



# NATIONAL SCIENCE BOARD SCIENCE & ENGINEERING INDICATORS 2020



## Labor Force

# Science and Engineering Labor Force

## Technical Appendix

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This publication is part of the *Science and Engineering Indicators* suite of reports. *Indicators* is a congressionally mandated report on the state of the U.S. science and engineering enterprise. It is policy relevant and policy neutral. *Indicators* is prepared under the guidance of the National Science Board by the National Center for Science and Engineering Statistics, a federal statistical agency within the National Science Foundation. With the 2020 edition, *Indicators* is changing from a single report to a set of disaggregated and streamlined reports published on a rolling basis. Detailed data tables will continue to be available online.



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## Technical Appendix

### Data Used in the Science and Engineering Labor Force Report

The *Science and Engineering Labor Force* report uses a variety of data sources, including, but not limited to, the National Center for Science and Engineering Statistics (NCSES) Scientists and Engineers Statistical Data System (SESTAT), National Survey of College Graduates (NSCG), Survey of Doctorate Recipients (SDR), Survey of Earned Doctorates (SED), and Survey of Graduate Students and Postdoctorates in Science and Engineering (GSS); the U.S. Census Bureau's American Community Survey (ACS); the Occupational Employment Statistics (OES) survey administered by the Bureau of Labor Statistics (BLS); the Current Population Survey (CPS) sponsored jointly by the Census Bureau and BLS; and the U.S. Department of State Nonimmigrant Visa Statistics. Different sources cover different segments of the population and different levels of detail on the various topics (Table SA3-1). Although data collection methods and definitions can differ across surveys in ways that affect estimates, presenting data from different sources facilitates a more accurate and comprehensive picture of the very specialized S&E workforce. Long-term trends, international trends, and comparisons of S&E and non-S&E workers are discussed in the report when the suitable data are available.

TABLE SA3-1

#### Major sources of data on the U.S. labor force

(Data sources and information)

Data source	Data collection/ sponsor agency	Data years	Information used in report	Respondent	Coverage
Occupational Employment Statistics (OES), <a href="https://www.bls.gov/oes/">https://www.bls.gov/oes/</a>	Department of Labor, Bureau of Labor Statistics	Through 2017	Worker occupation, salary, industry, employer location (national, state, metropolitan statistical area)	Employing organizations	All full-time and part-time wage and salary workers in nonfarm industries; does not cover self-employed, owners and partners in unincorporated firms, household workers, or unpaid family workers
National Survey of College Graduates (NSCG), <a href="https://www.nsf.gov/statistics/srvygrads/">https://www.nsf.gov/statistics/srvygrads/</a>	Department of Commerce, Census Bureau; National Center for Science and Engineering Statistics, National Science Foundation	Through 2017	Employment status, occupation, job characteristics (work activities, technical expertise), salary, detailed educational history, demographic characteristics	Individuals	Individuals with a bachelor's degree or higher in any field, including an oversample of individuals with a bachelor's degree or higher in an S&E or S&E-related field or with non-S&E degrees but working in an S&E or S&E-related occupation
Survey of Doctorate Recipients (SDR), <a href="https://www.nsf.gov/statistics/srvydoctoratework/">https://www.nsf.gov/statistics/srvydoctoratework/</a>	National Center for Science and Engineering Statistics, National Science Foundation	Through 2017	Employment status, occupation, job characteristics (work activities, technical expertise), salary, detailed educational history, demographic characteristics	Individuals	Individuals with U.S.-awarded research doctorates (includes both U.S. and non-U.S. residents)
American Community Survey (ACS), <a href="https://www.census.gov/programs-surveys/acs/">https://www.census.gov/programs-surveys/acs/</a>	Department of Commerce, Census Bureau	Through 2017	Employment status, occupation, educational attainment, demographic characteristics	Households	U.S. population
Current Population Survey (CPS), <a href="https://www.census.gov/cps/">https://www.census.gov/cps/</a> , <a href="https://www.bls.gov/cps/">https://www.bls.gov/cps/</a>	Department of Commerce, Census Bureau/Department of Labor, Bureau of Labor Statistics	Through 2017	Employment status, occupation	Households	Civilian noninstitutional population ages 16 or over

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## NCSES Data

The data from NCSES within National Science Foundation (NSF) provide detailed employment, education, and demographic information for adult scientists and engineers under age 76 residing in the United States. Scientists and engineers are defined as individuals who have a bachelor's level or higher degree in science and engineering (S&E) or S&E-related fields or who have a non-S&E degree at the bachelor's level or higher and are working in S&E or S&E-related occupations. Unless otherwise noted, the report uses the term *scientists and engineers* to refer to this broad definition and the term *college graduates* to refer to the population with at least a bachelor's degree. The data available on scientists and engineers are collected by two large demographic and workforce surveys of individuals conducted by NCSES: the NSCG and SDR.

