college-trained people to improve the process of upgrading by introducing better means of training on the job.

1. Upgrading as used in this context includes promotion for which a capable worker is prepared by formal training on the job or by school course work arranged for by the employer or the employee. It also includes promotions unaccompanied by such training or course work.

Whichever approach is taken, it is helpful to know what part of the total needs can be expected, on the basis of past experience, to be met by upgrading of workers already employed.

Table 5 shows, for the period 1962-1975, rough estimates of shifts out of technical occupations and of shifts into technical occupations, including both upgrading within the establishment and similar upward shifts involving workers who move from one establishment to another. As the summary table below also shows, the numbers expected to shift are large. However, great care must be taken in using the data, because only rough tentative estimates could be made.1/

If the data shown in table 5 are accepted as roughly indicative of the volume of occupational shifts, we can make the following statement of technical job openings during the 1962-1975 period and of how they might be filled:

| | Number | Percent |
|---|---|---|
| (A) Job openings resulting from - | | |
| Growth in number of jobs | 78,900 | 39 |
| Deaths and retirement | 36,500 | 18 |
| Shifts to other occupations | 86,600 | 43 |
| Total | 202,000 | 100 |
| (B) Job openings filled by - | | |
| Occupational shifts of workers | 124,300 | 62 |
| Recruitment from schools and from other sources | 77,700 | 38 |
| Total | 202,000 | 100 |

The patterns of job transfers into technical occupations are based on the situation that existed in 1962. A change in the future in these patterns -- for example, through increases in the availability of technically trained school graduates -- can radically affect shifts into technical occupations.

Tables 6 and 7, at the end of this volume, give -- for each occupation group separately -- data corresponding to the figures in the table just above. Note that the figures refer to job openings, and that any job may, because of

1. The appendix of this volume contains a statement of the estimating method used.

death, retirement, or occupation shift, become open more than once during the period covered by the projections.

# APPENDIX

## METHODS USED IN PROJECTING TO 1970 AND 1975 THE NUMBER OF JOBS IN TECHNICAL OCCUPATIONS AND THE REPLACEMENT NEEDS

In this technical appendix, describing the methods by which the reported projections were made, the first section takes up the methods used in projecting the number of jobs in technical occupations. The next sections take up the methods used in estimating the number of vacancies that will occur (through death and retirement, and through persons leaving technical occupations) and the number of persons that will shift into technical occupations from other occupations.

### Projected Number of Jobs

These projections of how many jobs there will be in technical occupations in New York State in 1970 and in 1975 are based on estimates of how much employment will change in various industries as a result of industrial expansion or decline (element #1), and on estimates of how much of a change there will be in the proportion that persons in technical occupations are of all employees (element #2).

Projections were first made for the State as a whole and then for areas within the State.

### State Projections

Element #1 required an estimate of the number of jobs in each technical occupation in 1970 and 1975 that resulted from changes in the industrial structure.

The first step was to project total employment to 1970 and 1975 by industry group. This was done by the use of logarithmic regressions for the period 1947-1963 for each of the industry groups. It was done in two different ways,

using two different sets of regressions. The first was based on the New York State employment data alone. The second set was obtained from figures showing New York's employment as a percent of United States employment; this percent was projected to 1970 and 1975, and applied to 1970 and 1975 employment projections that have been made by the U.S. Bureau of Labor Statistics. (This method will be described in detail in a forthcoming report on manpower trends in New York State.)

The two different resulting sets of figures were then compared, for the period 1960 through 1963, with the actual shifts in employment that took place in those years. In each industry group, the set that best matched this recent trend was used for projecting employment.

The next step was to state the number of persons in each of the technical occupations listed in table 1, as of 1962, as a percent of 1962 total employment, in each industry group. These industry-occupation percents were then multiplied by the industry group employment projections for 1970 and 1975. Within each technical occupation the resulting industry group projections were added to yield a projected over-all number for that occupation for 1970, and also one for 1975, based on the relative importance of the occupation in 1962.

Element #2 adjusts these tentative projections by estimating the degree to which the relative importance of technical occupations in terms of 1962 employment will change in the future. Such a revision was made possible by the fact that many firms that were covered by the 1962 survey reported how many persons they expected to be employing in each technical occupation in 1967, five years after the reporting date, and what they expected the firm's total employment to be at that time. This information was received from establishments that employed approximately three-eighths of all persons in technical occupations. Table 8 presents this information for each of the fifteen technical occupation

groups. It shows, for each, how much the ratio of technical employment to total employment in reporting firms is expected to change between 1962 and 1967, on the basis of the employer estimates.

Firms expecting large increases in their technical employment were believed to be more likely to report their expectations in the course of the survey than were other firms. Accordingly, the 1962 forecasts of these firms as to their technical employment five years later (shown in table 8) in relation to their total employment is probably greater than would be a five-year projection of technical employment that took in all firms. The averages of the rates of change they predicted may, however, be taken as furnishing conservative estimates of the rates of change in all firms' technical employment over a longer period, namely, the eight years between 1962 and 1970. Accordingly, employers' five-year projections were adopted, for each occupation listed in table 1, as representing the probable 1962-1970 rate of change in the proportion that technical employment is of total employment.

To extend these rates of change from the period 1962-1970 to the period 1962-1975, they were increased pro-rata, that is, by five-eighths.

Before making the final calculations, a few ratios that appeared to be extreme were adjusted on a judgmental basis.

Mathematics technicians will serve to illustrate how the two elements are applied. In 1962 there were 831 such technicians. When the number in each relevant industry is changed as much as the total-employment change that is expected for the industry, the combined result is that in 1975 -- if the relative importance of mathematics technicians did not change -- there would be 15.9 percent more of them, or 963.

Turning to element #2, namely possible change in the ratio of these technicians to total employment in the relevant industries, the extrapolation of

the combined employer forecasts indicated that the ratio would be 12.4 percent higher in 1975. The 963 figure, increased by this percent, rises to 1,082.

Table 1 shows this 1975 projection, and the 1970 projection, for each technical occupation, for the State as a whole. Table 3 shows how much of the total projected rise is due to element #1 and how much to element #2.

Area Estimates

Estimates for each area were made by utilizing methods similar to those used for the State as a whole, but with lesser detail by occupation and industry.

First, industry projections of total employment in 1970 and 1975 were obtained for New York City by projecting to those years, through the use of logarithmic regression techniques, the New York City employment of each industry stated as a percentage of employment in the State as a whole for that industry. Specifically, employment statistics series were available for New York City for the period from 1947 to 1963 for manufacturing and from 1950 to 1963 for non-manufacturing. Proportions obtained for 1970 and 1975 from the 1947-1963 or 1950-1963 regression line were applied to the earlier-determined New York State figures, and in this way estimates of total employment for New York City by industry group were obtained.

Subtracting these New York City total-employment-projection figures from those for the State as a whole yielded 1970 and 1975 projections for the Remainder of the State. Just as the New York State projections were used in making New York City projections, by finding ratios between State and City, so the Remainder of the State projections were used in making projections for the various industrial areas outside New York City. In making employment projections for the areas, however, the first step was different, since an employment series back to 1947 or 1950, comparable to that used before, was not available for areas outside New York City. Data for the years 1958 through 1964 were used instead.

Within each industry division (1-digit group), the ratio of employment in a given area to employment in the Remainder of the State (New York State minus New York City) was found for 1958 and 1959 (averaged), for 1960-1962 (averaged), and for 1963-1964 (averaged). These ratios were then extrapolated to 1970 and 1975 by following the movements between these three periods. As already indicated, the ratios were applied to (multiplied by) the previously obtained 1970 and 1975 estimates of total employment for the Remainder of the State. The result was employment estimates by industry division for 1970 and for 1975.

The next step was to state the number of persons in each technical occupation group in 1962 as a percent of 1962 total employment in the various industry divisions, in each area. These industry-occupation percents were then multiplied (as in the State-wide calculations) by the industry-division employment projections for 1970 and 1975. Within each technical occupation group the resulting industry-division projections were added up, yielding a projected total number for that occupation in that area for 1970, and also one for 1975, based on the relative importance of the occupation group in 1962 (as in element #1 of the State-wide projections).

When these area estimates were added to those for New York City, within each technical occupation group, the sum did not exactly equal the corresponding State-wide projections. The main reason was that greater industry detail and occupation detail had been used in the State-wide calculation. Accordingly, minor adjustments were made on a pro-rata basis, so that the area figures totaled up to the State-wide projections for employment in the technical occupation group.

The resulting figures were preliminary estimates that needed to be refined by adjusting to the change in the probable relative importance of the given technical occupation in the later years (element #2 of the estimating process). As in the State-wide calculations, this refinement is based on reports made by

many firms in the survey as to their expected technical employment and total employment in 1967, compared with 1962. These reported figures yield ratios of technical employment to total employment for each of those two years.

For each occupation group, in each area, the change between the 1962 ratio and the later ratio was used to refine the preliminary 1970 and 1975 projection on the same basis as the refinement of the State-wide projections. Table 2 presents these final projections for each area.

## Job Openings Resulting from Deaths and Retirements

In order to determine the number of job openings that will result from deaths and retirements, it is necessary to start with an age-sex distribution of the population in question and then to apply worker separation rates (namely, death and retirement). In the present estimates, use was made of separation rates computed by the U.S. Department of Labor and age distributions from the 1960 Census of Population.

The procedure is illustrated in the table on page 16, using as an example medical and dental technicians in New York State (the Census classification). In the case of the male technicians, it applies 10-year separation rates for males to the employment in each age group, determining in this way the number of separations for the group during a 10-year period. Adding up these numbers gives the total separations -- 1,015 -- for the male medical and dental technicians. Dividing this total by the number of males employed in the occupation gives an over-all 10-year death and retirement rate of 16 percent. On the assumption that the changes took place during the period at a constant rate per year, the annual death and retirement rate is 1.8 percent per year.

Rates of death and retirement having been ascertained, the calculations of the number of deaths and retirements in particular technical occupations used

the following formula:

$$\text{Number of deaths and retirements for any given number of years (n)} = ar\,\frac{(1 - R^n)}{1 - R}$$

where a = number of persons in the occupation for the first year,
r = rate of deaths and retirements per year (see table on page 18), and
R = average annual ratio of change of employment in the occupation.

