TRANE

Operation Maintenance

CVHE-OM-8

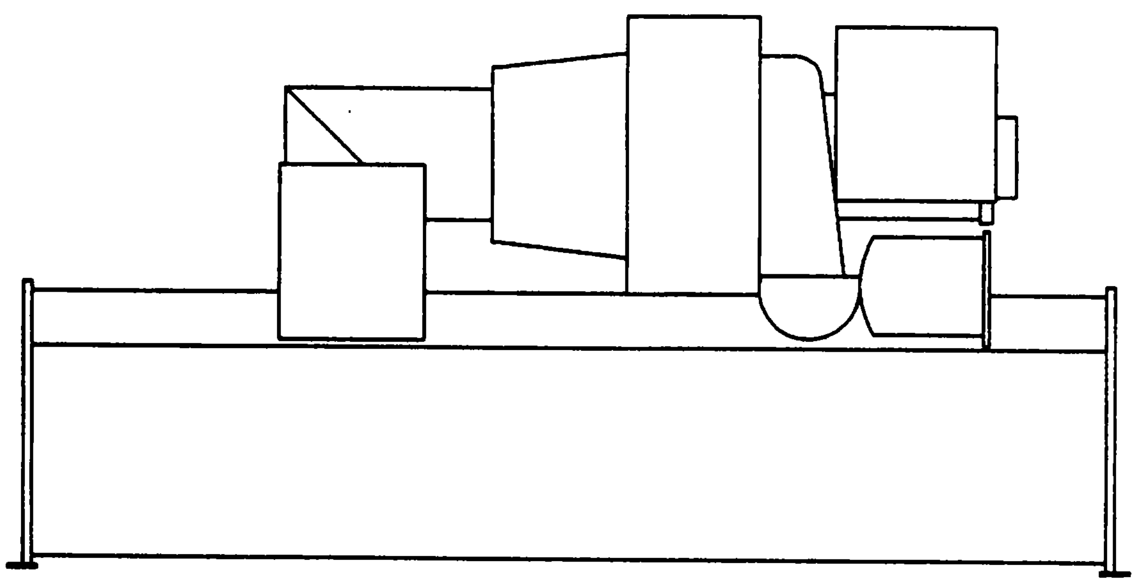
Library	**Service Literature**
Product Section	**Refrigeration**
Product	**Centrifugal Liquid Chillers**
Model	**CVHE/F/G**
Literature Type	**Operation/Maintenance**
Sequence	**8**
Date	**May 31, 1999**
File No.	**SV-RF-CTV-CVHE-OM-8-599**
Supersedes	**SV-RF-CTV-CVHE-M-7-2/94**

Water-Cooled Hermetic CenTraVac®

MODELS CVHE, CVHF, CVHG with UCP2 Control Panel

DSEQ - CVHE "1V - 2M"
CVHF "Y0"
CVHG "N0"

CVHE 60 HZ 230, 250, 280, 320, 360, 400, 450, 500, 560, 630, 710, 800
CVHE 50 HZ 190, 210, 240, 270, 300, 330, 370, 420, 470, 530, 590, 660
CVHF 60 HZ 305, 350, 410, 485, 555, 640, 650, 770, 910, 1060, 1280
CVHG 60 HZ 405, 475,
CVHG 50 HZ 350, 410, 480, 565, 670, 780, 1067



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Warnings and Cautions

NOTICE

Warnings and Cautions appear at appropriate locations throughout this manual.

Read these carefully.

Warning: Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices and where property-damage only accidents could occur.

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Product Coding Definition

The CVHE/F/G is defined using the product definition and selection (PDS) system. This system describes the product offerings in terms of a product coding block which is made up of feature categories and feature codes.

The operating components and options for any Model CVHE/F/G CenTraVac® unit can be identified by referring to the alpha-numeric product identification coding block located on the nameplate for the unit. The coding block precisely identifies all characteristics of a unit. Be sure to refer to the service model when ordering replacements parts or requesting service. An example of a typical product code is given on this page.

Note: Unit-mounted starters are identified by a separate number found on the starter.

Typical Product Description Block

MODL CVHE	DSEQ 2R	NTON 320	VOLT 575
HRTZ 60	TYPE SNGL	CPKW 142	CPIM 222
EVTM IECU	EVTH 28	EVSZ 032S	EVBS 280
EVWC STD	EVWP 2	EVWT NMAR	EVPR 150
EVCO VICT	EVWA LELE	CDTM IECU	CDTH 28
CDSZ 032S	CDBS 250	CDWC STD	CDWP 2
CDWT NMAR	CDPR 150	CDCO VICT	CDWA LELE
CDTY STD	TSTY STD	ECTY WEOR	ORSZ 230
PURG PURE	WCNM SNMP	SPKG DOM	OPTI CPDW
HHOP NO	GENR NO	GNSL NO	SOPT SPSH
ACCY ISLS	HGBP WO	LUBE SNGL	AGLT CUL
CNIF UCP2	SRTY USTR	SRRL 207	PNCO TERM
AGLS CUL	EFLD WATE	CFLD WATE	TEST AIR
REF 123			

MODL
Unit Model
CVHE = 3 stage direct drive
CVHF = 2 stage direct drive
CVHE = 3 stage direct drive

DSEQ
Design Sequence
AO = Original design

EER
Energy Efficiency Rating

GENR
Gas Powered Chiller
YES = Yes gas powered chiller
NO = No gas powered chiller

HRTZ
Unit Hertz
60 = 60 Hertz
50 = 50 Hertz

NTON
Nominal Tons
190 = 190 Nominal Tons
210 = 210 Nominal Tons
230 = 230 Nominal Tons
240 = 240 Nominal Tons
250 = 250 Nominal Tons
270 = 270 Nominal Tons
280 = 280 Nominal Tons
300 = 300 Nominal Tons
320 = 320 Nominal Tons
330 = 330 Nominal Tons
350 = 350 Nominal Tons
360 = 360 Nominal Tons
370 = 370 Nominal Tons
400 = 400 Nominal Tons
410 = 410 Nominal Tons
420 = 420 Nominal Tons
450 = 450 Nominal Tons
470 = 470 Nominal Tons
480 = 480 Nominal Tons
485 = 485 Nominal Tons
500 = 500 Nominal Tons
530 = 530 Nominal Tons
555 = 555 Nominal Tons
560 = 560 Nominal Tons
565 = 565 Nominal Tons
590 = 590 Nominal Tons
630 = 630 Nominal Tons
640 = 640 Nominal Tons
650 = 650 Nominal Tons
660 = 660 Nominal Tons
670 = 670 Nominal Tons
710 = 710 Nominal Tons
770 = 770 Nominal Tons
780 = 780 Nominal Tons
800 = 800 Nominal Tons
910 = 910 Nominal Tons
920 = 920 Nominal Tons
1060 = 1060 Nominal Tons
1067 = 1067 Nominal Tons
1280 = 1280 Nominal Tons

VOLT
Unit Voltage
208 = 208 Volt 3 Phase
380 = 380 Volt 3 Phase
400 = 400 Volt 3 Phase
415 = 415 Volt 3 Phase
440 = 440 Volt 3 Phase
460 = 460 Volt 3 Phase
480 = 480 Volt 3 Phase
575 = 575 Volt 3 Phase
600 = 600 Volt 3 Phase
2300 = 2300 Volt 3 Phase
2400 = 2400 Volt 3 Phase
3300 = 3300 Volt 3 Phase
4160 = 4160 Volt 3 Phase
6000 = 6000 Volt 3 Phase
6600 = 6600 Volt 3 Phase

CPKW
Compressor Motor Power
142 = 142 KW compressor motor 60hz
154 = 154 KW com pressor motor 60hz
171 = 171 KW compressor motor 60hz
187 = 187 KW compressor motor 60hz
204 = 204 KW compressor motor 60hz
231 = 231 KW compressor motor 60hz
257 = 257 KW compressor motor 60hz
287 = 287 KW compressor motor 60hz
323 = 323 KW compressor motor 60hz
361 = 361 KW compressor motor 60hz
403 = 403 KW compressor motor 60hz
453 = 453 KW compressor motor 60hz
512 = 512 KW compressor motor 60hz
588 = 588 KW compressor motor 60hz

Product Coding Definition

653 = 653 KW compressor motor 60hz
745 = 745 KW compressor motor 60hz
856 = 856 KW compressor motor 60hz
957 = 957 KW compressor motor 60hz
1062 = 1062 KW compressor motor 60hz
1228 = 1228 KW compressor motor 60hz
143 = 143 KW compressor motor 50hz
156 = 156 KW compressor motor 50hz
170 = 170 KW compressor motor 50hz
193 = 193 KW compressor motor 50hz
215 = 215 KW compressor motor 50hz
242 = 242 KW compressor motor 50hz
270 = 270 KW compressor motor 50hz
301 = 301 KW compressor motor 50hz
337 = 337 KW compressor motor 50hz
379 = 379 KW compressor motor 50hz
433 = 433 KW compressor motor 50hz
489 = 489 KW compressor motor 50hz
548 = 548 KW compressor motor 50hz
621 = 621 KW compressor motor 50hz
716 = 716 KW compressor motor 50hz
799 = 799 KW compressor motor 50hz
892 = 892 KW compressor motor 50hz

CPIM
Compressor Impeller Diameter
210 = 210 Impeller Cutback
212 = 212 Impeller Cutback
213 = 213 Impeller Cutback
215 = 215 Impeller Cutback
217 = 217 Impeller Cutback
218 = 218 Impeller Cutback
220 = 220 Impeller Cutback
222 = 222 Impeller Cutback
223 = 223 Impeller Cutback
225 = 225 Impeller Cutback
227 = 227 Impeller Cutback
228 = 228 Impeller Cutback
230 = 230 Impeller Cutback
232 = 232 Impeller Cutback
233 = 233 Impeller Cutback
235 = 235 Impeller Cutback
237 = 237 Impeller Cutback
238 = 238 Impeller Cutback
240 = 240 Impeller Cutback
242 = 242 Impeller Cutback
245 = 245 Impeller Cutback
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255 = 255 Impeller Cutback
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257 = 250 Impeller Cutback
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321 = 321 Impeller Cutback
322 = 322 Impeller Cutback
323 = 323 Impeller Cutback
324 = 324 Impeller Cutback
325 = 325 Impeller Cutback
326 = 326 Impeller Cutback
327 = 327 Impeller Cutback
328 = 328 Impeller Cutback
329 = 329 Impeller Cutback
330 = 330 Impeller Cutback

Type
Unit Type
AUX = Auxiliary Condenser
HTRC = Heat Recovery
SNGL = Single Condenser Cooling Only

ECTY
Economizer Type
WEOR = 2 Stage Standard Economizer
REOR = 2 Stage Removable Orifice Economizer

EVSZ
Evaporator Size
032S = 320 Ton Short Shell
032L = 320 Ton Long Shell
050S = 500 Ton Short Shell
050L = 500 Ton Long Shell
080S = 800 Ton Short Shell
080L = 800 Ton Long Shell
142M = 1420 Ton Medium Shell
142L = 1420 Ton Long Shell
142E = 1420 Ton Extended Shell
210L = 2100 Ton Long Shell
250E = 2500 Ton Extended Shell

EVBS
Evaporator Tube Bundle Size
200 = 200 Nominal ton Evap
230 = 230 Nominal Ton Evap
250 = 250 Nominal Ton Evap
280 = 280 Nominal Ton Evap
320 = 320 Nominal Ton Evap
350 = 350 Nominal Ton Evap
360 = 360 Nominal Ton Evap
400 = 400 Nominal Ton Evap
450 = 450 Nominal Ton Evap
500 = 500 Nominal Ton Evap
550 = 550 Nominal Ton Evap
560 = 560 Nominal Ton Evap
630 = 630 Nominal Ton Evap
710 = 710 Nominal Ton Evap
800 = 800 Nominal Ton Evap
890 = 890 Nominal Ton Evap
1080 = 1080 Nominal Ton Evap
1220 = 1220 Nominal Ton Evap
1420 = 1420 Nominal Ton Evap
1610 = 1610 Nominal Ton Evap
1760 = 1760 Nominal Ton Evap
1900 = 1900 Nominal Ton Evap
2100 = 2100 Nominal Ton Evap
2300 = 2300 Nominal Ton Evap
2500 = 2500 Nominal Ton Evap

EVTM
Evaporator Tubes
IECU = 1.0" Internally Enhanced CU Tubing
TECU = 3/4" Internally Enhanced CU Tubing
SBCU = 3/4" Smooth Bore CU Tubing

EVTH
Evaporator Tube Thickness
28 = .028" Tube Wall Thickness Evap
35 = .035" Tube Wall Thickness Evap

EFLD
Evaporator Fluid Type
WATE = Water
CACL = Calcium Chloride
EG = Ethylene Glycol
PG = Propylene Glycol

EVWT
Evaporator Waterbox Type
NMAR = Nonmarine
MAR = Marine

EVWP
Evaporator Water Pass
1 = 1 Pass Evaporator
2 = 2 Pass Evaporator
3 = 3 Pass Evaporator

EVWC
Evaporator Waterbox Construction
STD = Standard Construction

EVPR
Evaporator Waterbox Pressure
150 = 150 PSIG
300 = 300 PSIG

EVCO
Evaporator Waterbox Connection
Vict = Victaulic Connection
FLNG = Flanged Connection

Product Coding Definition

EVWA
Evap Waterbox Arrangement
RERE = Inlet - RH End
RERE = Outlet - RH End

RELE = Inlet - RH End
RELE = Outlet - LH End

LELE = Inlet - LH End
LELE = Outlet - LH End

LERE = Inlet - LH End
LERE = Outlet - RH End

END = In one end out the other

LFLR = Inlet - LH Front
LFLR = Outlet - LH Rear

LRLF = Inlet - LH Rear
LRLF = Outlet - LH Front

RFRR = Inlet - RH Front
RFRR = Outlet - RH Rear

RRRF = Inlet - RH Rear
RRRF = Outlet - RH Front

FRONT = In Front Out Front

REAR = In Rear Out Rear

LFRR = Inlet - LH Front
LFRR = Outlet - RH Rear

RRLF = Inlet - RH Rear
RRLF = Outlet - LH Front

LRRF = Inlet - LH Rear
LRRF = Outlet - RH Front

RFLR = Inlet - RH Front
RFLR = Outlet - LH Rear

CDSZ
Condenser Size
032S = 320 Ton Short Shell
032L = 320 Ton Long Shell
050S = 500 Ton Short Shell
050L = 500 Ton Long Shell
080S = 800 Ton Short Shell
080L = 800 Ton Long Shell
142L = 1420 Ton Long Shell
210L = 2100 Ton Long Shell
250L = 2500 Ton Long Shell

CDBS
Condenser Tube Bundle Size
230 = 230 Nominal Ton Cond
250 = 250 Nominal Ton Cond
280 = 280 Nominal Ton Cond
320 = 320 Nominal Ton Cond
360 = 360 Nominal Ton Cond
400 = 400 Nominal Ton Cond
450 = 450 Nominal Ton Cond
500 = 500 Nominal Ton Cond
560 = 560 Nominal Ton Cond
630 = 630 Nominal Ton Cond
710 = 710 Nominal Ton Cond
800 = 800 Nominal Ton Cond
890 = 890 Nominal Ton Cond

CDBS
Condenser Tube Size
980 = 980 Nominal Ton Cond
1080 = 1080 Nominal Ton Cond
1220 = 1220 Nominal Ton Cond
1420 = 1420 Nominal Ton Cond
1610 = 1610 Nominal Ton Cond
1760 = 1760 Nominal Ton Cond
1990 = 1990 Nominal Ton Cond
2100 = 2100 Nominal Ton Cond
2300 = 2300 Nominal Ton Cond
2500 = 2500 Nominal Ton Cond

CDTM
Condenser Tube Material
IECU = 1.0" Internally Enhanced CU Tube
TECU = 3/4" Internally Enhanced CU Tube
SBCU = 3/4" Smooth Bore CU Tube
SB91 = 3/4" Smooth Bore 90/10 CU/NI Tube

CDBS
Condenser Tube Size
980 = 980 Nominal Ton Cond
1080 = 1080 Nominal Ton Cond
1220 = 1220 Nominal Ton Cond
1420 = 1420 Nominal Ton Cond
1610 = 1610 Nominal Ton Cond
1760 = 1760 Nominal Ton Cond
1990 = 1990 Nominal Ton Cond
2100 = 2100 Nominal Ton Cond
2300 = 2300 Nominal Ton Cond
2500 = 2500 Nominal Ton Cond