The NSCG and SDR provide the most comprehensive information about the size and characteristics of the S&E labor force. Because the NSCG covers the entire population of college graduates residing in the United States, this survey provides information on individuals educated or employed in S&E fields as well as those educated or employed in non-S&E fields. Whereas NSCG data cover the general college-educated population, the SDR data provide information on scientists and engineers who earned their research doctoral degree in a science, engineering, or health (SEH) field from a U.S. academic institution. The SDR is a biennial survey that has been conducted since 1973; it is a unique source of information on educational and occupational achievements and career movements of the nation's doctoral scientists and engineers. More information on the NSCG and SDR are available at <https://www.nsf.gov/statistics/srvygrads/> and <https://www.nsf.gov/statistics/srvydoctoratework/>.

## Census Bureau Occupational Data

The S&E Labor Force Report uses data from the Census Bureau to analyze the growth in the S&E workforce since 1960 and long-term unemployment trends. The types of occupations categorized as S&E have changed over time since 1960 as the economy has become more knowledge based and technological, and new occupations have been created as a result. See **Table SA3-2** for a list of the occupations included in each year analyzed in the report.

Similarly, occupation codes have changed when defining S&E workers for the purposes of analyzing long-term employment trends. **Table SA3-3** and **Table SA3-4** shows the names and codes of the occupations included in each year analyzed in the report.

TABLE SA3-2

### S&E occupations in the U.S. Census and American Community Survey: Various years

(List of S&E occupations)

Decennial Census, 1960	Decennial Census, 1970	Decennial Census, 1980, 1990	Decennial Census, 2000	American Community Survey, 2010, 2017
Biological, agricultural, and environmental life scientists				Biological, agricultural, and environmental life scientists
Agricultural scientists	Agricultural scientists	Agricultural and food scientists	Agricultural and food scientists	Agricultural and food scientists
Biological scientists	Biological scientists	Biological and life scientists	Biological scientists	Biological scientists
Foresters and conservationists	Foresters and conservationists	Forestry and conservation scientists	Conservation scientists and foresters	Conservation scientists and foresters
	Marine scientists			
		Medical scientists	Medical scientists	Medical scientists
				Life scientists, all other
Mathematical scientists				Computer and mathematical scientists
Mathematicians			Computer scientists and systems analysts	Computer and information research scientists
Statisticians and actuaries			Computer support specialists	Computer network architects
			Computer software engineers	Computer support specialists

TABLE SA3-2

**S&E occupations in the U.S. Census and American Community Survey: Various years**

(List of S&amp;E occupations)

Decennial Census, 1960	Decennial Census, 1970	Decennial Census, 1980, 1990	Decennial Census, 2000	American Community Survey, 2010, 2017
	Computer systems analysts	Computer systems analysts and scientists	Network and computer systems administrators	Computer systems analysts
			Database administrators	Database administrators
				Information security analysts
			Network systems and data communication analysts	Network and computer systems administrators
	Operations and systems researchers and analysts	Operations and systems researchers and analysts	Operations research analysts	Operations research analysts
				Software developers, applications and systems software
				Web developers
	Computer specialists nec			Computer occupations, all other
			Logisticians	Logisticians
	Mathematicians		Mathematicians	Mathematicians
	Statisticians	Statisticians	Statisticians	Statisticians
		Mathematical scientists nec	Miscellaneous mathematical science occupations, including mathematicians and statisticians	Miscellaneous mathematical science occupations
Physical scientists				Physical scientists
Chemists	Physicists and astronomers	Physicists and astronomers	Astronomers and physicists	Astronomers and physicists
Geologists and geophysicists	Atmospheric and space scientists	Atmospheric and space scientists	Atmospheric and space scientists	Atmospheric and space scientists
Physicists	Chemists	Chemists, except biochemists	Chemists and materials scientists	Chemists and materials scientists
Miscellaneous natural scientists	Geologists	Geologists and geodesists	Environmental scientists and geoscientists	Environmental scientists and geoscientists
	Life and physical scientists nec	Physical scientists nec	Physical scientists, all other	Physical scientists, all other
Social scientists				Social scientists
Economists	Economists	Economists	Economists	Economists
Psychologists	Psychologists	Psychologists	Psychologists	Psychologists
	Sociologists	Sociologists	Sociologists	Sociologists
	Political scientists		Market and survey researchers	Survey researchers
	Urban and regional planners	Urban planners	Urban and regional planners	Urban and regional planners
Miscellaneous social scientists	Social scientists nec	Social scientists nec	Miscellaneous social scientists, including sociologists	Miscellaneous social scientists and related workers
Engineers				Engineers
Aeronautical engineers	Aeronautical and astronautical engineers	Aerospace	Aerospace engineers	Aerospace engineers
Chemical engineers	Chemical engineers	Agricultural	Agricultural engineers	Agricultural engineers
Civil engineers	Civil engineers		Biomedical engineers	Biomedical engineers
Electrical engineers	Electrical and electronic engineers	Chemical	Chemical engineers	Chemical engineers
Industrial engineers	Industrial engineers	Civil	Civil engineers	Civil engineers
Mechanical engineers	Mechanical engineers		Computer hardware engineers	Computer hardware engineers