The derivation of the formula for the period 1962-1970 is shown on page 16.

In illustrating the application of the formula the technical occupation group used will be biological, medical, and dental technicians (males). Applying it will determine the number of male deaths and retirements in the 8-year period 1962-1970. For this purpose -

| | |
|---|---|
| n = 8 | r = .018 |
| a = 10,861 | R = 1.0498 |

The 5-percent increase per year (R) for an 8-year period works out to an over-all increase for the 8 years of 47.5 percent ($R^8$). Substituting these two figures in part of the formula gives -

$$\frac{1 - R^8}{1 - R} = \frac{1 - 1.4754}{1 - 1.0498} = \frac{-.4754}{-.0498} = 9.55$$

Therefore: Estimate of number of male deaths and retirements, 1962-1970 = 10,861 x .018 x 9.55 = 1,867

The tables of working life for women provide only 1-year separation rates for specific age groups and are based on 1950 distributions (whereas the separation rates for men are for a 10-year period and are based on 1960 Census data). Involved in the use of these data to estimate the annual separations of women from each technical occupation is the assumption that the marriage and family formation patterns of women in technical occupations are the same as for the total female population, and also the assumption that the age patterns in each technical occupation are the same as in the total female work force. Gross separations from an occupation are estimated by applying the annual separation rates to the age distribution for an occupation.

SEPARATIONS (DEATHS AND RETIREMENTS) OF MEDICAL AND DENTAL TECHNICIANS

| Age group | Males: Number employed (a) | Males: 10-year separation rate (b) | Males: 10-year separations | Females: Number employed (a) | Females: 1-year separation rate (c) | Females: 1-year separations |
|---|---|---|---|---|---|---|
| All ages | 6,321 | xx | 1,015 | 8,439 | xx | 499 |
| 14 - 19 | 134 | 1.77 | 2 | 442 | 5.83 | 26 |
| 20 - 24 | 840 | 1.94 | 16 | 2,077 | 10.76 | 223 |
| 25 - 29 | 1,037 | 2.44 | 25 | 1,403 | 6.23 | 87 |
| 30 - 34 | 901 | 3.88 | 35 | 1,018 | 1.82 | 19 |
| 35 - 44 | 1,604 | 8.08 | 130 | 1,593 | 1.74 | 28 |
| 45 - 54 | 993 | 22.94 | 228 | 1,175 | 4.41 | 52 |
| 55 - 59 | 349 | 61.28 | 214 | 345 | 6.33 | 22 |
| 60 - 64 | 247 | 77.04 | 190 | 237 | 6.85 | 16 |
| 65 plus | 216 | 81.00 | 175 | 149 | 17.39 | 26 |

a. Data from U. S. Bureau of the Census, 1960 Census of Population, Detailed Characteristics, New York, table 123, pages 663 and 665.

b. Based on data from U. S. Department of Labor, Office of Manpower, Automation, and Training, report 8, The Length of Working Life for Males, 1900-1960 (July 1963).

c. Data from U. S. Bureau of Labor Statistics, bulletin 1204, Tables of Working Life for Women (1950).

DERIVATION OF FORMULA: The formula on page 15, namely -

$$\text{Number of deaths and retirements for any given number of years (n)} = ar\,\frac{(1 - R^n)}{1 - R}$$

was derived as follows for the period 1962-1970:

Let a = 1962 employment, and
R = average annual ratio of change

Then $aR$ = 1963 employment, $aR^2$ = 1964 employment, . . . $aR^8$ = 1970 employment.

From this it follows that - $R = \sqrt[8]{\frac{\text{1970 employment}}{\text{1962 employment}}}$

If r = 1-year death and retirement rate, then -

$$\text{Total number of deaths and retirements, 1962-1970} = ar + aRr + \ldots aR^7r$$

$$= ar\,(1 + R + R^2 + \ldots + R^7)$$

$$= ar\,\frac{(1 - R^8)}{1 - R}$$

since $(1 - R)(1 + R + R^2 + \ldots + R^7) = 1 - R^8$

Not all of those who leave an occupation in a given year will be permanently lost to the occupation. Many women who leave the work force as they marry and begin their families will later re-enter the work force. Data in Bulletin 1204 of the U.S. Bureau of Labor Statistics (table on page 16, footnote c) indicate that about 9 out of 10 separations from the female work force between the ages of 14 and 34 were associated with marriage or the birth of a child, and that about 2 out of 3 of these people re-enter the work force at a later date. On the basis of these data, it was assumed that in a given year re-entries into an occupation by women previously separated would be equal to 60 percent ($\frac{9}{10} \times \frac{2}{3} = \frac{6}{10}$) of the separations of 14-to-34-year-old women from an occupation. Since very few separations from the work force after age 34 are associated with marriage or the birth of children, all separations after this age are considered to be permanent.

Subtracting the estimated number of re-entries from the gross separations leaves net separations, from which net annual separations are computed for each occupation. Thus, for the group of medical technicians used as an illustration in the table above, 60 percent of the 355 separations computed for the 14-to-34-year-old group, or 213 women, may be expected to return to the labor force. Therefore, the number of net separations per year for women equals 286 (499 total minus 213 re-entries) or 3.39 percent of the 8,439 women employed in 1960. By using the formula described above for males, it was found that 4,721 women will leave this occupation during the 8-year period 1962-1970 (14,584 x .0339 x 9.55).

Similar computations indicate that 3,989 females and 1,578 males will leave the medical technician occupation because of death, retirement, or other labor force separations during the 5-year period, 1970-1975.

Because the 1960 Census provides data by age-sex cohort only for the five technical occupational groups shown at the top of page 18, the annual death

and retirement rates could be computed only for these five groups:

Annual Rates of Death and Retirement
for Census Technician Occupations

| | Male | Female |
|---|---|---|
| Draftsmen | .0136 | .0299 |
| Medical and dental | .0180 | .0339 |
| Electrical and electronic | .0088 | .0290 |
| Other engineering and physical sciences | .0120 | .0316 |
| Technicians n.e.c. | .0150 | .0353 |

In applying these rates to the 15 technical occupation groups in the present study, the Census "electrical and electronic" death and retirement rates were applied to the survey "electronic, electrical, and electro-mechanical engineering technicians," on the understanding that they covered about the same types of job. Similarly, the Census "other engineering and physical science" rates were applied to the survey "mechanical engineering," "mathematics," "physical science," "industrial," and "civil engineering" technical occupation groups. The Census "draftsmen" rates were used for estimating deaths and retirements in the survey "draftsmen" and "structural design and related specialists." The Census "technicians n.e.c." rates were applied to the survey's remaining technical occupation groups.

Table 4 presents death and retirement estimates derived by the method indicated above for each of the technician groups covered by the present study. These estimates were not made for individual areas because age-sex employment distributions were not available for technician jobs in sufficient detail in the published 1960 Census data. However, reasonable approximations can be made by using the proportions in the State-wide table.

## Occupational Job Mobility

In addition to those created by industrial expansion and deaths and retirements, job openings are created as persons leave their occupations and take jobs in other occupations. For example, an engineering technician becomes an

engineer, or a physical science technician becomes a chemist or physicist. This includes shifts from one technical occupation to another, as when a draftsman becomes an engineering technician designer.

On the other side of the scale, are persons who are promoted into an occupation. For example, programmer and systems analyst jobs may be filled by persons who have been working as clerks, bookkeepers, managers, statisticians, accountants, etc. Some craftsmen become draftsmen or engineering technicians. Tool and die makers become tool designers. Product testers become troubleshooters or laboratory analysts.

Although exact data on occupational shifts of this kind are not available, the next paragraphs show that it is possible to arrive at some rough estimates.

Shifts Out

In the summer of 1962, the U.S. Census Bureau, using funds provided by the National Science Foundation and other government agencies, made a follow-up survey of 3,000 persons classified in technician occupations in the April 1960 Census. Preliminary analysis of the data shows that 7.8 percent of them were working in some different occupation group in 1962. This indicates a gross shift out of 3.5 percent per year.

The data were classified into four subgroups: 6.5 percent of the draftsmen, 6.3 percent of those in medical and dental technical occupations, 8.4 percent of those classified as engineering and physical science technicians, and 9.6 percent of all other technicians, had shifted out of the occupation they were in in 1960.

On the basis of these data, annual rates were computed which were utilized in the present estimates to compute gross shifts out of each occupation during the periods 1962-1970 and 1970-1975, employing a method similar to that

used in the previous section to estimate the number of deaths and retirements. The formula was:

$$\text{Gross shifts out, 1962-1970} = ar\frac{(1 - R^8)}{1 - R}$$

where a = employment in 1962,
r = rate of gross out-shifting in a 1-year period, based on the post-Census data, and
R = average annual ratio of change in employment in the occupation between 1962 and 1970

Applying the formula to the biological, medical, and dental group of technicians gave a figure, for the 1962-1970 period, of 7,047 persons shifting out (= 25,445 x .029 x 9.55). A similar computation for the 1970-1975 period gave 5,955. Table 9 presents the data for each of the occupation groups for the two periods, and also presents the basic factors utilized.

Shifts In

Data from the present study of technical occupations in 1962 were utilized to make a rough approximation of shifts into technical occupations. The survey gave data on the proportion of persons in technical occupations who were recruited from outside the establishment and who were upgraded within the establishment. It was possible to divide the proportion recruited outside into (a) those persons of whom experience was required for the job and (b) those of whom experience was not required.

These data were adjusted to eliminate the number who were promoted from one grade to a higher grade in the same job line. This type of upgrading was not included in the "shifts out" data and, therefore, could not appropriately be included among the "shifts in." That is, the assumption was made, as to upgrading within a firm having several technician grades, that only upgrading to the lowest grade of the technical job represented a shift from another occupation. In a firm in which there was only a single grade for the technical occupation, any upgrading to that occupation was counted.