CDTM
Condenser Tube Material
IECU = 1.0" Internally Enhanced CU Tube
TECU = 3/4" Internally Enhanced CU Tube
SBCU = 3/4" Smooth Bore CU Tube
SB91 = 3/4" Smooth Bore 90/10 CU/NI Tube

CDTH
Condenser Tube Thickness
28 = .028" Wall Thickness
35 = .035" Wall Thickness

CFLC
Condenser Fluid Type
WATE - Fluid Type = Water
CLCA - Fluid Type = Calcium Chloride
EG - Fluid Type = Ethylene Glycol
PG - Fluid Type = Propylene Glycol

CDTY
Condenser Shell Construction
STD = Standard Condenser Construction
ASME = ASME Condenser Construction

CDWT
Condenser Waterbox Type
NMAR = Nonmarine
MAR = Marine

CDWC
Condenser Waterbox Weld Type
STD = Standard Waterbox
ASME = ASME Waterbox

CDPR
Condenser Water Side Pressure
150 = 150 PSIG
300 = 300 PSIG

CDWP
Condenser Water Pass
2 = 2 Pass
3 = 3 Pass

CDCO
Condenser Waterbox Connection
VICT = Victaulic Connection
FLNG = Flanged Connection

CDWA
Cond Waterbox Arrangement
RERE = In RH End - Out RH End
LELE = In LH End - Out LH End
LFLF = In LH Fron - Out LH Front
LRLR = In LH Rear - Out LH Rear
RFRF = In RH Front - Out RH Front
RRRR = In RH Rear - Out RH Rear
RRRF = In RH Rear - Out RH Front
RRRF = IN RH Rear - Out RH Front

TSTY
Tube Sheet Construction
STD = Standard
ASME = ASME

ORSZ
Orifice Size
180 = 180 Nominal Ton Orifice
200 = 200 Nominal Ton Orifice
210 = 210 Nominal Ton Orifice
230 = 230 Nominal Ton Orifice
240 = 240 Nominal Ton Orifice
250 = 250 Nominal Ton Orifice
265 = 265 Nominal Ton Orifice
280 = 280 Nominal Ton Orifice
300 = 300 Nominal Ton Orifice
320 = 320 Nominal Ton Orifice
340 = 340 Nominal Ton Orifice
360 = 360 Nominal Ton Orifice
375 = 375 Nominal Ton Orifice
400 = 400 Nominal Ton Orifice
415 = 415 Nominal Ton Orifice
450 = 450 Nominal Ton Orifice
460 = 460 Nominal Ton Orifice
500 = 500 Nominal Ton Orifice
510 = 510 Nominal Ton Orifice
560 = 560 Nominal Ton Orifice
585 = 585 Nominal Ton Orifice
630 = 630 Nominal Ton Orifice
650 = 650 Nominal Ton Orifice
710 = 710 Nominal Ton Orifice
750 = 750 Nominal Ton Orifice
790 = 790 Nominal Ton Orifice
800 = 800 Nominal Ton Orifice
835 = 835 Nominal Ton Orifice
880 = 880 Nominal Ton Orifice
900 = 900 Nominal Ton Orifice
935 = 935 Nominal Ton Orifice
990 = 990 Nominal Ton Orifice
1000 = 1000 Nominal Ton Orifice
1045 = 1045 Nominal Ton Orifice
1100 = 1100 Nominal Ton Orifice
1120 = 1120 Nominal Ton Orifice
1185 = 1185 Nominal Ton Orifice
1250 = 1250 Nominal Ton Orifice
1265 = 1265 Nominal Ton Orifice
1335 = 1335 Nominal Ton Orifice
1400 = 1400 Nominal Ton Orifice
1475 = 1475 Nominal Ton Orifice
1540 = 1540 Nominal Ton Orifice
1600 = 1600 Nominal Ton Orifice
1735 = 1735 Nominal Ton Orifice
1800 = 1800 Nominal Ton Orifice
1810 = 1810 Nominal Ton Orifice
1890 = 1890 Nominal Ton Orifice
1970 = 1970 Nominal Ton Orifice
2060 = 2060 Nominal Ton Orifice
2150 = 2150 Nominal Ton Orifice

Product Coding Definition

AGLT
Agency Listing
None = No Agency Listing
UL = U.L. Listed
CUL = UL Listed with EER

HHOP
High Humidity Opion
Yes = With High Humidity Option
No = Without High Humidity Option

HGBP
Hot Gas Bypass
With = Hotgas By pass
WO = Without Hotgas Bypass

OPTI
Unit Options
AAZ = International Package
CPDW = Compressor Doweling Only
FRCL = Free Cooling
INSL = Unit Insulation
JAGA = Control Panel Gauges for Japan,
SPSH = Separable Shells with Compressor Doweling

LUBE
Dual Oil Filters
SNGL = Single Oil Filter

PURG
Purge Unit
PURG = Purifier Purge

CNIF
Control Interface
UCP2 = Micro Processor 2nd Generation

COPT
Control Options for UCP2
ACOS = Water Temperature Sensor
ARMN = Refrg Monitor without Scanner
ARMS = Refrg Monitor with Scanner
BRTS = Bearing Oil Temperature Sensors
CLCT = Condenser Limit Controls
CLDC = Complex Character CLD
CWR = Chilled Water Reset Ambient
DIST = Discharge Temperature Sensor
MONP = Monitoring Package
OPTM = Options Module
PNCH = Printer Interface Module
TRMI = Tracer 100 Interface Module
TRMS = Tracer Summit Interface Module
WFCH = Water Pressure Sensors. 150 PSI
WFCL = Water Pressure Sensors <150 PSI
WVUO = Under-Over Voltage Protection

AMOP
Air Monitor Options
AAKT = Audible Alarm Kit
AA1L = Audible Alarm Kit with 1 Light
AA3L = Audible Alarm Kit with 3 Lights
4CSK = 4-Channel Scanner Kit

ACCY
Unit Accessory
2FS1 = 2 Flow Switches 150 PSI NEMA 1
2FS2 = 2 Flow Switches 300 PSI NEMA 1
2FS3 = 2 Flow Switch 150 PSI Vapor
2FS4 = 2 Flow Switch 300 PSI Vapor
2TME = 2 Thermometers 10" Extd Well
2TMS = 2 Thermometers 10" Std Well
2TR5 = 2 TR5 Timers
3FS1 = 3 Flow Switches 150 PSI NEMA 1
3FS2 = 3 Flow Switches 300 PSI NEMA 1
3FS3 = 3 Flow Switch 150 PSI Vapor
3FS4 = 3 Flow Switch 300 PSI Vapor
3TME = 3 Thermometers 10" Extd Well
3TR5 = 3 TR5 Timers
FS1 = 1 Flow Switch 150 PSI NEMA 1
FS2 = 1 Flow Switch 300 PSI NEMA 1
FS3 = 1 Flow Switch 150 PSI Vapor
FS4 = 1 Flow Switch 300 PSI Vapor
ISLS = Spring Isolators
TME = 1 Thermometer 10" Evtd Well
TMS = 1 Thermometer 10" Std Well
TR5 = 1 TR5 Timer

MODL
Starter Model
CVSF = Centrifugal Chiller Starter

SRTY
Starter Type
USRT = Star-Delta
USOL = Solid State
RSTR = Star-Delta
RSOL = Solid State
RXL = X-Line Full Volt
RAIR = Autotransformer
RPIR = Primary Reactor
CSTR = Star-Delta
CSOL = Solid State
CXL = X-Line Full Volt
CATR - Autotransformer
CPIR = Primary Reactor

VOLT
Starter Voltage
208 = 208 Volt 60 Hz 3 Phase
208 = 230 Volt 60 Hz 3 Phase
380 = 380 Volt 60 Hz 3 Phase
440 = 440 Volt 60 Hz 3 Phase
460 = 460 Volt 60 Hz 3 Phase
480 = 480 Volt 60 Hz 3 Phase
575 = 575 Volt 60 Hz 3 Phase
600 = 600 Volt 60 Hz 3 Phase
2300 = 2300 Volt 60 Hz 3 Phase
2400 = 2400 Volt 60 Hz 3 Phase
4160 = 4160 Volt 60 Hz 3 Phase
3300 = 3300 Volt 60 Hz 3 Phase
6600 = 6600 Volt 60 Hz 3 Phase

380A = 380 Volt 50 HZ 3 Phase
400 = 400 Volt 50 HZ 3 Phase
415 = 415 Volt 50 HZ 3 Phase
330A = 3300 Volt 50 HZ 3 Phase
6000 = 6000 Volt 50 Hz 3 Phase
660A = 6600 Volt 50 Hz 3 Phase

SRRL
Starter Size Based on Max RLA
94 = 94 Maximum Starter RLA
155 = 155 Maximum Starter RLA
187 = 187 Maximum Starter RLA
200 = 200 Maximum Starter RLA
207 = 207 Maximum Starter RLA
233 = 233 Maximum Starter RLA
346 = 346 Maximum Starter RLA
360 = 360 Maximum Starter RLA
372 = 372 Maximum Starter RLA
467 = 467 Maximum Starter RLA
553 = 553 Maximum Starter RLA
592 = 592 Maximum Starter RLA
606 = 606 Maximum Starter RLA
700 = 700 Maximum Starter RLA
935 = 935 Maximum Starter RLA
1080 = 1080 Maximum RLA
1212 = 1212 Maximum Starter RLA
1402 = 1402 Maximum Starter RLA
1856 = 1856 Maximum Starter RLA

PNCO
Connection Type
CB = Circuit Breaker
CBCL = Circuit Breaker Current Limiting
CBHC = Circuit Breaker Higher-Interrupt
CBIC = Circuit Breaker High-Interrupt
DISC = Non-fused Disconnect Switch
ISSW = Isolation Switch
TERM = Terminal Block Connection

AGLS
Agency Listing
None = No Agency Listing
UL = U.L. Listed
CUL = UL Listed with EER
CLCA = California Code (Includes U.L. Listing

SRFC
Power Factor Correct Capacitor
YES = PFCC Correct to 93.5 - 95.5% PF

DMPP
Digital Meter/Protection Package
IQDP = I.Q. Data Plus II
IQD = I.Q. Data

SRLT
Surge Protector/Lightning Arrestor
YES = Surge protector/Lightning Arrestor

UNVR
Under/Over Voltage Relay
YES = Under/Over Voltage Relay

GRDF
Ground Fault Protection
YES = Ground Fault Protection

SRMT
Control Meters
CTRB = Volt & Amp Meters
CTRV = Volt Meters
CTRA = Amp Meters

MODL
Adaptive Frequency Drive
AFDB = Adaptive Frequency Drive

SRRL
Frequency Drive Frame Size
386 = Frame Size - 386 Max RLA
500 = Frame Size - 500 Max RLA
643 = Frame Size - 643 Max RLA

FSUP
Factory Startup
LM = 50 Miles or Less
HM = 51 Miles or More

HRIN
Harmonic Attenuation
LNRC = Remote Mounted Line Reactor
UNLR = Unit Mounted Line Reactor
S12 = 12 Pulse Auto Transformer

Product Coding Definition

CHSZ
Heat Recovery Condenser Shell Size
032S = 320 Ton Short Shell
032L = 320 Ton Long Shell
050S = 500 Ton Short Shell
050L = 500 Ton Long Shell
080S = 800 Ton Short Shell
080L = 800 Ton Long Shell
142L = 1420 Ton Long Shell
210L = 2100 Ton Long Shell

CHBS
Condenser Tube Bundle Size
230 = 230 Nominal Tons
250 = 250 Nominal Tons
280 = 280 Nominal Tons
320 = 320 Nominal Tons
400 = 400 Nominal Tons
450 = 450 Nominal Tons
500 = 500 Nominal Tons
560 = 560 Nominal Tons
630 = 630 Nominal Tons
710 = 710 Nominal Tons
800 = 800 Nominal Tons
890 = 890 Nominal Tons
980 = 980 Nominal Tons
1080 = 1080 Nominal Tons
1220 = 1220 Nominal Tons
1420 = 1420 Nominal Tons
1610 = 1610 Nominal Tons
1760 = 1760 Nominal Tons
1900 = 1900 Nominal Tons
2100 = 2100 Nominal Tons

CHTM
Condenser Tube Material
IECU = 1.0" Internally Enhanced Cu Tube
TECU = 0.75" Internally Enhanced CU Tube
SBCU = 0.75" Smooth Bore CU Tube
SB91 = 0.75" Smooth Bore 90/10 CU/NI Tube
SBTI = 0.75" Smooth Bore Titanium
SB73 = 0.75" Smooth Bore 70/30 CU/NI Tube

CHTH
Condenser Tube Wall Thickness
28 = .028" Tube Wall Thickness
35 = .035" Tube Wall Thickness
25 = .025" Tube Wall Thickness
42 = .042" Tube Wall Thickness
49 = .049" Tube Wall Thickness

HFLD
Condenser Fluid Type
WATE = Fluid Type - Water
CACL = Fluid Type - Calcium Chloride
EG = Fluid Type = Ethylene Glycol
PG = Fluid Type - Propylene Glycol

CHWC
Condenser Waterbox Construction
STD = Standard Waterbox Construction
ASME = ASME Waterbox Construction

CHWT
Condenser Waterbox Type
NMAR = Non-marine Waterbox
MAR = Marine Waterbox

CHPR
Condenser Waterbox Pressure
150 = 150 PSIG Water Pressure
300 = 300 PSIG Water Pressure

CHCO
Condenser Waterbox Connection
VICT = Victaulic Connection
FLNG = Flanged Connection

CHWA
Condenser Waterbox Arrangement
RERE = In RH End - Out RH End
LERE = In LH End - Out LH End
LFLF = In LH Front - Out LH Front
LRLR = In LH Rear - Out LH Rear
RFRF = In RH Front - Out RH Front
RRRR = In RH Rear - Out RH Rear
LFLR = In LH Front - Out LH Rear
LRLF = In LH Rear - Out LH Front
RFRR = In RH Front - Out RH Rear
RRRF = In RH Rear - Out RH Front

CABS
Condenser Bundle Size
80 = 80 Nominal Tons
130 = 130 Nominal Tons

CATM
Condenser Tube Material
IECU = 1.0" Internally Enhanced Cu Tube
TECU = 0.75" Internally Enhanced CU Tube
SBCU = 0.75" Smooth Bore CU Tube
SB91 = 0.75" Smooth Bore 90/10 CU/NI Tube
SB73 = 0.75" Smooth Bore 70/30 CU/NI Tube
SBTI = 0.75" Smooth Bore Titanium

CATH
Condenser Tube Wall Thickness
28 = .028" Tube Wall Thickness
35 = .035" Tube Wall Thickness
42 = .042" Tube Wall Thickness

HFLD
Condenser Fluid Type
WATE = Fluid Type - Water
CACL = Fluid Type - Calcium Chloride
EG = Fluid Type - Ethylene Glycol
PG = Fluid Type - Propylene Glycol

CAWT
Condenser Waterbox Type
NMAR = Non-marine Waterbox
MAR = Marine Waterbox

CAPR
Condenser Water Side Pressure
150 = 150 PSIG Water Pressure
300 = 300 PSIG Water Pressure

CACO
Condenser Waterbox Connection
VICT = Victaulic Connection
FLNG = Flanged Connection

CAWA
Condenser Waterbox Arrangement
RERE = In RH End - Out RH End
LELE = In LH End - Out LH End
LFLF = In LH Front - Out LH Front
LRLR = In LH Rear - Out LH Rear
RFRF = In RH Front - Out RH Front
RRRR = In RH Rear - Out RH Rear
LFLR = In LH Front - Out LH Rear
LRLF = In LH Rear - Out LH Front
RFRR - In RH Front - Out RH Rear
RRRF - In RH Rear - Out RH Front

General Information

Literature Change

CVHE-OM-8

May 1999
(Supersedes: CVHE-M-7)

About this manual

This manual contains new and updated information describing the operation and maintenance of 50/60 Hz. CVHE, CVHF and CVHG centrifugal chillers equipped with micro-computer-based control systems, whether standard (cooling) or heat recovery. It includes (for daily maintenance procedures) Adaptive Frequency™ Drive and Solid State Starter check lists as well.