TABLE SA3-2

**S&E occupations in the U.S. Census and American Community Survey: Various years**

(List of S&amp;E occupations)

Decennial Census, 1960	Decennial Census, 1970	Decennial Census, 1980, 1990	Decennial Census, 2000	American Community Survey, 2010, 2017
Metallurgical engineers and metallurgists	Metallurgical and materials engineers	Electrical and electronic	Electrical and electronics engineers	Electrical engineers
Mining engineers	Mining engineers		Environmental engineers	Environmental engineers
		Industrial	Industrial engineers, including health and safety	Industrial engineers, including health and safety engineers
		Marine and naval architects		
		Marine engineers	Marine engineers	Marine engineers and naval architects
		Metallurgical and materials	Materials engineers	Materials engineers
		Mechanical	Mechanical engineers	Mechanical engineers
		Mining	Mining and geological engineers, including mining safety engineers	Mining and geological engineers, including mining safety engineers
		Nuclear	Nuclear engineers	Nuclear engineers
	Petroleum engineers	Petroleum	Petroleum, mining and geological engineers, including mining safety engineers	Petroleum engineers
Sales engineers	Sales engineers	Sales engineers	Sales engineers	Sales engineers
			Ship engineers	Ship engineers
Engineers nec	Engineers nec	Engineers nec	Miscellaneous engineers, including agricultural and biomedical	Engineers, all others

nec = not elsewhere classified.

**Source(s)**

Census Bureau, Decennial Census, and the American Community Survey (ACS) Public Use Microdata Sample (PUMS).

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TABLE SA3-3

**S&E occupations in the Current Population Survey: Various years**

(List of S&amp;E occupations)

1990–2002	2003–10	2011–17
		Logisticians
Computer systems analysts and scientists	Computer scientists and systems analysts	
		Computer and information research scientists
		Computer systems analysts
		Information security analysts
	Computer software engineers	Software developers, applications and systems software
		Web developers
	Computer support specialists	
		Computer support specialists
	Database administrators	Database administrators
	Network and computer systems administrators	Network and computer systems administrators



TABLE SA3-3

**S&E occupations in the Current Population Survey: Various years**

(List of S&amp;E occupations)