SOURCES OF BIOLOGICAL, MEDICAL, AND DENTAL TECHNICIANS

| Source | Number | Percent |
|---|---|---|
| Total | 20,724 | 100.0 |
| Recruited | 18,552 | 89.5 |
| With experience required | 7,630 | 36.8 |
| From other occupations | 3,815 | 18.4 |
| From same occupation | 3,815 | 18.4 |
| No experience required | 10,922 | 52.7 |
| Upgraded within firm | 2,172 | 10.5 |
| Total, excluding recruitment from same occupation | 16,909 | 100.0(a) |
| Shift in from other occupation | 5,987 | 35.4 |
| In same firm (upgraded) | 2,172 | 12.8 |
| From different firm | 3,815 | 22.6 |
| Recruited with no experience required | 10,922 | 64.6 |

a. Table 10 presents this distribution for each of the fifteen technical occupation groups.

In cases in which the employer recruited for these jobs outside the firm, and required experience, it was assumed (in the absence of data on this point) that one-half of the single-grade and lower-grade jobs were filled by persons upgraded from other occupations outside the firm and that the other half were filled by persons with experience in the particular technical jobs who were transferred from other employers. The second group was excluded because the filling of jobs by transfer without change of occupation does not add to the over-all supply of technicians in an occupation.

The table above shows the details of the method, using biological, medical, and dental technicians as an example.

In the biological-medical-dental field, the need during the period 1962-1975 will be to fill 46,600 job openings -- namely 21,400 for expansion, 12,200 because of deaths and retirements, and 13,000 because of shifts to other occupations. If the proportions hold that are shown in the table just above, 16,500 of these job openings will be filled by shifts from other occupations and 30,100 in other ways. Table 6 presents the estimates of total needs for each of the

technical occupation groups, and table 7 presents the estimates of how these needs may be met.

As can be seen, the data on shifts-in and shifts-out are very rough approximations. A change in assumptions could produce different results. Small differences should be disregarded, and even large differences should be used mainly as an indication of direction.

As mentioned earlier, the patterns of transfers into technical occupations from other jobs used in the calculations are based on the situation that existed in 1962. A change in these patterns in the future -- for example, through increases in the availability of technically trained school graduates -- can radically affect shifts into technical occupations.

The available data indicate that there is a very large volume of occupational shifting into and out of technical occupations. They also suggest that this mobility can in some occupations be a greater source of job openings than industrial expansion or death and retirement, and be more important as a source for filling jobs than the schools and colleges. It is important, therefore, that better data on mobility be obtained. Unfortunately this would have required an effort beyond the capabilities of the present survey.

Georgraphic Mobility

Job openings in technical occupations may also occur because an incumbent moves to another state or area (for reasons other than the elimination of their jobs). By the same token, jobs may be filled by workers in technical occupations who move from another state or area.

One cannot determine from available data, for New York State as a whole or any of its areas, whether so far as technical jobs are concerned the balance in recent years has been on the side of geographic moves out or moves in. For present purposes, therefore, this factor has been disregarded.

# TABLES

Table 1. NUMBER OF JOBS IN SELECTED TECHNICAL OCCUPATIONS
ACTUAL 1962 AND PROJECTED 1970 AND 1975

| Technical occupation | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations | 148,684 | 192,994 | 227,551 | 29.8 | 17.9 | 53.0 |
| Draftsmen | 20,972 | 27,267 | 32,526 | 30.0 | 19.3 | 55.1 |
| Architectural and structural(a) | 6,294 | 8,744 | 11,004 | 38.9 | 25.8 | 74.8 |
| Construction | 5,973 | 8,382 | 10,606 | 40.3 | 26.5 | 77.6 |
| Electrical-electronic | 2,301 | 2,814 | 3,215 | 22.3 | 14.3 | 39.7 |
| Construction | 684 | 784 | 859 | 14.6 | 9.6 | 25.6 |
| Other | 1,617 | 2,030 | 2,356 | 25.5 | 16.1 | 45.7 |
| Mechanical | 6,526 | 7,992 | 9,057 | 22.5 | 13.3 | 38.8 |
| Construction | 1,020 | 1,440 | 1,837 | 41.2 | 27.6 | 80.1 |
| Other | 5,506 | 6,552 | 7,220 | 19.0 | 10.2 | 31.1 |
| Electro-mechanical | 3,767 | 5,124 | 6,156 | 36.0 | 20.1 | 63.4 |
| Construction | 211 | 240 | 261 | 13.7 | 8.8 | 23.7 |
| Other | 3,556 | 4,884 | 5,895 | 37.3 | 20.7 | 65.8 |
| Highway, street, and related construction | 270 | 369 | 463 | 36.7 | 25.5 | 71.5 |
| Map, topographical, and geological | 592 | 699 | 800 | 18.1 | 14.4 | 35.1 |
| Plant layout | 422 | 548 | 647 | 29.9 | 18.1 | 53.3 |
| General draftsmen and draftsmen n.e.c. | 800 | 977 | 1,184 | 22.1 | 21.2 | 48.0 |
| Structural design technicians and related specialists(a) | 2,516 | 3,149 | 3,776 | 25.2 | 19.9 | 50.1 |
| Construction | 2,004 | 2,612 | 3,230 | 30.3 | 23.7 | 61.2 |
| Electro and mechanical engineering technicians: | | | | | | |
| All fields; all functions(b) | 42,031 | 53,130 | 61,615 | 26.4 | 16.0 | 46.6 |
| Design | 7,689 | 9,795 | 11,424 | 27.4 | 16.6 | 48.6 |
| Development | 11,936 | 16,371 | 19,846 | 37.2 | 21.2 | 66.3 |
| Troubleshooting and related | 22,406 | 26,964 | 30,345 | 20.3 | 12.5 | 35.4 |
| Electronic | 10,791 | 14,257 | 17,015 | 32.1 | 19.3 | 57.7 |
| Design | 489 | 667 | 835 | 36.4 | 25.2 | 70.8 |
| Development | 4,873 | 6,866 | 8,462 | 40.9 | 23.2 | 73.7 |
| Troubleshooting and related | 5,429 | 6,724 | 7,718 | 23.9 | 14.8 | 42.2 |

Continued

Table 1 (continued)

| Technical occupation | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| Electro and mechanical engineering technicians (continued) | | | | | | |
| Electrical | 8,794 | 11,303 | 13,287 | 28.5 | 17.6 | 51.1 |
| Design | 1,006 | 1,331 | 1,590 | 32.3 | 19.5 | 58.1 |
| Development | 2,497 | 3,311 | 3,976 | 32.6 | 20.1 | 59.2 |
| Troubleshooting and related | 5,291 | 6,661 | 7,721 | 25.9 | 15.9 | 45.9 |
| Mechanical | 8,461 | 10,581 | 12,102 | 25.1 | 14.4 | 43.0 |
| Design | 4,450 | 5,473 | 6,241 | 23.0 | 14.0 | 40.2 |
| Development | 2,092 | 2,636 | 3,024 | 26.0 | 14.7 | 44.6 |
| Troubleshooting and related | 1,919 | 2,472 | 2,837 | 28.8 | 14.8 | 47.8 |
| Electro-mechanical | 13,985 | 16,989 | 19,211 | 21.5 | 13.1 | 37.4 |
| Design | 1,744 | 2,324 | 2,758 | 33.3 | 18.7 | 58.1 |
| Development | 2,474 | 3,558 | 4,384 | 43.8 | 23.2 | 77.2 |
| Troubleshooting and related | 9,767 | 11,107 | 12,069 | 13.7 | 8.7 | 23.6 |
| Mathematics technicians | 831 | 974 | 1,082 | 17.2 | 11.1 | 30.2 |
| Physical science technicians | 8,969 | 12,294 | 14,599 | 37.1 | 18.7 | 62.8 |
| Chemical and related | 5,162 | 7,077 | 8,303 | 37.1 | 17.3 | 60.8 |
| Pharmaceuticals | 363 | 435 | 480 | 19.8 | 10.3 | 32.2 |
| Fuels | 338 | 383 | 410 | 13.3 | 7.0 | 21.3 |
| Beverages and other food products | 478 | 507 | 519 | 6.1 | 2.4 | 8.6 |
| Industrial and other chemicals | 3,983 | 5,752 | 6,894 | 44.4 | 19.9 | 73.1 |
| Metallurgical and related | 987 | 1,222 | 1,373 | 23.8 | 12.4 | 39.1 |
| Physics-chemical | 1,638 | 2,155 | 2,498 | 31.6 | 15.9 | 52.5 |
| Physics, radiation, and nuclear | 761 | 1,272 | 1,741 | 67.1 | 36.9 | 128.8 |
| Meteorology, minerals and soil, and other | 421 | 568 | 684 | 34.9 | 20.4 | 62.5 |
| Biological, medical, dental, and related science technicians(a) | 25,445 | 37,542 | 46,799 | 47.5 | 24.7 | 83.9 |
| Agricultural and related | 340 | 488 | 567 | 43.5 | 16.2 | 66.8 |
| Biological and medical laboratory | 9,898 | 14,619 | 18,327 | 47.7 | 25.4 | 85.2 |
| General medical assistants, doctor's office (other than nurse or secretary) | 1,114 | 1,807 | 2,344 | 62.2 | 29.7 | 110.4 |
| X-ray and related equipment technicians | 3,013 | 4,496 | 5,615 | 49.2 | 24.9 | 86.4 |
| Other medical technicians | 1,801 | 2,442 | 2,900 | 35.6 | 18.8 | 61.0 |