IMPORTANT: *ALL DIAGNOSTIC INFORMATION IS PROVIDED IN THE CLEAR LANGUAGE DISPLAY MANUAL, WHICH SHIPS WITH THE UNIT OR IS AVAILABLE AT THE NEAREST TRANE OFFICE.*

By carefully reviewing this information and following the instructions given, the owner/operator can successfully operate and maintain a CVHE, CVHF or CVHG unit.

If mechanical problems do occur, however, contact a qualified service organization to ensure proper diagnosis and repair of the unit.

Commonly Used Acronyms

For convenience, a number of acronyms are used throughout this manual. These acronyms are listed alphabetically below, along with the "translation" of each:

AFDB = Adaptive Frequency Drive
ASME = American Society of Mechanical Engineers
ASHRAE = American Society of Heating, Refrigerating and Air Conditioning Engineers
BAS = Building Automation System
CABS = Auxiliary Condenser Tube-Bundle Size

CDBS = Condenser Bundle Size

CDSZ = Condenser Shell Size
CLD = Clear Language Display

CWR = Chilled Water Reset

DTFL = Design Delta-T at Full Load (i.e., the difference between entering and leaving chilled water temperatures)
ENT Entering Chilled Water Temperature
FC = Free Cooling

GPM = Gallons-per-minute
HGBP = Hot Gas Bypass
HVAC = Heating, Ventilating, and Air Conditioning

IE = Internally-Enhanced Tubes
IPC = Interprocessor Communication
LBU = La Crosse Business Unit

LCD = Liquid Crystal Display
LED = Light Emitting Diode
PFCC = Power Factor Correction Capacitor

PSID = Pounds-per-Square-Inch (differential pressure)
PSIG = Pounds-per-Square-Inch (gauge pressure)
RCLD = Remote Clear Language Display

UCP2 = Chiller Control Panel for CenTraVacs

Warnings and Cautions

Notice that warnings and cautions appear at appropriate intervals throughout this manual. Warnings are provided to alert installing contractors to potential hazards that could result in personal injury or death, while cautions are designed to alert personnel to conditions that could result in equipment damage.

Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

Unit Nameplate

The unit nameplate is located on the left side of the unit control panel (UCP). The following information is provided on the unit nameplate.

- Service model and size descriptor
- Unit serial number
- Identifies unit electrical requirements
- Lists correct operating charges and type of refrigerant
- Lists unit test pressures and maximum operating pressures.
- Identifies unit Installation and Operation and Maintenance manuals
- Product description block (Identifies all unit components and unit "design sequence" used to order literature and make other inquiries about the unit).
- Lists drawing numbers for unit wiring diagrams.

Mechanical Operation - CVHE/G

Overview

THE FOLLOWING INFORMATION APPLIES TO THE TRANE MODEL CVHE AND CVHG CENTRIFUGAL CHILLER ONLY. CVHF INFORMATION IS DISCUSSED IN ANOTHER SECTION OF THIS MANUAL. Refer to the appropriate operation manual for refrigeration cycle descriptions of other models.

Each CVHE/G unit is composed of 5 basic components.

-- the evaporator,
-- 3-stage compressor,
-- water-cooled condenser,
-- 2-stage economizer,
-- related interconnecting piping.

A heat-recovery or auxiliary condenser can be factory-added to the basic unit assembly to provide a heat-recovery cycle.

Figure 1 illustrates the general component layout of a typical CVHE chiller.

CVHE cooling-only and heat recovery modes of operation are described in the following sections. A pressure enthalpy diagram (shown in Figure 2) is provided to further illustrate unit operation.

Cooling-Only Cycle

When the CVHE is functioning in the cooling mode, liquid refrigerant is distributed along the length of the evaporator and sprayed through small holes in a distributor (i.e., running the entire length of the shell) to uniformly coat each evaporator tube. Here, the liquid refrigerant absorbs enough heat from the system water circulating through the evaporator tubes to vaporize.

The gaseous refrigerant is then drawn through the eliminators (which remove droplets of liquid refrigerant from the gas) and first-stage variable inlet guide vanes, and into the first stage impeller.

Note: Inlet guide vanes are designed to modulate the flow of gaseous refrigerant to meet system capacity requirements; they also prorate the gas, allowing it to enter the impeller at an optimal angle that maximizes efficiency at all load conditions.

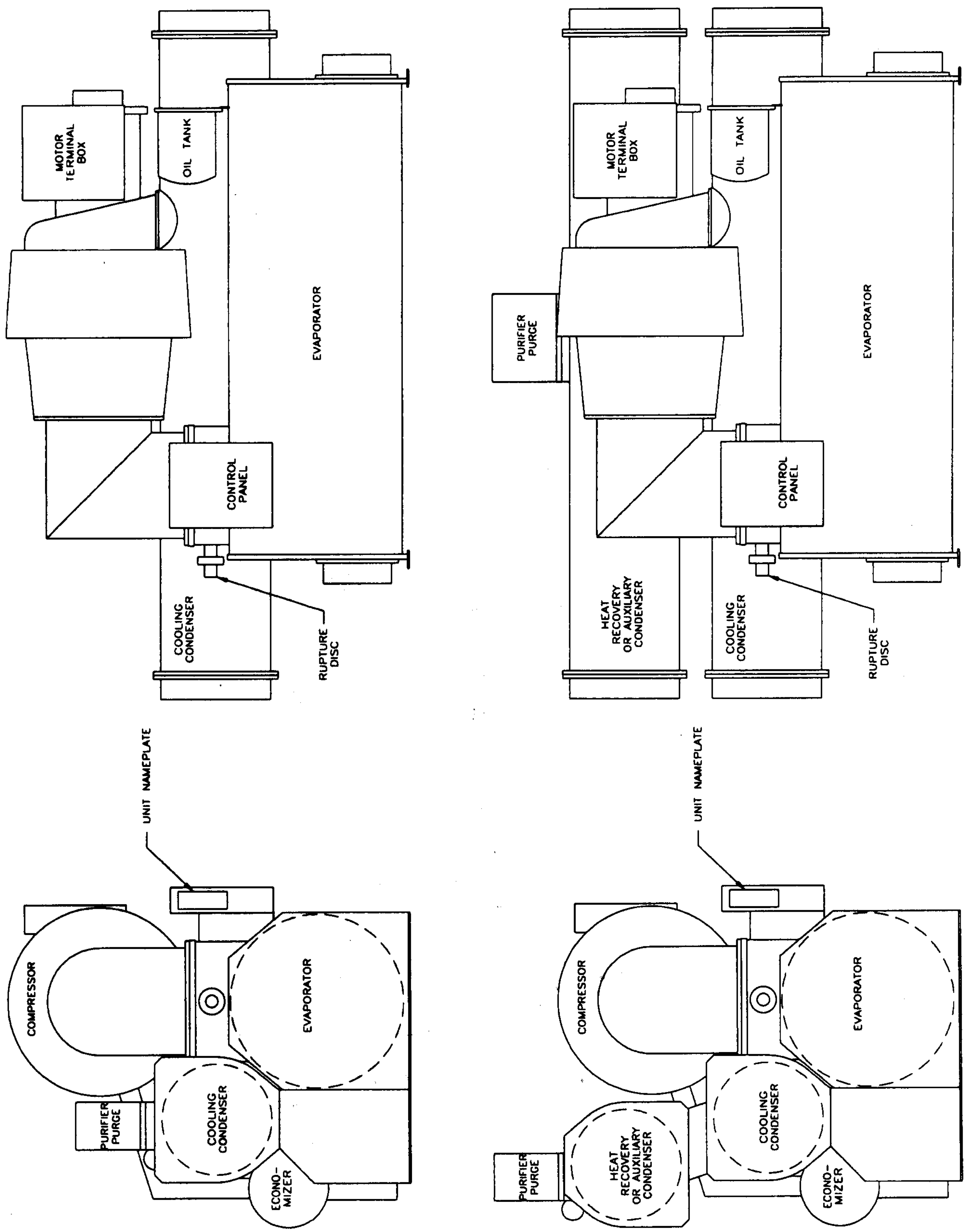
Compressed gas from the first-stage impeller flows through the fixed, second-stage inlet vanes and into the second-stage impeller. Here, the refrigerant gas is again compressed, and then discharged through the third-stage variable guide vanes and into the third-stage impeller.

Once the gas is compressed a third time, it is discharged into the condenser. Baffles within the condenser shell distribute the compressed refrigerant gas evenly across the condenser tube bundle. Cooling tower water circulated through the condenser tubes absorbs heat from the refrigerant, causing it to condense. The liquid refrigerant then passes through orifice plate "A" and into the economizer.

The economizer reduces the energy requirements of the refrigerant cycle by eliminating the need to pass all gaseous refrigerant through three stages of compression. See Figure 3. Notice that some of the liquid refrigerant flashes to a gas because of the pressure drop created by the orifice plates, thus further cooling the liquid refrigerant. This flash gas is then drawn directly from the first (Chamber A) and second (Chamber B) stages of the economizer into the third-and second-stage impellers of the compressor, respectively.

All remaining liquid refrigerant flows through another orifice plate "C" to the evaporator.

Figure 1
General CVHE/G Unit Components



Mechanical Operation - CVHE/G

Figure 2
Pressure Enthalpy Curve

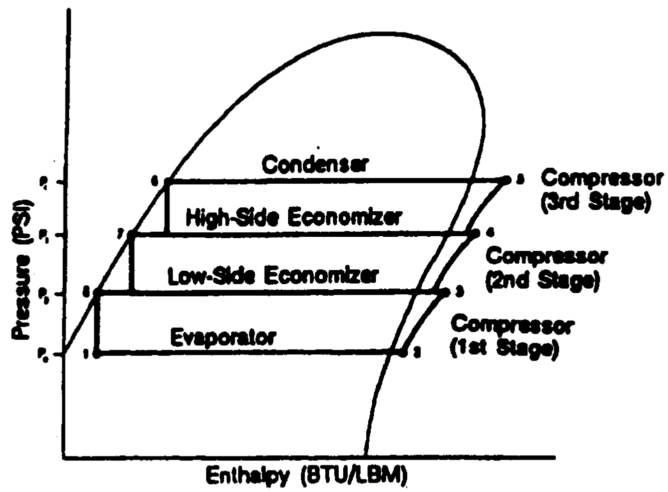
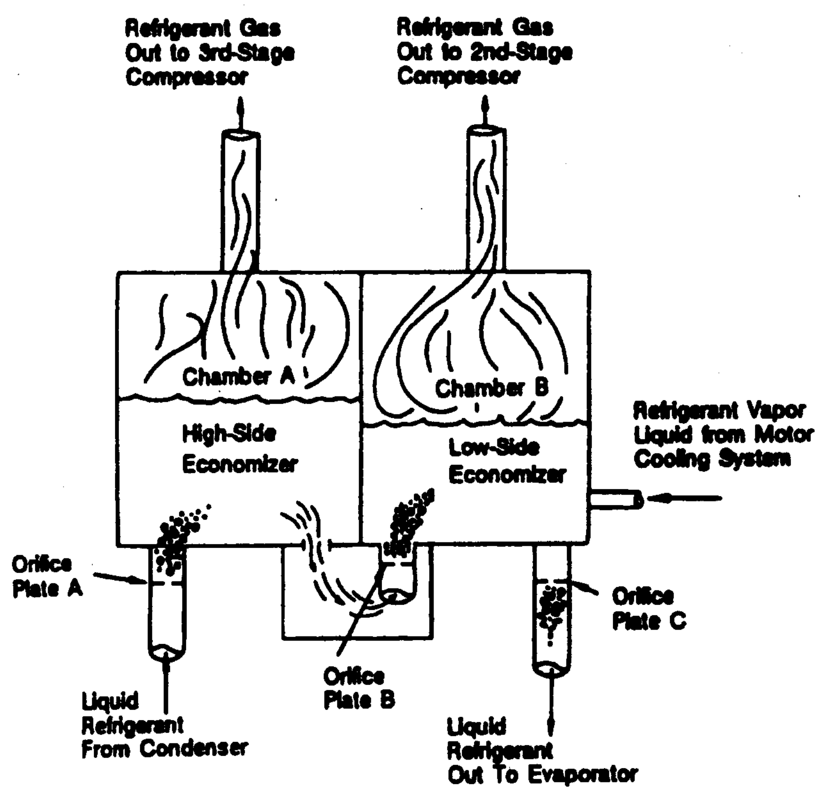


Figure 3
2-Stage Economizer



Compressor Lubrication System - CVHE and CVHG

A schematic diagram of the compressor lubrication system is illustrated in Figure 4 for the CVHE and in Figure 5 for the CVHG; this system supplies oil to the compressor motor bearings.

Oil is pumped from the oil tank (i.e., by a pump and motor located within the tank) through an oil pressure-regulating valve designed to maintain a net oil pressure of 12 to 18 psid. It is then filtered and sent to the compressor motor bearings. The oil filter assembly is equipped with filter during filter replacement.

From the bearings, the oil drains back to the oil tank through return lines.

WARNING
SURFACE TEMPERATURES MAY EXCEED 150°F. Use caution while working on certain areas of the unit, failure to do so may result in death or personal injury.

To ensure proper lubrication and prevent refrigerant from condensing in the oil tank, a 750-watt heater is immersed in the oil tank and is used to warm the oil while the unit is off. When the unit starts, the oil tank heater is de-energized. This heater energizes as needed to maintain 140° to 145°F (60-63 C) when the chiller is not running.

When the chiller is operating, the temperature of the oil tank is typically 115° to 160°F (46-72 C). Notice that the oil tank is vented between the compressor inlet vanes and the first-stage impeller suction cover. During normal system operation, motor barrel pressure is greater than that of the oil tank. Therefore, any gaseous refrigerant that enters the motor bearing cavities is drawn toward the oil tank where it is removed by the vent line.

A dual eductor system is used to reclaim oil from the suction cover and from the evaporator, and deposit it back into the oil tank. These eductors use high pressure condenser gas to draw the oil from the suction cover and evaporator back to the educators, from the eductors the oil is discharged to the top of the oil tank.

The evaporator eductor line has a shutoff valve located at the evaporator. This valve ships from the factory with two turns open.

Note: CVHEs and CVHGs utilize a circuit module control relay and solenoid valve that temporarily close the oil sump vent line during the chiller start sequence. This prevents the loss of oil pressure that can occur during start-up by isolating the oil sump from the low-pressure cavity at the opposite end of the sump vent line.

Liquid refrigerant is used to cool the oil supply to the inboard motor bearing on larger units (360-1250). Oil entering the oil cooler assembly from the oil tank (via the regulating valve and filter) flows into a coil inside the cooler shell.

See Figure 6. As the oil passes through this coil, it is cooled by a mixture of gaseous and liquid refrigerant that surround the coil exterior.

Once the cooled oil leaves the cooler shell, it flows directly to the inboard motor bearing, and eventually returns to the oil tank.

The oil cooler is piped into the return circuit of the motor cooling system. Part of the refrigerant that is used to cool the compressor motor passes through the oil cooler shell on its way to the economizer.

Motor Cooling System

CVHE/G compressor motors are cooled with liquid refrigerant; see Figures 4 and 5 for a schematic illustration of this pressurized system.

Liquid refrigerant flows from the condenser sump to the bottom of the compressor motor, Figures 7 and 8 (CVHE and CVHG), where it enters the motor chamber through a control orifice. As the liquid refrigerant touches the warm motor components, a portion of it flashes to a gas and cools the motor. This "flash" gas, along with any excess liquid refrigerant, then drains to the second-stage of the economizer.

Because of the positive pressure differential between the condenser and economizer, proper refrigerant flow through the motor is maintained at all load conditions.

