

Notes on the function gsw_dynamic_enthalpy_CT_exact(SA,CT,p)

Young (2010) has defined dynamic enthalpy h^\dagger to be the difference between enthalpy and potential enthalpy, that is, $h - h^0 = h - c_p^0 \Theta$. Hence dynamic enthalpy h^\dagger is also equal to the following pressure integral of specific volume for a seawater parcel which does not exchange heat or salt as its pressure is changed during the integration,

$$\hat{h}^\dagger(S_A, \Theta, p) = h(S_A, \Theta, p) - c_p^0 \Theta = \int_{P_0}^P \hat{v}(S_A, \Theta, p') dP', \quad (1)$$

The lower limit of the integration is $P_0 \equiv 101\,325$ Pa and the pressure integral is done with pressure in Pa (not dbar). Enthalpy and dynamic enthalpy have units of J kg^{-1} .

This function, `gsw_dynamic_enthalpy_CT_exact(SA,CT,p)`, evaluates dynamic enthalpy h^\dagger in terms of the input variables Absolute Salinity S_A Conservative Temperature Θ and pressure p . This function uses the full TEOS-10 Gibbs function $g(S_A, t, p)$ of IOC *et al.* (2010), being the sum of the IAPWS-09 and IAPWS-08 Gibbs functions.

This function is essentially the following calls to two other GSW functions,

```
t = gsw_t_from_CT(SA,CT,p);
dynamic_enthalpy_CT_exact = gsw_enthalpy_t_exact(SA,t,p) - cp0*CT;
```

References

- IAPWS, 2008: Release on the IAPWS Formulation 2008 for the Thermodynamic Properties of Seawater. The International Association for the Properties of Water and Steam. Berlin, Germany, September 2008, available from www.iapws.org. This Release is referred to in the text as **IAPWS-08**.
- IAPWS, 2009: Supplementary Release on a Computationally Efficient Thermodynamic Formulation for Liquid Water for Oceanographic Use. The International Association for the Properties of Water and Steam. Doorwerth, The Netherlands, September 2009, available from <http://www.iapws.org>. This Release is referred to in the text as **IAPWS-09**.
- IOC, SCOR and IAPSO, 2010: *The international thermodynamic equation of seawater – 2010: Calculation and use of thermodynamic properties*. Intergovernmental Oceanographic Commission, Manuals and Guides No. 56, UNESCO (English), 196 pp. Available from <http://www.TEOS-10.org>
- Young, W. R., 2010: Dynamic enthalpy, Conservative Temperature, and the seawater Boussinesq approximation. *Journal of Physical Oceanography*, **40**, 394–400.