



AEROSPACE

Colorado Industry Cluster Profile

The aerospace cluster includes companies that develop products and systems for commercial, military, and space applications. Colorado's aerospace companies have expertise ranging from research and development to the design and manufacture of guided missiles and space vehicles, satellites and other communications equipment, and navigation and detection instruments. Companies in the aerospace cluster also produce planetary spacecraft and launch systems and provide mission support.

Colorado's aerospace cluster has achieved critical mass. Colorado is home to four military commands, eight major space contractors, and several universities involved in leading space research. Colorado has more than 300 companies in the space industry. Over 120 businesses are classified as aerospace companies and an additional 200 companies have either some aerospace operations or serve as suppliers to the aerospace cluster. Direct employment in the aerospace cluster totals 25,870 private sector workers and approximately 28,470 military personnel. These 54,340 workers in the aerospace cluster support an additional 112,280 workers in all industries throughout Colorado, bringing direct and indirect employment supported by the aerospace cluster to 166,620 workers.

Recent developments in the aerospace cluster include:

- Centennial-based United Launch Alliance (ULA) won a \$600 million contract in 2009 to provide launch services, data tracking, and other support for four upcoming NASA missions. The missions are expected to begin in 2011 and will explore the behavior of Earth's magnetic and energy fields. ULA announced its 36th successful launch in 36 months. The Delta IV rocket launched the third Wideband Global SATCOM (WGS-3) satellite for the Air Force in December 2009.
- Longmont-based DigitalGlobe launched the WorldView-2 orbiter in October 2009. The satellite offers high-spatial, resolution imagery of the Earth's surface used for environmental monitoring, oil and gas exploration, urban planning, and map creation. The company also announced plans to expand its headquarters operations given the increasing volume of satellite imagery production and a growing workforce.
- Ball Aerospace & Technologies Corporation was awarded a \$9.7 million contract from the NASA Langley Research Center in 2009. Under the contract, Ball will assess and potentially recondition the Stratospheric Aerosol and Gas Experiment (SAGE III) spaceflight instrument. Ball was also awarded a \$13.4 million contract under the U.S. Air Force Space Test Program for the development of up to six Space Test Program Standard Interface Vehicles. Ball is also the prime contractor for NASA's Kepler Mission. Over the next three-and-a-half years, Kepler will search for Earth-sized planets and will explore the structure of stars similar to the Earth's sun. Kepler launched into space in March 2009.
- The University of Colorado at Boulder (CU-Boulder) received a \$2.4 million NASA contract in 2009 to build and design four ultraviolet telescopes to measure physical and chemical processes occurring in gas clouds near the sun. The telescopes will be developed by CU-Boulder's Center for Astrophysics and Space Astronomy and will launch in 2010 from White Sands Missile Range in New Mexico. CU-Boulder was also awarded a \$3.3 million NASA contract in 2009 for a one-year study of Venus' atmosphere and climate, surface history, and to determine the viability of landing a spacecraft on the

planet. The study is part of NASA's \$650 million solar system mission led by other leading atmospheric research institutions including the University of Arizona and Washington University in St. Louis.

- Westminster will be home to a new data center for the Information Technology division of defense contractor General Dynamics Corp. Up to 100 information technology security specialists, engineers, administrators, and service desk agents will work to support a General Dynamics contract with the U.S. Department of Homeland Security's U.S. Citizenship and Immigration Services division.
- California-based GeoOptics LLC and Golden-based Broad Reach Engineering have partnered with CU-Boulder's Laboratory for Atmospheric and Space Physics to develop microsattellites to monitor the Earth's atmosphere. The first 18 microsattellites are expected to launch in 2012 and will provide real-time data to improve climate change research, weather forecasting, and hurricane predictions.

