NOMENCLATURE

A	Area
A_f	Flame area
C_d	Discharge coefficient
$c_{\rho g}$	Specific heat of gas at constant pressure
$C_{12}H_{24}$	Kerosene
CO	Carbon monoxide
CO_2	Carbon dioxide
D	Diameter
H	Lower specific energy of fuel
H_2	Hydrogen
I	Turbulence intensity
k	Turbulence kinetic energy
K	Hole pressure-drop coefficient
L	Reference length
L_e	Mixing length
$\dot{m}$	Mass flow rate
NO	Nitric oxide
NO_x	Oxides of nitrogen
O_2	Oxygen
P	Pressure
q	Fuel/Air ratio by mass

q_{an}	Annulus dynamic pressure
Q	Volume rate of flow
R	Reference radius
S_T	Turbulent flame speed
T	Temperature
u', w'	Turbulent velocity fluctuations
UHC	Unburnt hydrocarbons
V	Velocity
v_θ	Tangential velocity component
v_r	Radial velocity component
v_z	Axial velocity component
x, y, z	Cartesian coordinates

Greek Alphabet

ϕ	Equivalence ratio
ρ	Density
α	Flow coefficient
Δ	Increment or change in quantity
ε	Rate of dissipation
η	Efficiency
ρ	Density
θ	Loading parameter
θ_j	Jet angle

Superscripts

$\bar{(\,)}$	Mean value

Subscripts

1,3	Upstream of a specific point
2,4	Downstream of a specific point
a	Air
atm	Atmosphere
comb	Combustor
eff	Effective
f	Fuel
max	Maximum
ref	Reference
t	Throat

REFERENCES

[1] Dong, M., Lin, T.-K., Lilley, D.G., *Flowfield prediction and color graphic interpretation*, Computers in Engineering, Vol. 2, 1994

[2] Smith, K., Fahme, A., *Testing of a full scale, low emissions ceramic gas turbine combustor*, International Gas Turbine and Aeroengine Congress and Exhibition, 1997

[3] Bauer, H.J., Scherrer, B., Wittig, S., *Local measurements in a three dimensional jet-stabilized model combustor*, International Gas Turbine and Aeroengine Congress and Exhibition, 1995

[4] Charles, R.E., Samuelsen, G.S., *An experimental data base for the computational fluid dynamics of combustors*, International Gas Turbine and Aeroengine Congress and Exhibition, 1988

[5] Bicen, A.F., Heitor, M.V., Whitelaw, J.H., *Velocity and temperature measurements in a can-type gas-turbine combustor*, Advanced Instrumentation for Aero Engine Components, 1986

[6] Bicen, A.F., Senda, M. & Whitelaw, J.H., *Scalar characteristics of combusting flow in a model annular combustor*, International Gas Turbine and Aeroengine Congress and Exhibition, 1988

[7] Cameron, C.D., Brouwer, J., Wood, C.P., Samuelsen, G.S., *A detailed characterization of the velocity and thermal fields in a model can combustor with wall jet injection*, International Gas Turbine and Aeroengine Congress and Exhibition, 1988

[8] Brum, R.D., Samuelsen, G.S., *Two-component laser anemometry measurements of non-reacting and reacting complex flows in a swirl-stabilized combustor*, Experiments in Fluids, 1987

[9] Black, J.D., Brocklehurst, H.T., & Priddin, C.H., *Non-intrusive thermometry in liquid kerosene fuelled combustor sector rigs using coherent anti-stokes raman (CARS) and comparison with CFD temperature predictions*, International Gas Turbine and Aeroengine Congress and Exhibition, 1996

[10] Crocker, D.S., Nickolaus, D., Smith, C.E., *CFD modeling of a gas turbine combustor from compressor exit to turbine inlet*, Journal of Engineering for Gas Turbines and Power, Vol. 121, 1999

[11] Peters, J.E., *Current gas turbine combustion and fuels research and devlopment*, Journal of Propulsion, Vol. 4, No.3, 1987

[12] Sanborn, J.W., Lenertz, J.E., Johnson, J.D., *Advanced turbofan engine combustion system design and test verification*, Journal of Propulsion, Vol. 5, No. 4, 1987

[13] Wild, P.N., Boysan F., Swithenbank, J., *Spray combustor modelling*, Journal of the institute of energy, March 1988

[14] Etemad, S., Forbes, B.C., *CFD modelling of a gas turbine combustor air swirler effect*, Computational Fluid Dynamics in Aeropropulsion, 1995

[15] Cline, Michael C., Micklow, Gerald J., Yang, S.L., Nguyen, H. Lee, *Numerical analysis of the flowfields in a staged gas turbine combustor*, Journal of Propulsion and Power, Vol. 11, No. 5, 1995