Figure 4
CVHE Compressor Lubrication and Motor-Cooling Systems

CVHE Compressor Lubrication, Motor Cooling and Oil Reclaim Systems

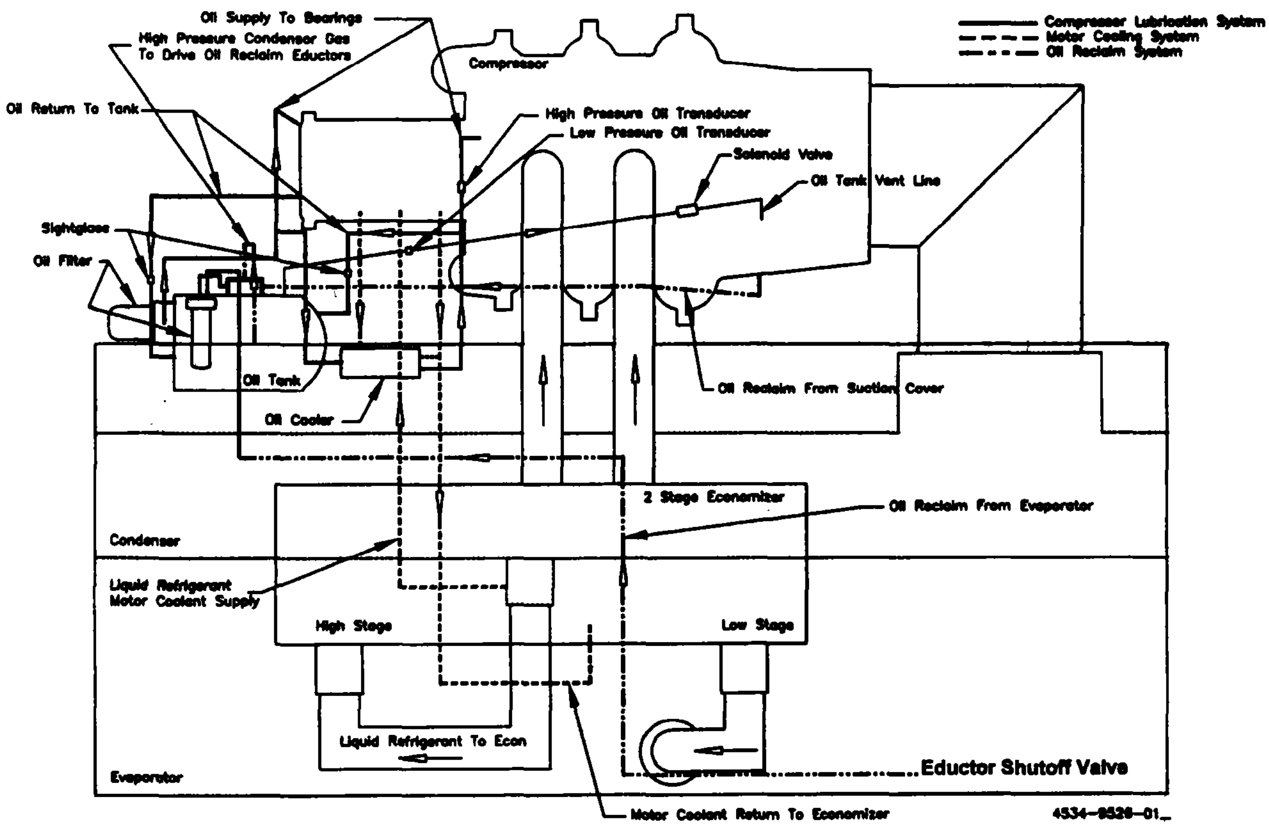


Figure 5
CVHG Compressor Lubrication and Motor-Cooling Systems

CVHG Compressor Lubrication, Motor Cooling and Reclaim Systems

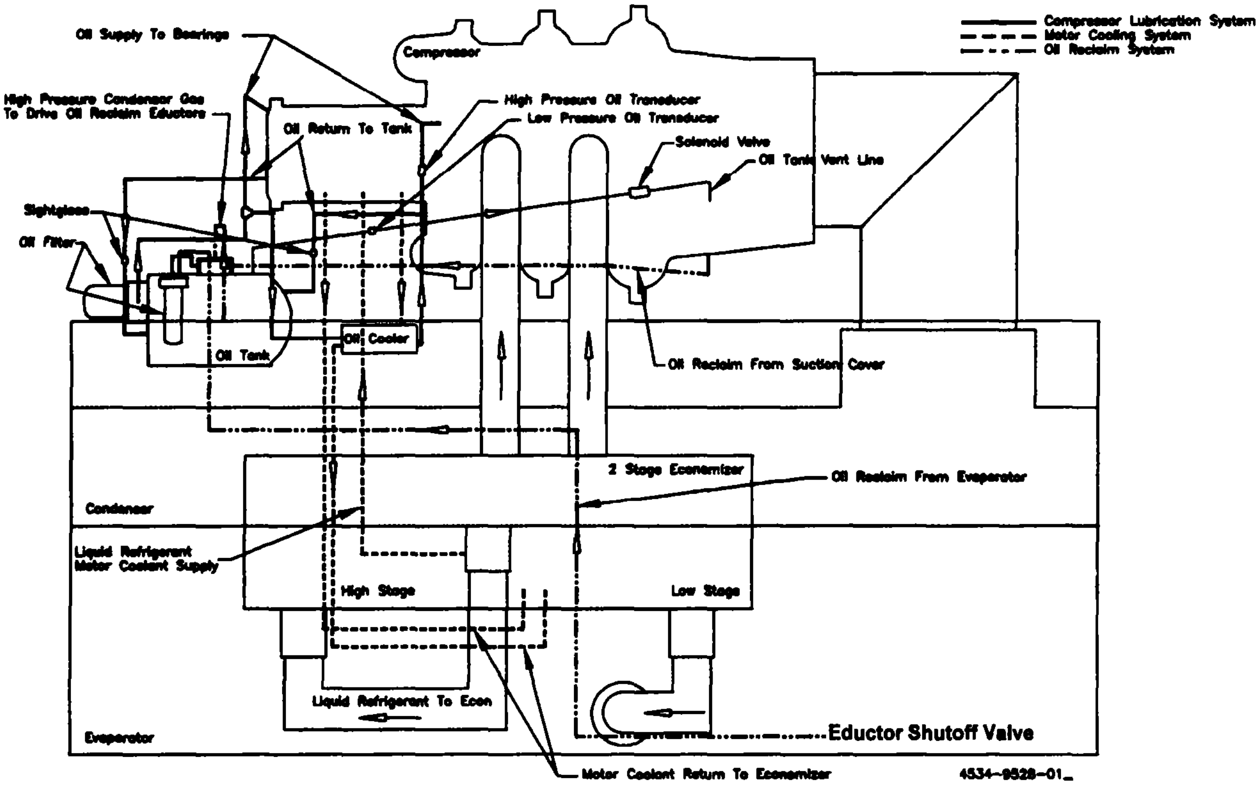


Figure 6
CVHE/F/G Oil Cooler Assembly

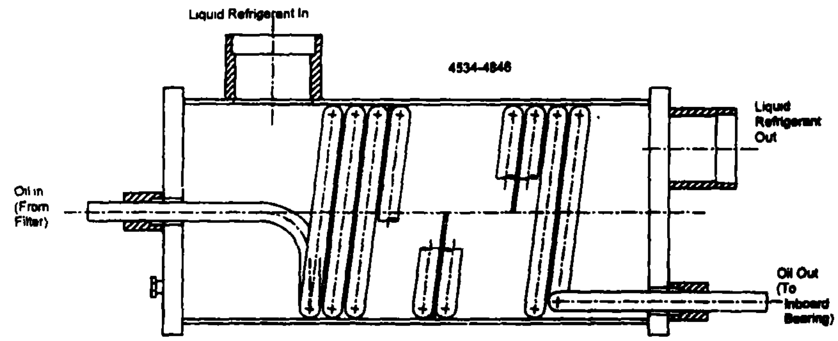


Figure 7
CVHE Motor Cooling System View

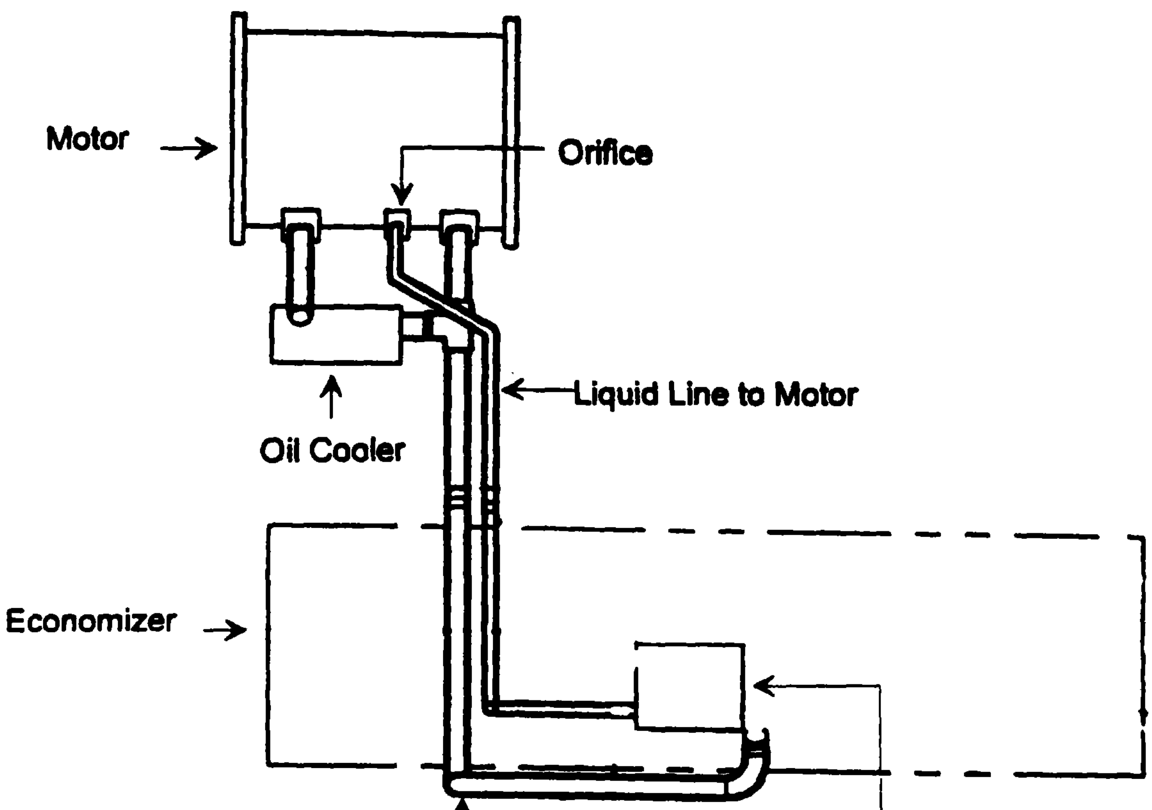
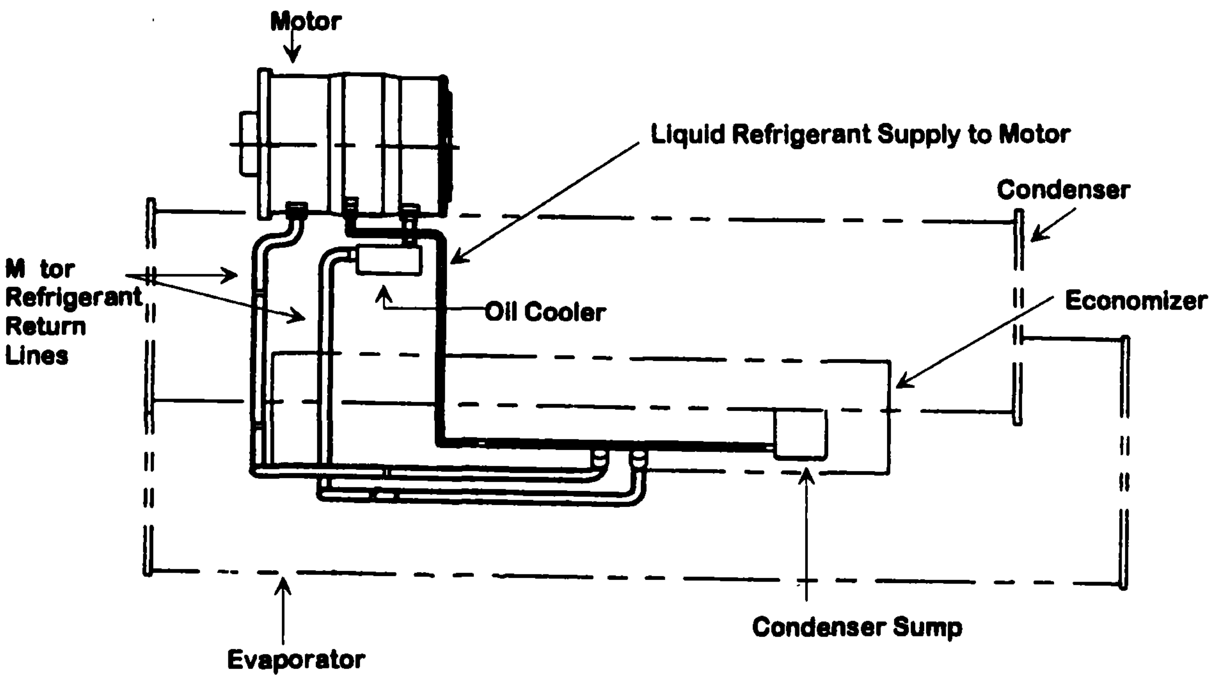


Figure 8
CVHG Motor Cooling System View



Mechanical Operation - CVHF

Overview

THE FOLLOWING DESCRIPTION APPLIES TO THE TRANE MODEL CVHF CENTRIFUGAL CHILLER ONLY. Refer to the appropriate operation manual for refrigeration cycle descriptions of other models.

Each CVHF unit is composed of 5 basic components:

-- the evaporator
-- 2 stage compressor
-- water-cooled condenser
-- single-stage economizer
-- related interconnecting piping

A heat-recovery or auxiliary condenser can be factory-added to the basic unit assembly to provide a heat-recovery cycle.

Figure 9 illustrates the general component layout of a typical CVHF chiller.

CVHF cooling-only and heat recovery modes of operation are described in the following sections. A pressure/enthalpy diagram (shown in Figure 10) is provided to further illustrate unit operation.

Cooling-Only Cycle

When the CVHF is functioning in the cooling mode, liquid refrigerant is distributed along the length of the evaporator and sprayed through small holes in a distributor (i.e., running the entire length of the shell) to uniformly coat each evaporator tube. Here, the liquid refrigerant absorbs enough heat from the system water circulating through the evaporator tubes to vaporize.

The gaseous refrigerant is then drawn through the eliminators (which remove droplets of liquid refrigerant from the gas), first-stage variable inlet guide vanes, and into the first-stage impeller.

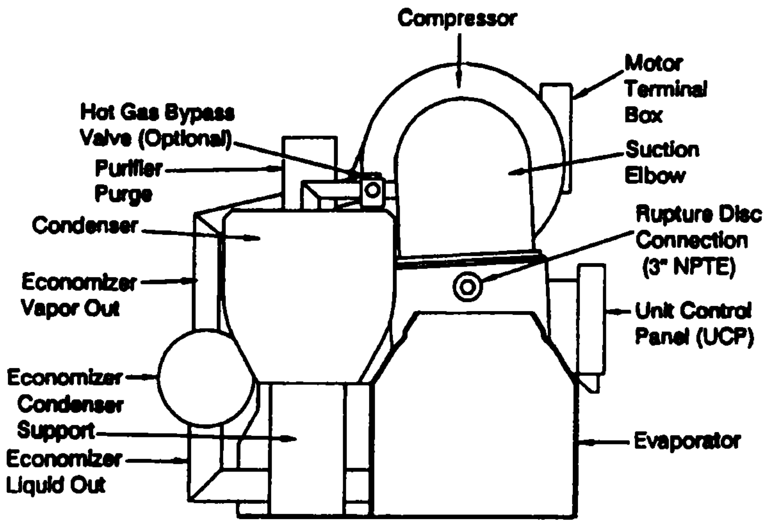
Note: Inlet guide vanes are designed to modulate the flow of gaseous refrigerant to meet system capacity requirements; they also prerotate the gas allowing it to enter the impeller at an optimal angle that maximizes efficiency at all load conditions.

Compressed gas from the first-stage impeller is discharged through the second-stage variable guide vanes and into the second-stage impeller. Here, the refrigerant gas is again compressed, and then discharged into the condenser.

Baffles within the condenser shell distribute the compressed refrigerant gas evenly across the condenser tube bundle. Cooling tower water, circulated through the condenser tubes, absorbs heat from the refrigerant, causing it to condense. The liquid refrigerant then flows out of the bottom of the condenser, passing through an orifice plate and into the economizer.