Colorado's numerous federal labs conduct cutting-edge space research. The National Oceanic and Atmospheric Administration (NOAA) and the University Corporation for Atmospheric Research (UCAR) are dedicated to exploring and monitoring the Earth's atmosphere. The Cooperative Institute for Research in the Atmosphere (CIRA) is a partnership between NOAA and Colorado State University. CIRA provides global and regional climate research, satellite observations, and air quality measurements. In 2009, CIRA was granted a five-year extension of its research partnership with NOAA. Under the agreement, CIRA will receive as much as \$64.4 million for continued research in weather- and aviation-related satellite technology.

The Laboratory for Atmospheric and Space Physics (LASP) at CU-Boulder serves as one of the country's premier labs for designing, building, and controlling spacecraft and scientific instruments. A proven training ground for future space scientists and engineers, LASP is the only lab in the world to have designed and built instruments that have visited every planet in the solar system. LASP was awarded a \$42 million NASA contract in 2009 for the development of a solar radiation sensor. The Total and Spectral Solar Irradiance Sensor (TSIS) will be joined to a satellite system currently under development by Northrop Grumman and Ball Aerospace & Technologies Corporation. In 2009, LASP and CU-Boulder's Aerospace Engineering Sciences Department were awarded a three-year, \$840,000 grant to construct a five-pound spacecraft. The spacecraft will monitor the effects of solar flares on Earth's atmosphere and will gather real-time data about electrons trapped in the Earth's magnetosphere.

Colorado is a national hub for the understanding and dissemination of aerospace knowledge. The National Space Symposium, considered the premier forum for aerospace in the nation, celebrated its 25th anniversary in 2009. With 8,000 attendees in Colorado Springs, the Symposium focused on new technologies, discoveries, and industry opportunities and attracted the greatest minds and most influential people in the aerospace cluster.

In addition to research assets, Colorado's aerospace cluster also has the support of public-private partnerships. The Colorado Space Coalition, a group of industry stakeholders, works to make Colorado a center of excellence for space. The coalition – including aerospace companies, military leaders, academic groups, and economic development organizations – promotes the state's significant aerospace assets nationally and advances legislation vital to industry growth and success.

Military Bases

Colorado is home to a diverse mix of Department of Defense (DoD) military installations that foster important synergies between private aerospace companies and government entities.

- **Buckley Air Force Base** in Aurora is home to the 460th Space Wing and supports 77 tenant organizations that represent all branches of the military. Tenants are located both on and off base.
- **Air Force Bases** in Colorado Springs include Peterson Air Force Base, Cheyenne Mountain Air Force Station, and Schriever Air Force Base.

- **Peterson Air Force Base** is the home of the 21st Space Wing as well as the North American Aerospace Defense Command (NORAD), the United States Northern Command (USNORTHCOM), Air Force Space Command (AFSPC), U.S. Army Space and Missile Defense Command/U.S. Army Strategic Command (SMDC/ARSTRAT), and the 302nd Airlift Wing (AFRES). The 21st Space Wing is responsible for worldwide missile warning and space control.
- **Cheyenne Mountain Air Force Station** is operated by Air Force Space Command. It hosts the NORAD and USNORTHCOM Alternate Command Center and serves as a training site for crew qualification.
- **Schriever Air Force Base** is the home of the 50th Space Wing as well as the Space Innovation and Development Center (SIDC), the 310th Space Wing (AFRC), the Missile Defense Integrated Operations Center (MDIOC), and the Joint Functional Component Command – Integrated Missile Defense (JFCC-IMD). The 50th Space Wing provides space combat capability through command, control, operations, and support of communication, navigation, warning, surveillance, and weather satellite weapons systems.
- The **United States Air Force Academy** in Colorado Springs was established in 1954 as an accredited college to educate officers for the U.S. Air Force. The Academy conducts over \$50 million in research annually in the areas of aeronautics and astronautics.

Military Aerospace Profile

Government Installation	Personnel
Buckley Air Force Base	10,310
Peterson Complex*	7,580
U.S. Air Force Academy	7,950
Schriever Air Force Base	2,630
Total Employment	28,470

*Peterson Complex total includes personnel at Peterson Air Force Base and Cheyenne Mountain Air Force Station (including NORAD, USNORTHCOM, AFSPC, and SMDC/ARSTRAT).

