Table S7-unbalanced exchange rxns

| Reaction Abreviation |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Exch_10fthf[e] | N: -7 | C: -20 | O: -7 | H: -21 | charge: 2 |  |  |
| Exch_5fthf[e] | N: -7 | C: -20 | O: -7 | H: -21 | charge: 2 |  |  |
| Exch_5mta[e] | S: -1 | N: -5 | C: -11 | O: -3 | H: -15 |  |  |
| Exch_accoa[e] | S: -1 | $\mathrm{N}:-7$ | C: -23 | O: -17 | P: -3 | H: -34 | charge: 4 |
| Exch_ade[e] | N: -5 | C: -5 | H: -5 |  |  |  |  |
| Exch_adocbl[e] | N: -18 | K: -1 | C: -72 | O: -17 | P: -1 | H: -100 |  |
| Exch_adp[e] | N: -5 | C: -10 | O: -10 | P: -2 | H: -12 | charge: 3 |  |
| Exch_ahcys[e] | S: -1 | N : -6 | C: -14 | O: -5 | H: -20 |  |  |
| Exch_ala-L[e] | $\mathrm{N}:-1$ | C: -3 | O: -2 | H: -7 |  |  |  |
| Exch_amet[e] | S: -1 | N : -6 | C: -15 | O: -5 | H: -23 | charge: -1 |  |
| Exch_amp[e] | N: -5 | C: -10 | O: -7 | P: -1 | H: -12 | charge: 2 |  |
| Exch_arg-L[e] | $\mathrm{N}:-4$ | C: -6 | O: -2 | H: -15 | charge: -1 |  |  |
| Exch_asn-L[e] | $\mathrm{N}:-2$ | C: -4 | O: -3 | H: -8 |  |  |  |
| Exch_asp-L[e] | $\mathrm{N}:-1$ | C: -4 | O: -4 | H: -6 | charge: 1 |  |  |
| Exch_atp[e] | $\mathrm{N}:-5$ | C: -10 | O: -13 | P: -3 | H: -12 | charge: 4 |  |
| Exch_C10H8O5[e] | C: -10 | O: -5 | H: -8 | charge: 2 |  |  |  |
| Exch_C9H9O4[e] | C: -9 | O: -4 | H: -9 | charge: 1 |  |  |  |
| Exch_cdp[e] | $\mathrm{N}:-3$ | C: -9 | O: -11 | P: -2 | H: -12 | charge: 3 |  |
| Exch_chor[e] | C: -10 | O: -6 | H: -8 | charge: 2 |  |  |  |
| Exch_cmp[e] | $\mathrm{N}:-3$ | C: -9 | O: -8 | P: -1 | H: -12 | charge: 2 |  |
| Exch_coa[e] | S: -1 | N: -7 | C: -21 | O: -16 | P: -3 | H: -32 | charge: 4 |
| Exch_ctp[e] | $\mathrm{N}:-3$ | C: -9 | O: -14 | P: -3 | H: -12 | charge: 4 |  |
| Exch_cys-L[e] | S: -1 | $\mathrm{N}:-1$ | C: -3 | O: -2 | H: -7 |  |  |
| Exch_dad-5[e] | N: -5 | C: -10 | O: -3 | H: -13 |  |  |  |
| Exch_dmpp[e] | C: -5 | O: -7 | P: -2 | H: -9 | charge: 3 |  |  |
| Exch_fad[e] | $\mathrm{N}:-9$ | C: -27 | O: -15 | P: -2 | H: -31 | charge: 2 |  |
| Exch_fadh2[e] | N: -9 | C: -27 | O: -15 | P: -2 | H: -33 | charge: 2 |  |
| Exch_Fe(2)[e] | F: -1 | charge: -2 |  |  |  |  |  |
| Exch_Fe(3)[e] | F: -1 | charge: -3 |  |  |  |  |  |
| Exch_fldox[e] | x: -1 |  |  |  |  |  |  |
| Exch_fldrd[e] | x: -1 | H: -2 |  |  |  |  |  |
| Exch_for[e] | C: -1 | O: -2 | H: -1 | charge: 1 |  |  |  |
| Exch_gdp[e] | N: -5 | C: -10 | O: -11 | P: -2 | H: -12 | charge: 3 |  |
| Exch_gln-L[e] | $\mathrm{N}:-2$ | C: -5 | O: -3 | H: -10 |  |  |  |
| Exch_glu-L[e] | $\mathrm{N}:-1$ | C: -5 | O: -4 | H: -8 | charge: 1 |  |  |
| Exch_glx[e] | C: -2 | O: -3 | H: -1 | charge: 1 |  |  |  |
| Exch_gly[e] | $\mathrm{N}:-1$ | C: -2 | O: -2 | H: -5 |  |  |  |