The economizer reduces the energy requirements of the refrigerant cycle by eliminating the need to pass all gaseous refrigerant through both stages of compression. See Figure 11. Notice that some of the liquid refrigerant flashes to a gas because of the pressure drop created by the orifice plate, thus further cooling the liquid refrigerant. This flash gas is then drawn directly from the economizer into the second-stage impellers of the compressor. All remaining liquid refrigerant flows out of the economizer, passes through another orifice plate and into the evaporator.

Figure 9
Gen ral CVHF Components



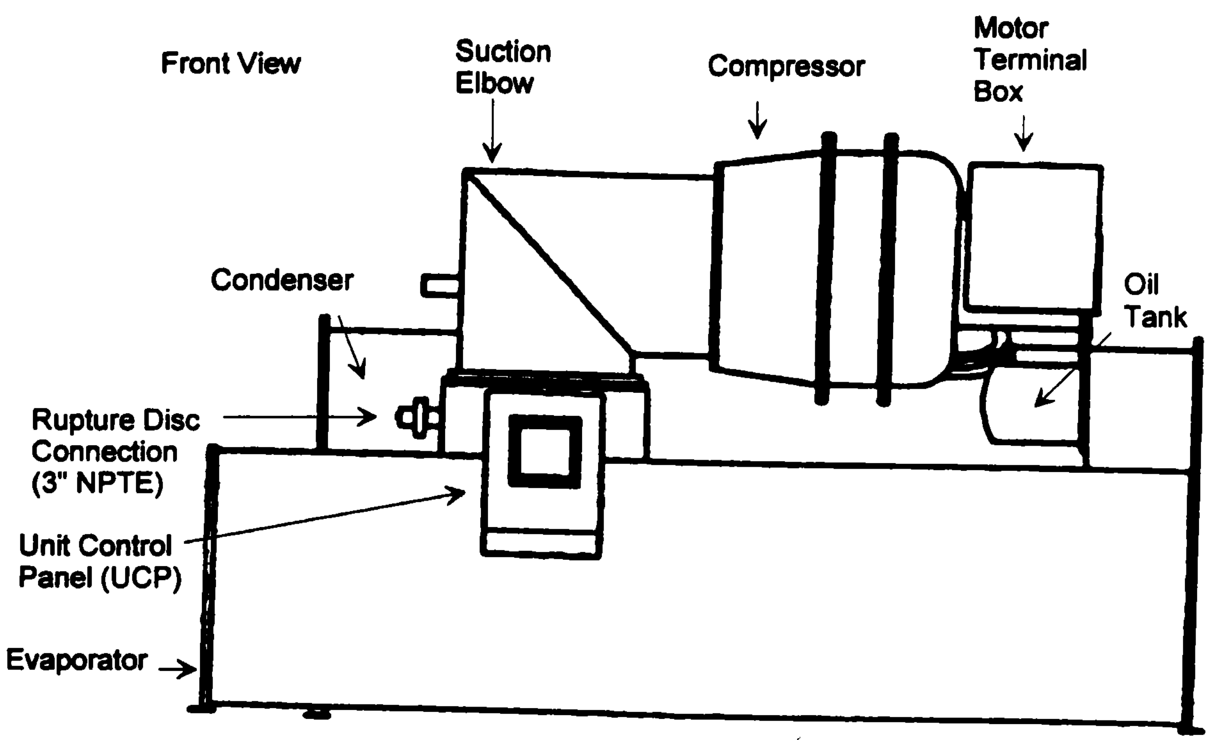


Figure 10
CVHF Pressure/Enthalpy Curve

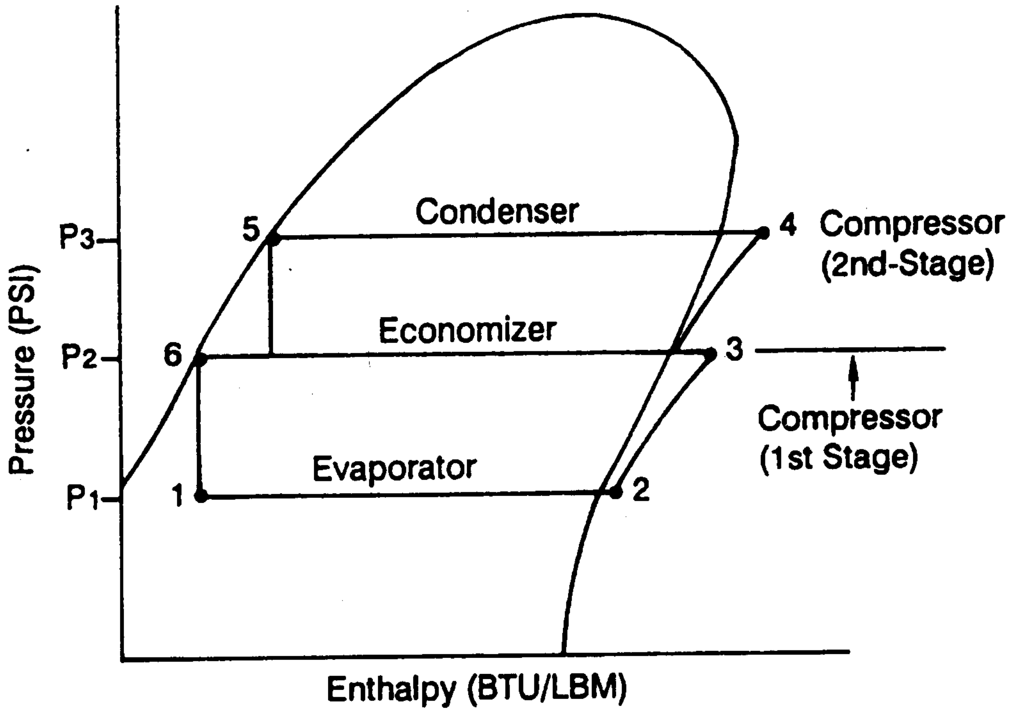
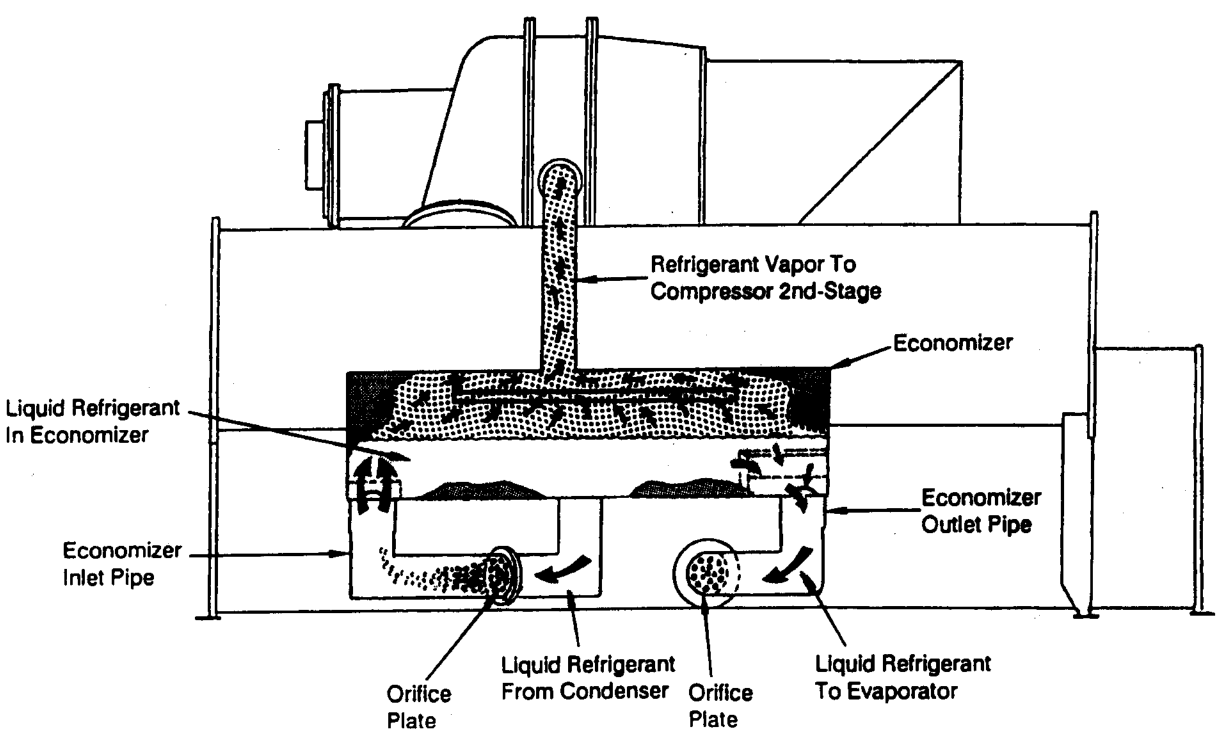


Figure 11
CVHF Economizer Operation



Compressor Lubrication System - CVHF

The CVHF compressor lubrication system, which supplies oil to the compressor motor bearings, is illustrated in Figure 12.

Oil is pumped from the oil tank (i.e., by a pump and motor located within the tank) through an oil pressure-regulating valve designed to maintain a net oil pressure-regulating valve designed maintain a net oil pressure of 12 to 18 psid. It is then filtered and sent to the compressor motor bearings. The oil filter assembly is equipped with refrigerant valves to isolate the filter during filter replacement.

From the bearings, the oil drains back to the oil tank through return lines.

⚠ WARNING
SURFACE TEMPERATURES MAY EXCEED 150°F. Use caution while working on certain areas of the unit, failure to do so may result in death or personal injury.

To ensure proper lubrication and prevent refrigerant from condensing in the oil tank, a 750-watt heater is immersed in the oil tank and is used to warm the oil while the unit is off. When the unit starts, the oil tank heater is de-energized.

Operating in response to a signal from the UCP, this heater energizes as needed to maintain an oil tank temperature of 140° to 145°F (60-63 C) when the chiller is not running. When the chiller is operating, the temperature of the oil tank is typically 30°F above sat. evap temp to 150°F (16.7°C above sat. evap. temp to 72°C).

The oil tank is vented between the compressor inlet vanes and the first-stage impeller suction cover. During normal system operation, motor barrel pressure is greater than that of the oil tank. Therefore, any gaseous refrigerant that enters the motor bearing cavities is drawn toward the oil tank where it is removed by the vent line.

A dual eductor system is used to reclaim oil from the suction cover and from the evaporator, and deposits it back into the oil tank. These eductors use high pressure condenser gas to draw the oil from the suction cover and evaporator back to the eductors, from the eductors the oil is discharged to the top of the oil tank.

The evaporator eductor line has a shutoff valve located at the evaporator. This valve ships from the factory with two turns open.

Note: CVHFs utilize a circuit module control relay and solenoid valve that temporarily close the oil sump vent line during the chiller start sequence. This prevents the loss of oil pressure that can occur during start-up by isolating the oil sump from the low-pressure cavity at the opposite end of the sump vent line.

Liquid refrigerant is used to cool the oil supply to the inboard motor bearing. Oil entering the oil cooler assembly from the oil tank (via the regulating valve and filter) flows into a coil inside the cooler shell. As the oil passes through this coil, it is cooled by a mixture of gaseous and liquid refrigerant that surround the coil exterior.

Once the cooled oil leaves the cooler shell, it flows directly to the inboard motor bearing, and eventually returns to the oil tank.

The refrigerant-side of the oil cooler is piped into the return circuit of the motor cooling system. Part of the refrigerant that is used to cool the compressor motor passes through the oil cooler shell on its way to the economizer.

Motor Cooling System

CVHF compressor motors are cooled with liquid refrigerant. This pressurized cooling system is illustrated in Figure 13.

Liquid refrigerant flows from the condenser sump to the bottom of the compressor motor where it enters the motor chamber through a control orifice. When the liquid refrigerant contacts the warmer motor components, a portion of it flashes to a gas and cools the motor. This "flash" gas, along with any excess liquid refrigerant, then drains to the evaporator sump.

Because of the positive pressure differential between the condenser and evaporator, proper refrigerant flow through the motor is maintained at all load conditions.

Figure 12
CVHF Compressor Motor Lubrication

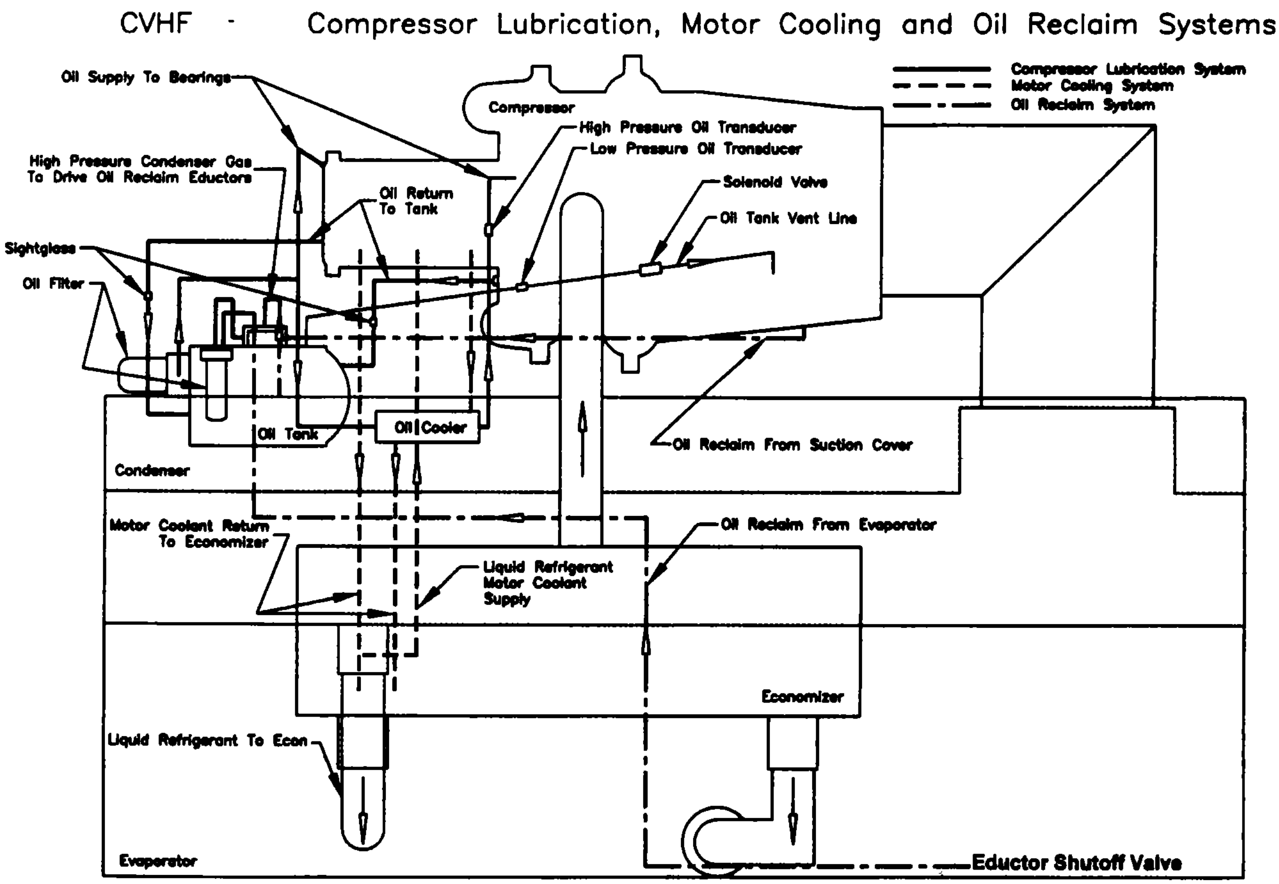
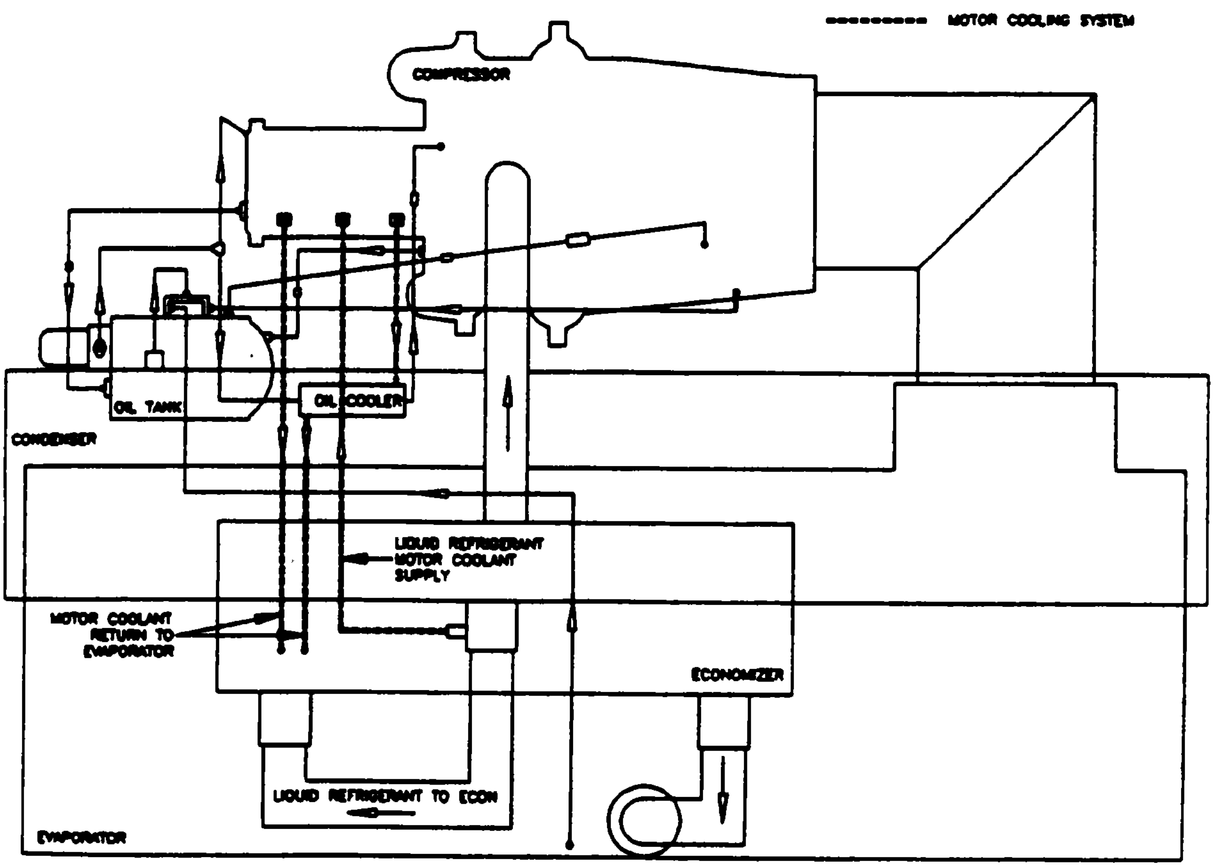


