Resume of Bobby W. Sanders

Bobby W. Sanders is President of TechLand Research. The focus of this technology company is on research and consulting efforts in the areas of aerodynamic design, experimental testing, and data analysis. The particular emphasis is on supersonic aerodynamics. He has fifty years of experience in inlet and airbreathing propulsion research and three years in launch vehicle aerodynamics and testing.. Prior to founding TechLand, he served as manager in the Inlets and Propulsion Airframe Integration Technology Branch at NASA Lewis Research Center from 1987 to 1996. During this period, in addition to management functions, he also served as a key member on U.S. Government/Industry teams that were responsible for the guidance of several national programs. He received the NASA Exceptional Service Award for his outstanding contributions to aerodynamic research. Mr. Sanders is a widely recognized national technical authority and consultant in high-speed inlet technology for airbreathing propulsion systems.

His work at NASA included all aspects of inlet research, from conceptual definition to complete inlet design (aerodynamic and mechanical) and experimental testing. His inlet designs have included the design of complex inlet systems necessary for operation with an engine. He led highly innovative research on supersonic transport inlets that resulted in concepts with improved performance and stability characteristics. In this research, he developed inlet bleed stability systems that function to provide large operability margins and function to control inlet bleed so that optimum inlet performance levels are realized. He tested these systems on inlets terminated by a J-85 engine and also proposed and installed one of these systems in a full-scale SR-71 inlet. This stability bleed control concept has been integrated into several experimental inlet models and has functioned to improve inlet performance while offering increased operability margins. He received a patent for a device that improves inlet stability.

He led a national government/industry team whose charter was to design and test an inlet system for a proposed Mach 5 cruise aircraft. He was a key member of the National Aerospace Program (NASP) Inlet Specialist Team. He defined and scoped important NASP inlet and inlet/combustor parameters and led a series of research tests that provided definitive information on inlet performance and interaction issues.

He initiated the research effort on the variable diameter centerbody (VDC) inlet. His extensive aerodynamic design and analysis of the VDC inlet subsonic diffuser provided aerodynamic lines that were compatible with the folding-leaf variable geometry concept. He conceived of the mechanism to provide a variable diameter centerbody. The system had to provide the required area variation, function rapidly, allow inlet bleed, provide a reasonable aerodynamic subsonic diffuser, and also prevent leakage between the leaves. The resulting inlet model was successfully tested as part of the High Speed Research (HSR) program. As a member of the HSR Inlet Integrated Technology Development (ITD) Team Mr. Sanders' extensive technical knowledge of supersonic inlets, broad knowledge of inlet aerodynamic design, extensive experience in inlet test techniques, and knowledge of available test hardware had a major impact on the overall inlet research effort for the HSR program.

Mr. Sanders' outstanding contributions to high-speed aerospace technology have continued since the founding of TechLand Research. His expertise is recognized throughout the aerospace community. He has provided consulting to aerospace companies (The Boeing Company, Ramgen Power Systems, Raytheon Missile Systems, Pratt & Whitney, and Lockheed Martin Aeronautics Company), to the Air Force, and to NASA (Glenn, Marshall, and Armstrong Research Centers).

While at TechLand, Mr. Sanders conceived and invented several concepts that offer significant increases in performance and safety, and reduced weight for high-speed aircraft. Many of these innovative technologies have received funding from government agencies (through Small Business Innovation Research grants or from agency program funds) to support further development. Several of these innovations have been issued patents. One of these technologies was a high-performance, external-compression supersonic inlet that was selected to replace the baseline inlet for the High Speed Research (HSR) propulsion system. This inlet offered improved performance, simplicity, and increased safety for the high-speed propulsion system and aircraft. Mr. Sanders originated a unique axisymmetric inlet that offers high performance and operability with a relatively simple variable geometry system. He has identified an inlet design concept to eliminate sonic boom signature originating from the propulsion system of a supersonic aircraft. This design concept would allow a supersonic commercial aircraft to fly over land and thus greatly improve the economics of the aircraft. He developed a new variable geometry concept for a supersonic cruise inlet that was flight-tested on the NASA Armstrong F-15B research aircraft.

Mr. Sanders also conceived, developed, and patented a rotary airflow control valve and isolator for a pulse detonation engine (PDE). This enabling technology was successfully demonstrated in an operating pulse detonation engine for a Phase II SBIR research activity for the Air Force Research Laboratory (AFRL). He has developed innovative approaches to remotely vary boundary layer bleed patterns in wind tunnel models of high-speed inlets. Proof-of-concept models of two of these systems were fabricated and bench tested in a recent Phase II SBIR study for AFRL.