Private Aerospace Economic Profile

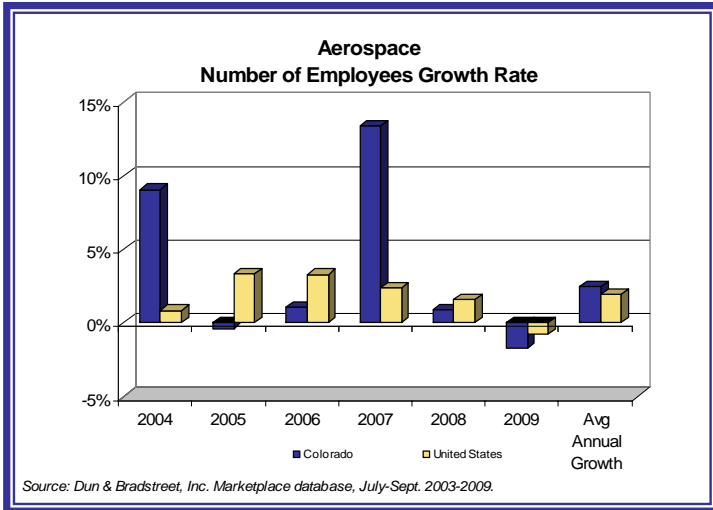
The aerospace cluster is defined by 18, six-digit North American Industry Classification System (NAICS) codes including search, detection, and navigation instrument manufacturing; guided missile and space vehicle manufacturing; satellite telecommunications; and research and development.

Colorado ranked first out of the 50 states in the U.S. for private aerospace employment concentration in 2009. Colorado's aerospace cluster ranked third out of the 50 states in total private sector employment.

	Colorado	U.S.
Direct Employment, 2009	25,870	374,110
Number of Direct Companies, 2009	120	4,340
One-Year Direct Employment Growth, 2008-2009	-1.8%	-0.8%
Five-Year Direct Employment Growth, 2004-2009	13.1%	10.1%
Avg. Annual Direct Employment Growth, 2004-2009	2.5%	1.9%
Direct Employment Concentration	1.2%	0.3%

*Note: Data reflects only private aerospace employment in Colorado and excludes military employment.
Sources: Dun & Bradstreet, Inc. Marketplace database, July-Sept. 2003-2009; Development Research Partners.*

Private Aerospace Employment



- In 2009, aerospace companies employed about 1.2 percent of Colorado's total employment base, compared with a 0.3 percent concentration nationally.
- Aerospace companies directly employed about 25,870 people in Colorado.
- Total Colorado aerospace employment increased 13.1 percent between 2004 and 2009, compared with a 10.1 percent increase nationally. Aerospace employment growth in Colorado averaged 2.5 percent per year over the past five years.
- Most of Colorado's aerospace employees were involved in manufacturing search and navigation equipment (65 percent) or guided missiles and space vehicles (31 percent).

- About 96 percent of Colorado's aerospace employees worked in Arapahoe (28 percent), Jefferson (27 percent), El Paso (23 percent), and Boulder (18 percent) Counties.

Wages

Colorado's aerospace cluster payroll was over \$2.8 billion in 2008. The 2008 average annual salary for an aerospace worker in Colorado was \$107,720, compared with the national average of \$85,980.