Continued

Table 1 (continued)

| Technical occupation | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| Biological, medical, dental, and related science technicians(a) (continued) | | | | | | |
| Therapists | 1,883 | 2,802 | 3,515 | 48.8 | 25.4 | 86.7 |
| Dental laboratory technicians | 2,844 | 4,159 | 5,269 | 46.2 | 26.7 | 85.3 |
| Dental hygienists | 1,874 | 2,775 | 3,470 | 48.1 | 25.0 | 85.2 |
| Dental assistants | 2,331 | 3,464 | 4,196 | 48.6 | 21.1 | 80.0 |
| Industrial engineering technicians and related specialists | 6,901 | 7,904 | 8,632 | 14.5 | 9.2 | 25.1 |
| Industrial engineering technicians | 2,224 | 2,473 | 2,654 | 11.2 | 7.3 | 19.3 |
| Quality control and reliability technicians | 1,279 | 1,485 | 1,628 | 16.1 | 9.6 | 27.3 |
| Production planners, estimators, and related specialists | 2,918 | 3,398 | 3,749 | 16.4 | 10.3 | 28.5 |
| Equipment specialists | 480 | 548 | 601 | 14.2 | 9.7 | 25.2 |
| Civil engineering and construction technicians and specialists | 13,464 | 17,486 | 21,085 | 29.9 | 20.6 | 56.6 |
| Surveyors and related specialists | 2,381 | 2,976 | 3,454 | 25.0 | 16.1 | 45.1 |
| Civil engineering and construction technicians | 4,932 | 6,528 | 7,978 | 32.4 | 22.2 | 61.8 |
| Construction inspectors | 2,804 | 3,927 | 4,839 | 40.0 | 23.2 | 72.6 |
| Construction specification writers and cost estimators | 3,347 | 4,055 | 4,814 | 21.2 | 18.7 | 43.8 |
| Sales and service technicians | 1,932 | 2,278 | 2,506 | 17.9 | 10.0 | 29.7 |
| Technical writing and illustration specialists | 3,034 | 3,792 | 4,395 | 25.0 | 15.9 | 44.9 |
| Technical writers and related specialists and general and other | 1,952 | 2,486 | 2,904 | 27.4 | 16.8 | 48.8 |
| Technical illustrators | 1,082 | 1,306 | 1,491 | 20.7 | 14.2 | 37.8 |

Continued

Table 1 (concluded)

| Technical occupation | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| Safety and sanitation inspectors and related specialists | 4,084 | 5,081 | 5,790 | 24.4 | 14.0 | 41.8 |
| Industrial safety and fire prevention and air safety | 2,313 | 2,899 | 3,304 | 25.3 | 14.0 | 42.8 |
| Sanitation | 1,771 | 2,182 | 2,486 | 23.2 | 13.9 | 40.4 |
| Product testing and inspection specialists | 8,059 | 9,335 | 10,246 | 15.8 | 9.8 | 27.1 |
| Instruments, meters, and related equipment | 2,335 | 2,754 | 3,107 | 17.9 | 12.8 | 33.1 |
| Machinery, transportation and other metal equipment, and appliances n.e.c. | 2,762 | 3,235 | 3,508 | 17.1 | 8.4 | 27.0 |
| Chemical and other nonmetal products n.e.c. | 1,926 | 2,200 | 2,401 | 14.2 | 9.1 | 24.7 |
| Food and agricultural products | 563 | 598 | 620 | 6.2 | 3.7 | 10.1 |
| Industrial X-ray and related processes | 308 | 360 | 400 | 16.9 | 11.1 | 29.9 |
| General and other | 165 | 188 | 210 | 13.9 | 11.7 | 27.3 |
| Data-processing systems analysis and programming specialists(a) | 6,153 | 8,251 | 9,848 | 34.1 | 19.4 | 60.1 |
| Systems analysts | 1,875 | 2,594 | 3,082 | 38.3 | 18.8 | 64.4 |
| Programmers | 3,205 | 4,163 | 4,953 | 29.9 | 19.0 | 54.5 |
| Combination: systems analysis and programming | 936 | 1,269 | 1,503 | 35.6 | 18.4 | 60.6 |
| Airway tower specialists and flight dispatchers | 1,373 | 1,503 | 1,584 | 9.5 | 5.4 | 15.4 |
| Broadcasting, motion picture, and recording studio specialists | 2,920 | 3,008 | 3,068 | 3.0 | 2.0 | 5.1 |

a. Subgroups do not add up to total because no details are given for occupation groups in which only a small number of technicians are employed.

b. Total of all fields (electronic, electrical, mechanical, and electro-mechanical) as well as the total of all functions (design, development, and troubleshooting).

Table 2. NUMBER OF JOBS IN SELECTED TECHNICAL OCCUPATION GROUPS, BY AREA
ACTUAL 1962 AND PROJECTED 1970 AND 1975

A. New York City

| Technical occupation group | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations | 62,739 | 78,929 | 91,279 | 25.8 | 15.6 | 45.5 |
| Draftsmen | 10,432 | 12,959 | 15,107 | 24.2 | 16.6 | 44.8 |
| Structural design technicians and related specialists | 1,748 | 2,186 | 2,640 | 25.1 | 20.8 | 51.0 |
| Electro and mechanical engineering technicians | 13,894 | 16,677 | 18,819 | 20.0 | 12.8 | 35.4 |
| Field | | | | | | |
| Electronic | 2,912 | 3,500 | 3,900 | 20.2 | 11.4 | 33.9 |
| Electrical | 3,985 | 5,233 | 6,205 | 31.3 | 18.6 | 55.7 |
| Mechanical | 2,260 | 2,769 | 3,182 | 22.5 | 14.9 | 40.8 |
| Electro-mechanical | 4,737 | 5,175 | 5,532 | 9.2 | 6.9 | 16.8 |
| Function | | | | | | |
| Design | 1,761 | 2,088 | 2,372 | 18.6 | 13.6 | 34.7 |
| Development | 2,903 | 4,001 | 4,765 | 37.8 | 19.1 | 64.1 |
| Troubleshooting and related | 9,230 | 10,588 | 11,682 | 14.7 | 10.3 | 26.6 |
| Mathematics technicians | 156 | 183 | 206 | 17.3 | 12.6 | 32.1 |
| Physical science technicians | 1,937 | 2,352 | 2,656 | 21.4 | 12.9 | 37.1 |
| Biological, medical, dental, and related science technicians | 14,107 | 20,129 | 24,610 | 42.7 | 22.3 | 74.5 |
| Industrial engineering technicians and related specialists | 1,685 | 1,786 | 1,863 | 6.0 | 4.3 | 10.6 |
| Civil engineering and construction technicians and specialists | 5,590 | 6,714 | 7,527 | 20.1 | 12.1 | 34.7 |
| Sales and service technicians | 1,101 | 1,246 | 1,335 | 13.2 | 7.1 | 21.3 |
| Technical writing and illustration specialists | 1,588 | 1,939 | 2,228 | 22.1 | 14.9 | 40.3 |
| Safety and sanitation inspectors and related specialists | 2,367 | 2,878 | 3,165 | 21.6 | 10.0 | 33.7 |
| Product testing and inspection specialists | 1,667 | 1,977 | 2,186 | 18.6 | 10.6 | 31.1 |
| Data-processing systems analysis and programming specialists | 3,673 | 4,990 | 5,944 | 35.9 | 19.1 | 61.8 |
| Airway tower specialists and flight dispatchers | 536 | 587 | 619 | 9.5 | 5.5 | 15.5 |
| Broadcasting, motion picture, and recording studio specialists | 2,258 | 2,326 | 2,374 | 3.0 | 2.1 | 5.1 |

Table 2 (continued)

B. Nassau-Suffolk

| Technical occupation group | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations(a) | 22,835 | 29,964 | 35,987 | 31.2 | 20.1 | 57.6 |
| Draftsmen | 2,459 | 3,324 | 3,983 | 35.2 | 19.8 | 62.0 |
| Structural design technicians and related specialists | 528 | 643 | 752 | 21.8 | 17.0 | 42.4 |
| Electro and mechanical engineering technicians | 10,082 | 12,681 | 14,886 | 25.8 | 17.4 | 47.6 |
| Field | | | | | | |
| Electronic | 3,815 | 4,670 | 5,445 | 22.4 | 16.6 | 42.7 |
| Electrical | 1,249 | 1,522 | 1,778 | 21.9 | 16.8 | 42.4 |
| Mechanical | 1,680 | 2,036 | 2,328 | 21.2 | 14.3 | 38.6 |
| Electro-mechanical | 3,338 | 4,453 | 5,335 | 33.4 | 19.8 | 59.8 |
| Function | | | | | | |
| Design | 1,776 | 2,246 | 2,640 | 26.5 | 17.5 | 48.6 |
| Development | 3,451 | 4,023 | 4,600 | 16.6 | 14.3 | 33.3 |
| Troubleshooting and related | 4,855 | 6,412 | 7,646 | 32.1 | 19.2 | 57.5 |
| Mathematics technicians | 466 | 531 | 577 | 13.9 | 8.7 | 23.8 |
| Physical science technicians | 393 | 535 | 656 | 36.1 | 22.6 | 66.9 |
| Biological, medical, dental, and related science technicians | 1,905 | 3,582 | 5,039 | 88.0 | 40.7 | 164.5 |
| Industrial engineering technicians and related specialists | 1,218 | 1,438 | 1,627 | 18.1 | 13.1 | 33.6 |
| Civil engineering and construction technicians and specialists | 1,411 | 2,087 | 2,696 | 47.9 | 29.2 | 91.1 |
| Sales and service technicians | 281 | 374 | 440 | 33.1 | 17.6 | 56.6 |
| Technical writing and illustration specialists | 797 | 976 | 1,131 | 22.5 | 15.9 | 41.9 |
| Safety and sanitation inspectors and related specialists | 200 | 310 | 380 | 55.0 | 22.6 | 90.0 |
| Product testing and inspection specialists | 2,255 | 2,460 | 2,655 | 9.1 | 7.9 | 17.7 |
| Data-processing systems analysis and programming specialists | 297 | 430 | 542 | 44.8 | 26.0 | 82.5 |
| Airway tower specialists and flight dispatchers | 516 | 565 | 595 | 9.5 | 5.3 | 15.3 |

Table 2 (continued)

