

Documentation on Input Format for Water-Source Capability
using Smooth or Fluted Tube-in-Tube Water-to-Ref HXs

Reference: Rousseau P.G., M. van Eldik, G.P. Greyvenstein, "Detailed simulation of fluted tube water heating condensers", *International Journal of Refrigeration* 26 (2003) 232-239.

Mark 7, Version 07a

C.K. Rice, ORNL, Nov 14, 2007

Modifications made to use water-to-refrigerant HXs in the ORNL HPDM
Also new input for scaling or specifying indoor air-side flow resistances
and for specifying water loop pressure drops, if desired.

Nov 07 Updates --- Improved glycol properties, freezing point calculations, glycol % now
in weight % just as for the brines, ethanol added. Option completed for water in annulus
of w-to-ref HX.

Starting with the first input line of the HX coil data, the following are the current
input definitions for use with water to refrigerant HXs. Seven fluid types are currently
available for use with the water-source version

C FIRST HX INPUT LINE (FOR EITHER INDOOR OR OUTDOOR HX WITH DIFFERENCES NOTED)

C GENERAL INPUT FOR WATER-TO-REFRIGERANT HX
C TAIL - WATER TEMPERATURE ENTERING HEAT EXCHANGER (F)
C TWBI - FRACTION OR % GLYCOL/BRINE CONC.
C IF>1.0, WEIGHT %
C IF<1.0, WEIGHT FRACTION
C ITYHX - FLAG FOR HX TYPE
C =0, FOR AIR-TO-REFRIGERANT
C =1, FOR WATER-TO-REFRIGERANT
C ITYGL - FLAG FOR TYPE OF GLYCOL/BRINE

C =1, FOR NO GLYCOL, WATER ONLY
C =2, FOR PROPYLENE GLYCOL
C =3, FOR ETHYLENE GLYCOL
C =4, FOR SODIUM CHLORIDE
C =5, FOR CALCIUM CHLORIDE
C =6, FOR METHANOL
C =7, FOR ETHANOL

C IFLCF - FLAG FOR HX FLUID CONFIGURATION
C =0, WATER ON INSIDE, REFRIGERANT IN OUTSIDE ANNULUS(default)
C =1, WATER IN OUTSIDE ANNULUS, REFRIGERANT ON INSIDE

C

C NEXT LINE

C FRQ - PUMP OPERATING SPEED PARAMETER
C > 5 OPERATING DRIVE FREQUENCY (HZ)
C <=5 OPERATING DRIVE FREQUENCY RATIO
C RELATIVE TO NOMINAL FREQUENCY 'FRQNM';
C FRQNM - NOMINAL PUMP DRIVE FREQUENCY (HZ)

C QANM - NOMINAL WATER FLOW RATE (GPM)
C >0, THE STANDARD GPM (SGPM) for a default or specified pump inlet temp.
C <0, THE NEGATIVE OF THE ACTUAL GPM (AGPM)
C (CONVERTED IMMEDIATELY TO SGPM in DATAIN,
C based on given inlet conditions to the unit)

C SIZMT - NOMINAL PUMP MOTOR SIZE (HP)
C (ONLY USED IF ICH = 3 AND FANEF <= 1.0)
C IF > 0.0, USED TO DETERMINE RELATIVE MOTOR LOADING
C AND RESULTANT PM-ECM EFFICIENCY
C IF <= 0.0, DENOTES THAT MOTOR EFFICIENCY IS TO BE
C EVALUATED AT NOMINAL LOAD
C AND THAT (IF FRQ = FRQNM)
C THE REQUIRED MOTOR SIZE IS TO BE CALCULATED.

C FANEF IF > 1.0, SPECIFY DIRECTLY THE REFERENCE POWER DRAW (WATTS)
C AT NOMINAL WATER FLOW RATE
C AT REFERENCE UPSTREAM PUMP INLET WATER TEMPERATURES

C NOTE:TENTATIVE #s OF 100 F HEATING, 50 F COOLING -- INDOOR COIL,
C OF 50 F HEATING, 100 F COOLING -- OUTDOOR COIL,
C OR REFERENCE DOWNSTREAM PUMP INLET WATER TEMPERATURES
C NOTE:TENTATIVE #s OF 110 F HEATING, 40 F COOLING -- INDOOR COIL,