1990–2002	2003–10	2011–17
	Network systems and data communications analysts	Computer network architects
		Computer occupations, all other
	Mathematicians	Mathematicians
Operations and systems researchers and analysts	Operations research analysts	Operations research analysts
Statisticians	Statisticians	Statisticians
Mathematical scientists nec	Miscellaneous mathematical science occupations	Miscellaneous mathematical science occupations, including mathematicians and statisticians
Aerospace	Aerospace engineers	Aerospace engineers
Agricultural	Agricultural engineers	Agricultural engineers
	Biomedical engineers	Biomedical and agricultural engineers
Chemical	Chemical engineers	Chemical engineers
Civil	Civil engineers	Civil engineers
	Computer hardware engineers	Computer hardware engineers
Electrical and electronic	Electrical and electronic engineers	Electrical and electronics engineers
Industrial	Environmental engineers	Environmental engineers
	Industrial engineers, including health and safety	Industrial engineers, including health and safety
Marine and naval architects	Marine engineers and naval architects	Marine engineers and naval architects
Metallurgical and materials	Materials engineers	Materials engineers
Mechanical	Mechanical engineers	Mechanical engineers
Mining	Mining and geological engineers, including mining safety engineers	Mining and geological engineers, including mining safety engineers
Nuclear	Nuclear engineers	Nuclear engineers
Petroleum	Petroleum engineers	Petroleum, mining and geological engineers, including mining safety engineers
Engineers nec	Engineers, all other	Miscellaneous engineers, including nuclear engineers
Agricultural and food scientists	Agricultural and food scientists	Agricultural and food scientists
Biological and life scientists	Biological scientists	Biological scientists
Forestry and conservation scientists	Conservation scientists and foresters	Conservation scientists and foresters
Medical scientists	Medical scientists	Medical scientists, and life scientists, all other
	Life scientists, all other	Life scientists, all other
Physicists and astronomers	Astronomers and physicists	Astronomers and physicists
Atmospheric and space scientists	Atmospheric and space scientists	Atmospheric and space scientists
Chemists, except biochemists	Chemists and materials scientists	Chemists and materials scientists
Geologists and geodesists	Environmental scientists and geoscientists	Environmental scientists and geoscientists
Physical scientists nec	Physical scientists, all other	Physical scientists, all other
Economists	Economists	Economists
	Market and survey researchers	Survey researchers
Psychologists	Psychologists	Psychologists
Sociologists	Sociologists	Sociologists
	Urban and regional planners	Urban and regional planners
Social scientists nec	Miscellaneous social scientists and related workers	Miscellaneous social scientists, including survey researchers and sociologists
	Social science research assistants	Social science research assistants
Sales engineers	Sales engineers	Sales engineers
	Ship engineers	Ship engineers

**Source(s)**

National Bureau of Economic Research, Merged Outgoing Rotation Group files (1990–2017); Bureau of Labor Statistics, Current Population Survey (CPS).

TABLE SA3-4

**S&E technicians and computer programmers occupations in the Current Population Survey: Various years**

(List of S&amp;E technician and computer programmer occupations)

1990–2002	2003–10	2011–17
Electrical and electronic technicians	Engineering technicians, except drafters	Engineering technicians, except drafters
Industrial engineering technicians		
Mechanical engineering technicians		
Engineering technicians nec	Geological and petroleum technicians	Geological and petroleum technicians, and nuclear technicians
Biological technicians	Biological technicians	Biological technicians
Chemical technicians	Chemical technicians	Chemical technicians
Science technicians nec	Other life, physical, and social science technicians	Other life, physical, and social science technicians
Computer programmers	Computer programmers	Computer programmers

**Source(s)**

National Bureau of Economic Research, Merged Outgoing Rotation Group files (1990–2017); Bureau of Labor Statistics, Current Population Survey (CPS).

## The Skilled Technical Workforce Data

We define the skilled technical workforce using a combination of occupation designations from NCSSES and from work conducted on behalf of the National Academies Board on Science, Technology, and Economic Policy (“the Academies”) for individuals whose educational attainment levels are less than a bachelor’s degree. Jonathan Rothwell’s 2015 publication “Defining Skilled Technical Work”—prepared for the Academies’ project on “The Supply Chain for Middle-Skilled Jobs: Education, Training, and Certification Pathways,” provides an approach to designating occupations that require significant scientific and technological expertise, but not necessarily a bachelor’s level degree or higher.<sup>1</sup> This section will briefly explain the approach used for the Academies’ work and the NCSSES occupations included in the definition used for the “Science and Engineering Labor Force” thematic report prepared for *Indicators 2020*.

Following the methodology of the Rothwell publication, this work uses skills-based data to identify occupations that rely upon workers with relatively high levels of scientific and technological skills and expertise. The U.S. Department of Labor sponsors data collected as part of the O\*NET program. The O\*NET program has created a content model capturing the distinguishing characteristics of an occupation and standardizing them into a measurable set of variables. Rothwell’s analysis, as outlined in the paper, utilizes the O\*NET knowledge survey, which asks workers to rate the level of knowledge needed to perform their job across 33 distinct knowledge domains on a 1 to 7 scale. Using the O\*NET version 19.0 and 2014 OES data, this report defines the occupations of the skilled technical workforce (STW) at the Standard Occupation Codes (SOC) level. The Rothwell criteria for inclusion of an occupation in the STW was a knowledge score in technical fields of at least 4.50 and a minority of individuals in that occupation with an educational attainment of a bachelor’s degree or higher.<sup>2</sup>

