HFC-143a (Lemmon and Jacobsen)

1 Temperature Scale

International Temperature Scale of 1990 (ITS-90)

2 Libraries and Single Shot Programs

Library for UNIX	libdr143a_lj.a
Library for Windows	dr143a_lj.lib/ dr143a_lj.dll
Single shot program for UNIX	dr143a_lj-ss
Single shot program for Windows	dr143a_lj-ss.exe

3 Fundamental Constants

Molecular formula	CH_3CF_3
Molar mass	$M = 84.0410$ g/mol
Gas constant	$R = 98.9335$ J/(kg·K)
Critical temperature	$T_c = 345.8570$ K (72.7070 ° C)
Critical pressure	$P_c = 3.7610$ MPa
Critical specific volume	$v_c = 0.002320$ m^3/kg
Triple-point temperature	$T_t = 161.340$ K (−111.810 ° C)
Triple-point pressure	$P_t = 1.0749$ Pa

4 Reference State

The specific enthalpy and the specific entropy of the saturated liquid at 273.15 K are 200 J/kg and 1.0 J/(kg·K), respectively.

5 Valid Range of Equation of State

Upper limit of temperature	$T_{max} = 650$ K
Lower limit of temperature	$T_{min} = 161.340$ K
Upper limit of pressure	$P_{max} = 50$ MPa

6 References

Equation of state and Melting pressure:

E. W. Lemmon and R. T. Jacobsen, An International Standard Formulation for the Thermodynamic Properties of 1,1,1-Trifluoroethane (HFC-143a) for Temperatures From 161 K to 450 K and Pressures to 50 MPa, J. Phys. Chem. Eng. Data, 29, 4, pp.521-552, (2000).

Transport properties:

The current version of this library has not supported the calculation of the transport properties yet.

7 Available Functions and Valid Range of Parameters

All functions listed below have the return value and argument(s) in single precision. The functions with the return value and argument(s) in double precision begin with "D" prefix, for instance, double precision functions corresponding to PST and HPT in single precision are DPST and DHPT, respectively.

Function	Return value and Argument(s)	Valid range of argument(s)
AIPPT(P,T)	N/A	
AJTPT(P,T)	AJTPT: Joule-Thomson coefficient [K/Pa] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
AKPD(P)	AKPD: Isentropic exponent of saturated liquid [-] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
AKPDD(P)	AKPDD: Isentropic exponent of saturated vapor [-] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
AKPT(P,T)	AKPT: Isentropic exponent [-] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
AKTD(T)	AKTD: Isentropic exponent of saturated liquid [-] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
AKTDD(T)	AKTDD: Isentropic exponent of saturated vapord [-] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
ALAPP(P)	N/A	
ALAPT(T)	N/A	
ALHP(P)	ALHP: Latent Heat of Vaporization [J/kg] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
ALHT(T)	ALHT: Latent Heat of Vaporization [J/kg] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
ALMPD(P)	N/A	
ALMPDD(P)	N/A	
ALMPT(P,T)	N/A	
ALMTD(T)	N/A	
ALMTDD(T)	N/A	
AMUPD(P)	N/A	
AMUPDD(P)	N/A	
AMUPT(P,T)	N/A	
AMUTD(T)	N/A	
AMUTDD(T)	N/A	
BPPT(P,T)	BPPT: Volumetric coefficient of expansion [1/K] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
BSPT(P,T)	BSPT: Isentropic compressibility [1/Pa] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
BTPT(P,T)	BTPT: Isothermal compressibility [1/Pa] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
BVPT(P,T)	BVPT: Pressure coefficient [1/K] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
CPPD(P)	CPPD: Isobaric heat capacity of saturated liquid [J/(kg·K)] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
CPPDD(P)	CPPDD: Isobaric heat capacity of saturated vapor [J/(kg·K)] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
CPPT(P,T)	CPPT: Isobaric heat capacity [J/(kg·K)] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
CPTD(T)	CPTD: Isobaric heat capacity of saturated liquid [J/(kg·K)] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
CPTDD(T)	CPTDD: Isobaric heat capacity of saturated vapor [J/(kg·K)] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$