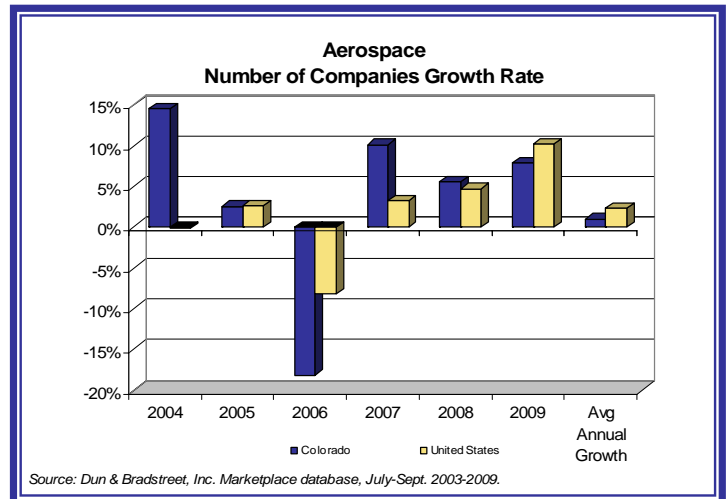
Colorado Occupational Salaries, 2008 Annual Average

Aerospace Engineers	\$99,050
Atmospheric and Space Scientists	\$84,390
Computer Software Engineers, Systems Software	\$97,190

Source: U.S. Bureau of Labor Statistics, State Occupational Employment and Wage Estimates, May 2008, www.bls.gov.

Private Aerospace Companies

- Over 120 aerospace companies operated in Colorado in 2009.
- The number of aerospace companies in Colorado grew 5.1 percent from 2004 to 2009, compared with a 12.1 percent increase nationwide.
- Over half of Colorado's aerospace companies employed fewer than 10 people, while 13 percent employed 250 or more.
- About 70 percent of Colorado's aerospace companies were involved in manufacturing search and navigation equipment (40 percent) or optical instruments and lenses (30 percent).
- The highest percentages of Colorado aerospace businesses were located in Boulder (25 percent), El Paso (21 percent), Arapahoe (13 percent), and Jefferson (11 percent) Counties.



Major Aerospace Contractors

Eight of the country's major space contractors have a significant presence in Colorado. These companies help the Department of Defense (DoD) to procure, place, and manage national space assets for the military. They also provide manned and unmanned spacecraft, instrumentation, and ground control services for NASA and other agencies.

- **Ball Corporation** employs about 3,400 people in Colorado. Of these workers, about 2,300 are employed by **Ball Aerospace & Technologies Corporation** in Boulder County. The company provides imaging and communications equipment, software, and services to its government and commercial aerospace customers. www.ballaerospace.com
- **Boeing Company** employs more than 2,300 workers in Colorado and has several major defense activities around the state, including Missile Defense, Space and Intelligence support, Services and Support operations, Cyber operations, as well as Boeing military aircraft at Fort Carson. www.boeing.com
- **ITT Corporation** has two divisions in Colorado. The **Systems Division** in Colorado Springs employs over 600 people and provides government, commercial, and international customers solutions for air and missile defense, satellite communications, command, and control. The division also provides full logistics support services. The **Space Systems Division, Visual Information Solutions** group employs 150 people in Boulder. The company provides software solutions and training for commercial, research, and government markets. www.itt.com
- **Lockheed Martin** employs over 11,300 people in Colorado, nearly 5,500 of whom work at the Space Systems unit headquartered in Jefferson County. Space Systems designs, develops, tests, and manufactures advanced technology systems for its government and commercial customers. The company also develops products ranging from human space flight systems and navigation, meteorological, and communications systems to remote sensing and missile defense systems. www.lockheedmartin.com
- **Northrop Grumman** provides a diverse portfolio of products and services related to systems integration, defense electronics, information technology, and battle management. In addition, the company works with advanced aircraft, unmanned aerial vehicles, missile systems, naval vessels, and space technology. Northrop Grumman employs over 2,700 people throughout Colorado. www.northropgrumman.com
- **Raytheon Company** manages spacecraft missions and analyzes post-launch data through a variety of technologies including radio frequency, command, control, communications and intelligence, and electro-optical/infrared. The company employs about 2,600 people throughout the state. www.raytheon.com
- **Sierra Nevada Corporation (SNC)** has a significant and growing presence in Colorado. SNC's Space Systems Group, with locations in Louisville and Littleton, develops small spacecraft, satellite components, and space propulsion systems for government and commercial customers. The company's Intelligence, Surveillance and Reconnaissance Group in Centennial provides products and services for a variety of airborne systems. SNC employment in Colorado is approaching 600 with plans to add an additional 200 in 2010. www.sncorp.com
- **United Launch Alliance (ULA)** is a joint venture between Lockheed Martin's Atlas and Boeing's Delta launch divisions. ULA is headquartered in Centennial with over 1,800 members of its 3,900-person U.S. workforce concentrated in Metro Denver. Most of ULA's management, engineering, and mission support functions are concentrated in Colorado, while most assembly and integration operations are concentrated in Alabama, Texas, and California. www.ulalaunch.com