Mr. Sanders developed the aerodynamic design of an over-under dual-flow hypersonic inlet for application to turbine-based combined cycle engines. A large scale joint NASA/AFRL research effort based on this design included exploratory testing of this inlet in the NASA GRC 1x1 SWT, and large-scale testing of a complex model of the inlet in the 10x10 SWT. Currently, he is supporting the third phase of testing, in preparation for future research with integrated turbojet and dual mode ramjet engines.

In addition to the NASA Exceptional Service Award, Mr. Sanders has received numerous awards (individual and team) for his contributions to aeronautical programs such as: YF-12, F-106, Turboprop, SCAR, Supersonic Fan, VDC Inlet, Mach 5, NASP (Gene Zara Award), and HSR. He holds several patents.

Publications by Bobby W. Sanders

1. Cubbison, R. W. and Sanders, B. W.: "Effect of Bleed-System Back Pressure and Porous Area on the Performance of an Axisymmetric Mixed-compression Inlet at Mach 2.50", NASA TM X-1710, 1968, 69N14075.

2. Sanders, B. W. and Mitchell, G. A. "Throat-bypass Bleed Systems for Increasing the Stable Airflow Range of a Mach 2.50 Axisymmetric Inlet with 40-Percent Internal Contraction", NASA TM X-2779, 1968, 73N22947.

3. Karabinus, R. J. and Sanders, B. W.: "Measurements of Fluctuating Pressures in 8- by 6-Foot Supersonic Wind Tunnel for the Mach Number Range of 0.56 to 2.07", NASA-TM-X-2009, 1970, 70N25702.

4. Mitchell, G. A. and Sanders, B. W.: "Increasing the Stable Operating Range of a Mach 2.5 Inlet", AIAA Paper 70-686, AIAA Propulsion Joint Specialist Conference, 6th, San Diego, CA., June 1970, 70A33585.

5. Mitchell, G. A. and Sanders, B. W.: "Increasing the Stable Operating Range of a Mach 2.5 Inlet", NASA- TM X-52799, 1970, 70N27028.

6. Mitchell, G. A. and Sanders, B. W.: "Airflow Control System for Supersonic Inlets", US-Patent-3,799,475, 74N20646.

7. Bowditch, D. N.; Coltrin, R. E.; Sanders, B. W.; Sorensen, N. E.; and Wasserbauer, J. F.: "Supersonic Cruise Inlets", NASA SP-259, Aircraft Propulsion Conference, 1971, pp.283-312, NASA-Lewis Research Center, 71N19460.

8. Shaw, R. J.; Mitchell, G. A.; and Sanders, B. W.: "Forward Slanted Slot Throat Bypass to Increase the Stable Airflow Range of a Mach 2.5 Inlet with 60-Percent Internal Contraction", NASA TM X-2973, 1971.

9. Bishop, A. R. and Sanders, B. W.: "Modification of a Three-Dimensional Supersonic Nozzle Analysis and Comparison with Experimental Data", NASA TMX-3025, 1974, 74N18651.

10. Shaw, R. J.; Mitchell, G. A.; and Sanders, B. W.: "Distributed Porous Throat Stability Bypass to Increase the Stable Airflow Range of a Mach 2.5 Inlet with 60-Percent Internal Contraction", NASA TMX-2974, 1974, 74N25531.

11. Shaw, R. J.; Mitchell, G. A.; and Sanders, B. W.: "Distributed Educated Throat Stability Bypass to Increase the Stable Airflow Range of a Mach 2.5 Inlet with 60-Percent Internal Contraction", NASA TMX-2975, 1974, 74N25535.

12. Mitchell, G. A.; Sanders, B. W.; and Shaw, R. J.: "Throat Stability-Bypass Systems to Increase the Stable Airflow Range of a Mach 2.5 Inlet with 60-Percent Internal Contraction", NASA TM X-2976, 1974, 74N28476.

13. Mitchell, G. A. and Sanders, B. W.: "Pressure Activated Stability-Bypass-Control Valves to Increase the Stable Airflow Range of a Mach 2.5 Inlet with 40-Percent Internal Contraction", NASA TM X-2792, 1974, 74N28478.

