

ASTRONAUTS FOR HIRE

**The Emergence of
a Commercial
Astronaut
Corps**



**Erik
Seedhouse**

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Erik Seedhouse

Astronauts for Hire

The Emergence of a Commercial Astronaut Corps



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Preface

“We’re really on the cusp of an exciting new capability for our country and for our economy.”

Lori Garver, NASA’s deputy administrator, explaining why NASA is seeking \$75 million for NASA’s Commercial Reusable Suborbital Research program

As the main engine ignites, the crew feels a deep rumble far below them and a sudden sensation of motion as the launch vehicle lifts off, trailing a 150-m-long fountain of sun-bright exhaust in an inferno of smoke, searing light, and earth-shaking noise. The three crewmembers feel the thunder of the launch, the numbing noise, and the incredible acceleration, as they are pushed forcefully back into their seats. The gut-wrenching journey to orbit – an event planned for many months and anticipated by the crew for several years – takes less than nine minutes. Once in orbit, the thrill of the ascent is replaced by a moment of fulfillment as the spacefarers get their first glimpse of Earth from space – a moment worth a lifetime of anticipation and the hundreds of hours spent training. But this is no ordinary spaceflight. Seated either side of the pilot are two commercial astronauts – astronauts for hire – employed by a research company to conduct experiments in low-Earth orbit.

Until recently, spaceflight had been the providence of a select corps of professional astronauts whose missions, in common with all remarkable exploits, were experienced vicariously by the rest of the world via television reports and internet feeds. These spacefarers risked their lives in the name of science, exploration, and adventure, thanks to government-funded manned spaceflight programs.

All that is about to change.

Section I describes how Astronauts for Hire (A4H) was created in 2010 by Veronica Ann Zabala-Aliberto, Ryan Kobrick, Amnon Govrin, Brian Shiro, and Joe Palaia. Here, the reader is introduced to A4H’s vision for opening the space frontier to commercial astronauts and describes the tantalizing science opportunities offered when suborbital and orbital trips become routine. Section I goes on to describe the training and qualification necessary to become a member of the future astronaut corps. The process of acquiring the necessary qualifications to become a government-sponsored astronaut can take 20 years or more. To submit a competitive application, it is generally accepted a candidate must possess a myriad of

qualifications, ranging from the requisite Ph.D. and a pilot's license to skydiving credentials and scuba-diving experience. For the budding commercial astronaut, the standards are still challenging, but not as demanding as government selection. Section I concludes by introducing the reader to A4H's suborbital and orbital qualification process, such as the demands of high-altitude indoctrination and the punishing ride in NASTAR's centrifuge.

Section II describes the vehicles that will fly the new crop of commercial astronauts. Anticipation is on the rise for the new fleets of commercial suborbital and orbital spaceships that will serve the scientific and educational market. These reusable rocket-propelled vehicles are expected to offer quick, routine, and affordable access to the edge of space, along with the capability to carry research and educational crew members such as A4H'ers. Yet to be demonstrated is the hoped-for flight rates of suborbital vehicles. Quick turnaround of these craft is central to realizing the profit-making potential of repeated sojourns by commercial astronauts to suborbital and orbital heights. As Section II outlines, vehicle builders still face rigorous shake-out schedules, flight-safety hurdles, as well as extensive trial runs of their respective craft before suborbital space jaunts become commonplace. Section II examines some of these "cash and carry" suborbital craft under development by such companies as Blue Origin, Masten Space Systems, Virgin Galactic, and XCOR Aerospace, and describes the hurdles the space industry must overcome before the hiring of commercial astronauts can develop into a profitable economic entity. It also provides positive suggestions for how the commercial spaceflight industry can plan and prepare for the challenges of marketing and financing the hiring of astronauts. Section II continues by examining the role of commercial operators as enablers of the future of astronauts for hire. It concludes with a vision of a partnership with governments and the private sector and how this collaboration will eventually integrate the free market's innovation of commercial space activities.

Section III describes the various missions this new corps of astronauts will fly and the customers who will employ them. It begins with an assessment of suborbital flights, which may be used to carry out a variety of high-altitude science studies, including access to three to four minutes of microgravity for experimentation in disciplines such as astronomy, life sciences, and microgravity physics. Section III continues by examining the types of missions that will accelerate human expansion outward, beginning with orbital science missions to commercial trips to low-Earth orbit and continuing with Exploration Class missions through cislunar space, the establishment of interplanetary spaceports, lunar bases, and outposts on the surface of Mars. Along the way, it describes the tasks commercial astronauts will perform, ranging from mining asteroids to harvesting helium.