Figure 13
CVHF Motor Cooling System



Free Cooling Cycle CVHE/F/G

Based on the principle that refrigerant migrates to the coldest area in the system, the free cooling option adapts the basic chiller to function as a simple heat exchanger. However, it does not provide control of the leaving chilled water temperature.

If condenser water is available at a temperature lower than the required leaving chilled water temperature, the operator manually stops the compressor and starts the free cooling cycle by enabling the Free cooling mode in the "Operator Settings" Group of the Human Interface.

Several components must be factory-supplied or field-installed to equip the unit for free cooling operation:

-- options module 1U5

-- a refrigerant gas line, including an electrically-actuated shutoff valve, between the evaporator and condenser;

-- a valve liquid return line, including an electrically-actuated shutoff valve, between the condenser sump and the evaporator;

-- a liquid refrigerant storage vessel; and,

-- additional refrigerant.

When the chiller operator initiates changeover to the free cooling mode, the compressor will shut down if running, the shutoff valves in the liquid and gas lines open; UCP (i.e., unit control panel) control logic prevents the compressor from energizing during free cooling. Liquid refrigerant then drains (by gravity) from the storage tank into the evaporator and floods the tube bundle. See Figure 4.

Since the temperature and pressure of the refrigerant in the evaporator are higher than in the condenser (i.e., because of the difference in water temperature), the refrigerant in the evaporator vaporizes and travels to the condenser. Cooling tower water causes the refrigerant to condense, and it flows (again, by gravity) back to the evaporator.

This compulsory refrigerant cycle is sustained as long as a temperature differential exists between condenser and evaporator water. The actual cooling capacity provided by the free cooling cycle is determined by the difference between these temperatures which, in turn, determines the rate of refrigerant flow between the evaporator and condenser shells.

If the system load exceeds the available free cooling capacity, the operator must manually initiate changeover to the mechanical cooling mode by disabling the free cooling mode in the "Operator Settings" Group of the Human Interface. The gas and liquid line valves then close and compressor operation begins. Refrigerant gas is drawn out of the evaporator by the compressor, where it is then compressed and discharged to the condenser.

Most of the condensed refrigerant initially follows the path of least resistance by flowing into the storage tank. This tank is vented to the economizer sump through a small bleed line; when the storage tank is full, liquid refrigerant must flow through the bleed line restriction. Because the pressure drop through the bleed line is greater than that of the orifice flow control device, the liquid refrigerant flows normally from the condenser through the orifice system and into the economizer.

Note: During changeover from free cooling to mechanical cooling, the refrigerant transfer process is completed within 3 minutes. The micro-computer-based control system prevents carry-over by not allowing the unit to load for a period of two minutes.

High Humidity Option

HHOP is provided to prevent the formation of moisture on components inside the motor terminal box on chillers without unit mounted starters when the dew point in the equipment room is above 74° F (23.3° C).

Heat Recovery Cycle

"Heat recovery" is designed to salvage the heat that is normally rejected to the atmosphere through the cooling tower, and put it to beneficial use.

For example, a high-rise office building may require simultaneous heating and cooling during the winter months. With the addition of a heat recovery cycle, heat removed from the building cooling load can be transferred to areas of the building that require heat. (Keep in mind that the heat recovery cycle is only possible if a cooling load exists to act as a heat source.)

To provide a heat recovery cycle, a heat-recovery condenser is added to the unit; see Figure 2. Though physically identical to the standard cooling condenser, the heat-recovery condenser is piped into a heat circuit rather than to the cooling tower.

During the heat recovery cycle, the unit operates just as it does in the "cooling only" mode except that the cooling load heat is rejected to the heating water circuit rather than to the cooling tower water circuit.

When hot water is required, the heating water circuit pumps energize. Water circulated through the heat-recovery (or auxiliary) condenser tube bundle by the pumps absorbs cooling -load from the compressed refrigerant gas discharge by the compressor. The heated water is then used to satisfy heating requirements.

Auxiliary Condensers

Unlike the heat-recovery condenser (which is designed to satisfy comfort heating requirements), the auxiliary condenser serves a preheat function only, and is used in those applications where hot water is needed for use in kitchens, lavatories, etc. While the operation of the auxiliary condenser is physically identical to that of the heat-recovery condenser, it is comparatively smaller in size, and its heating capacity is not controlled.

Trane does not recommend operating the auxiliary condenser alone because of its small size.

Ice Machine Control

UCP2 provides a service level "Enable/Disable" menu entry for the Ice Building feature when the Ice Building option is installed. UCP2 will accept either an isolated contact closure (J3, 7 & 8 on the options module) or a remote communicated input (Tracer) to initiate the ice building mode where the unit runs fully loaded at all times. Ice building will be terminated either by opening the contact or based on entering evaporator water temperature. UCP2 will not permit the Ice Building mode to be entered again until the unit is switched to the Non-Ice Building mode and back into the Ice Building mode. It is not acceptable to reset the chilled water setpoint low to achieve a fully loaded compressor.

When entering Ice-Building the compressor will be loaded at its maximum rate and when leaving Ice Building the compressor will be unloaded at its maximum rate. While loading and unloading the compressor, all surge detection will be ignored.

While in the ice building mode, current limit setpoints less than the maximum will be ignored. Ice Building can be terminated by one of the following means:

1. Opening the external Ice Contacts/Remote communicated input (Tracer).

2. Satisfying an evaporator entering water temperature setpoint.

3. Surging for 15 minutes at full open IGV.

Base Loading

Tracer Base Loading:

Current Setpoint Range:
(20 - 100) % RLA

The Tracer commands the chiller to enter the base load mode by setting the base load mode request bit to 1. If the chiller is not running, it will start regardless of the differential to start (either chilled water or hot water). If the chiller is already running, it will continue to run regardless of the differential to stop (either chilled water or hot water), using the base load control algorithm. While the unit is running in base loading, it will report that status back to the Tracer by setting "Base Load Status = true" in the Tracer Status Byte. When the Tracer removes the base load mode request (sets the bit to 0). The unit will continue to run, using the normal chilled or hot water control algorithm, and will turn off, only when the differential to stop has been satisfied.

External Base Loading:

Current Setpoint Range:
(20 - 100) % RLA

The Chiller module accepts 2 inputs to work with external base loading. The first input is on Chiller module terminals J7-1 and J7-2. This input looks for a switch closure to enter the base-loading mode. The second input is found on Chiller module terminals J7-11 and J7-12. This input selects the base loading setpoint, and can be controlled by either a 2-10Vdc or 4-20ma Signal. To use a 2-10Vdc input, dip switch 2-1 should be in the 'OFF' position. To use a 4-20mA input, dip switch 2-1 should be in the 'ON' Position. You must also set the correct input type in the Machine configuration menu. This menu is titled "External Setpoints Input". The graphs in Figure 14 show the relationship between input and % RLA.

While in base loading the active current limit setpoint is set to the Tracer or external base load setpoint, providing that the base load setpoint is not equal to 0 (or out of range). If it is out of range, the front panel current limit setpoint is used. During base loading, all limits are enforced with the exception of current limit. The human interface displays the message "Unit is Running Base Loaded". Hot gas bypass is not run during base loading. If base loading and ice making are commanded simultaneously, ice making takes precedence.

Base Loading Control

Algorithm:

Base loading control is basically a variation of the current limit algorithm. During base loading, the leaving water control algorithm provides a 1250 step load command every 5 seconds. The current limit routine limits the loading when the current is below setpoint. When the current is within the deadband of the setpoint the current limit algorithm holds against this loading command. If the current exceeds the setpoint, the current limit algorithm unloads. The "Capacity Limited By High Current" message normally displayed while the current limit routine is active is suppressed while base loading.

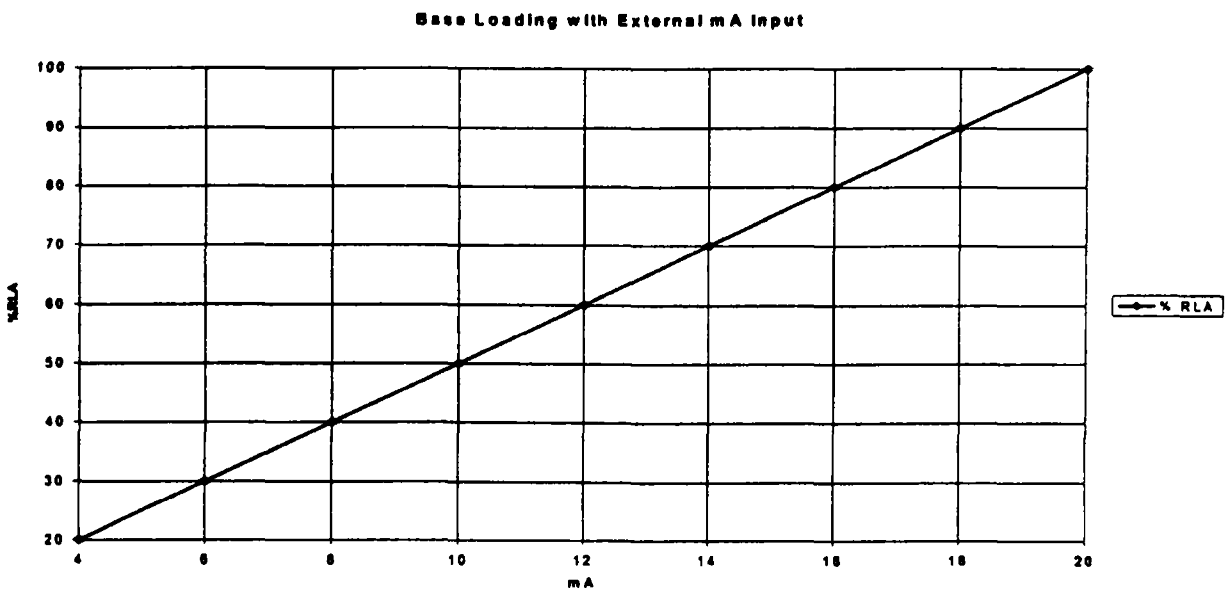
Unit Mounted Refrigerant Monitor

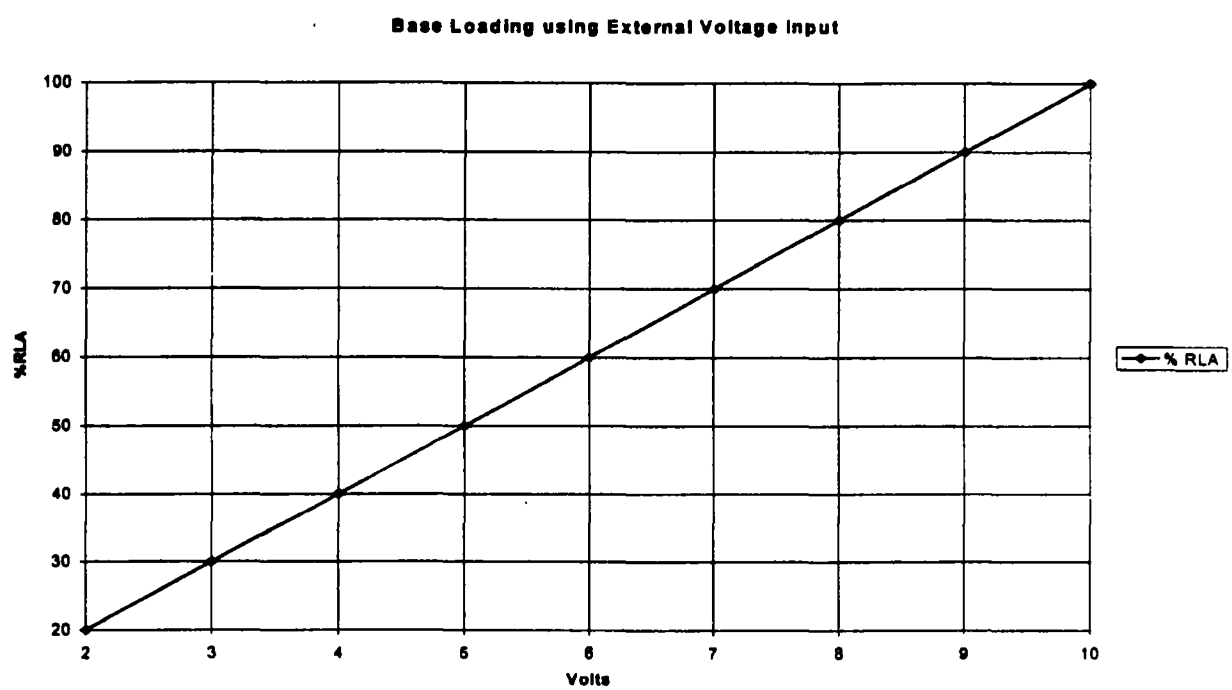
Refer to RMWD-IOM-1D or the most current revision. This can be obtained from the nearest Trane office in your area.

Unit Mounted Adaptive Frequency™ Drive

The AFDB, is a water-cooled pulse width modulated inverter. The function of the inverter is to change a DC input voltage to a symmetrical AC output voltage of desired magnitude and frequency. It is designed for 460/480-volt application. Circuit breakers, surge capacitors and ground faults are standard on all AFDB units. The CTV unit control panel has full control of the AFDB unit operation, including the start/stop functions. AFDB-OM-1 (or most recent revision) covers the features and specifications of the Trane Adaptive Frequency drive.

Figure 14
Bas L ading with External mA Input and with External Voltage Input





Chiller Control System

Unit Control Panel

Safety and operating controls are housed in the UCP2 unit control panel, the starter panel and the purge control panel, the control panel layout is illustrated in Figure 15.