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C          OF 40 F HEATING, 110 F COOLING -- OUTDOOR COIL,
C          (MODEL PREDICTED PRESSURE DROPS ARE NOT USED
C          IN CALCULATING PUMP POWER IN THIS OPTION);
C  FANEF    IF = 0.0, PUMP POWER TO BE SPECIFIED AS PER UNIT FLOW (WATTS/GPM)
C          (USING WDF(IDF or ODF) VARIABLE LATER ON SAME INPUT LINE)
C  FANEF    IF <= 1.0 but >0.0,
C          SPECIFIED VALUE OF SEPARATE OR COMBINED
C          EFFICIENCIES OF PUMP AND/OR DRIVE :
C.....the rest of FANEF settings the same as for air-to-ref HX
C
C  INDOOR COIL VARIABLES ONLY:
C  DLOOP - IF > 0, PRESSURE DROP COEFFICIENT SO THAT DP_EXT=DLOOP*Q^2
C          WHERE DLOOP=DP_ref/(Q_ref**2), UNITS OF INCHES H2O/GPM^2
C          IF <=0, SPECIFIED EXTERNAL (CIRCUIT) PRESSURE DROP (INCHES H2O)
C  FIXCAP - HOUSE HEATING LOAD (USED TO CALCULATE RESISTANCE HEAT)
C          (BTU/H)
C  OUTDOOR COIL VARIABLES ONLY:
C  MFANFT - FLAG FOR USING STATIC EFFICIENCY VS. SPECIFIC SPEED CURVE FIT
C          FOR THE EFFICIENCY OF THE OUTDOOR PUMP --
C
C          =0, SPECIFIED VALUE OF 'FANEF' IS USED;
C          =1, CURVE FIT FOR PUMP STATIC EFFICIENCY IS USED
C          WITH PUMP MOTOR EFFICIENCY EITHER
C          SPECIFIED IN 'FANEF' OR CALCULATED INTERNALLY.
C  NEWER COIL VARIABLES
C  TRF - REFERENCE PUMP INLET TEMPERATURE(F) FOR PUMP TEST WHERE SGPM
C          AND PUMP POWER WERE DETERMINED
C          IF > 0.0, REFERENCE TEMPERATURE AT PUMP INLET (F)
C          (This is now the recommended way to specify temps for a downstream pump.)
C          IF = 0.0, DEFAULT VALUES FOR A DOWNSTREAM PUMP ARE ASSUMED
C          IF < 0.0, INDICATES THAT FLOWS ARE TO BE CALCULATED

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DIRECTLY FROM GIVEN SGPMS.

C WDF - PUMP POWER VALUE PER GPM (WATTS/GPM),
C 40W/GPM INDOOR LOOP (DEFAULT)
C 30W/GPM OUTDOOR LOOP (DEFAULT)
C
C INDOOR COIL ONLY
C IHETRV- FLAG TO OMIT HEATER IF SET TO 1
C CAPAPP - INDOOR ONLY -- APPLIED NOMINAL COOLING CAPACITY
C OF FILTER AND HEATER SECTIONS (TONS)
C USED TO SCALE FILTER AND HEATER VALUES BY CAPAPP/CAPDEF, CAPDEF=2.5 TONS
C IF =0,0, THEN DEFAULT FILTER AND HEATER VALUES OR THOSE
C PROVIDED AS INPUT BELOW WILL BE USED
C AFLTRV - INDOOR ONLY -- APPLIED AREA OF FILTER SECTION,
C USE DEFAULT IF NO ENTRY OR SET TO 0.0
C AHETRV - INDOOR ONLY -- APPLIED AREA OF HEATER SECTION,
C USE DEFAULT IF NO ENTRY OR SET TO 0.0
C RACKSV - INDOOR ONLY -- NUMBER OR HEATER ELEMENTS (1-4),
C USE DEFAULT (3) IF NO ENTRY OR SET TO 0.0
C OUTDOOR COIL ONLY
C DLOOP - IF > 0, PRESSURE DROP COEFFICIENT SO THAT $DP_{EXT}=DLOOP*Q^2$
C WHERE $DLOOP=DP_{ref}/(Q_{ref}^{**2})$, UNITS OF INCHES H2O/GPM^2
C IF <=0, SPECIFIED EXTERNAL (CIRCUIT) PRESSURE DROP (INCHES H2O)
C