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In writing this book, the author has been fortunate to have had five reviewers who made such positive comments concerning the content of this publication. He is also grateful to Maury Solomon at Springer and to Clive Horwood and his team at Praxis for guiding this book through the publication process. The author also gratefully acknowledges all those who gave permission to use many of the images in this book, especially Astronauts for Hire members Brian Shiro, Jason Reimuller, Chris Altman, Luis Zea, Veronica Aliberto-Zabala, and Joe Palaia.

The author also expresses his deep appreciation to Christine Cressy, whose attention to detail and patience greatly facilitated the publication of this book, to Jim Wilkie for creating the cover of this book, and to Stewart Harrison, who sourced several of the references that appear in this book.

Once again, no acknowledgment would be complete without special mention of our rambunctious cats, Jasper MiniMach and Lava, who provided endless welcome (and occasionally unwelcome!) distraction and entertainment.

*This book is dedicated to my wife, Doina,
without whom I would never have had the chance of pursuing
my dream of flying into space*

About the author

Erik Seedhouse is a Norwegian-Canadian suborbital astronaut whose life-long ambition to work in space is one step closer to being realized thanks to the organization that provided the inspiration for this book. After completing his first degree in Sports Science at Northumbria University, the author joined the legendary 2nd Battalion the Parachute Regiment, the world's most elite airborne regiment. During his time in the "Para's", Erik spent six months in Belize, where he was trained in the art of jungle warfare and conducted several border patrols along the Belize–Guatemala border. Later, he spent several months learning the intricacies of desert warfare on the Akamas Range in Cyprus. He made more than 30 jumps from a Hercules C130 aircraft, performed more than 200 helicopter abseils, and fired more light anti-tank weapons than he cares to remember!

Upon returning to the comparatively mundane world of academia, the author embarked upon a Master's degree in Medical Science at Sheffield University. He supported his studies by winning prize money in 100 km ultradistance running races. Shortly after placing third in the World 100 km Championships in 1992 and setting the North American 100 km record, the author turned to ultradistance triathlon, winning the World Endurance Triathlon Championships in 1995 and 1996. For good measure, he also won the inaugural World Double Ironman Championships in 1995 and the infamous Decatriathlon, the world's longest triathlon – an event requiring competitors to swim 38 km, cycle 1,800 km, and run 422 km. Non-stop!

Returning to academia once again in 1996, Erik pursued his Ph.D. at the German Space Agency's Institute for Space Medicine. While conducting his Ph.D. studies, he still found time to win Ultraman Hawai'i and the European Ultraman Championships as well as completing the Race Across America (RAAM) bike race. Due to his success as the world's leading ultradistance triathlete, Erik was featured in dozens of magazines and television interviews. In 1997, *GQ* magazine nominated him as the "Fittest Man in the World".

In 1999, Erik decided it was time to get a real job. He retired from being a professional triathlete and started his post-doctoral studies at Vancouver's Simon Fraser University's School of Kinesiology. In 2005, the author worked as an astronaut training consultant for Bigelow Aerospace in Las Vegas and wrote

Tourists in Space, a training manual for spaceflight participants. He is a Fellow of the British Interplanetary Society and a member of the Space Medical Association. Recently, he was one of the final 30 candidates of the Canadian Space Agency's Astronaut Recruitment Campaign. Erik works as a manned spaceflight consultant, professional speaker, triathlon coach, and author. He is the Training Director for Astronauts for Hire (www.astronauts4hire.org) and completed his suborbital astronaut training in May 2011. He is eligible for spaceflight assignments and plans to travel into space as an A4H astronaut on board one or more (hopefully several!) of the commercial spacecraft written about in this book.

In addition to being a suborbital astronaut, triathlete, skydiver, pilot, and author, Erik is an avid mountaineer and is currently pursuing his goal of climbing the Seven Summits. *Astronauts for Hire* is his ninth book. When not writing, he spends as much time as possible in Kona on the Big Island of Hawai'i and at his real home in Sandefjord, Norway. Erik is owned by three rambunctious cats – Jasper, Mini-Mach, and Lava – none of whom has expressed any desire to travel into space but who nevertheless provided invaluable assistance in writing this book (!).