C. Westchester

| Technical occupation group | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations(a) | 5,749 | 7,986 | 9,771 | 38.9 | 22.4 | 70.0 |
| Draftsmen | 817 | 1,182 | 1,552 | 44.7 | 31.3 | 90.0 |
| Electro and mechanical engineering technicians | 1,312 | 1,840 | 2,177 | 40.2 | 18.3 | 65.9 |
| Field | | | | | | |
| Electronic | 314 | 425 | 525 | 35.4 | 23.5 | 67.2 |
| Electrical | 304 | 496 | 600 | 63.2 | 21.0 | 97.4 |
| Mechanical | 155 | 207 | 243 | 33.5 | 17.4 | 56.8 |
| Electro-mechanical | 539 | 712 | 809 | 32.1 | 13.6 | 50.1 |
| Function | | | | | | |
| Design | 129 | 182 | 216 | 41.1 | 18.7 | 67.4 |
| Development | 373 | 576 | 757 | 54.4 | 31.4 | 102.9 |
| Troubleshooting and related | 810 | 1,082 | 1,204 | 33.6 | 11.3 | 48.6 |
| Physical science technicians | 457 | 592 | 705 | 29.5 | 19.1 | 54.3 |
| Biological, medical, dental, and related science technicians | 1,023 | 1,609 | 2,043 | 57.3 | 27.0 | 99.7 |
| Industrial engineering technicians and related specialists | 134 | 170 | 200 | 26.9 | 17.6 | 49.3 |
| Civil engineering and construction technicians and specialists | 912 | 1,144 | 1,435 | 25.4 | 25.4 | 57.3 |
| Product testing and inspection specialists | 570 | 731 | 820 | 28.2 | 12.2 | 43.9 |
| Data-processing systems analysis and programming specialists | 278 | 413 | 484 | 48.6 | 17.2 | 74.1 |

Table 2 (continued)

D. Albany

| Technical occupation group | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations(a) | 7,241 | 9,537 | 11,474 | 31.7 | 20.3 | 58.5 |
| Draftsmen | 774 | 1,116 | 1,412 | 44.2 | 26.5 | 82.4 |
| Electro and mechanical engineering technicians | 2,010 | 2,606 | 3,047 | 29.7 | 16.9 | 51.6 |
| Field | | | | | | |
| Electronic | 280 | 352 | 400 | 25.7 | 13.6 | 42.9 |
| Electrical | 390 | 557 | 696 | 42.8 | 25.0 | 78.5 |
| Mechanical | 603 | 711 | 783 | 17.9 | 10.1 | 29.9 |
| Electro-mechanical | 737 | 986 | 1,168 | 33.8 | 18.5 | 58.5 |
| Function | | | | | | |
| Design | 749 | 901 | 1,032 | 20.3 | 14.5 | 37.8 |
| Development | 421 | 613 | 785 | 45.6 | 28.1 | 86.5 |
| Troubleshooting and related | 840 | 1,092 | 1,230 | 30.0 | 12.6 | 46.4 |
| Physical science technicians | 761 | 1,011 | 1,215 | 32.9 | 20.2 | 59.7 |
| Biological, medical, dental, and related science technicians | 1,075 | 1,499 | 1,857 | 39.4 | 23.9 | 72.7 |
| Industrial engineering technicians and related specialists | 602 | 738 | 843 | 22.6 | 14.2 | 40.0 |
| Civil engineering and construction technicians and specialists | 760 | 1,095 | 1,420 | 44.1 | 29.7 | 86.8 |
| Safety and sanitation inspectors and related specialists | 199 | 250 | 307 | 25.6 | 22.8 | 54.3 |
| Product testing and inspection specialists | 462 | 505 | 552 | 9.3 | 9.3 | 19.5 |
| Data-processing systems analysis and programming specialists | 263 | 321 | 377 | 22.1 | 17.4 | 43.3 |
| Broadcasting, motion picture, and recording studio specialists | 105 | 108 | 110 | 2.9 | 1.9 | 4.8 |

Table 2 (continued)

E. Binghamton

| Technical occupation group | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations(a) | 3,886 | 5,126 | 6,233 | 31.9 | 21.6 | 60.4 |
| Draftsmen | 528 | 755 | 1,030 | 43.0 | 36.4 | 95.1 |
| Electro and mechanical engineering technicians | 1,763 | 2,189 | 2,591 | 24.2 | 18.4 | 47.0 |
| Field | | | | | | |
| Electronic | 450 | 600 | 750 | 33.3 | 25.0 | 66.7 |
| Electrical | 199 | 226 | 257 | 13.6 | 13.7 | 29.1 |
| Mechanical | 346 | 410 | 474 | 18.5 | 15.6 | 37.0 |
| Electro-mechanical | 768 | 953 | 1,110 | 24.1 | 16.5 | 44.5 |
| Function | | | | | | |
| Design | 347 | 470 | 613 | 35.4 | 30.4 | 76.7 |
| Development | 521 | 663 | 798 | 27.3 | 20.4 | 53.2 |
| Troubleshooting and related | 895 | 1,056 | 1,180 | 18.0 | 11.7 | 31.8 |
| Physical science technicians | 268 | 407 | 489 | 51.9 | 20.1 | 82.5 |
| Biological, medical, dental, and related science technicians | 278 | 430 | 544 | 54.7 | 26.5 | 95.7 |
| Industrial engineering technicians and related specialists | 251 | 311 | 337 | 23.9 | 8.4 | 34.3 |
| Civil engineering and construction technicians and specialists | 371 | 496 | 608 | 33.7 | 22.6 | 63.9 |
| Data-processing systems analysis and programming specialists | 120 | 155 | 190 | 29.2 | 22.6 | 58.3 |

Table 2 (continued)

F. Buffalo

| Technical occupation group | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations(a) | 12,968 | 16,043 | 18,309 | 23.7 | 14.1 | 41.2 |
| Draftsmen | 1,978 | 2,316 | 2,571 | 17.1 | 11.0 | 30.0 |
| Electro and mechanical engineering technicians | 3,149 | 3,879 | 4,411 | 23.2 | 13.7 | 40.1 |
| Field | | | | | | |
| Electronic | 503 | 700 | 875 | 39.2 | 25.0 | 74.0 |
| Electrical | 883 | 1,000 | 1,100 | 13.3 | 10.0 | 24.6 |
| Mechanical | 917 | 1,154 | 1,301 | 25.8 | 12.7 | 41.9 |
| Electro-mechanical | 846 | 1,025 | 1,135 | 21.2 | 10.7 | 34.2 |
| Function | | | | | | |
| Design | 691 | 778 | 868 | 12.6 | 11.6 | 25.6 |
| Development | 976 | 1,355 | 1,655 | 38.8 | 22.1 | 69.6 |
| Troubleshooting and related | 1,482 | 1,746 | 1,888 | 17.8 | 8.1 | 27.4 |
| Physical science technicians | 1,798 | 2,110 | 2,330 | 17.4 | 10.4 | 29.6 |
| Biological, medical, dental, and related science technicians | 1,853 | 2,617 | 3,193 | 41.2 | 22.0 | 72.3 |
| Industrial engineering technicians and related specialists | 726 | 832 | 903 | 14.6 | 8.5 | 24.4 |
| Civil engineering and construction technicians and specialists | 1,423 | 1,813 | 2,100 | 27.4 | 15.8 | 47.6 |
| Sales and service technicians | 124 | 146 | 162 | 17.7 | 11.0 | 30.6 |
| Technical writing and illustration specialists | 151 | 232 | 274 | 53.6 | 18.1 | 81.5 |
| Safety and sanitation inspectors and related specialists | 287 | 378 | 462 | 31.7 | 22.2 | 61.0 |
| Product testing and inspection specialists | 808 | 934 | 1,028 | 15.6 | 10.1 | 27.2 |
| Data-processing systems analysis and programming specialists | 323 | 410 | 481 | 26.9 | 17.3 | 48.9 |
| Broadcasting, motion picture, and recording studio specialists | 172 | 177 | 181 | 2.9 | 2.3 | 5.2 |

Table 2 (continued)

G. Rochester

| Technical occupation group | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations(a) | 8,163 | 11,812 | 14,461 | 44.7 | 22.4 | 77.2 |
| Draftsmen | 978 | 1,420 | 1,902 | 45.2 | 33.9 | 94.5 |
| Electro and mechanical engineering technicians | 2,315 | 3,227 | 3,823 | 39.4 | 18.5 | 65.1 |
| Field | | | | | | |
| Electronic | 75 | 94 | 118 | 25.3 | 25.5 | 57.3 |
| Electrical | 580 | 731 | 838 | 26.0 | 14.6 | 44.5 |
| Mechanical | 875 | 1,239 | 1,459 | 41.6 | 17.8 | 66.7 |
| Electro-mechanical | 785 | 1,163 | 1,408 | 48.2 | 21.1 | 79.4 |
| Function | | | | | | |
| Design | 588 | 786 | 904 | 33.7 | 15.0 | 53.7 |
| Development | 1,036 | 1,520 | 1,845 | 46.7 | 21.4 | 78.1 |
| Troubleshooting and related | 691 | 921 | 1,074 | 33.3 | 16.6 | 55.4 |
| Physical science technicians | 1,333 | 2,029 | 2,468 | 52.2 | 21.6 | 85.1 |
| Biological, medical, dental, and related science technicians | 1,209 | 1,889 | 2,389 | 56.2 | 26.5 | 97.6 |
| Industrial engineering technicians and related specialists | 504 | 646 | 727 | 28.2 | 12.5 | 44.2 |
| Civil engineering and construction technicians and specialists | 543 | 834 | 1,079 | 53.6 | 29.4 | 98.7 |
| Sales and service technicians | 103 | 132 | 150 | 28.2 | 13.6 | 45.6 |
| Safety and sanitation inspectors and related specialists | 129 | 170 | 205 | 31.8 | 20.6 | 58.9 |
| Product testing and inspection specialists | 537 | 777 | 907 | 44.7 | 16.7 | 68.9 |
| Data-processing systems analysis and programming specialists | 321 | 454 | 553 | 41.4 | 21.8 | 72.3 |

Table 2 (continued)