[16] Koopman, Johannes W., Griebel, Peter, Hassa, Christoph, *Numerical and experimental investigation of a rich quench lean combustor sector*, International Gas Turbine and Aeroengine Congress and Exhibition, 1996

[17] Baron, F., Kanniche, M., Mechitoua, N., *Influence of inlet conditions on flow and combustion characteristics of a model annular combustor*, International Gas Turbine and Aeroengine Congress and Exhibition, 1994

[18] Biswas, D., Kawano, K., Iwasaki, H., Ishizuka, M., Yamanaka, S., *Three-dimensional computation of gas turbine combustors and the validation studies of turbulence and combustion models*, International Gas Turbine and Aeroengine Congress and Exhibition, 1997

[19] Pope, Stephen B., *Simulating the performance of gas-turbine combustors*, Cornell Engineering Quarterly, 1994

[20] Dong, M., Lilley, D. G., *Combustion schemes for turbulent flames*, Combustion Modelling, Scaling and Air Toxins, 1994

[21] Markatos, N.C., *Mathematical modelling of single- and two-phase flow problems in the process industries*, Revue De L'institut Francais Du Petrole, Vol. 48, 1993

[22] Kurreck, M., Willmann, M., Wittig, S., *Prediction of the three-dimensional reacting two-phase flow within a jet-stabilized combustor*, Journal of Engineering for Gas Turbines and Power, Vol. 120, 1998

[23] Martino, P. Di, Colantuoni, S., Cirillo, L. & Cinque G., *CFD modelling of an advanced 1600K reverse-flow combustor*, International Gas Turbine and Aeroengine Congress and Exhibition, 1994

[24] Martino, P. Di, Colantuoni, S., Cirillo, L. & Cinque G., *Numerical study of an annular reverse flow gas turbine combustor*, Engineering Systems Design and Analysis, Volume 8: Part B, 1994

[25] Ebbinghaus, A., Swithenbank, J., *Mixing of multiple jets in a can combustor*, International Gas Turbine and Aeroengine Congress and Exhibition, 1995

[26] Crocker, D.S., Smith, C.E., *Numerical investigation of enhanced dilution zone mixing in a reverse flow gas turbine combustor*, Journal of Engineering for Gas Turbines and Power, Vol. 117, pp. 272-281, April 1995

[27] Hornsby, C., Norster, E.R., *Application of CFD to DLN combustion*, International Gas Turbine and Aeroengine Congress and Exhibition, 1997

[28] McGuirk, J. J., Spencer, A., *Computational methods for modelling port flows in gas-turbine combustors*, International Gas Turbine and Aeroengine Congress and Exhibition, 1995

[29] Anand, M.S., Zhu, J., Connor, C. & Razdan, M.K., *Combustor flow analysis using an advanced finite-volume design system*, International Gas Turbine and Aeroengine Congress and Exhibition, 1999

[30] Lefebvre, Arthur H., *Gas Turbine Combustion*, Hemisphere publishing corporation

[31] Harman, Richard T.C., *Gas Turbine Engineering*, Macmillan Press LTD

[32] Beckwith, T.G., Marangoni, R.D., Lienhard, J.H., *Mechanical measurements*, Addison Wesley, Fifth Edition

[33] Du Toit, C.G., *CFD modelling of a simple cylindrical combustor*, 1996

[34] Du Toit, C.G., *CFD modelling of combustor with coating*, 1996

[35] Du Toit, C.G., *CFD modelling of TFD combustor: Part III*, 1996

[36] Du Toit, C.G., *CFD modelling of TFD combustor: Part IV*, 1997

[37] Du Toit, C.G., *The simulation of combustion in the TFD combustor without a thermal barrier coating*, 1996

[38] STAR-CD, *Version 3.05 manuals*, Computational Dynamics Ltd., London, UK, 1998

[39] Moffat, Robert J., *Experimental Methods for Heat Transfer Measurements in Electronic Systems*, Flomerics Limited

[40] Hicks, R.A., Wilson, C.W., *Comparison between measured and predicted wall temperatures in a gas turbine combustor*, International Gas Turbine and Aeroengine Congress and Exhibition, 1999

[41] *The Jet Engine*, Rolls-Royce, Second edition

[42] Dreyer, A.A., Van Niekerk, J.E., *One-dimensional combustor heat transfer*, 1997

[43] Dreyer, A.A., Van Niekerk van, J.E., *One-dimensional combustor hole flow analysis*, 1996

[44] Turck, W.A., *Isotermiese metings*, 1995

[45] Turck, W.A., *Verbrandingstoetse sonder termiese beskermingslaag*, 1996

[46] Van Niekerk , J.E., *Experimental set-up for CFD combustion model verification*, 1995

[47] Van Niekerk , J.E., *Verbrandingstoetse met termiese beskermingslaag*, 1996