Additional Major Private Aerospace Companies

- ABSL Space Products
www.abslspaceproducts.com
- Aeroflex Incorporated
www.aeroflex.com
- Barber-Nichols
www.barber-nichols.com
- DigitalGlobe
www.digitalglobe.com
- GeoEye
www.geoeye.com
- Honeywell
www.honeywell.com
- IHS Aerospace & Defense
<http://aero-defense.ihs.com>
- L-3 Communications West
www.l-3com.com
- Merrick & Company
www.merrick.com
- MicroSat Systems Inc. (Sierra Nevada Corp.)
www.micosatsystems.com
- Research Electro-Optics, Inc.
www.reoinc.com
- Rocky Mountain Instrument Company
<http://rmico.com>
- Science Applications International Corp.
www.saic.com
- SEAKR Engineering, Inc.
www.seakr.com
- SpaceDev Inc. (Sierra Nevada Corp.)
www.spacedev.com
- Surrey Satellite Technology Ltd.
www.sstl.co.uk

Key Reasons for Aerospace Companies to Locate in Colorado

Colorado is a top aerospace location offering:

1. The ability to recruit and retain technical and scientific employees

- Almost 36 percent of Colorado's adult population has completed a bachelor's or higher-level degree. That makes Colorado the second-most educated state in the country behind Massachusetts. (U.S. Census Bureau, 2008 American Community Survey)
- Colorado ranked eighth in the number of Ph.D. scientists and engineers as a percent of the workforce in 2006. This measure points to a large pool of potential innovators in the state. (National Science Foundation, 2008)
- Colorado ranked 11th in the number of patents issued per one million people in 2008. A high number of patents indicates a high rate of innovation. (United States Patent and Trademark Office, 2009; U.S. Census Bureau, 2009)
- Colorado ranked third in the nation for its ability to support a knowledge- and technology-based economy, according to the Milken Institute's 2008 *State Technology and Science Index*. The index measured 77 indicators in five categories – education, the science and engineering workforce, research and development, high-tech employment concentration, and entrepreneurial environment. (Milken Institute, 2008)
- *Forbes* magazine named Boulder first among the 25 "Smartest Cities in America" in 2008. The ranking of the nation's largest metro areas was based on each area's percentage of adult population with at least a bachelor's degree, and Boulder's 53 percent was highest overall. (*Forbes*, 2008)
- The Metro Denver WIRED Initiative – a four-year, \$15 million regional workforce development grant housed at the Metro Denver Economic Development Corporation – ended in early 2010. WIRED worked to develop a labor force skilled in STEM (science, technology, engineering, and math) for the fastest-growing industries, including aerospace, and awarded more than \$2 million for six programs that specifically addressed future aerospace workforce needs. (Metro Denver WIRED Initiative)

2. Proximity to vendors and customers

- Colorado's aerospace cluster is anchored by eight large prime contractors: Lockheed Martin, Northrop Grumman, Raytheon, Ball Aerospace, Boeing, United Launch Alliance, Sierra Nevada Corporation, and ITT Corporation.