Function	Return value and Argument(s)	Valid range of argument(s)
CRP(A)	CRP: Critical Constants $A = 'H'$: specific enthalpy, 358.906 kJ/kg $A = 'P'$: pressure, 3.7610 MPa (37.610 bar) $A = 'S'$: specific entropy, 1.4906 kJ/(kg·K) $A = 'T'$: temperature, 345.8570 K (72.7070 $^\circ$C) $A = 'V'$: specific volume, 0.002320 m^3/kg	'H', 'P', 'S', 'T', and 'V'
CVPD(P)	CVPD: Isochoric heat capacity of saturated liquid [J/(kg·K)] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
CVPDD(P)	CVPDD: Isochoric heat capacity of saturated vapor [J/(kg·K)] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
CVPT(P, T)	CVPT: Isochoric heat capacity [J/(kg·K)] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
CVTD(T)	CVTD: Isochoric heat capacity of saturated liquid [J/(kg·K)] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
CVTDD(T)	CVTDD: Isochoric heat capacity of saturated vapor [J/(kg·K)] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
EPSPD(P)	N/A	
EPSPDD(P)	N/A	
EPSPT(P, T)	N/A	
EPSTD(T)	N/A	
EPSTDD(T)	N/A	
FC(A)	FC: Fundamental constants $A = 'M'$: Molar mass, 84.0410 g/mol $A = 'R'$: Gas constant, 98.9335 J/(kg·K)	'M' and 'R'
GAMPD(P)	GAMPD: Heat capacity ratio of saturated liquid [-] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
GAMPDD(P)	GAMPDD: Heat capacity ratio of saturated vapor [-] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
GAMPT(P, T)	GAMPT: Heat capacity ratio [-] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
GAMTD(T)	GAMTD: Heat capacity ratio of saturated liquid [-] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
GAMTDD(T)	GAMTDD: Heat capacity ratio of saturated vapor [-] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
HPD(P)	HPD: Specific enthalpy of saturated liquid [J/kg] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
HPDD(P)	HPDD: Specific enthalpy of saturated vapor [J/kg] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
HPS(P, S)	HPS: Specific enthalpy [J/kg] P: Pressure [Pa], [bar] S: Specific entropy [J/(kg·K]	$P_t \leq P \leq P_{max}$ SPT(P, T_t) $\leq S \leq$ SPT(P, T_{max})
HPT(P, T)	HPT: Specific enthalpy [J/kg] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
HPX(P, X)	HPX: Specific enthalpy [J/kg] P: Pressure [Pa], [bar] X: Dryness fraction [-]	$P_t \leq P \leq P_c$ $0 \leq X \leq 1.0$
HTD(T)	HTD: Specific enthalpy of saturated liquid [J/kg] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
HTDD(T)	HTDD: Specific enthalpy of saturated vapor [J/kg] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
HTX(T, X)	HTX: Specific enthalpy [J/kg] T: Temperature [K], [$^\circ$C] X: Dryness fraction [-]	$T_t \leq T \leq T_c$ $0 \leq X \leq 1.0$
IDENTF(A)	IDENTF : Package Identification (CHARACTER*20) $A = 'C'$: Molecular formula, CH_3CF_3 $A = 'S'$: Substance name, HFC-143a (R143a) $A = 'V'$: Version number, 13.1	'C', 'S', and 'V'
PLDT(T)	N/A	
PMLT(T)	PMLT: Pressure on melting curve [Pa], [bar] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_{max}$
PRPD(P)	N/A	

Function	Return value and Argument(s)	Valid range of argument(s)
PRPDD(P)	N/A	
PRPT(P, T)	N/A	
PRTD(T)	N/A	
PRTDD(T)	N/A	
PSBT(T)	N/A	
PST(T)	PST: Saturation pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
PSTD(T)	N/A	
PSTDD(T)	N/A	
SIGP(P)	N/A	
SIGT(T)	N/A	
SPD(P)	SPD: Specific entropy of saturated Liquid [J/(kg·K)] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
SPDD(P)	SPDD: Specific entropy of saturated vapor [J/(kg·K)] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
SPT(P, T)	SPT: Specific entropy [J/(kg·K)] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
SPX(P, X)	SPX: Specific entropy [J/(kg·K)] P: Pressure [Pa], [bar] X: Dryness fraction [-]	$P_t \leq P \leq P_c$ $0 \leq X \leq 1.0$
STD(T)	STD: Specific entropy of saturated liquid [J/(kg·K)] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
STDD(T)	STDD: Specific entropy of saturated vapor [J/(kg·K)] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
STX(T, X)	STX: Specific entropy [J/(kg·K)] T: Temperature [K], [$^\circ$C] X: Dryness fraction [-]	$T_t \leq T \leq T_c$ $0 \leq X \leq 1.0$
TLDP(P)	N/A	
TMLP(P)	TMLP: Temperature on melting-line [K], [$^\circ$C] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_{max}$
TPH(P, H)	TPH: Temperature [K], [$^\circ$C] P: Pressure [Pa], [bar] H: Specific enthalpy [J/kg]	$P_t \leq P \leq P_{max}$ HPT(P, T_t) $\leq H \leq$ HPT(P, T_{max})
TPH2(P, H)	N/A	
TPS(P, S)	TPS: Temperature [K], [$^\circ$C] P: Pressure [Pa], [bar] S: Specific entropy [J/(kg·K)]	$P_t \leq P \leq P_{max}$ SPT(P, T_t) $\leq S \leq$ SPT(P, T_{max})
TPS2(P, S)	N/A	
TPSEUP(P)	N/A	
TPV(P, V)	TPV: Temperature [K], [$^\circ$C] P: Pressure [Pa], [bar] V: Specific volume [m^3/kg]	$P_t \leq P \leq P_{max}$ VPT(P, T_t) $\leq V \leq$ VPT(P, T_{max})
TRPL(A)	TRPL: Properties at Triple Point $A = $ 'P': Pressure, 1.0749 KPa $A = $ 'T': Temperature, 161.340 K (-111.810 $^\circ$C)	'P' and 'T'
TSBP(P)	N/A	
TSP(P)	TSP: Saturation temperature [K], [$^\circ$C] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
TSPD(P)	N/A	
TSPDD(P)	N/A	
UPD(P)	UPD: Specific internal energy of saturated liquid [J/kg] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
UPDD(P)	UPDD: Specific internal energy of saturated vapor [J/kg] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
UPS(P, S)	UPS: Specific internal energy [J/kg] P: Pressure [Pa], [bar] S: Specific entropy [J/(kg·K)]	$P_t \leq P \leq P_{max}$ SPT(P, T_t) $\leq S \leq$ SPT(P, T_{max})
UPT(P, T)	UPT: Specific internal energy [J/kg] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
UPX(P, X)	UPX: Specific internal energy [J/kg] P: Pressure [Pa], [bar] X: Dryness fraction [-]	$P_t \leq P \leq P_c$ $0 \leq X \leq 1.0$

