ADDENDA

ANSI/ASHRAE Addendum g to
ANSI/ASHRAE Standard 55-2020

Thermal Environmental Conditions for Human Occupancy

Approved by ASHRAE and the American National Standards Institute on April 29, 2022.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (https://www.ashrae.org/continuous-maintenance).

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FOREWORD

Addendum g makes changes to the definition of the SET temperature and to the SET code to align with international standards.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum g to Standard 55-2020

Revise Section 3 as shown. The remainder of Section 3 is unchanged.

temperature, standard effective (SET): the temperature of ~~an imaginary~~ a hypothetical isothermal environment at 50% rh, <0.1 m/s (20 fpm) average air speed V_a, and $\overline{t}_r = t_a$, in which the total heat loss from the skin of an imaginary occupant ~~with an activity level of 1.0 met and a clothing level of 0.6 clo~~ wearing clothing, standardized for the activity concerned, is the same as that from a person in the actual environment with actual clothing and activity level.

Revise Table D-1 as shown.

Table D-1 Validation Table for SET Computer Model

Temperature		MRT		Air Speed		RH			SET	
°C	°F	°C	°F	m/s	fpm	%	met	clo	°C	°F
25	77	25	77	0.15	29.5	50	1	0.5	~~23.8~~23.3	74.9
0	32	25	77	0.15	29.5	50	1	0.5	12.3	54.1
10	50	25	77	0.15	29.5	50	1	0.5	17.0	~~62.5~~62.6
15	59	25	77	0.15	29.5	50	1	0.5	19.3	66.7
20	68	25	77	0.15	29.5	50	1	0.5	21.6	~~70.8~~70.9
30	86	25	77	0.15	29.5	50	1	0.5	26.4	~~79.6~~79.5
40	104	25	77	0.15	29.5	50	1	0.5	~~34.3~~34.1	~~93.7~~93.4
25	77	25	77	0.15	29.5	10	1	0.5	23.3	~~74.0~~73.9
25	77	25	77	0.15	29.5	90	1	0.5	~~24.9~~24.8	~~76.8~~76.6
25	77	25	77	0.1	19.7	50	1	0.5	24.0	75.2
25	77	25	77	0.6	118.1	50	1	0.5	21.4	70.5
25	77	25	77	1.1	216.5	50	1	0.5	20.3	~~68.6~~68.5
25	77	25	77	3	590.6	50	1	0.5	18.8	65.8
25	77	10	50	0.15	29.5	50	1	0.5	15.2	~~59.3~~59.4
25	77	40	104	0.15	29.5	50	1	0.5	31.8	89.2
25	77	25	77	0.15	29.5	50	1	0.1	20.7	69.3
25	77	25	77	0.15	29.5	50	1	1	27.3	81.1
25	77	25	77	0.15	29.5	50	1	2	32.5	~~90.4~~90.5
25	77	25	77	0.15	29.5	50	1	4	~~37.7~~37.8	~~99.8~~100.0
25	77	25	77	0.15	29.5	50	0.8	0.5	23.3	73.9
25	77	25	77	0.15	29.5	50	2	0.5	~~29.7~~26.0	~~85.5~~78.8
25	77	25	77	0.15	29.5	50	4	0.5	~~36.0~~30.5	~~96.7~~86.9

Revise Normative Appendix D4 as shown below.

D4. COMPUTER PROGRAM FOR CALCULATION OF SET:

The following code is one implementation of the SET calculation using JavaScript in SI units. If the following code is used to calculate the cooling effect as described in Normative Appendix D, the input parameter CALCULATE_CE should be set equal to "true." Alternatively, if it is used to calculate the SET temperature CALCULATE_CE should be set to "false".

```
FindSaturatedVaporPressureTorr = function(T) {

/*
    Helper function for pierceSET calculates Saturated Vapor Pressure(Torr)
    at Temperature T (˚C)
*/

   return Math.exp(18.6686 - 4030.183/(T + 235.0));
}
pierceSET = function(TA, TR, VEL, RH, MET, CLO, WME, PATM, CALCULATE_CE=false) {

   /*
       Input variables – TA (air temperature): ˚C, TR (mean radiant temperature): ˚C,
       VEL (air speed): m/s, RH (relative humidity): %, MET: met unit, CLO: clo unit,
       WME (external work): W/m^2, PATM (atmospheric pressure): kPa
    */

   var KCLO = 0.25;
   var BODYWEIGHT = 69.9;                    //kg
   var BODYSURFACEAREA = 1.8258;             //m^2
   var METFACTOR = 58.2;                     //W/m^2
   var SBC = 0.000000056697;                 //Stefan-Boltzmann constant (W/m^2K4)
   var CSW = 170.0;
   var CDIL = 120.0200;
   var CSTR = 0.5;
   var LTIME = 60.0;
   var VaporPressure = RH * FindSaturatedVaporPressureTorr(TA)/100.0;
   var AirVelocityAirSpeed = Math.max(VEL, 0.1);
   var TempSkinNeutral = 33.7;
   var TempCoreNeutral = 36.8;
   var TempBodyNeutral = 36.49;
   var SkinBloodFlowNeutral = 6.3;
   var TempSkin = TempSkinNeutral;           //Initial values
   var TempCore = TempCoreNeutral;
   var SkinBloodFlow = SkinBloodFlowNeutral;
   var MSHIV = 0.0;
   var ALFA = 0.1;
   var ESK = 0.1 * MET;
   var PressureInAtmospheres = PATM * 0.009869;
   var RCL = 0.155 * CLO;
   var FACL = 1.0 + 0.15 * CLO;
   var LR = 2.2/PressureInAtmospheres;       //Lewis Relation is 2.2 at sea level
   var RM = MET * METFACTOR;
   var M = MET * METFACTOR;

   if (CLO <= 0) {
       var WCRIT = 0.38 * Math.pow(AirVelocityAirSpeed, -0.29);
       var ICL = 1.0;
   } else {
       var WCRIT = 0.59 * Math.pow(AirVelocityAirSpeed, -0.08);
       var ICL = 0.45;
   }
   var CHC = 3.0 * Math.pow(PressureInAtmospheres, 0.53);
   var CHCV = 8.600001 * Math.pow((AirVelocity * PressureInAtmospheres), 0.53);
   var CHC = Math.max(CHC, CHCV);
```

```
let heatTransferConvMet;
if (MET < 0.85) {
  heatTransferConvMet = 3.0;
} else {
  heatTransferConvMet = 5.66 * Math.pow(MET - 0.85, 0.39);
}
let CHC = 3.0 * Math.pow(PressureInAtmospheres, 0.53);
let CHCV = 8.600001 * Math.pow(AirSpeed * PressureInAtmospheres, 0.53);
CHC = Math.max(CHC, CHCV);
if (!CALCULATE_CE) {
  CHC = Math.max(CHC, heatTransferConvMet);
}
var CHR = 4.7;
var CTC = CHR + CHC;
var RA = 1.0/(FACL * CTC);              //Resistance of air layer to dry heat transfer
var TOP = (CHR * TR + CHC * TA)/CTC;
var TCL = TOP + (TempSkin - TOP)/(CTC * (RA + RCL));
/*
    TCL and CHR are solved iteratively using: H(Tsk - TOP) =  CTC(TCL - TOP),
    where H = 1/(RA + RCL) and RA = 1/FACL*CTC
*/

var TCL_OLD = TCL;
var flag = true;
var DRY, HFCS, ERES, CRES, SCR, SSK, TCSK, TCCR, DTSK, DTCR, TB, SKSIG, WARMS, COLDS, CRSIG,
    WARMC, COLDC, BDSIG, WARMB, COLDB, REGSW, ERSW, REA, RECL, EMAX, PRSW, PWET, EDIF, ESK;
for (var TIM = 1; TIM <= LTIME; TIM++) {  //Begin iteration
      do {
            if (flag) {
                TCL_OLD = TCL;
                CHR = 4.0 * SBC * Math.pow(((TCL + TR)/2.0 + 273.15), 3.0) * 0.72;
                CTC = CHR + CHC;
                RA = 1.0/(FACL * CTC);   //Resistance of air layer to dry heat transfer
                TOP = (CHR * TR + CHC * TA)/CTC;
            }
            TCL = (RA * TempSkin + RCL * TOP)/(RA + RCL);
            flag = true;
        } while (Math.abs(TCL - TCL_OLD) > 0.01);
        flag = false;
        DRY = (TempSkin - TOP)/(RA + RCL);
        HFCS = (TempCore - TempSkin) * (5.28 + 1.163 * SkinBloodFlow);
        ERES = 0.0023 * M * (44.0 - VaporPressure);
        CRES = 0.0014 * M * (34.0 - TA);
        SCR = M - HFCS - ERES - CRES - WME;
        SSK = HFCS - DRY - ESK;