H. Syracuse

| Technical occupation group | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations(a) | 5,490 | 7,110 | 8,281 | 29.5 | 16.5 | 50.8 |
| Draftsmen | 795 | 1,111 | 1,313 | 39.7 | 18.2 | 65.2 |
| Electro and mechanical engineering technicians | 1,758 | 2,213 | 2,523 | 25.9 | 14.0 | 43.5 |
| Field | | | | | | |
| Electronic | 508 | 636 | 735 | 25.2 | 15.6 | 44.7 |
| Electrical | 386 | 492 | 571 | 27.5 | 16.1 | 47.9 |
| Mechanical | 257 | 322 | 367 | 25.3 | 14.0 | 42.8 |
| Electro-mechanical | 607 | 763 | 850 | 25.7 | 11.4 | 40.0 |
| Function | | | | | | |
| Design | 389 | 501 | 566 | 28.8 | 13.0 | 45.5 |
| Development | 471 | 709 | 896 | 50.5 | 26.4 | 90.2 |
| Troubleshooting and related | 898 | 1,003 | 1,061 | 11.7 | 5.8 | 18.2 |
| Physical science technicians | 323 | 424 | 489 | 31.3 | 15.3 | 51.4 |
| Biological, medical, dental, and related science technicians | 827 | 1,211 | 1,509 | 44.7 | 24.6 | 80.3 |
| Industrial engineering technicians and related specialists | 300 | 349 | 382 | 16.3 | 9.5 | 27.3 |
| Civil engineering and construction technicians and specialists | 462 | 608 | 734 | 31.6 | 20.7 | 58.9 |
| Technical writing and illustration specialists | 108 | 138 | 162 | 27.8 | 17.4 | 50.0 |
| Safety and sanitation inspectors and related specialists | 100 | 140 | 175 | 40.0 | 25.0 | 75.0 |
| Product testing and inspection specialists | 355 | 388 | 407 | 9.3 | 4.9 | 14.6 |
| Data-processing systems analysis and programming specialists | 250 | 283 | 313 | 13.2 | 10.6 | 25.2 |

Table 2 (continued)

I. Utica

| Technical occupation group | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations(a) | 2,890 | 3,746 | 4,443 | 29.6 | 18.6 | 53.7 |
| Draftsmen | 236 | 316 | 385 | 33.9 | 21.8 | 63.1 |
| Electro and mechanical engineering technicians | 1,171 | 1,524 | 1,848 | 30.1 | 21.3 | 57.8 |
| Field | | | | | | |
| Electronic | 701 | 987 | 1,250 | 40.8 | 26.6 | 78.3 |
| Electrical | 111 | 142 | 172 | 27.9 | 21.1 | 55.0 |
| Mechanical | 113 | 128 | 138 | 13.3 | 7.8 | 22.1 |
| Electro-mechanical | 246 | 267 | 288 | 8.5 | 7.9 | 17.1 |
| Function | | | | | | |
| Design | 154 | 194 | 247 | 26.0 | 27.3 | 60.4 |
| Development | 290 | 389 | 477 | 34.1 | 22.6 | 64.5 |
| Troubleshooting and related | 727 | 941 | 1,124 | 29.4 | 19.4 | 54.6 |
| Biological, medical, dental, and related science technicians | 315 | 497 | 618 | 57.8 | 24.3 | 96.2 |
| Industrial engineering technicians and related specialists | 259 | 292 | 312 | 12.7 | 6.8 | 20.5 |
| Civil engineering and construction technicians and specialists | 225 | 308 | 350 | 36.9 | 13.6 | 55.6 |
| Product testing and inspection specialists | 125 | 138 | 153 | 10.4 | 10.9 | 22.4 |
| Data-processing systems analysis and programming specialists | 206 | 254 | 304 | 23.3 | 19.7 | 47.6 |

Table 2 (continued)

J. All Other Areas

| Technical occupation group | 1962 | 1970 | 1975 | Percent change 1962-1970 | Percent change 1970-1975 | Percent change 1962-1975 |
|---|---|---|---|---|---|---|
| All technical occupations(a) | 16,723 | 22,741 | 27,313 | 36.0 | 20.1 | 63.3 |
| Draftsmen | 1,975 | 2,768 | 3,271 | 40.2 | 18.2 | 65.6 |
| Electro and mechanical engineering technicians | 4,577 | 6,294 | 7,490 | 37.5 | 19.0 | 63.6 |
| Field | | | | | | |
| Electronic | 1,233 | 2,293 | 3,017 | 86.0 | 31.6 | 144.7 |
| Electrical | 707 | 904 | 1,070 | 27.9 | 18.4 | 51.3 |
| Mechanical | 1,255 | 1,605 | 1,827 | 27.9 | 13.8 | 45.6 |
| Electro-mechanical | 1,382 | 1,492 | 1,576 | 8.0 | 5.6 | 14.0 |
| Function | | | | | | |
| Design | 1,105 | 1,649 | 1,966 | 49.2 | 19.2 | 77.9 |
| Development | 1,494 | 2,522 | 3,268 | 68.8 | 29.6 | 118.7 |
| Troubleshooting and related | 1,978 | 2,123 | 2,256 | 7.3 | 6.3 | 14.1 |
| Physical science technicians | 1,612 | 2,742 | 3,491 | 70.1 | 27.3 | 116.6 |
| Biological, medical, dental, and related science technicians | 2,843 | 4,079 | 4,997 | 43.5 | 22.5 | 75.8 |
| Industrial engineering technicians and related specialists | 1,222 | 1,342 | 1,438 | 9.8 | 7.2 | 17.7 |
| Civil engineering and construction technicians and specialists | 1,767 | 2,387 | 3,136 | 35.1 | 31.4 | 77.5 |
| Sales and service technicians | 183 | 220 | 243 | 20.2 | 10.5 | 32.8 |
| Technical writing and illustration specialists | 103 | 133 | 155 | 29.1 | 16.5 | 50.5 |
| Safety and sanitation inspectors and related specialists | 588 | 665 | 747 | 13.1 | 12.3 | 27.0 |
| Product testing and inspection specialists | 1,181 | 1,298 | 1,395 | 9.9 | 7.5 | 18.1 |
| Data-processing systems analysis and programming specialists | 422 | 541 | 660 | 28.2 | 22.0 | 56.4 |
| Broadcasting, motion picture, and recording studio specialists | 128 | 132 | 134 | 3.1 | 1.5 | 4.7 |

a. Subgroups do not add up to total because no details are given for occupational groups in which only a small number of technicians are employed.

Table 3. RELATIVE IMPORTANCE OF CHANGES IN NUMBER OF JOBS IN TECHNICAL OCCUPATION GROUPS CAUSED BY INDUSTRY EXPANSION AND THOSE CAUSED BY INCREASES IN THE RATIO OF TECHNICIAN TO TOTAL EMPLOYMENT 1962-1975

| Technical occupation group | Employment in technical occupations | | Percent change, 1962-1975 | | |
|---|---|---|---|---|---|
| | 1962 | 1975 | Total change | Caused by industry expansion | Caused by change in ratio of technician to total employment |
| All technical occupations | 148,684 | 227,551 | 53.0 | 21.9 | 31.1 |
| Draftsmen | 20,972 | 32,526 | 55.1 | 24.4 | 30.7 |
| Structural design technicians and related specialists | 2,516 | 3,776 | 50.1 | 26.6 | 23.5 |
| Electro and mechanical engineering technicians | 42,031 | 61,615 | 46.6 | 13.2 | 33.4 |
| Mathematics technicians | 831 | 1,082 | 30.2 | 15.9 | 14.3 |
| Physical science technicians | 8,969 | 14,599 | 62.8 | 13.5 | 49.3 |
| Biological, medical, dental, and related science technicians | 25,445 | 46,799 | 83.9 | 49.6 | 34.3 |
| Industrial engineering technicians and related specialists | 6,901 | 8,632 | 25.1 | 5.3 | 19.8 |
| Civil engineering and construction technicians and specialists | 13,464 | 21,085 | 56.6 | 23.4 | 33.2 |
| Sales and service technicians | 1,932 | 2,506 | 29.7 | 11.1 | 18.6 |
| Technical writing and illustration specialists | 3,034 | 4,395 | 44.9 | 19.0 | 25.9 |
| Safety and sanitation inspectors and related specialists | 4,084 | 5,790 | 41.8 | 36.4 | 5.4 |
| Product testing and inspection specialists | 8,059 | 10,246 | 27.1 | 7.6 | 19.5 |
| Data-processing systems analysis and programming specialists | 6,153 | 9,848 | 60.1 | 13.8 | 46.3 |
| Airway tower specialists and flight dispatchers | 1,373 | 1,584 | 15.4 | 0.4 | 15.0 |
| Broadcasting, motion picture, and recording studio specialists | 2,920 | 3,068 | 5.1 | -0.5 | 5.6 |

Table 4. NUMBER OF DEATHS AND RETIREMENTS, BY TECHNICAL OCCUPATION GROUP, 1962-1975

| Technical occupation group | 1962-1970 | | | 1970-1975 | | | 1962-1975 | |
|---|---|---|---|---|---|---|---|---|
| | Number in technical occupations in 1962 | Number of deaths and retirements, 1962-1970 | Deaths and retirements as percent of technicians in 1962 | Number in technical occupations in 1970 | Number of deaths and retirements, 1970-1975 | Deaths and retirements as percent of technicians in 1970 | Number of deaths and retirements, 1962-1975 | Deaths and retirements as percent of technicians in 1962 |
| All technical occupations | 148,684 | 20,465 | 13.8 | 192,994 | 16,037 | 8.3 | 36,502 | 24.6 |
| Draftsmen | 20,972 | 2,641 | 12.6 | 27,267 | 2,052 | 7.5 | 4,693 | 22.4 |
| Structural design technicians and related specialists | 2,516 | 305 | 12.1 | 3,149 | 233 | 7.4 | 538 | 21.4 |
| Electro and mechanical engineering technicians | 42,031 | 3,604 | 8.6 | 53,130 | 2,720 | 5.1 | 6,324 | 15.0 |
| Mathematics technicians | 831 | 146 | 17.6 | 974 | 104 | 10.7 | 250 | 30.1 |
| Physical science technicians | 8,969 | 1,164 | 13.0 | 12,294 | 928 | 7.5 | 2,092 | 23.3 |
| Biological, medical, dental, and related science technicians | 25,445 | 6,588 | 25.9 | 37,542 | 5,567 | 14.8 | 12,155 | 47.8 |
| Industrial engineering technicians and related specialists | 6,901 | 715 | 10.4 | 7,904 | 494 | 6.3 | 1,209 | 17.5 |
| Civil engineering and construction technicians and specialists | 13,464 | 1,456 | 10.8 | 17,486 | 1,135 | 6.5 | 2,591 | 19.2 |
| Sales and service technicians | 1,932 | 251 | 13.0 | 2,278 | 179 | 7.9 | 430 | 22.3 |
| Technical writing and illustration specialists | 3,034 | 441 | 14.5 | 3,792 | 331 | 8.7 | 772 | 25.4 |
| Safety and sanitation inspectors and related specialists | 4,084 | 549 | 13.4 | 5,081 | 408 | 8.0 | 957 | 23.4 |
| Product testing and inspection specialists | 8,059 | 1,138 | 14.1 | 9,335 | 800 | 8.6 | 1,938 | 24.0 |
| Data-processing systems analysis and programming specialists | 6,153 | 939 | 15.3 | 8,251 | 742 | 9.0 | 1,681 | 27.3 |
| Airway tower specialists and flight dispatchers | 1,373 | 172 | 12.5 | 1,503 | 114 | 7.6 | 286 | 20.8 |
| Broadcasting, motion picture, and recording studio specialists | 2,920 | 356 | 12.2 | 3,008 | 230 | 7.6 | 586 | 20.1 |

