

## Notes on the function gsw\_dynamic\_enthalpy\_t\_exact(SA,t,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  $\text{J kg}^{-1}$ .

This function, `gsw_dynamic_enthalpy_t_exact(SA,t,p)`, evaluates dynamic enthalpy  $h^\dagger$  in terms of the input variables Absolute Salinity  $S_A$  *in situ* temperature  $t$  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,

```
CT = gsw_CT_from_t(SA,t,p);
dynamic_enthalpy_t_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](http://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.