The UCP2 control consists of a modular design partitioned by major function or group of functions. All modules communicate with each other through the IPC circuit.

Major components within each of these control groups are described below.

Unit-mounted temperature sensors, pressure transducers and functional switches provide analog and binary inputs to the various modules.

The "microcomputer-based" modules are described below. All wiring to the modules are to pluggable terminal blocks.

Chiller Module (1U1)

The chiller module, located in the UCP2 control panel, is the "Master" of the chiller communicating commands to other modules and collecting data, status and diagnostic information from the other modules over the IPC (Inter Processor Communications) link. The Chiller Module performs the Leaving Chilled Water Temperature and Limit Control Algorithms arbitrating capacity against any operating limit the chiller may find itself working against. The Chiller module contains non-volatile memory both checking for valid set points and retaining them on any power loss.

Inputs and Outputs are chilled water system level I/O including evaporator and condenser water temperatures, outdoor air temperature, evaporator and condenser water pump control, status and alarm relays, external Auto-Stop, emergency stop, evaporator and condenser water pressure drops and evaporator and condenser water flow switches. Connection points of standard and optional inputs and outputs for the chiller module (1U1) are shown in Figure 16.

For more information regarding the UCP2 control module screens, refer to CVHE-CLD-1 or later, which is the Clear Language Display manual that ships with CVHE, CVHF and CVHG units from the factory. This manual also may be obtained from the nearest Trane office.

Figure 15
UCP2 Control Panel

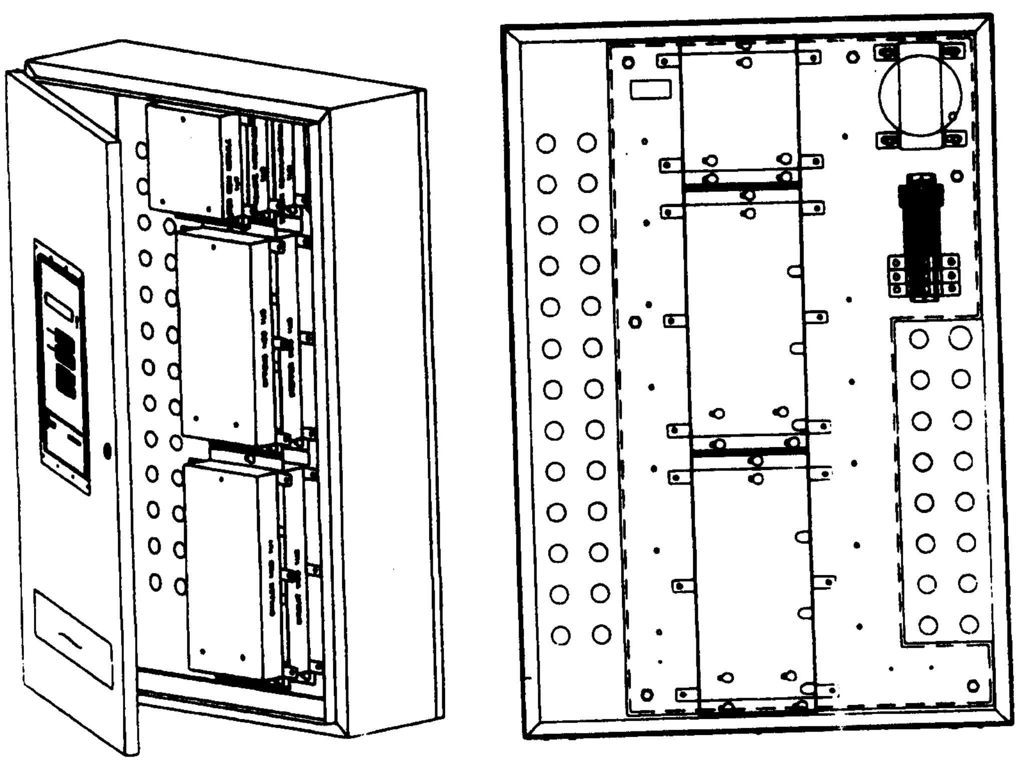
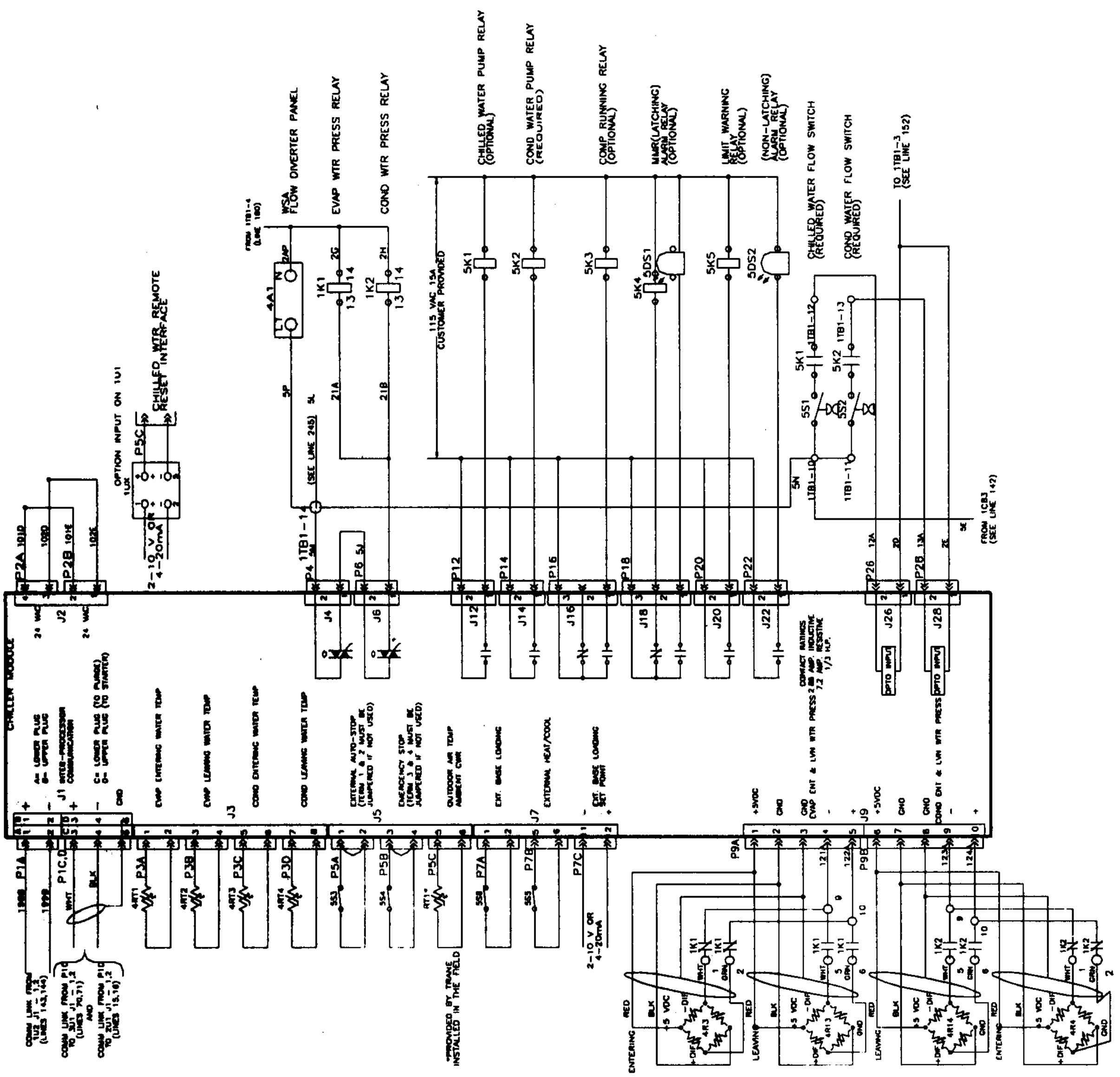


Figure 16 - Chiller Module (1U1) - CVHE/F/G



Circuit Module (1U2)

The Circuit Module serves as an input/output expander and has inputs and outputs associated with motor, refrigerant and lubrication functions. These include, motor winding temperatures, oil temperature, RFGT Monitor Connection, optional condenser refrigerant pressure, oil sump pressure, oil pump discharge pressure, vent line valve operation, oil tank heater operation and oil pump operation.

Note: The oil heater no longer needs to run when the unit is running. When the unit is OFF, the heater will be ON.

You will notice that the oil sump may run colder when the unit is running and the oil heater is OFF. The chiller will operate at oil sump temperatures 30° F (16.6°C) above the saturated temperature. The high oil temperature still remains at 180° F (82°).

Connection points of inputs and outputs for the Circuit Module (1U2) are shown in Figure 17.

Stepper Module (1U3)

The Stepper Module drives the stepper motor inlet guide vane actuator on CenTraVac® Chillers. The Stepper Module receives from the Chiller Module the direction and distance to drive the inlet guide vanes and then generates the appropriate signals to operate the stepper motor. The Stepper Module has inputs and outputs used to support functions on the module. These include saturated evaporated refrigerant temperature, bearing temperatures, compressor discharge temperature, inlet guide vane binary position indicator (B.P.I.), and saturated condenser refrigerant temperature.

Connection points of inputs and outputs of the Stepper Module (1U3) are shown in Figure 18.

Clear Language Display Module (1U4)

The Clear Language Display Module, located on the UCP2 control panel door, provides display of chiller data and access to operator/serviceman controls, set points and chiller setup information. All information is stored in non-volatile memory in the Chiller Module. The Clear Language Display and the Chiller Module work together to display and store information requiring non-volatility. The connections to the Clear Language Display Module (1U4) are shown in Figure 19. The front face of the Clear Language Display Module consists of a LCD Display, a LED, and a keypad. The LCD Display presents the operating status of the unit, operating set points, operating conditions, unit configurations, purge operating conditions, service test, unit configuration, and diagnostics in a clear language display. The LED is red in color and will only be "ON" when a manual reset is required to restore the unit to full operation. The keypad has 16 keys arranged in a 4 c 4 matrix. See CVHE-CLD-1 or latest revision for operation and set-ups on the Clear Language Display.

Options Module (1U5)

The Options Module provides control or interface requirements for a number of options. Features supported by the Options Module include Ice-Making, Heat Recovery, External Chilled Water Setpoint, External Current Limit Setpoint, Free Cooling, Evaporator Differential Water Pressure Drop, Condenser Differential Water, Pressure Drop Percent RLA of Compressor, Tracer Temperature Sensor, Head Relief Request, Maximum Capacity Relay, and Tracer Controlled Relay. Connection points of inputs and outputs of the Option Module (1U5) are shown in Figure 20.

Starter Module (2U1)

The Starter Module located in the Compressor Motor Starter Panel provides control of the starter when starting, running and stopping the motor. The Starter Module provides interface to and control of the Y-Delta, X-Line, P-Reactor, A-Transformer and Solid State Starters; interface to and control of Adjustable Speed Drives is also supported.

The Starter Module also provides protection to both the motor and the compressor in the form of starting and running overload, phase reversal, phase loss, phase unbalance, momentary power loss and compressor surge. Typical wiring connections to the Starter Module are shown in Figures 21 and 22.

See "as built" wiring diagrams that ship with the unit for specific details and trouble shooting for the type of starter on the unit.

Purge Module (3U1)

The Purge Module provides control of the Purge used on CVHE, CVHF and CVHG units. The Purge Module provides all the inputs and Outputs to control the purge, optimizing both purge and chiller efficiency. The Purge Module resides in the purge control panel and communicates with the Chiller Module over the IPC (Inter-Processor Communications Link) uploading setpoints and down loading data and diagnostics. Connection points of the input and outputs to the Purge Module are shown in Figure 23.