Table 5. ROUGH ESTIMATE OF NET OCCUPATIONAL MOBILITY, BY TECHNICAL OCCUPATION GROUP 1962-1970 AND 1962-1975

| Technical occupation group | 1962-1970 | | | | 1962-1975 | | | |
|---|---|---|---|---|---|---|---|---|
| | Shifts out of technical occupations | Shifts into technical occupations | Net change (shifts in minus shifts out) | Net change as percent of technicians in 1962 | Shifts out of technical occupations | Shifts into technical occupations | Net change (shifts in minus shifts out) | Net change as percent of technicians in 1962 |
| All technical occupations | 49,037 | 70,262 | 21,225 | 14.3 | 86,616 | 124,257 | 37,641 | 25.3 |
| Draftsmen | 6,222 | 7,594 | 1,372 | 6.5 | 11,054 | 13,678 | 2,624 | 12.5 |
| Structural design technicians and related specialists | 733 | 1,205 | 472 | 18.8 | 1,292 | 2,228 | 936 | 37.2 |
| Electro and mechanical engineering technicians | 14,573 | 22,747 | 8,174 | 19.4 | 25,576 | 40,003 | 14,427 | 34.3 |
| Mathematics technicians | 279 | 212 | - 67 | - 8.1 | 477 | 365 | -112 | -13.5 |
| Physical science technicians | 3,225 | 4,544 | 1,319 | 14.7 | 5,795 | 7,961 | 2,166 | 24.1 |
| Biological, medical, dental, and related science technicians | 7,047 | 9,109 | 2,062 | 8.1 | 13,002 | 16,464 | 3,462 | 13.6 |
| Industrial engineering technicians and related specialists | 2,288 | 3,485 | 1,197 | 17.3 | 3,882 | 5,935 | 2,053 | 29.7 |
| Civil engineering and construction technicians and specialists | 4,726 | 7,684 | 2,958 | 22.0 | 8,409 | 14,022 | 5,613 | 41.7 |
| Sales and service technicians | 749 | 824 | 75 | 3.9 | 1,281 | 1,398 | 117 | 6.1 |
| Technical writing and illustration specialists | 1,206 | 1,797 | 591 | 19.5 | 2,110 | 3,170 | 1,060 | 34.9 |
| Safety and sanitation inspectors and related specialists | 1,619 | 2,124 | 505 | 12.4 | 2,822 | 3,680 | 858 | 21.0 |
| Product testing and inspection specialists | 3,104 | 3,951 | 847 | 10.5 | 5,284 | 6,737 | 1,453 | 18.0 |
| Data-processing systems analysis and programming specialists | 1,683 | 3,011 | 1,328 | 21.6 | 3,015 | 5,353 | 2,338 | 38.0 |
| Airway tower specialists and flight dispatchers | 513 | 768 | 255 | 18.6 | 857 | 1,275 | 418 | 30.4 |
| Broadcasting, motion picture, and recording studio specialists | 1,070 | 1,207 | 137 | 4.7 | 1,760 | 1,988 | 228 | 7.8 |

Table 6. NUMBER OF JOB OPENINGS IN TECHNICAL OCCUPATION GROUPS, BY SOURCE 1962-1970 AND 1962-1975

| Technical occupation group | 1962-1970 | | | | 1962-1975 | | | |
|---|---|---|---|---|---|---|---|---|
| | Total job openings | Expansion | Deaths and retirements | Shifts to other occupations | Total job openings | Expansion | Deaths and retirements | Shifts to other occupations |
| All technical occupations | 113,812 | 44,310 | 20,465 | 49,037 | 201,985 | 78,867 | 36,502 | 86,616 |
| Draftsmen | 15,158 | 6,295 | 2,641 | 6,222 | 27,301 | 11,554 | 4,693 | 11,054 |
| Structural design technicians and related specialists | 1,671 | 633 | 305 | 733 | 3,090 | 1,260 | 538 | 1,292 |
| Electro and mechanical engineering technicians | 29,276 | 11,099 | 3,604 | 14,573 | 51,484 | 19,584 | 6,324 | 25,576 |
| Mathematics technicians | 568 | 143 | 146 | 279 | 978 | 251 | 250 | 477 |
| Physical science technicians | 7,714 | 3,325 | 1,164 | 3,225 | 13,517 | 5,630 | 2,092 | 5,795 |
| Biological, medical, dental, and related science technicians | 25,732 | 12,097 | 6,588 | 7,047 | 46,511 | 21,354 | 12,155 | 13,002 |
| Industrial engineering technicians and related specialists | 4,006 | 1,003 | 715 | 2,288 | 6,822 | 1,731 | 1,209 | 3,882 |
| Civil engineering and construction technicians and specialists | 10,204 | 4,022 | 1,456 | 4,726 | 18,621 | 7,621 | 2,591 | 8,409 |
| Sales and service technicians | 1,346 | 346 | 251 | 749 | 2,285 | 574 | 430 | 1,281 |
| Technical writing and illustration specialists | 2,405 | 758 | 441 | 1,206 | 4,243 | 1,361 | 772 | 2,110 |
| Safety and sanitation inspectors and related specialists | 3,165 | 997 | 549 | 1,619 | 5,485 | 1,706 | 957 | 2,822 |
| Product testing and inspection specialists | 5,518 | 1,276 | 1,138 | 3,104 | 9,409 | 2,187 | 1,938 | 5,284 |
| Data-processing systems analysis and programming specialists | 4,720 | 2,098 | 939 | 1,683 | 8,391 | 3,695 | 1,681 | 3,015 |
| Airway tower specialists and flight dispatchers | 815 | 130 | 172 | 513 | 1,354 | 211 | 286 | 857 |
| Broadcasting, motion picture, and recording studio specialists | 1,514 | 88 | 356 | 1,070 | 2,494 | 148 | 586 | 1,760 |

Table 7. ROUGH ESTIMATE OF NUMBER OF JOBS THAT WILL BE FILLED THROUGH UPGRADING AND THROUGH RECRUITMENT BY TECHNICAL OCCUPATION GROUP, 1962-1970 AND 1962-1975

A. 1962-1970

| Technical occupation group | Total job openings | Shifts into technician jobs from other occupations | | | Recruitment from other sources |
|---|---|---|---|---|---|
| | | Total | Within same firm | From different firm | |
| All technical occupations | 113,812 | 70,262 | 41,590 | 28,672 | 43,550 |
| Draftsmen | 15,158 | 7,594 | 3,107 | 4,487 | 7,564 |
| Structural design technicians and related specialists | 1,671 | 1,205 | 752 | 453 | 466 |
| Electro and mechanical engineering technicians | 29,276 | 22,747 | 17,038 | 5,709 | 6,529 |
| Mathematics technicians | 568 | 212 | 161 | 51 | 356 |
| Physical science technicians | 7,714 | 4,544 | 2,986 | 1,558 | 3,170 |
| Biological, medical, dental, and related science technicians | 25,732 | 9,109 | 3,294 | 5,815 | 16,623 |
| Industrial engineering technicians and related specialists | 4,006 | 3,485 | 2,756 | 729 | 521 |
| Civil engineering and construction technicians and specialists | 10,204 | 7,684 | 4,031 | 3,653 | 2,520 |
| Sales and service technicians | 1,346 | 824 | 393 | 431 | 522 |
| Technical writing and illustration specialists | 2,405 | 1,797 | 625 | 1,172 | 608 |
| Safety and sanitation inspectors and related specialists | 3,165 | 2,124 | 421 | 1,703 | 1,041 |
| Product testing and inspection specialists | 5,518 | 3,951 | 2,864 | 1,087 | 1,567 |
| Data-processing systems analysis and programming specialists | 4,720 | 3,011 | 2,166 | 845 | 1,709 |
| Airway tower specialists and flight dispatchers | 815 | 768 | 622 | 146 | 47 |
| Broadcasting, motion picture, and recording studio specialists | 1,514 | 1,207 | 374 | 833 | 307 |

Table 7 (concluded)

B. 1962-1975

| Technical occupation group | Total job openings | Shifts into technician jobs from other occupations | | | Recruitment from other sources |
|---|---|---|---|---|---|
| | | Total | Within same firm | From different firm | |
| All technical occupations | 201,985 | 124,257 | 73,345 | 50,912 | 77,728 |
| Draftsmen | 27,301 | 13,678 | 5,597 | 8,081 | 13,623 |
| Structural design technicians and related specialists | 3,090 | 2,228 | 1,391 | 837 | 862 |
| Electro and mechanical engineering technicians | 51,484 | 40,003 | 29,964 | 10,039 | 11,481 |
| Mathematics technicians | 978 | 365 | 277 | 88 | 613 |
| Physical science technicians | 13,517 | 7,961 | 5,231 | 2,730 | 5,556 |
| Biological, medical, dental, and related science technicians | 46,511 | 16,464 | 5,953 | 10,511 | 30,047 |
| Industrial engineering technicians and related specialists | 6,822 | 5,935 | 4,693 | 1,242 | 887 |
| Civil engineering and construction technicians and specialists | 18,621 | 14,022 | 7,356 | 6,666 | 4,599 |
| Sales and service technicians | 2,285 | 1,398 | 667 | 731 | 887 |
| Technical writing and illustration specialists | 4,243 | 3,170 | 1,103 | 2,067 | 1,073 |
| Safety and sanitation inspectors and related specialists | 5,485 | 3,680 | 730 | 2,950 | 1,805 |
| Product testing and inspection specialists | 9,409 | 6,737 | 4,883 | 1,854 | 2,672 |
| Data-processing systems analysis and programming specialists | 8,391 | 5,353 | 3,851 | 1,502 | 3,038 |
| Airway tower specialists and flight dispatchers | 1,354 | 1,275 | 1,033 | 242 | 79 |
| Broadcasting, motion picture, and recording studio specialists | 2,494 | 1,988 | 616 | 1,372 | 506 |

