

# **2C ENGINEERING LLC ORGANIZATION**

2C ENGINEERING LLC was formed on November 27, 2006 in the state of Colorado. Clarke Chambellan, PE, is a member/manager of the company.

## **PURPOSE**

The company was formed to provide engineering services to companies and institutions needing short term engineering expertise in the areas of mechanical design and engineering, engineering analysis, and optical layout.

These services include mechanical engineering and design, product configuration, mechanism design, material investigations, stress and thermal analysis using conventional and finite element methods, optical layouts for imaging and laser systems, prototyping of small nonferrous parts and CAD drawings.

## **FACILITIES**

The company is currently located in Erie, Colorado.

## **EQUIPMENT**

- Personal Computers, three axis desktop milling machine, lathe, and machine tool accessories

## **SOFTWARE**

- Various CAD packages including SolidWorks, Alibre, Cadkey 99, Keycreator, Google Sketchup
- Finite element analysis software ALGOR
- CAM software: Visualmill, Cutting Edge, AlibreCAM, and Spectracam
- Miscellaneous engineering software including Mathcad, VisSim, and AFGROW
- Microsoft Office
- Microsoft FORTRAN

**CLARKE CHAMBELLAN, PE**  
**MEMBER/MANAGER**

**EDUCATION**

- Colorado State University Bachelor of Science, Mechanical Engineering 1979
- Denver University Masters of Science, Mechanical Engineering 2007

**PROFESSIONAL HISTORY**

- 2C Engineering LLC, Owner, 2006
- National Center for Atmospheric Research (NCAR), Engineer III, 1989-2006
- Chambellan Engineering and Machining, Owner, 1991-1995
- University of Colorado:
  - Center for Astrophysics and Space Astronomy (CASA), Lead Mechanical Engineer, 1987-1989
  - Laboratory of Atmospheric and Space Physics (LASP), Mechanical Engineer, 1983-1987
- Ball Aerospace, Mechanical engineer, 1980-1982
- Public Service Company of Colorado (PSCO), Mechanical Engineer, 1980

**SUMMARY OF PROFESSIONAL EXPERIENCE**

Mr. Chambellan has worked extensively with organizations requiring a mechanical engineer capable of effectively solving challenges related to leading edge scientific instrumentation. Developing these instruments has required the application of engineering principles in many different fields such as dynamics, thermal, material, stress, optics, and fluids. These tasks were accomplished using a variety of methods including hand calculations, standard software programs and custom programs.

He has provided the mechanical design of numerous instruments as well as providing the working drawings for fabrication, assembly and documentation of these instruments.

**PROJECTS**

***NCAR***

- Instrument calibration cell design.
- Aircraft POD mounted instrument air sample inlet design.
- Aircraft Mounted Microwave temperature profiler design. Conceptual design of instrument layout and scanning mirror actuation.
- LIDAR scanning mirror support design.
- Aircraft mounted open cell hygrometer design and analysis.
- CCD Cooling Plate. Thermal design of a CCD cooling plate.
- Solar Balloon Experiment. Design and analysis of high altitude, balloon borne telescope pointing system components. Stress analysis of structural components. Design of flexible telescope mounting bearings. Finite element analysis of hermetic electronic enclosures.

- Fabre-Perot Interferometer. Design and analysis of optical mounting components. Design of stress free optical mount.
- Low Oscillation Experiment. Conceptual design of instrument layout design of tracking mirror, optical mounting, instrument structure, thin mount for quarter wave plate, and mounting pedestal.
- High Resolution Doppler LIDAR Instrument. Repackaging of instrument from “C-tainer” installation to Falcon business jet installation. Structural analysis of mounting components, containment analysis.
- DLSP. Design of calibration optic assembly. Utilized components of existing design and improved transport mechanism.
- Meteor Shower Telescope. Designed aircraft mounting for telescope used to gather atmospheric data from meteor traces.
- TIMED experiment. Design of XPS instrument. Packaging and mounting of detectors. Design of filter changer.
- STARE Instrument. Design of distant star planet survey telescope based on scientist’s specifications.
- LOWK Instrument. Designed instrument layout, optical mounts, transport mechanisms for optical components, kinematic and thermally stable base plate.
- CHIP Instrument. Designed instrument layout, optical mounts, kinematic and thermally stable base plate. Thermal stabilization fluid system design.
- Advanced Stokes Polarimeter. Design of focal plane assembly to fit on National Solar Observatory optical bench. Custom CCD mounts. CCD transport and rotation mounts. Design of optical beam compression assembly. Design of beam splitting transport and rotation mount.

### ***University of Colorado***

#### ***Center For Astrophysics and Space Astronomy***

- X-Ray Telescope. Design of X-Ray telescope for rocket or satellite based experiment. The design is based on scientist’s specifications. Developed material processes to fabricate optical surface and obtain a stress free substrate.
- Design of EUV Rocket Borne Telescope. Conceptual and actual design of experiment payload. Analyzed payload per NASA requirements for weight, center of gravity and strength.
- Filter Wheel Design. Design of six-position filter wheel mechanism for Sommers Bausch Observatory telescope. Design of electronic position readout.

#### ***Laboratory for Atmospheric and Space Physics***

- Solar Stellar Irradiance Comparison Experiment. Design of satellite borne instrument. Designed optical mounts and position mechanisms. Design of 1.5 atm pressurized case. Designed instrument doors. Utilized CNC technology to fabricate complex o-ring grooves.

### ***Ball Aerospace***

- Investigated schemes for low radar profile satellites.
- Earth Radiation Budget Satellite. Designed solar panel mounting substrates. Designed mass simulators.
- Chemical Release Emissions Facility. Layout and design of mountings for electronic boxes on space craft bus.

### **AWARDS**

NOMINATED for NCAR 2006 Scientific and Technical Advancement Award. High Altitude Observatory (HAO) scientists and support staff including: Greg Card, Clarke Chambellan, David Elmore, Alice Lecinski, Ron Lull, Stan Solomon, Kim Streater, and Qian Wu for their work on the Fabry-Perot Interferometer (FPI) to support ground-based observations at the NSF Polar Cap Observatory through measurements of mesospheric and thermosphere winds at multiple wavelengths and altitudes. The instrument has been operated for three years, and the data from it has been submitted to the CEDAR database for community use.

NCAR 2003 Scientific and Technical Advancement Award. Awarded for contributions to the International H<sub>2</sub>O Project (IHOP 2002).

NCAR 1993 Scientific and Technical Advancement Award. Awarded for contributions to the Advanced Stokes Polarimeter.

### **PUBLICATION CONTRIBUTIONS**

Elmore, D. F., G. L. Card, C. W. Chambellan, D. M. Hassler, H. L. Hull, A. R. Lecinski, R. M. MacQueen, K. V. Streater, J. L. Streete, and O. R. White

1998 Chromospheric Helium Imaging Photometer (An Instrument for High Time Cadence 1083-nm Wavelength Solar Observations). In *Applied Optics*, 37(19): 4270-4276.

W. Cash, T. Cook, C. Chambellan, D. Heyse, D. Hofmockel, T. P. Snow, D. Windt, and C. Zaidins

1989 A far ultraviolet rocket-borne spectrograph. In *Experimental Astronomy* 1:123-143.

David Charbonneau, Timothy M. Brown, David W. Latham, and Michel Mayor

1999 Detection of Planetary Transits Across a Sun-like Star. In *Astrophysical Journal Letters* (accepted, 23 November 1999).

S. Tomczyk, K. Streater, G. Card, D. Elmore, H. Hull, and A. Cacciani

1995 An instrument to observe low-degree solar oscillations. In *Solar Physics* 159(1).