14. Sanders, B.W.; Bishop, A.R.; and Webb, J.A.: "Gust Generator for a Supersonic Wind Tunnel", NASA-TM X-3120; 1974.

15. Mitchell, G. A. and Sanders, B. W.: "Poppet Valve Control of the Throat Stability Bypass to Increase Stable Operating Range of a Mach 2.5 Inlet with 60-Percent Internal Contraction", NASA-TM-X-3297, 1975, 76N10004.

16. "Wind Tunnel Performance of a YF-12 Aircraft Flight Inlet Modified by Various Stability-Bypass Porous-Bleed Configurations (U)", NASA TM X-73801, 79N10167.

17. "Comparison of One-third Scale and Full Scale Isolated Inlet Performance (U)", YF-12 Experiments Symposium, Vol.3, pp.87-114, Hugh L. Dryden Flight Research Center, 1978, 79N72837.

18. "Full Scale YF-12 Inlet Calibration and Flow System Interactions (U)", YF-12 Experiments Symposium, Vol.3, pp.55-86, Hugh L. Dryden Res. Center, 1978, 70N72836.

19. Sanders, B.W.: "Dynamic Response of a Mach 2.5 Axisymmetric Inlet and Turbojet Engine with a Poppet-Valve Controlled Inlet Stability Bypass System when Subjected to Internal and External Airflow Transients", NASA TP-1531, 1980, 80N14123.

20. Sanders, B.W.: "Turbojet -Exhaust-Nozzle Secondary-Airflow Pumping as an Exit Control of an Inlet-Stability Bypass System for a Mach 2.5 Axisymmetric Mixed-Compression Inlet", NASA TP-1532, 1980, 80N14124.

21. Schwendemann, M. F. and Sanders, B. W.: "Tangential Blowing for Control of Strong Normal Shock - Boundary Layer Interactions on Inlet Ramps", AIAA Paper 82-1082, AIAA, SAE, and ASME Joint Propulsion Conference, 18th, Cleveland, OH, June 1982, 82A37684.

22. "Application of Viscous Internal Flow Codes', First National Aerospace Plane Technology Symposium, NASA-Langley Research Center. May 1986.

23. "Overall Plans for Test at LeRC", First National Aerospace Plane Technology Symposium, NASA-Langley Research Center. May 1986.

24. "Mach 5 Cruise Inlet Research", Langley Symposium on Aeronautics, Vol.2, pp.285-304, NASA-Langley Research Center, 86X10217.

25. "Future GASL Model System Test Plans (U)", Second National Aerospace Plane Technology Symposium. Johns Hopkins University. November 1986. (SECRET)

26. Sanders, B.W. and Weir, L.J.: "2-D Inlet Test in NASA Lewis Research Center 1x1 SWT (U)", NASP-CP-3020, Third National Aerospace Plane Symposium, NASA-Ames Research Center. June 1987. (SECRET)

27. Anderson, G.Y.; Bencze, D.P.; and Sanders, B.W.: “Ground Tests Confirm the Promise of Hypersonic Propulsion”, Aerospace America, Vol.25, pp 38-42, September 1987.

28. Weir, L.J. and Sanders, B.W.: "Low Speed Inlet Performance (U)", NASP CP-4026. Fourth National Aerospace Plane Technology Symposium. Paper # 101. Naval Post Graduate School, Monterey, CA. Feb. 1988. (SECRET)

29. Fernandez, R., Sanders, B.W., and Weir, L.J.: "Small Scale Multi-Module Inlet Test Results, Mach 3.5 (U)", NASP CP-5028. Fifth National Aerospace Plane Symposium. Paper #46. NASA-Langley, Hampton, VA. Oct., 1988. (SECRET)

30. Weir, L.J.; Benson, T.J.; Sanders, B.W.; Rupp, G.D.; and Rose, W.C.: "Mach 5 inlet Validation and Performance Results", Sixth National Aerospace Plane Symposium, Paper # 53. Naval Post Graduate School, Monterey, CA. April 1989. (ITAR)

31. "Supersonic Testing of a NASP Type Hypersonic Inlet (U)", Eight National Aerospace Plane Symposium, Paper # 17A, Naval Post Graduate School, Monterey, CA. (SECRET)

32. "Inlet Research for the National Aerospace Plane (U)", Tenth National Aerospace Plane Technology Symposium. Paper # 165. Naval Post Graduate School, Monterey CA. May 1991. (SECRET)

33. "Low Speed Inlet Systems", NASP Inlet Research for TMP 2.1.01, August, 1991.