Using the occupation designations from the Rothwell approach in combination with occupations designated by NCSES as S&E or S&E-related occupations, the report uses ACS public use microdata (PUMS) to measure the size of this workforce. A crosswalk was produced between the SOC codes to the ACS occupation codes to enable aggregation up to the ACS occupation codes. This crosswalk is based on a crosswalk between SOC and occupation codes provided by the Census Bureau. SOC codes that did not have entries in the O\*NET database were manually mapped to a similar field using the shared 5-digit codes. This resulted in multiple SOC codes being mapped to a single occupation code, so the OES employment data were used to create employment-weighted fractions of the O\*NET scores for each SOC code.<sup>3</sup> **Table SA3-5** provides a list of the STW occupations and the employment of the STW in each occupation.

TABLE SA3-5

### Skilled technical workforce occupations and employment in the American Community Survey: 2017

(Number)

Occupation	Employment
All occupations	17,002,829
Architecture and engineering occupations	820,722
Aerospace engineers	14,817
Architects, except naval	16,343
Biomedical engineers	2,251
Chemical engineers	4,590
Civil engineers	40,535
Computer hardware engineers	10,147
Drafters	111,986
Electrical and electronics engineers	44,860
Engineering technicians, except drafters	282,729
Engineers, all other	98,116
Environmental engineers	3,179
Industrial engineers, including health and safety	58,093
Marine engineers and naval architects	3,385
Materials engineers	9,022
Mechanical engineers	57,159
Petroleum engineers	6,223
Surveying and mapping technicians	50,951
Surveyors, cartographers, and photogrammetrists	6,336
Arts, design, entertainment, sports, and media occupations	172,073
Broadcast and sound engineering technicians and radio operators	60,549
Photographers	75,542
Technical writers	14,358
Television, video, and motion picture camera operators and editors	21,624
Business and financial operations occupations	251,418
Appraisers and assessors of real estate	35,683
Logisticians	75,039
Tax examiners and collectors, and revenue agents	25,111
Wholesale and retail buyers, except farm products	115,585
Computer and mathematical occupations	1,322,376
Actuaries	292
Computer and information research scientists	614
Computer network architects	44,698
Computer occupations, all other	292,350
Computer programmers	99,088
Computer support specialists	322,811
Computer systems analysts	131,080
Database administrators	30,626
Information security analysts	29,472

TABLE SA3-5

**Skilled technical workforce occupations and employment in the American Community Survey: 2017**

(Number)

<b>Occupation</b>	<b>Employment</b>
Miscellaneous mathematical science occupations	4,939
Network and computer systems administrators	85,465
Operations research analysts	35,719
Software developers, applications and systems software	190,212
Web developers	55,010
Construction and extraction occupations	3,552,569
Boilermakers	13,629
Brickmasons, blockmasons, and stonemasons	133,466
Carpenters	1,073,301
Construction and building inspectors	64,108
Derrick, rotary drill, and service unit operators, oil, gas, and mining	23,853
Drywall installers, ceiling tile installers, and tapers	128,315
Earth drillers, except oil and gas	20,783
Electricians	704,915
Elevator installers and repairers	20,282
First-line supervisors of construction trades and extraction workers	729,497
Glaziers	39,124
Mining machine operators	47,317
Pipelayers, plumbers, pipefitters, and steamfitters	503,334
Structural iron and steel workers	50,645
Food preparation and serving related occupations	347,626
Chefs and head cooks	347,626
Healthcare practitioners and technical occupations	3,482,364
Audiologists	927
Chiropractors	2,165
Clinical laboratory technologists and technicians	152,214
Dental hygienists	115,444
Diagnostic related technologists and technicians	245,205
Dietitians and nutritionists	25,531
Emergency medical technicians and paramedics	139,476
Health diagnosing and treating practitioners, all other	5,554
Health practitioner support technologists and technicians	418,491
Licensed practical and licensed vocational nurses	749,084
Medical records and health information technicians	144,144
Miscellaneous health technologists and technicians	91,556
Nurse anesthetists	2,142
Nurse practitioners	4,617
Occupational therapists	6,870
Opticians, dispensing	46,859
Other healthcare practitioners and technical occupations	45,169
Pharmacists	6,560
Physical therapists	11,157
Physician assistants	5,891
Physicians and surgeons	5,601
Radiation therapists	9,173
Recreational therapists	2,203
Registered nurses	1,143,855
Respiratory therapists	71,674
Speech-language pathologists	2,631
Therapists, all other	28,171