- Major military operations in the state include Buckley AFB, Peterson AFB, Schriever AFB, and Cheyenne Mountain Air Force Station. In addition, the U.S. Air Force Academy is located outside of Colorado Springs.
- Cheyenne Mountain Air Force Station hosts the NORAD and USNORTHCOM Alternate Command Center.
- Prime contractors and military installations support more than 300 Colorado aerospace businesses and suppliers. (Colorado Space Coalition, 2008)
- In 2009, the U.S. Department of Defense awarded Colorado a Procurement Technical Assistance Center (PTAC), a local resource available at no or nominal cost that can provide assistance to business firms in marketing products and services to the federal, state, and local governments. The central office for Colorado's PTAC is located in Colorado Springs and a satellite office is opening in Jefferson County to assist businesses statewide to compete for military and other funding.
- Colorado recipients were awarded more than \$1.3 billion in NASA prime contracts in 2009. The state ranked fourth overall for NASA funding. (National Aeronautics and Space Administration, 2009)

3. Low to moderate costs of doing business

- Colorado's simple corporate income tax structure is based on single-factor apportionment, which allows companies to pay taxes based solely on their sales in the state. Colorado's corporate income tax rate of 4.63 percent is one of the lowest in the nation. (State of Colorado; The Tax Foundation)
- Colorado ranked second in the 2009 *ALEC-Laffer State Economic Competitiveness Index*, which evaluates the link between states' policies and economic performance. States that perform well on the index tend to have low regulatory and tax burdens and a sustainable approach to public spending. (American Legislative Exchange Council, 2009)

4. Pro-business and flexible state and local governments

- Colorado is the nation's third-best state for business, according to an annual ranking by CNBC.com. The ranking was based on 40 metrics in 10 broad categories, and Colorado received top-10 rankings in the categories that measure business friendliness, access to capital, and overall economy. (CNBC, 2009)
- Colorado ranked fourth overall on *Forbes'* 2009 "Best States for Business" list. Rankings were based on each state's regulatory environment, business costs, labor supply, quality of life, economic climate, and growth potential. Colorado received top-20 rankings for five of the six criteria, including labor supply (first overall) and growth potential (second overall). (*Forbes.com*, 2009)
- Colorado ranked third in the 2008 *U.S. Economic Freedom Index*. The state earned high scores for fiscal indicators, indicators of social welfare and related spending, and the measure of overall government size. (Pacific Research Institute, 2008)
- Several Colorado metropolitan areas ranked high on *Forbes'* 2009 list of the "Best Places for Business and Careers," which considers the cost of doing business, educational attainment, and other factors. The Fort Collins metro area ranked second overall, Colorado Springs ranked 10th, the Denver-Aurora-Broomfield region ranked 14th, and Boulder ranked 20th. (*Forbes*, 2009)

5. Proximity to colleges/universities

- Two academic institutions in Colorado offer nationally ranked aerospace programs or degrees:
 - The U.S. Air Force Academy, located in Colorado Springs, ranked second among schools that do not offer doctoral degrees for its undergraduate aerospace engineering program. (*U.S. News & World Report*, 2009)
 - The University of Colorado at Boulder (CU-Boulder) offers a top-20 ranked aerospace engineering doctorate program. CU-Boulder is a member of the U.S. Air Force Space Education Consortium. (*U.S. News & World Report*, 2009)