34. Coltrin, R.E.; Sanders, B.W.; and Bencze, D.P.: "Transonic Airframe Propulsion Integration", First Annual High Speed Research Workshop (Airframe/Propulsion Integration), Williamsburg, VA. May 1991.

35. Sanders, B.W. and Weir, L.J.: "Design of a High Performance External Compression Inlet for Cruise at Mach 2.4", Final Report, SBIR Phase I, Contract No. NAS3-97064, TechLand Report No. TR-091797, September 1997.

36. Sanders, B.W. and Weir, L.J.: "Mechanical Bleed Valve Study", Final Report for Boeing Company (St. Louis) Purchase Order No. Z71165, November 1997.

37. Sanders, B.W. and Weir, L.J.: "Mixed-Compression Inlet for Supersonic Cruise with High Performance and Operability", Final Report, SBIR Phase I, Contract No. NAS3-98041, TechLand Report No. TR-100998, October 1998.

38. Sanders, B.W. and Weir, L.J.: "2DB Inlet Test Results", Final report for Boeing Purchase Contract No. JR5955, October 1998, TechLand Report No. TR-103198.

39. Sanders, B.W. and Weir, L.J.: "Advanced Technology Inlet Design, NRA 8-21 Cycle II: DRACO Flowpath Hypersonic Inlet Design", Final Report for NASA MSFC Purchase Order H-31407D, December 1999.

40. Weir, L.J., Sanders, B.W., and Podleski, S.D.: "Design of a High Performance External Compression Inlet for Cruise at Mach 2.4", Final Report, SBIR Phase II, Contract No. NAS3-98019, TechLand Report No. TR-033100, 31 March 2000.

41. Weir, L.J., Sanders, B.W., and Podleski, S.D.: "Flight Testing of a New Design Concept for Axisymmetric Inlets", Final Report, SBIR Phase I, Contract No. NAS4-00011, TechLand Report No. TR-060900, June 2000.

42. Sanders, B.W. and Weir, L.J.: "ASPIRE SR-71 Flow Quality Assessment – Local Flow Field Conditions on Top of the SR-71", Final Report for NASA GRC Purchase Order C-71146-K, TechLand Report TR-051401, May 2001.

43. Sanders, B.W. and Weir, L.J.: "High Performance, Low-Sonic-Boom Supersonic Cruise Inlet", Final Report, SBIR Phase I, Contract No. NAS4-02012, TechLand Report No. TR-050202, May 2002.

44. Weir, L. J., Sanders, B.W., and Vachon, M.J.: "A New Design Concept for Supersonic Axisymmetric Inlets". AIAA 2002-3775; July 2002.

45. Sanders, B.W., Meleason, E.T., and Weir, L.J.: "Airflow Controller and Isolator for Pulse Detonation Engines", Final Report, SBIR Phase I, Contract Number F33615-02-M-2258, TechLand Report Number TRR-032703, March 2003.

46. Weir, L.J.; and Sanders, B.W.: Investigation of a Two-Dimensional, Mixed-Compression Mach 5.0 Inlet. NASA CR-2004-213122; July 2004.

47. Weir, L.J. and Sanders, B.W.: "Mode Transition Variable Geometry for High Speed Inlets for Hypersonic Aircraft". Final Report, SBIR Phase I, Contract No. NNC05CA60C, TechLand Report No. TRR-072505, July 2005.

48. Weir, L.J., Sanders, B.W., Meleason, E. J., and Podleski, S.D.: "Flight Testing of a New Design Concept for Axisymmetric Inlets", Final Report, SBIR Phase II, Contract No. NAS4-01031, TechLand Report No. TR-020406, February 2006.

49. Sanders, B.W., Meleason, E.T., and Weir, L.J.: "Airflow Controller and Isolator for Pulse Detonation Engines", Final Report, SBIR Phase II, Contract Number F33615-03-C-2336, July 2006.

50. "Supersonic Inlet Aerodynamic Design and Research Model Requirements Definition", final report for AFRL Purchase Order Number DD2941 (Wyle Prime Contract Number F33601-03-F-004), October 2007.

51. Sanders, B.W. and Weir, L.J.: "Aerodynamic Design of a Dual-Flow Mach 7 Hypersonic Inlet System for a Turbine-Based Combined-Cycle Hypersonic Propulsion System". NASA CR-2008-215214; 2008.

52. Saunders, J.D.; Slater, J.W.; Dippold, V.; Lee, J.; Sanders, B.W.; and Weir, L. J.: "Inlet Mode Transition Screening Test for a Turbine-Based Combined-Cycle Propulsion System." Presented at the 30th JANNAF Airbreathing Propulsion Subcommittee Meeting, May 2008.