TABLE SA3-5

## Skilled technical workforce occupations and employment in the American Community Survey: 2017

(Number)

Occupation	Employment
Installation, maintenance, and repair occupations	3,342,386
Aircraft mechanics and service technicians	145,131
Automotive service technicians and mechanics	719,165
Bus and truck mechanics and diesel engine specialists	254,358
Computer, automated teller, and office machine repairers	115,042
Electric motor, power tool, and related repairers	19,380
Electrical and electronics repairers, industrial and utility	11,456
Electronic equipment installers and repairers, motor vehicles	5,992
Electronic home entertainment equipment installers and repairers	31,129
First-line supervisors of mechanics, installers, and repairers	222,437
Heating, air conditioning, and refrigeration mechanics and installers	352,308
Heavy vehicle and mobile equipment service technicians and mechanics	178,049
Industrial and refractory machinery mechanics	330,052
Locksmiths and safe repairers	22,143
Maintenance and repair workers, general	450,626
Maintenance workers, machinery	20,987
Millwrights	34,573
Other installation, maintenance, and repair workers	222,753
Precision instrument and equipment repairers	47,805
Radio and telecommunications equipment installers and repairers	111,152
Riggers	11,626
Small engine mechanics	36,222
Life, physical, and social science occupations	176,698
Agricultural and food science technicians	22,472
Atmospheric and space scientists	1,511
Biological technicians	9,661
Chemical technicians	38,813
Chemists and materials scientists	5,580
Geological and petroleum technicians	12,971
Medical scientists	2,769
Miscellaneous life, physical, and social science technicians	75,021
Miscellaneous social scientists and related workers	5,622
Urban and regional planners	2,278
Management occupations	451,544
Architectural and engineering managers	26,560
Computer and information systems managers	159,209
Medical and health services managers	264,299
Natural sciences managers	1,476
Material moving occupations	71,244
Crane and tower operators	53,368
Pumping station operators	17,876
Office and administrative support occupations	78,599
Computer operators	53,197
Office machine operators, except computer	25,402
Personal care and service occupations	23,019
Morticians, undertakers, and funeral directors	23,019
Production occupations	2,637,706
Aircraft structure, surfaces, rigging, and systems assemblers	7,372
Bakers	166,992
Computer control programmers and operators	82,028

TABLE SA3-5

**Skilled technical workforce occupations and employment in the American Community Survey: 2017**

(Number)

Occupation	Employment
Engine and other machine assemblers	7,729
First-line supervisors of production and operating workers	735,137
Furnace, kiln, oven, drier, and kettle operators and tenders	8,640
Machinists	312,964
Miscellaneous plant and system operators	41,595
Prepress technicians and workers	21,074
Production workers, all other	1,042,583
Stationary engineers and boiler operators	66,260
Structural metal fabricators and fitters	23,203
Tool and die makers	48,861
Water and wastewater treatment plant and system operators	73,268
Protective service occupations	208,453
Firefighters	208,453
Sales and related occupations	10,316
Sales engineers	10,316
Transportation occupations	53,716
Sailors and marine oilers	20,224
Transportation inspectors	33,492

**Note(s)**

The American Community Survey does not cover employment among self-employed workers and employment in private households. Employment estimates are of employed individuals aged 25 and older. Values do not include those employed in military occupations.

**Source(s)**

Census Bureau, American Community Survey (ACS), 2017, Public Use Microdata Sample (PUMS).

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## Notes

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- 1 The Rothwell publication can be found at [http://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga\\_167744.pdf](http://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_167744.pdf).
- 2 OES employment data as published may have aggregations or suppressions. SOC codes that appear in the OES data but not the O\*NET data were assigned imputed knowledge and education scores based on the mean of the values assigned to matching 5-digit codes. If matching 5-digit codes were not available, matching 4-digit codes were used.
- 3 This follows Rothwell's method of imputation between 5- and 6-digit categories (see page 9 of [http://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga\\_167744.pdf](http://sites.nationalacademies.org/cs/groups/pgasite/documents/webpage/pga_167744.pdf)).