Table 8. RATIO OF TECHNICIAN TO TOTAL EMPLOYMENT IN FIRMS REPORTING RATIO BY TECHNICAL OCCUPATION GROUP, 1962 AND 1967

| Technical occupation group | 1962 | | | 1967 | | | Percent change in ratio, 1962-1967 |
|---|---|---|---|---|---|---|---|
| | Total employment | Number in technical occupations | Ratio (a) | Total employment | Number in technical occupations | Ratio (a) | |
| All technical occupations | (b) | 44,525 | (b) | (b) | 59,660 | (b) | (b) |
| Draftsmen | 419,775 | 5,372 | 1.280 | 484,282 | 7,148 | 1.476 | 15.3 |
| Structural design technicians and related specialists | 40,980 | 635 | 1.550 | 45,333 | 782 | 1.725 | 11.3 |
| Electro and mechanical engineering technicians | 307,862 | 16,015 | 5.202 | 355,375 | 21,852 | 6.149 | 18.2 |
| Mathematics technicians | 22,557 | 158 | 0.700 | 26,970 | 203 | 0.753 | 7.6 |
| Physical science technicians | 237,821 | 2,966 | 1.247 | 269,464 | 4,271 | 1.585 | 27.1 |
| Biological, medical, dental, and related science technicians | 149,430 | 5,696 | 3.812 | 171,005 | 7,437 | 4.349 | 14.1 |
| Industrial engineering technicians and related specialists | 242,221 | 2,040 | 0.842 | 275,186 | 2,584 | 0.939 | 11.5 |
| Civil engineering and construction technicians and specialists | 88,831 | 2,833 | 3.189 | 106,138 | 3,977 | 3.747 | 17.5 |
| Sales and service technicians | 63,259 | 401 | 0.634 | 74,511 | 521 | 0.699 | 10.3 |
| Technical writing and illustration specialists | 104,992 | 1,018 | 0.970 | 131,909 | 1,451 | 1.100 | 13.4 |
| Safety and sanitation inspectors and related specialists | 140,735 | 1,279 | 0.909 | 162,554 | 1,515 | 0.932 | 2.5 |
| Product testing and inspection specialists | 190,468 | 2,081 | 1.093 | 229,663 | 2,795 | 1.217 | 11.3 |
| Data-processing systems analysis and programming specialists | 334,758 | 2,111 | 0.631 | 374,872 | 2,939 | 0.784 | 24.2 |
| Airway tower specialists and flight dispatchers | 4,939 | 1,154 | 23.365 | 5,023 | 1,284 | 25.561 | 9.4 |
| Broadcasting, motion picture, and recording studio specialists | 56,574 | 766 | 1.354 | 63,617 | 901 | 1.416 | 4.6 |

a. Number in technical occupation as percent of total employment.
b. "Total employment" figures are not additive.

Table 9. ROUGH ESTIMATE OF NUMBER OF JOBS VACATED BY PERSONS WHO SHIFT TO OTHER OCCUPATIONS BY TECHNICAL OCCUPATION GROUP, 1962-1970 AND 1962-1975

A. 1962-1970

| Technical occupation group | Number in technical occupations, 1962 ("a") | Annual rate of shift out (a) ("r") | Annual employment change factor (b) ("R") | Total shifts out, 1962-1970 | |
|---|---|---|---|---|---|
| | | | | Number | As percent of technicians in 1962 |
| All technical occupations | 148,684 | xx | xx | 49,037 | 33.0 |
| Draftsmen | 20,972 | .033 | 1.0334 | 6,222 | 29.7 |
| Structural design technicians and related specialists | 2,516 | .033 | 1.0285 | 733 | 29.1 |
| Electro and mechanical engineering technicians | 42,031 | .039 | 1.0297 | 14,573 | 34.7 |
| Mathematics technicians | 831 | .039 | 1.0200 | 279 | 33.6 |
| Physical science technicians | 8,969 | .039 | 1.0402 | 3,225 | 36.0 |
| Biological, medical, dental, and related science technicians | 25,445 | .029 | 1.0498 | 7,047 | 27.7 |
| Industrial engineering technicians and related specialists | 6,901 | .039 | 1.0171 | 2,288 | 33.2 |
| Civil engineering and construction technicians and specialists | 13,464 | .039 | 1.0332 | 4,726 | 35.1 |
| Sales and service technicians | 1,932 | .045 | 1.0208 | 749 | 38.8 |
| Technical writing and illustration specialists | 3,034 | .045 | 1.0283 | 1,206 | 39.7 |
| Safety and sanitation inspectors and related specialists | 4,084 | 045 | 1.0277 | 1,619 | 39.6 |
| Product testing and inspection specialists | 8,059 | .'45 | 1.0185 | 3,104 | 38.5 |
| Data-processing systems analysis and programming specialists | 6,153 | .030 | 1.0374 | 1,683 | 27.4 |
| Airway tower specialists and flight dispatchers | 1,373 | .045 | 1.0114 | 513 | 37.4 |
| Broadcasting, motion picture, and recording studio specialists | 2,920 | .045 | 1.0037 | 1,070 | 36.6 |

Table 9 (concluded)

B. 1970-1975

| Technical occupation group | Number in technical occupations, 1962 ("a") | Annual rate of shift out (a) ("r") | Annual employment change factor (b) ("R") | Total shifts out, 1970-1975 | |
|---|---|---|---|---|---|
| | | | | Number | As percent of technicians in 1962 |
| All technical occupations | 192,994 | xx | xx | 37,579 | 25.3 |
| Draftsmen | 27,267 | .033 | 1.0359 | 4,832 | 23.0 |
| Structural design technicians and related specialists | 3,149 | .033 | 1.0370 | 559 | 22.0 |
| Electro and mechanical engineering technicians | 53,130 | .039 | 1.0301 | 11,003 | 26.2 |
| Mathematics technicians | 974 | .039 | 1.0213 | 198 | 23.8 |
| Physical science technicians | 12,294 | .039 | 1.0350 | 2,570 | 28.7 |
| Biological, medical, dental, and related science technicians | 37,542 | .029 | 1.0451 | 5,955 | 23.4 |
| Industrial engineering technicians and related specialists | 7,904 | .039 | 1.0178 | 1,594 | 23.1 |
| Civil engineering and construction technicians and specialists | 17,486 | .039 | 1.0381 | 3,683 | 27.4 |
| Sales and service technicians | 2,278 | .045 | 1.0193 | 532 | 27.5 |
| Technical writing and illustration specialists | 3,792 | .045 | 1.0300 | 904 | 29.8 |
| Safety and sanitation inspectors and related specialists | 5,081 | .045 | 1.0265 | 1,203 | 29.5 |
| Product testing and inspection specialists | 9,335 | .045 | 1.0188 | 2,180 | 27.1 |
| Data processing systems analysis and programming specialists | 8,251 | .030 | 1.0360 | 1,332 | 21.6 |
| Airway tower specialists and flight dispatchers | 1,503 | .045 | 1.0106 | 344 | 25.1 |
| Broadcasting, motion picture, and recording studio specialists | 3,008 | .045 | 1.0039 | 690 | 23.6 |

a. Same rate is used for 1962-1970 and for 1970-1975.

b. This factor ("R") = annual ratio of change for the given period (1962-1970 or 1970-1975). For example, R = 1.0498 (roughly 1.050) for the biological-medical-dental group for the period 1962-1970; this means that the rate of increase for this group's employment is 4.98 percent per year in this period. For a further explanation, see page 15.

Table 10. RELATIVE IMPORTANCE FOR LOWEST GRADES AND SINGLE GRADES OF SHIFTS INTO TECHNICAL OCCUPATIONS AND OF RECRUITMENT BY TECHNICAL OCCUPATION GROUP, 1962

(Percent distribution)

| Technical occupation group | Total | Shifts into technician jobs from other occupations | | | Recruitment from other sources |
|---|---|---|---|---|---|
| | | Total | Within same firm | From different firm | |
| Draftsmen | 100.0 | 50.1 | 20.5 | 29.6 | 49.9 |
| Structural design technicians and related specialists | 100.0 | 72.1 | 45.0 | 27.1 | 27.9 |
| Electro and mechanical engineering technicians | 100.0 | 77.7 | 58.2 | 19.5 | 22.3 |
| Mathematics technicians | 100.0 | 37.3 | 28.3 | 9.0 | 62.7 |
| Physical science technicians | 100.0 | 58.9 | 38.7 | 20.2 | 41.1 |
| Biological, medical, dental,and related science technicians | 100.0 | 35.4 | 12.8 | 22.6 | 64.6 |
| ndustrial engineering technicians and related specialists | 100.0 | 87.0 | 68.8 | 18.2 | 13.0 |
| Civil engineering and construction technicians and specialists | 100.0 | 75.3 | 39.5 | 35.8 | 24.7 |
| Sales and service technicians | 100.0 | 61.2 | 29.2 | 32.0 | 38.8 |
| Technical writing and illustration specialists | 100.0 | 74.7 | 26.0 | 48.7 | 25.3 |
| Safety and sanitation inspectors and related specialists | 100.0 | 67.1 | 13.3 | 53.8 | 32.9 |
| Product testing and inspection specialists | 100.0 | 71.6 | 51.9 | 19.7 | 28.4 |
| Data-processing systems analysis and programming specialists | 100.0 | 63.8 | 45.9 | 17.9 | 36.2 |
| Airway tower specialists and flight dispatchers | 100.0 | 94.2 | 76.3 | 17.9 | 5.8 |
| Broadcasting, motion picture, and recording studio specialists | 100.0 | 79.7 | 24.7 | 55.0 | 20.3 |