        TCSK = 0.97 * ALFA * BODYWEIGHT;
        TCCR = 0.97 * (1 - ALFA) * BODYWEIGHT;
        DTSK = (SSK * BODYSURFACEAREA)/(TCSK * 60.0); //°C/min
        DTCR = SCR * BODYSURFACEAREA/(TCCR * 60.0);   //°C/min
        TempSkin = TempSkin + DTSK;
        TempCore = TempCore + DTCR;
        TB = ALFA * TempSkin + (1 - ALFA) * TempCore;
        SKSIG = TempSkin - TempSkinNeutral;
                    if (SKSIG > 0) {
                         WARMS = SKSIG;
                         COLDS = 0.0;
 }
                   else {
          WARMS = 0.0;
          COLDS = -1.0 * SKSIG;
    }
        CRSIG = (TempCore - TempCoreNeutral);
     if (CRSIG > 0) {
          WARMC = CRSIG;
```

```
            COLDC = 0.0;
 }
      else {
           WARMC = 0.0;
           COLDC = -1.0 * CRSIG;
    }
        BDSIG = TB - TempBodyNeutral;
        WARMB = (BDSIG > 0) * BDSIG;
        SkinBloodFlow = (SkinBloodFlowNeutral + CDIL * WARMC)/(1 + CSTR * COLDS);
        SkinBloodFlow = Math.max(0.5, Math.min(90.0, SkinBloodFlow));
        REGSW = CSW * WARMB * Math.exp(WARMS/10.7);
        REGSW = Math.min(REGSW, 500.0);
        var ERSW = 0.68 * REGSW;

       //Evaporative resistance of air layer
        var REA = 1.0/(LR * FACL * CHC);
       //Evaporative resistance of clothing (icl=.45)
        var RECL = RCL/(LR * ICL);
        var EMAX = (FindSaturatedVaporPressureTorr(TempSkin) - VaporPressure)/(REA + RECL);
        var PRSW = ERSW/EMAX;
        var PWET = 0.06 + 0.94 * PRSW;
        var EDIF = PWET * EMAX - ERSW;
        var ESK = ERSW + EDIF;
        if (PWET > WCRIT) {
            PWET = WCRIT;
            PRSW = WCRIT/0.94;
            ERSW = PRSW * EMAX;
            EDIF = 0.06 * (1.0 - PRSW) * EMAX;
            ESK = ERSW + EDIF;
        }
        if (EMAX < 0) {
            EDIF = 0;
            ERSW = 0;
            PWET = WCRIT;
            PRSW = WCRIT;
            ESK = EMAX;
        }
        ESK = ERSW + EDIF;
        MSHIV = 19.4 * COLDS * COLDC;
        M = RM + MSHIV;
        ALFA = 0.0417737 + 0.7451833/(SkinBloodFlow + 0.585417);
    }                          //End iteration

var HSK = DRY + ESK;           //Total heat loss from skin
var RN = M - WME;              //Net metabolic heat production
var ECOMF = 0.42 * (RN - (1 * METFACTOR));
if (ECOMF < 0.0) ECOMF = 0.0;  //From Fanger
EMAX = EMAX * WCRIT;
var W = PWET;
var PSSK = FindSaturatedVaporPressureTorr(TempSkin);
var CHRS = CHR;                //Definition of ASHRAE standard environment... denoted "S"
if (MET < 0.85) {
var CHCS = 3.0;
} else {
        var CHCS = 5.66 * Math.pow(((MET - 0.85)), 0.39);
        CHCS = Math.max(CHCS, 3.0);
    }
CHCS = 3.0 * Math.pow(PressureInAtmospheres, 0.53);
if (!CALCULATE_CE && MET > 0.85) {
  CHCS = Math.max(CHCS, heatTransferConvMet);
}
if (CHCS < 3.0) CHCS = 3.0;
var CTCS = CHCS + CHRS;
var RCLOS = 1.52/((MET - WME/METFACTOR) + 0.6944) - 0.1835;
var RCLS = 0.155 * RCLOS;
var FACLS = 1.0 + KCLO * RCLOS;
```

```
var FCLS = 1.0/(1.0 + 0.155 * FACLS * CTCS * RCLOS);
var IMS = 0.45;
var ICLS = IMS * CHCS/CTCS * (1 – FCLS)/(CHCS/CTCS – FCLS * IMS);
var RAS = 1.0/(FACLS * CTCS);
var REAS = 1.0/(LR * FACLS * CHCS);
var RECLS = RCLS/(LR * ICLS);
var HD_S = 1.0/(RAS + RCLS);
var HE_S = 1.0/(REAS + RECLS);
//SET determined using Newton’s iterative solution
var DELTA = .0001;
var dx = 100.0;
var SET, ERR1, ERR2;
var SET_OLD = TempSkin – HSK/HD_S;       //Lower bound for SET
while (Math.abs(dx) > .01) {
       ERR1 = (HSK – HD_S * (TempSkin – SET_OLD) – W * HE_S * (PSSK – 0.5 *
    FindSaturatedVaporPressureTorr(SET_OLD)));
       ERR2 = (HSK – HD_S * (TempSkin – (SET_OLD + DELTA)) – W * HE_S * (PSSK – 0.5 *
    FindSaturatedVaporPressureTorr((SET_OLD + DELTA))));
        SET = SET_OLD – DELTA * ERR1/(ERR2 – ERR1);
        dx = SET – SET_OLD;
        SET_OLD = SET;
    }
    return SET;
}
```

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ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

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The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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