- The U.S. Air Force designated the University of Colorado at Colorado Springs as the lead university in the Space Education Consortium, which provides courses and curriculum throughout the country to help educate the future space workforce. (Colorado Space Coalition, 2009)
- In 2008, the 8th Continent Aerospace Business Incubator opened at the Colorado School of Mines. The incubator links developing aerospace companies with investors, legal resources, and public relations assistance.
- Metropolitan State College of Denver's Advanced Aviation and Aerospace Flight Simulation and Training Lab features AGI Corporation's Satellite Toolkit software system for simulating space mission analysis and orbital dynamics.
- In 2009, CU-Boulder and SpaceDev Inc. partnered to create eSpace: The Center for Space Entrepreneurship. eSpace is a not-for-profit organization dedicated to creating new entrepreneurial space companies, commercializing aerospace technologies created within these companies, and developing the aerospace workforce to support them.
- CU-Boulder ranked second among public universities for NASA research money received in fiscal year 2008. The university ranked sixth among all educational and nonprofit institutions receiving NASA funds. (National Aeronautics and Space Administration, 2009)
- Colorado State University (CSU) in Fort Collins is nationally known for its programs and institutes dedicated to atmospheric science and research. The university is also home to the Cooperative Institute for Research in the Atmosphere (CIRA), which recently renewed its research partnership with the National Oceanic and Atmospheric Administration (NOAA). (Colorado State University, 2009)
- Colorado has three institutions that are members of the Universities Space Research Association. The three schools – CU-Boulder, the Colorado School of Mines, and the University of Denver – all have graduate programs in space sciences or engineering.
- Nineteen astronauts had graduated from the University of Colorado as of 2009. (University of Colorado, 2009)