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Abbreviations

A4H	Astronauts for Hire
A-LOC	Almost Loss of Consciousness
AGSM	Anti-G Straining Maneuver
AMF	Advanced Medical Facility
AsMA	Aerospace Medical Association
CCDev	Commercial Crew Development
CELSS	Closed Environmental Life Support System
COMSTAC	Commercial Space Transportation Advisory Committee
COPD	Chronic Obstructive Pulmonary Disease
COTS	Commercial Orbital Transportation Services
CRS	Commercial Resupply Services
CRUsR	Commercial Reusable Suborbital Research program
CSA	Canadian Space Agency
CSF	Commercial Spaceflight Federation
CSLA	Commercial Space Launch Act
CST	Commercial Space Transportation
CVP	Central Venous Pressure
DOVE	Device for Orientation and Motion Environment
EA	Excalibur Almaz
EASA	European Aviation Safety Administration
ECLSS	Environmental Control Life Support System
EML	Earth–Moon Lagrange
ENT	Ear, Nose, Throat
EPU	Environmental Physiology Unit
ESA	European Space Agency
ETC	Environmental Tectonics Corporation
EVA	Extra Vehicular Activity
FAA	Federal Aviation Administration
FAI	Fédération Aéronautique Internationale
FMARS	Flashline Mars Arctic Research Station
G-LOC	Gravity Induced Loss of Consciousness

GCR	Galactic Cosmic Radiation
GOR	Gradual Onset Rate
GSFC	Goddard Spaceflight Center
GST	General Space Training
GTO	Geosynchronous Transfer Orbit
ICRP	International Commission on Radiological Protection
ILOB	Icarus Lunar Observatory Base
ISPCS	International Symposium for Personal and Commercial Spaceflight
ISRU	In-Situ Resource Utilization
ISS	International Space Station
ISU	International Space University
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
KSC	Kennedy Space Center
LAS	Launch Abort System
LEO	Low-Earth Orbit
LLOX	Lunar Liquid Oxygen
LPSA	Launch Purchases Services Act
LRO	Lunar Reconnaissance Orbiter
LSS	Lunar Support Scientist
MDRS	Mars Desert Research Station
MIT	Massachusetts Institute for Technology
NASTAR	National Aerospace Training and Research Center
NCRP	National Council on Radiation Protection
NEA	Near Earth Asteroid
NOAA	National Oceanographic and Atmospheric Agency
NPS	Nuclear Power System
NSRC	Next Generation Suborbital Researchers Conference
NTPS	National Test Pilot School
OCST	Office of Commercial Space Transportation
OSC	Orbital Sciences Corporation
OTV	Orbital Transfer Vehicle
PDR	Preliminary Design Review
PFST	Pre-Flight Space Training
PI	Principal Investigator
PSI	Planetary Science Institute
RAF	Royal Air Force
RBS	Reusable Booster System
REM	Research and Education Mission
RLV	Reusable Launch Vehicle
ROR	Rapid Onset Rate
RpK	Rocketplane Kistler
RRV	Reusable Re-entry Vehicle
RSC	Rocket Space Corporation
RTG	Radioisotope Thermoelectric Generator

SAR	Synthetic Aperture Radar
SAS	Special Air Service
SCR	Solar Cosmic Radiation
SEC	Shackleton Energy Company
SFU	Simon Fraser University
SMS	Space Motion Sickness
SNC	Sierra Nevada Corporation
SQM	Strange Quark Matter
SS1	SpaceShipOne
SS2	SpaceShipTwo
SST	Suborbital Scientist Training
SSTP	Suborbital Scientist Training Program
STC	Spaceport Traffic Control
SVMF	Space Vehicle Mockup Facility
SwRI	Southwest Research Institute
TGF	Terrestrial Gamma-ray Flash
TIA	Transient Ischemic Attack
TPS	Thermal Protection System
TRL	Technology Readiness Level
TSC	The Spaceship Company
UAE	United Arab Emirates
UCF	University of Central Florida
ULA	United Launch Alliance
UNISCA	United Nations International Student Conference of Amsterdam
USA	United Space Alliance
USAF	United States Air Force
VSE	Vision for Space Exploration
VTOL	Vertical Take-Off and Landing
WFPC	Wide Field and Planetary Camera
WK1	WhiteKnightOne
WK2	WhiteKnightTwo

