**NOMENCLATURE**
**(SAMPLE)**

| | |
|---|---|
| $A$ | area, $m^2$ |
| $c_p$ | specific heat at constant pressure, J/kg K |
| $\bar{c}_p$ | averaged specific heat within the range of ($T_w - T_b$); $\left(\frac{H_w - H_b}{T_w - T_b}\right)$, J/kg K |
| $D$ | inside diameter, m |
| $D_{hy}$ | hydraulic diameter, m; $\left(\frac{4\,A_{fl}}{P_{wetted}}\right)$ |
| $f$ | friction factor; $\left(\frac{\sigma_w}{\frac{G^2}{8\,\rho}}\right)$ |
| $f_d$ | drag coefficient |
| $G$ | mass flux, $kg/m^2s$; $\left(\frac{m}{A_{fl}}\right)$ |
| $g$ | gravitational acceleration, $m/s^2$ |
| $H$ | specific enthalpy, J/kg |
| $h$ | heat transfer coefficient, $W/m^2K$ |
| $HL$ | heat loss, W |
| $I$ | current, A |
| $k$ | thermal conductivity, W/m K |
| $L$ | length, m |
| $m$ | mass-flow rate, kg/s; $(\rho V)$ |

$p$ pressure, Pa

$POW$ power, W

$Q$ heat-transfer rate, W

$q$ heat flux, W/m$^2$; $\left(\frac{Q}{A_h}\right)$

$q_v$ volumetric heat flux, W/m$^3$; $\left(\frac{Q}{V_h}\right)$

$R$ molar gas constant, 8.31451 J/mol K

$R_a$ arithmetic average surface roughness, μm

$R_{el}$ electrical resistance, Ohm

$r$ radial coordinate or radius, m; regression coefficient

$T$ temperature, K

$t$ temperature, ºC

$U$ voltage, V

$u$ axial velocity, m/s

$V$ volume, m$^3$ or volumetric flow rate, m$^3$/s

$V_m$ molar volume, m$^3$/mol

$v$ radial velocity, m/s

$x, y, z$ coordinates, m

**Greek Letters**

$\alpha$ thermal diffusivity, m$^2$/s; $\left(\frac{k}{c_p\ \rho}\right)$

$\beta$ volumetric thermal expansion coefficient, 1/K

$\Delta$ difference

$\Delta_{HB}$ error in heat balance, %

$\delta$ thickness, mm

$\mu$ dynamic viscosity, Pa s

$\pi$ reduced pressure; $\left(\frac{p}{p_{cr}}\right)$

$P$ perimeter, m

$\rho$ density, kg/m$^3$

$\rho_{el}$ electrical resistivity, Ohm·m

$\sigma$ dispersion

$\sigma_w$ viscous stress, Pa

$\upsilon$ kinematic viscosity, m$^2$/s

$\xi$ friction coefficient

**Non-Dimensional Numbers**

**Ga** Galileo number; $\left(\frac{g\ D^3}{\nu^2}\right)$

**Gr** Grashof number; $\left(\frac{g\ \beta\ \Delta T\ D^3}{\nu^2}\right)$

**Gr**$_q$ modified Grashof number; $\left(\frac{g\ \beta\ q_w\ D^4}{k\ \nu^2}\right)$

**Nu** Nusselt number; $\left(\frac{h\ D}{k}\right)$

**Pr** Prandtl number; $\left(\frac{\mu\ c_p}{k}\right)=\left(\frac{\upsilon}{\alpha}\right)$

$\overline{\mathbf{Pr}}$ averaged Prandtl number within the range of $(T_w - T_b)$; $\left(\frac{\mu \ \bar{c}_p}{k}\right)$

**Re** Reynolds number; $\left(\frac{G\ D}{\mu}\right)$

**Ra** Raleigh number; (**Gr Pr**)

**St** Stanton number; $\left(\frac{\mathbf{Nu}}{\mathbf{Re\ Pr}}\right)$

Symbols with an overline at the top denote average or mean values (e.g., $\overline{\mathbf{Nu}}$ denotes average (mean) Nusselt number).

**Subscripts or Superscripts**

ac acceleration

amb ambient

ave average

b bulk

cal calculated

cr critical

cr sect cross section

dht deteriorated heat transfer

el electrical

ext external

f fluid

fl flow

fm flowmeter

fr friction

| | |
|---|---|
| g | gravitational |
| h | heated |
| HB | Heat Balance |
| hor | horizontal |
| hy | hydraulic |
| in | inlet |
| int | internal |
| iso | isothermal |
| ℓ | liquid or local |
| m | molar |
| max | maximum |
| meas | measured |
| min | minimum |
| nom | nominal or normal |
| 0 | constant properties, scale, reference, characteristic, initial, or axial value |
| out | outlet or outside |
| OD | outside diameter |
| p | pressure |
| pc | pseudocritical |
| T | value of turbulent flow |
| TS | test section |
| th | threshold value |
| tot | total |

v volumetric

vert vertical

w wall

**Acronyms and abbreviations widely used in text and list of references**

AC Alternating Current

A/D Analog-to-Digital (conversion)

A/I Analog Input

AECL Atomic Energy of Canada Limited (Canada)

AERE Atomic Energy Research Establishment (UK)