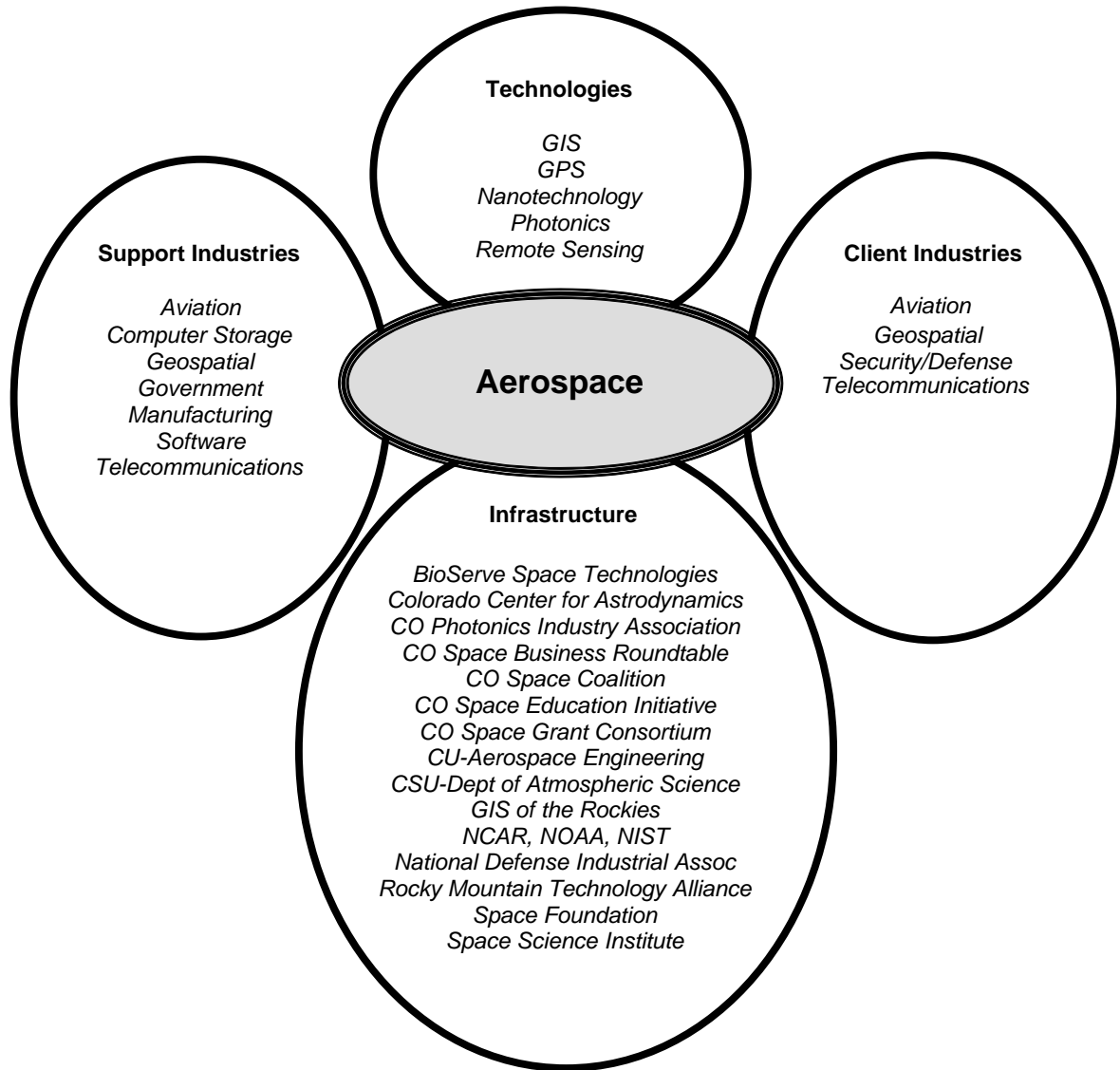
Aerospace Cluster Definition

NAICS Code*	NAICS Description	SIC Code	SIC Description
331512 (P)	Steel investment foundries	3324-9901	Aerospace investment castings, ferrous mfg.
331524 (P)	Aluminum foundries (except die-casting)	3365-0201	Aerospace castings, aluminum mfg.
331528 (P)	Other nonferrous foundries (except die-casting)	3369-9901	Aerospace castings, nonferrous: except aluminum mfg.
332111 (P)	Iron & steel forging	3462-05	Missile & ordnance forgings mfg.
332111 (P)	Iron & steel forging	3463-02	Nonferrous missile & ordnance forgings mfg.
332313 (P)	Plate work mfg.	3443-1104	Space simulation chambers, metal plate mfg.
332813 (P)	Electroplating, plating, polishing, anodizing & coloring	3471-0204	Decontaminating & cleaning of missile or satellite parts mfg.
332993 (P)	Ammunition (except small arms) mfg.	3483-0101	Arming & fusing devices for missiles mfg.
332993 (P)	Ammunition (except small arms) mfg.	3483-9910	Missile warheads mfg.
333314 (P)	Optical instrument & lens mfg.	3827	Optical instruments & lenses
334220 (P)	Radio & television broadcasting & wireless communications equipment mfg.	3663-9910	Space satellite communications equipment mfg.
334511	Search, detection & navigation instrument mfg.	3812	Search, detection, navigation, guidance
336414	Guided missile & space vehicle mfg.	3761	Guided missiles & space vehicles
336415	Guided missile & space vehicle propulsion unit & parts mfg.	3764	Space propulsion units & parts
336419	Other guided missile & space vehicle parts & aux. equipment mfg.	3769	Space vehicle equipment NEC
339113 (P)	Surgical appliance & supplies mfg.	3842-0113	Space suits mfg.
423860 (P)	Transportation equipment & supplies (except motor vehicle) merchant wholesalers	5088-0300	Aircraft & space vehicle supplies & parts - wholesale trade
423860 (P)	Transportation equipment & supplies (except motor vehicle) merchant wholesalers	5088-0305	Guided missiles & space vehicles – wholesale trade
423860 (P)	Transportation equipment & supplies (except motor vehicle) merchant wholesalers	5088-0307	Space propulsion units & parts – wholesale trade
517919 (P)	All other telecommunications	4899-9902	Missile tracking by telemetry or photography
541712 (P)	Research and development in the physical, engineering, and life sciences (except biotechnology)	3761	Guided missiles and space vehicles
927110	Space research and technology	9661	Space research and technology
927110	Space research and technology	4789-9902	Space flight operations, except government

**(P) indicates that only part of the NAICS industry category is represented in the industry cluster definition.*

Note: NEC indicates "not elsewhere classified."

Aerospace Cluster Relationships



For additional information, contact us:



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Economic Development Corporation

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COLORADO SPACE COALITION

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Colorado's aerospace cluster:

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