C NEXT LINE

C AAF - HEAT EXCHANGER ACTIVE UNCOILED LENGTH (L_{hx}) (FT)
C NT - NUMBER OF HX FLUTES (=0 FOR A SMOOTH TUBE)
C NSECT - NUMBER OF PARALLEL HX UNITS (Typically 1)
C WT - FLUTED TUBE OUTSIDE SURFACE AREA / UNIT LENGTH (FT), S_{vo}/L_{hx}
C IF VALUES ARE > 1 , THEN TAKEN AS SURFACE AREA (FT²)
C IF ZERO, WILL CALCULATE ASSUMING SMOOTH CIRCULAR GEOMETRY (as $\pi * D_{vo}$)
C ST - FLUTED TUBE INSIDE SURFACE AREA / UNIT LENGTH (FT), S_{vi}/L_{hx}
C IF VALUES ARE > 1 , THEN TAKEN AS SURFACE AREA (FT²)
C IF ZERO, CALCULATE FROM SMOOTH CIRCULAR GEOMETRY (as $\pi * D_{vi}$)
C RTB - TOTAL # OF HX TURNS (ALL CIRCUITS)
C NSECS - NUMBER OF PARALLEL CIRCUITS IN SUBCOOLED REGION OF HX
C (ONLY ACTIVE FOR CONDENSING MODE), TYPICALLY 1 FOR TUBE-IN-TUBE HXS
C (NSECS >1 HAS NOT YET BEEN TESTED)
C NCNFG - FLAG TO SPECIFY TYPE OF HX CONFIGURATION
C = 0, DEFAULT (SET TO COUNTERFLOW FOR WATER-TO-REF HX)
C = 1, FOR CROSS FLOW (NOT ACTIVE)
C = 2, FOR CROSS COUNTERFLOW (NOT ACTIVE)
C = 3, FOR CROSS PARALLEL FLOW (NOT ACTIVE)
C = 4, FOR COUNTERFLOW (ACTIVE)
C = 5, FOR PARALLEL FLOW (ACTIVE)
C

C NEXT LINE

C FINTY - TYPE OF WATER-TO-REF HX TYPE
C 1.0 -- ANNULAR, SMOOTH TUBES
C 2.0 -- ANNULAR, FLUTED TUBES
C FP - IF <=1, FLUTE PITCH (IN)
C IF > 1, HELIX ANGLE (DEGREES)
C DELTA - FLUTE DEPTH (IN)
C DEA - OUTSIDE VOLUME-BASED DIAMETER OF INNER TUBE, D_{vo}(IN)
C D_{vo} = D_{vi} + 2* tube wall thickness
c =Do if smooth tube (IN)
C DER - INSIDE VOLUME-BASED DIAMETER OF INNER TUBE, D_{vi}(IN)
C D_{vi} = SQRT(4*TUBE INSIDE VOLUME/PI/HX LENGTH)
c =Di if smooth tube (IN)
C DEO - INNER DIAMETER OF OUTSIDE TUBE, Do,i (IN)
C XKT - THERMAL CONDUCTIVITY OF TUBES (BTU/H-FT-F)
C HCONT - CONTACT CONDUCTANCE FACTOR FOR DOUBLE-WALLED HXS
C ISURF - INTEGER SETTING TO SELECT **DEFAULT** SMOOTH OR RIFLED TUBE SETTING
C FOR REFRIGERANT-SIDE
C =0, FOR SMOOTH TUBE (default)
C =1, FOR RIFLED TUBE

C NEXT LINE (not)

C NO BLANK LINE FOR FIN GEOMETRY

C

C NEXT LINE

C

C USER-SUPPLIED HEAT TRANSFER AND PRESSURE DROP MULTIPLIERS (ADJUSTMENT FACTORS)

C

C HTRML - REFRIGERANT-SIDE HEAT TRANSFER MULTIPLIER

C (USED HERE AS FLUTED TUBE MULTIPLIER BASED ON MANF. COIL DATA)

C PDRML - REFRIGERANT-SIDE PRESSURE-DROP MULTIPLIER

C (USED HERE AS FLUTED TUBE MULTIPLIER BASED ON MANF. COIL DATA)

C HTAML - WATER-SIDE HEAT TRANSFER MULTIPLIER

C PDAML - WATER-SIDE PRESSURE-DROP MULTIPLIER

C (USED HERE AS FLUTED TUBE MULTIPLIER BASED ON MANF. COIL DATA)

C CABML - TOTAL SYSTEM WATER-PRESSURE-DROP MULTIPLIER

C AARML - WATER-SIDE AREA MULTIPLIER FOR AUGMENTED SURFACES

C RARML - REFRIGERANT-SIDE AREA MULTIPLIER FOR AUGMENTED SURFACES

C

C END OF HX COIL INPUT