AGR Advanced Gas-cooled Reactor

AIAA American Institute of Aeronautics and Astronautics

AIChE American Institute of Chemical Engineers

ANS American Nuclear Society

ASME American Society of Mechanical Engineers

ASHRAE American Society of Heating, Refrigerating and Air-conditioning Engineers

AWG American Wire Gauge

BWR Boiling Water Reactor

CANDU CANada Deuterium Uranium (nuclear reactor)

CFD Computational Fluid Dynamics

CHF Critical Heat Flux

CRL Chalk River Laboratories, AECL (Canada)

DAS Data Acquisition System

DC Direct Current

| | |
|---|---|
| DOE | Department Of Energy (USA) |
| DP | Differential Pressure |
| emf | electromagnetic force |
| ENS | European Nuclear Society |
| EU | European Union |
| EXT | EXTernal |
| FA | Fuel Assembly |
| FBR | Fast Breeder Reactor |
| FM | FlowMeter |
| F/M | Ferritic-Martensitic (steel) |
| FR | Fuel Rod |
| f.s. | full scale |
| FT | Flow Transducer |
| GIF | Generation IV International Forum |
| HMT | Heat Mass Transfer |
| HT | Heat Transfer |
| HTC | Heat Transfer Coefficient |
| HTD | Heat Transfer Division |
| HTR | High Temperature Reactor |
| HVAC & R | Heating Ventilating Air-Conditioning and Refrigerating |
| IAEA | International Atomic Energy Agency (Vienna, Austria) |
| ID | Inside Diameter |
| INEEL | Idaho National Engineering and Environmental Laboratory (USA) |

| | |
|---|---|
| IP | Intermediate-Pressure (turbine) |
| IPPE | Institute of Physics and Power Engineering (Obninsk, Russia) |
| JAERI | Japan Atomic Energy Research Institute |
| JSME | Japan Society of Mechanical Engineers |
| KAERI | Korea Atomic Energy Research Institute (South Korea) |
| KPI | Kiev Polytechnic Institute (nowadays National Technical University of Ukraine "KPI") (Kiev, Ukraine) |
| KP-SKD | Channel Reactor of Supercritical Pressure (in Russian abbreviations) |
| LP | Low-Pressure (turbine) |
| LOCA | Loss Of Coolant Accident |
| LOECC | Loss Of Emergency Core Cooling |
| Ltd. | Limited |
| LWR | Light Water Reactor |
| MEI | Moscow Power Institute (Moscow, Russia) (In Russian abbreviations) |
| MIT | Massachusetts Institute of Technology (Cambridge, MA, USA) |
| MOX | Mixed Oxide (nuclear fuel) |
| NASA | National Aeronautics and Space Administration (USA) |
| NIST | National Institute of Standards and Technology (USA) |
| NPP | Nuclear Power Plant |
| OD | Outside Diameter |
| PC | Personal Computer |
| PDT | Pressure Differential Transducer |
| PLC | Programmable Logic Controller |
| ppb | parts per billion |

| | |
|---|---|
| ppm | parts per million |
| PT | Pressure Tube or Pressure Transducer |
| PWAC | Pratt & Whitney AirCraft |
| PWR | Pressurized Water Reactor |
| R | Refrigerant |
| RAS | Russian Academy of Sciences |
| RBMK | Reactor of Large Capacity Channel type (in Russian abbreviations) |
| RDIPE | Research and Development Institute of Power Engineering (Moscow, Russia) (NIKIET in Russian abbreviations) |
| R&D | Research and Development |
| RMS | Root-Mean-Square (error or surface roughness) |
| RPV | Reactor Pressure Vessel |
| RSC | Russian Scientific Centre |
| RTD | Resistance Temperature Detector |
| SCP | SuperCritical Pressure |
| SCR | SuperCritical Reactor |
| SCW | SuperCritical Water |
| SCWO | SuperCritical Water Oxidation (technology) |
| SCWR | SuperCritical Water-cooled Reactor |
| SFL | Supercritical Fluid Leaching |
| SFR | Sodium Fast Reactor |
| SKD | SuperCritical Pressure (in Russian abbreviations) |
| SMR | Steam-Methane-Reforming (process) |
| SS | Stainless Steel |
| TC | ThermoCouple |

| | |
|---|---|
| TE | TEmperature |
| TECO | TEmperature of $CO_2$ |
| TS | Test Section |
| TsKTI | Central Boiler-Turbine Institute (St.-Petersburg, Russia) (in Russian abbreviations) |
| UCG | Uranium-Carbide Grit pored over with calcium (nuclear fuel) |
| UK | United Kingdom |
| U.K.A.E.A. | United Kingdom Atomic Energy Authority (UK) |
| UNESCO | United Nations Educational, Scientific and Cultural Organization (Paris, France) |
| US or USA | United States of America |
| VHTR | Very High-Temperature Reactor |
| VNIIAM | All-Union Scientific-Research Institute of Atomic Machine Building (Russia) (in Russian abbreviations) |
| VTI | All-Union Heat Engineering Institute (Moscow, Russia) (in Russian abbreviations) |
| wt | weight |
| WWPR | Water-Water Power Reactor (“VVER” in Russian abbreviations) |