53. Saunders, J. D.; Slater, J. W.; and Dippold, V.; Weir, L. J.; and Sanders, B. W.: "Inlet Research Status for a Large-Scale Turbine-Based Combined Cycle Engine Testbed." Presented at the 31st JANNAF Airbreathing Propulsion Subcommittee Meeting, December 2009.

54. Saunders, J.D.; Stueber, T.J.; Thomas, S.R.; Suder, K.L.; Weir, L.J.; and Sanders, B.W.: "Testing of the NASA Hypersonics Project's Combined Cycle Engine Large Scale Inlet Mode Transition Experiment (CCE LIMX)". Prepared for the 58th Joint Army-Navy-NASA-Air Force (JANNAF) Propulsion Meeting, Arlington, Virginia, April 18–22, 2011. NASA/TM—2012-217217; January 2012.

55. Sanders, B.W.; Weir, L.J.; Saunders, J.D.; and Foster, L.E.: "Mach 4 Experimental Demonstration of Inlet Mode Transition Technology for a Turbine-Based Combined Cycle Hypersonic Propulsion System". NASA TM-2012-217647; October 2012.

56. Sanders, B.W. and Weir, L. J.: "Highly Compact Supersonic Cruise Missile (SSCM) Engine Inlet", Final Report, SBIR Phase 1, Contract No. N68335-12-C-0244, TechLand Report No. TRR-20121120, November 2012.

57. Saunders, J.D., Foster, L.E., Sanders, B.W., and Weir, L.J.: "Demonstration and Performance of Inlet Mode Transition for Turbine-Based Combined Cycle Hypersonic Propulsion". Prepared for the 33rd Joint Army-Navy-NASA-Air Force (JANNAF) Airbreathing Propulsion Meeting, Monterey, California, 3-6 December 2012.

58. Foster, L.E., Saunders, J.D., Sanders, B.W., and Weir, L.J.: "Highlights From a Mach 4 Experimental Demonstration of Inlet Mode Transition for Turbine-Based Combined Cycle Hypersonic Propulsion". Prepared for the 48th Joint Propulsion Conference and Exhibit, Atlanta, Georgia, July 30 to August 1, 2012. NASA TM-2012-217724, December 2012.

59. Weir, L.J. and Sanders, B.W.: "Inlet Performance and Mode Transition Technology for a Turbine-Based Combined Cycle Hypersonic Propulsion System". NASA CR-2013-217858; May 2013.

60. Saunders, J.D.; Davis, D.O.; Barsi, S.J.; Deans, M.C.; Weir, L.J.; and Sanders, B.W.: "Liquefied Bleed for Stability and Efficiency of High Speed Inlets", NARI Seedling Fund – Final Technical Report, 2014.

61. Weir, L.J. and Sanders, B.W.: "Innovative Methods for Parametric Bleed Pattern Variation in Wind Tunnel Models". AFRL-RQ-WP-TR-2016-0061, SBIR Phase I Final Report, February 2016.

62. Foster, L.E.; Stueber, T.J.; Saunders, J.D.; Sanders, B.W.; and Weir, L.J.: "Mach 2.5 to 3 Inlet Mode Transition Sequence Development for CCE-LIMX Closed-Loop Control Wind Tunnel Tests". Prepared for the 35th Joint Army-Navy-NASA-Air Force (JANNAF) Airbreathing Propulsion Meeting, Newport News, VA, May 2016.

63. Wilkin, H.L.; Maag, A.J.; Pastor-Barsi, C.M.; Foster, L.E.; Stueber, T.J.; Saunders, J.D.; Sanders, B.W.; and Weir, L.J.: "Combined-Cycle Engine Large Scale Inlet Mode Transition Experiment (CCE-LIMX) Phase 4 Program Overview". Prepared for the 36th Joint Army-Navy-NASA-Air Force (JANNAF) Airbreathing Propulsion Meeting, Newport News, VA, December 2017.

64. Foster, L.E.; Saunders, J.D.; Stueber, T.J.; Maag, A.J.; Wilkin, H.L.; Sanders, B.W.; and Weir, L.J.: "Inlet Sequence Development for Closed-Loop Controlled CCE-LIMX Mode Transition Experiments". Prepared for the 36th Joint Army-Navy-NASA-Air Force (JANNAF) Airbreathing Propulsion Meeting, Newport News, VA, December 2017.