Function	Return value and Argument(s)	Valid range of argument(s)
UTD(T)	UTD: Specific internal energy of saturated liquid [J/kg] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
UTDD(T)	UTDD: Specific internal energy of saturated vapor [J/kg] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
UTX(T, X)	UTX: Specific internal energy [J/kg] T: Temperature [K], [$^\circ$C] X: Dryness fraction [-]	$T_t \leq T \leq T_c$ $0 \leq X \leq 1.0$
VPD(P)	VPD: Specific volume of saturated liquid [m^3/kg] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
VPDD(P)	VPDD: Specific volume of saturated vapor [m^3/kg] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
VPS(P, S)	VPS: Specific volume [m^3/kg] P: Pressure [Pa], [bar] S: Specific entropy [J/(kg·K)]	$P_t \leq P \leq P_{max}$ SPT(P, T_t) $\leq S \leq$ SPT(P, T_{max})
VPT(P, T)	VPT: Specific volume [m^3/kg] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
VPX(P, X)	VPX: Specific volume [m^3/kg] P: Pressure [Pa], [bar] X: Dryness fraction [-]	$P_t \leq P \leq P_c$ $0 \leq X \leq 1.0$
VTD(T)	VTD: Specific volume of saturated liquid [m^3/kg] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
VTDD(T)	VTDD: Specific volume of saturated vapor [m^3/kg] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
VTX(T, X)	VTX: Specific volume [m^3/kg] T: Temperature [K], [$^\circ$C] X: Dryness fraction [-]	$T_t \leq T \leq T_c$ $0 \leq X \leq 1.0$
WPD(P)	WPD: Sound speed in saturated liquid [m/s] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
WPDD(P)	WPDD: Sound speed in saturated vapor [m/s] P: Pressure [Pa], [bar]	$P_t \leq P \leq P_c$
WPT(P, T)	WPT: Sound speed [m/s] P: Pressure [Pa], [bar] T: Temperature [K], [$^\circ$C]	$P_t \leq P \leq P_{max}$ $T_t \leq T \leq T_{max}$
WTD(T)	WTD: Sound speed in saturated liquid [m/s] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
WTDD(T)	WTDD: Sound speed in saturated vapor [m/s] T: Temperature [K], [$^\circ$C]	$T_t \leq T \leq T_c$
XPH(P, H)	XPH: Dryness Fraction [-] P: Pressure [Pa], [bar] H: Specific enthalpy [J/kg]	$P_t \leq P \leq P_c$ HPD(P) $\leq H \leq$ HPDD(P)
XPS(P, S)	XPS: Dryness Fraction [-] P: Pressure [Pa], [bar] S: Specific entropy [J/(kg·K)]	$P_t \leq P \leq P_c$ SPD(P) $\leq S \leq$ SPDD(P)
XPU(P, U)	XPU: Dryness Fraction [-] P: Pressure [Pa], [bar] U: Specific internal energy [J/kg]	$P_t \leq P \leq P_c$ UPD(P) $\leq U \leq$ UPDD(P)
XPV(P, V)	XPV: Dryness Fraction [-] P: Pressure [Pa], [bar] V: Specific volume [m^3/kg]	$P_t \leq P \leq P_c$ VPD(P) $\leq V \leq$ VPDD(P)
XTH(T, H)	XTH: Dryness Fraction [-] T: Temperature [K], [$^\circ$C] H: Specific enthalpy [J/kg]	$T_t \leq T \leq T_c$ HTD(T) $\leq H \leq$ HTDD(T)
XTS(T, S)	XTS: Dryness Fraction [-] T: Temperature [K], [$^\circ$C] S: Specific entropy [J/(kg·K)]	$T_t \leq T \leq T_c$ STD(T) $\leq S \leq$ STDD(T)
XTU(T, U)	XTU: Dryness Fraction [-] T: Temperature [K], [$^\circ$C] U: Specific internal energy [J/kg]	$T_t \leq T \leq T_c$ UTD(T) $\leq U \leq$ UTDD(T)
XTV(T, V)	XTV: Dryness Fraction [-] T: Temperature [K], [$^\circ$C] V: Specific volume [m^3/kg]	$T_t \leq T \leq T_c$ VTD(T) $\leq V \leq$ VTDD(T)