| Exch_gmp[e] | N: -5 | C: -10 | O: -8 | P: -1 | H: -12 | charge: 2 |  |
| Exch_gtp[e] | $\mathrm{N}:-5$ | C: -10 | O: -14 | P: -3 | H: -12 | charge: 4 |  |
| Exch_gua[e] | $\mathrm{N}:-5$ | C: -5 | O: -1 | H: -5 |  |  |  |
| Exch_h[e] | H: -1 | charge: -1 |  |  |  |  |  |
| Exch_h20[e] | O: -1 | H: -2 |  |  |  |  |  |
| Exch_h2s[e] | S: -1 | H: -2 |  |  |  |  |  |
| Exch_hco3[e] | C: -1 | O: -3 | H: -1 | charge: 1 |  |  |  |
| Exch_his-L[e] | $\mathrm{N}:-3$ | C: -6 | O: -2 | H: -9 |  |  |  |
| Exch_ile-L[e] | $\mathrm{N}:-1$ | C: -6 | O: -2 | H: -13 |  |  |  |
| Exch_leu-L[e] | $\mathrm{N}:-1$ | C: -6 | O: -2 | H: -13 |  |  |  |
| Exch_lys-L[e] | $\mathrm{N}:-2$ | C: -6 | O: -2 | H: -15 | charge: -1 |  |  |
| Exch_met-L[e] | S: -1 | $\mathrm{N}:-1$ | C: -5 | O: -2 | H: -11 |  |  |


| Exch_mg2[e] | \|M: -1 | charge: -2 |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Exch_nad[e] | $\mathrm{N}:-7$ | C: -21 | O: -14 | P: -2 | H: -26 | charge: 1 |
| Exch_nadh[e] | $\mathrm{N}:-7$ | C: -21 | O: -14 | P: -2 | H: -27 | charge: 2 |
| Exch_nadp[e] | $\mathrm{N}:-7$ | C: -21 | O: -17 | P: -3 | H: -25 | charge: 3 |
| Exch_nadph[e] | $\mathrm{N}:-7$ | C: -21 | O: -17 | P: -3 | H: -26 | charge: 4 |
| Exch_nh3[e] | $\mathrm{N}:-1$ | H: -3 |  |  |  |  |
| Exch_phe-L[e] | $\mathrm{N}:-1$ | C: -9 | O: -2 | H: -11 |  |  |
| Exch_pi[e] | O: -4 | P: -1 | H: -1 | charge: 2 |  |  |
| Exch_ppi[e] | O: -7 | P: -2 | H: -1 | charge: 3 |  |  |
| Exch_pro-L[e] | $\mathrm{N}:-1$ | C: -5 | O: -2 | H: -9 |  |  |
| Exch_pydx5p | $\mathrm{N}:-1$ | C: -8 | O: -6 | P: -1 | H: -8 | charge: 2 |
| Exch_selnp[e] | E: -1 | O: -3 | P: -1 | H: -2 | charge: 1 |  |
| Exch_ser-L[e] | $\mathrm{N}:-1$ | C: -3 | O: -3 | H: -7 |  |  |
| Exch_so4[e] | S: -1 | O: -4 | charge: 2 |  |  |  |
| Exch_sprm[e] | $\mathrm{N}:-4$ | C: -10 | H: -30 | charge: -4 |  |  |
| Exch_thf[e] | $\mathrm{N}:-7$ | C: -19 | O: -6 | H: -21 | charge: 2 |  |
| Exch_thr-L[e] | $\mathrm{N}:-1$ | C: -4 | O: -3 | H: -9 |  |  |
| Exch_trdox[e] | X: -1 |  |  |  |  |  |
| Exch_trdrd[e] | $x:-1$ | H: -2 |  |  |  |  |
| Exch_trp-L[e] | $\mathrm{N}:-2$ | C: -11 | O: -2 | H: -12 |  |  |
| Exch_tyr-D[e] | $\mathrm{N}:-1$ | C: -9 | O: -3 | H: -11 |  |  |
| Exch_tyr-L[e] | $\mathrm{N}:-1$ | C: -9 | O: -3 | H: -11 |  |  |
| Exch_udp[e] | $\mathrm{N}:-2$ | C: -9 | O: -12 | P: -2 | H: -11 | charge: 3 |
| Exch_ump[e] | $\mathrm{N}:-2$ | C: -9 | O: -9 | P: -1 | H: -11 | charge: 2 |
| Exch_utp[e] | $\mathrm{N}:-2$ | C: -9 | O: -15 | P: -3 | H: -11 | charge: 4 |
| Exch_val-L[e] | $\mathrm{N}:-1$ | C: -5 | O: -2 | $\mathrm{H}:-11$ |  |  |
| Exch_zn2[e] | Z: -1 | charge: -2 |  |  |  |  |