Figure 17 - Circuit Module (1U2) - CVHE/F/G

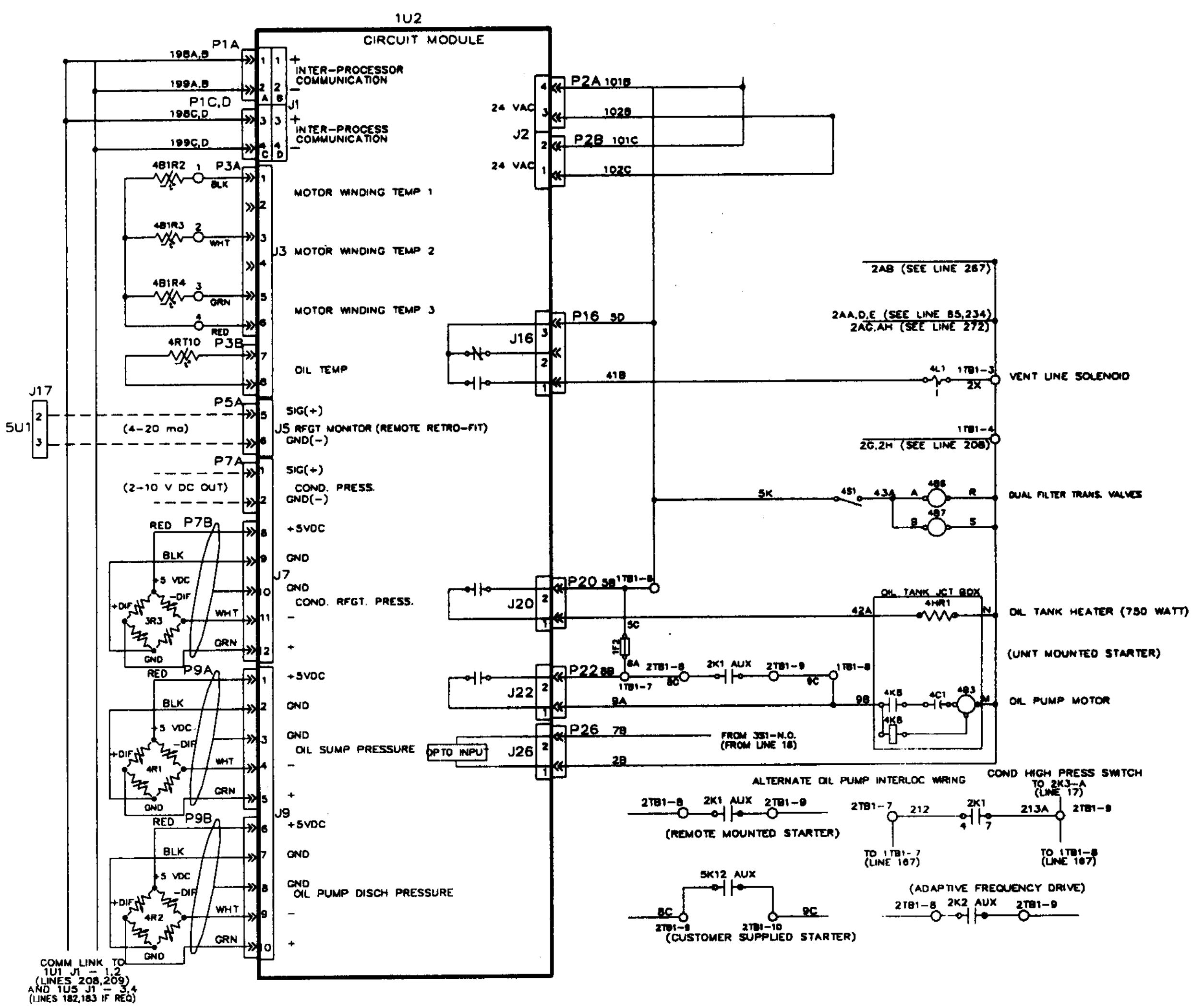


Figure 18 - Stepper Control Module (1U3) - CVHE/F/G

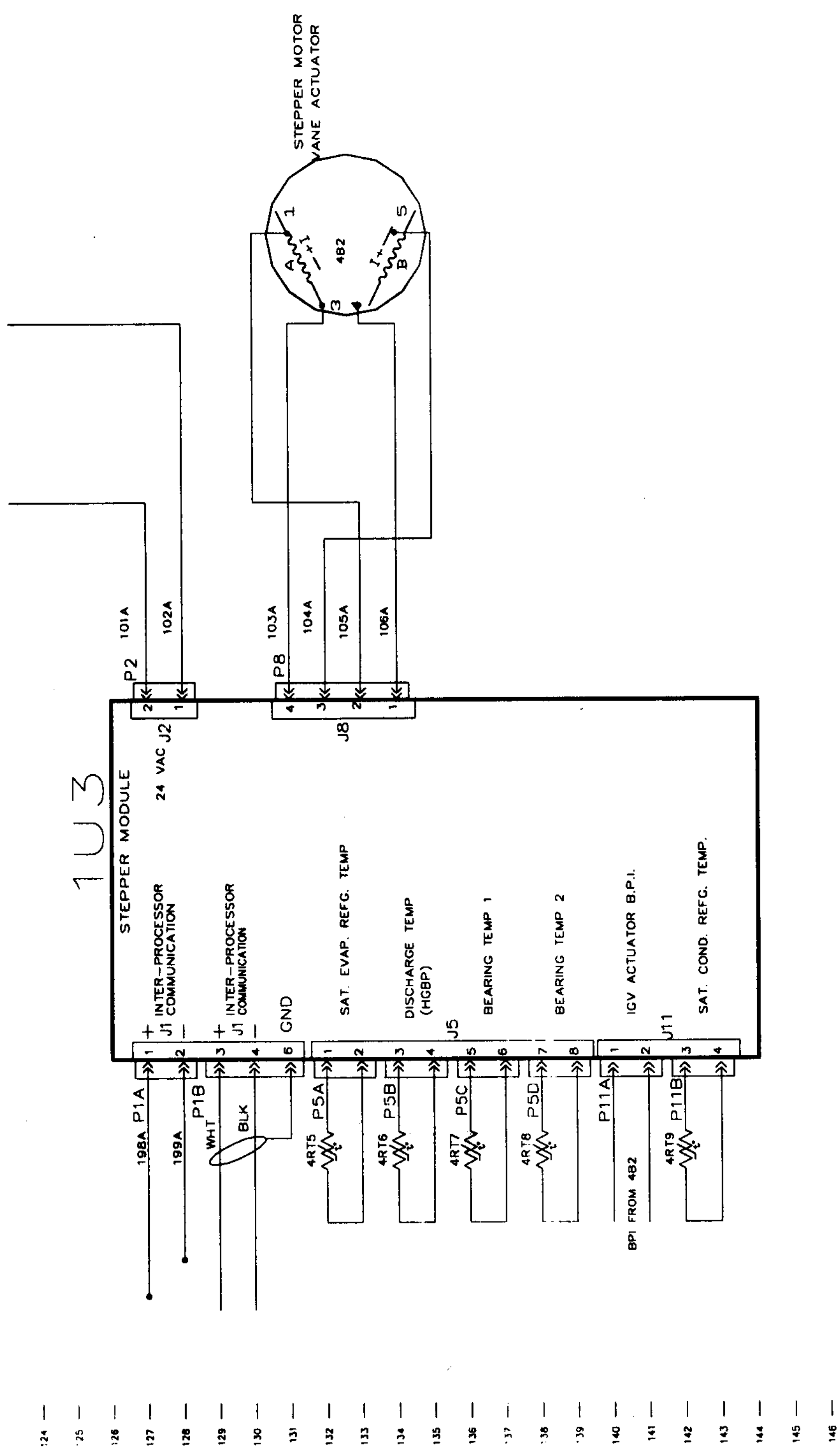


Figure 19 - Clear Language Display Module (1U4) - CVHE/F/G

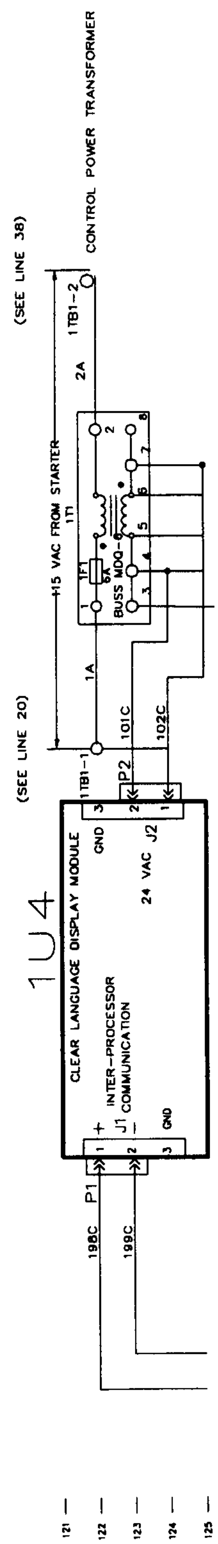


Figure 20 - Options Control Module (1U5) CVHE/F/G

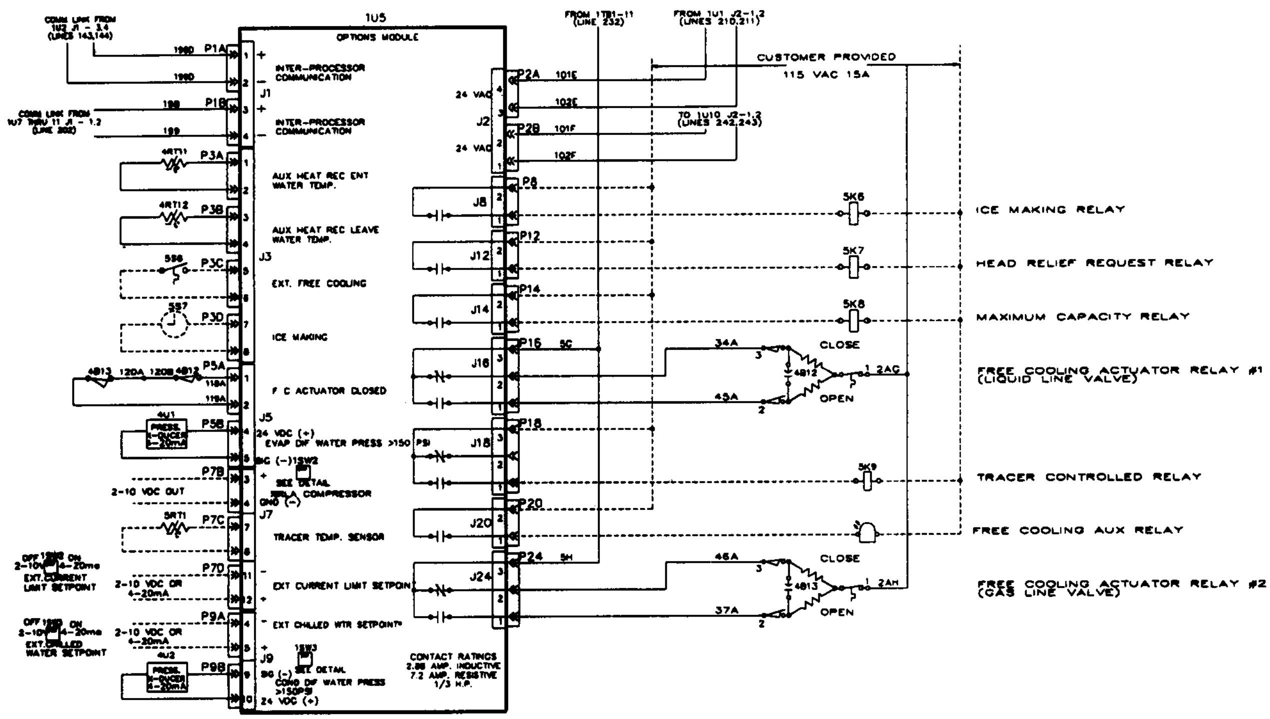


Figure 21 - Starter Module with Remote Across the Line Starter

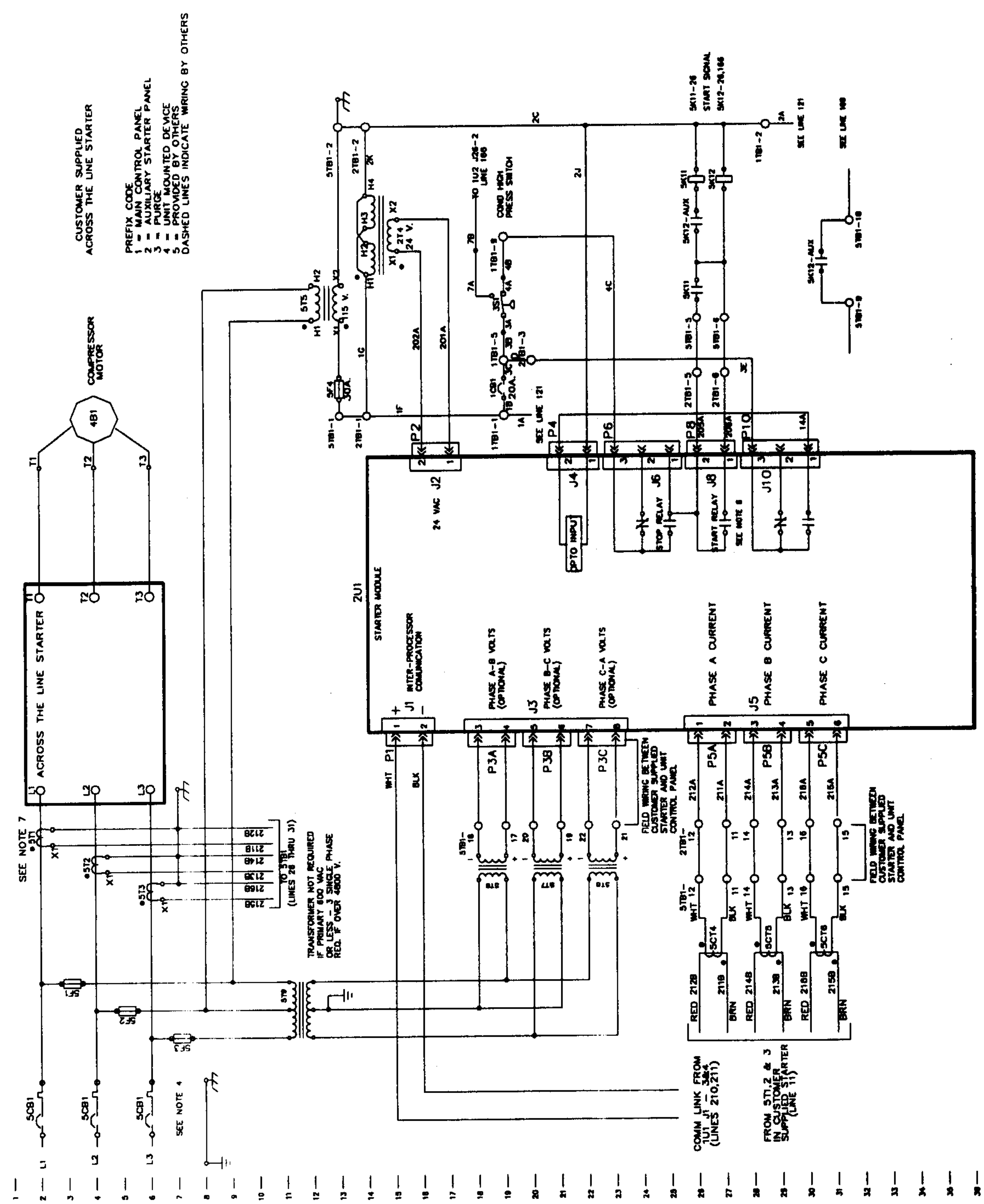
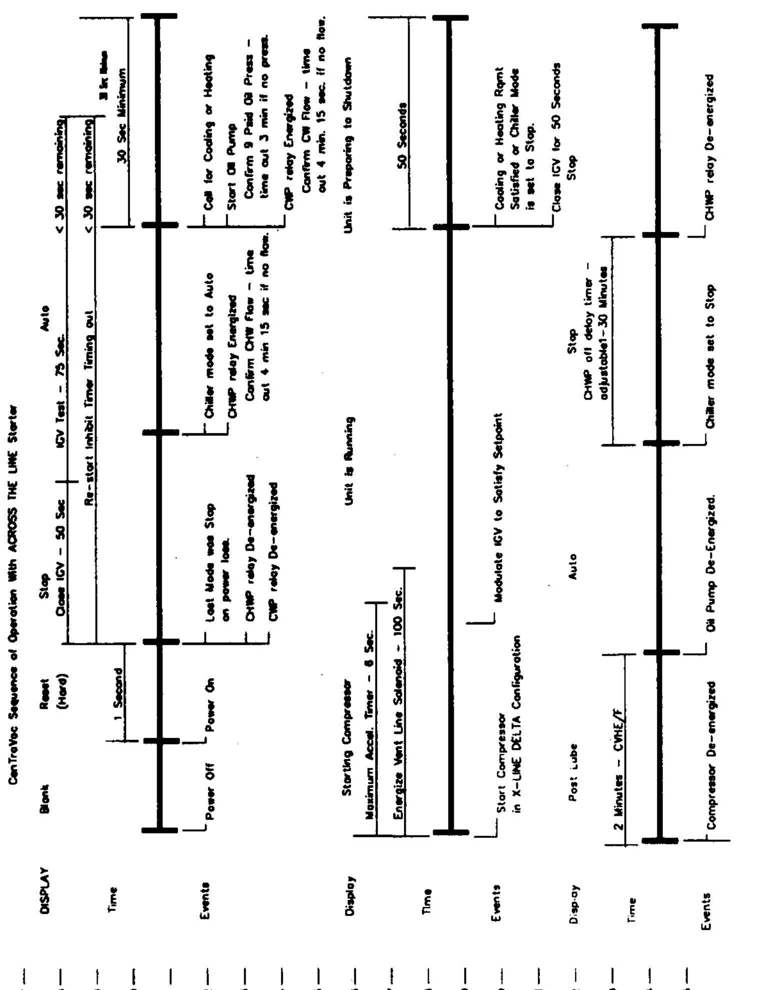


Figure 21 - Continued - Starter Module with Remote Across the Line Starter



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⚠ WARNING

HAZARDOUS VOLTAGE!

DISCONNECT ALL ELECTRIC POWER INCLUDING REMOTE DISCONNECTS BEFORE SERVICING.

FAILURE TO DISCONNECT POWER BEFORE SERVICING CAN CAUSE SEVERE PERSONAL INJURY OR DEATH.

⚠ AVERTISSEMENT

VOLTAGE HASARDEUX!

DECONNECTEZ TOUTES LES SOURCES ELECTRIQUES INCLUANT LES DISJONCTEURS SITUES A DISTANCE AVANT D'EFFECTUER L'ENTRETIEN.

FAUTE DE DECONNECTER LA SOURCE ELECTRIQUE AVANT D'EFFECTUER L'ENTRETIEN PEUT ENTRAINER DES BLESSURES CORPORELLES SEVERES OU LA MORT.

⚠ CAUTION

USE COPPER CONDUCTORS ONLY!

UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT OTHER TYPES OF CONDUCTORS.

FAILURE TO DO SO MAY CAUSE DAMAGE TO THE EQUIPMENT.

NOTES:

1. OPTIONAL STARTER INTERLOCK. SEE STARTER MANUFACTURES WIRING DIAGRAM FOR SPECIFIC APPLICATION.
2. UNLESS OTHERWISE NOTED,ALL SWITCHES ARE SHOWN AT 25 C (77 F), AT ATMOSPHERIC PRESSURE, AT 50% RELITIVE HUMIDTY, WITH ALL UTILITIES TURNED OFF AND AFTER A NORMAL SHUTDOWN HAS OCCURED.
3. NUMBERS ALONG THE RIGHT SIDE OF THE SCHEMATIC DESIGNATE THE LOCATION OF THE CONTACTS BY LINE NUMBER. AN UNDERLINED NUMBER INDICATES A NORMALLY CLOSED CONTACT.
4. THREE PHASE POWER SUPPLY VOLTAGE-SEE UNIT NAMEPLATE
5. REMOTE ACROSS THE LINE STARTER WIRING BETWEEN STARTER AND CONTROL MODULE ARE SHOWN. SEE STARTER MANUFACTURES WIRING DIAGRAM FOR SPECIFIC STARTER WIRING.
6. RELAY COILS ARE NOT SHOWN. CONTACTS ARE CONTROLLED BY THE LOGIC OF THE MICRO-CONTROLLER. SEE SEQUENCE OF OPERATION.
7. POLARITY MARKING ON THE CURRENT TRANSFORMER , (H1 MARKING ON CT) MUST BE FACING TOWARDS THE INCOMING CURRENT.

Figure 22 - Starter Module with Factory Mounted Wye-Delta Starter

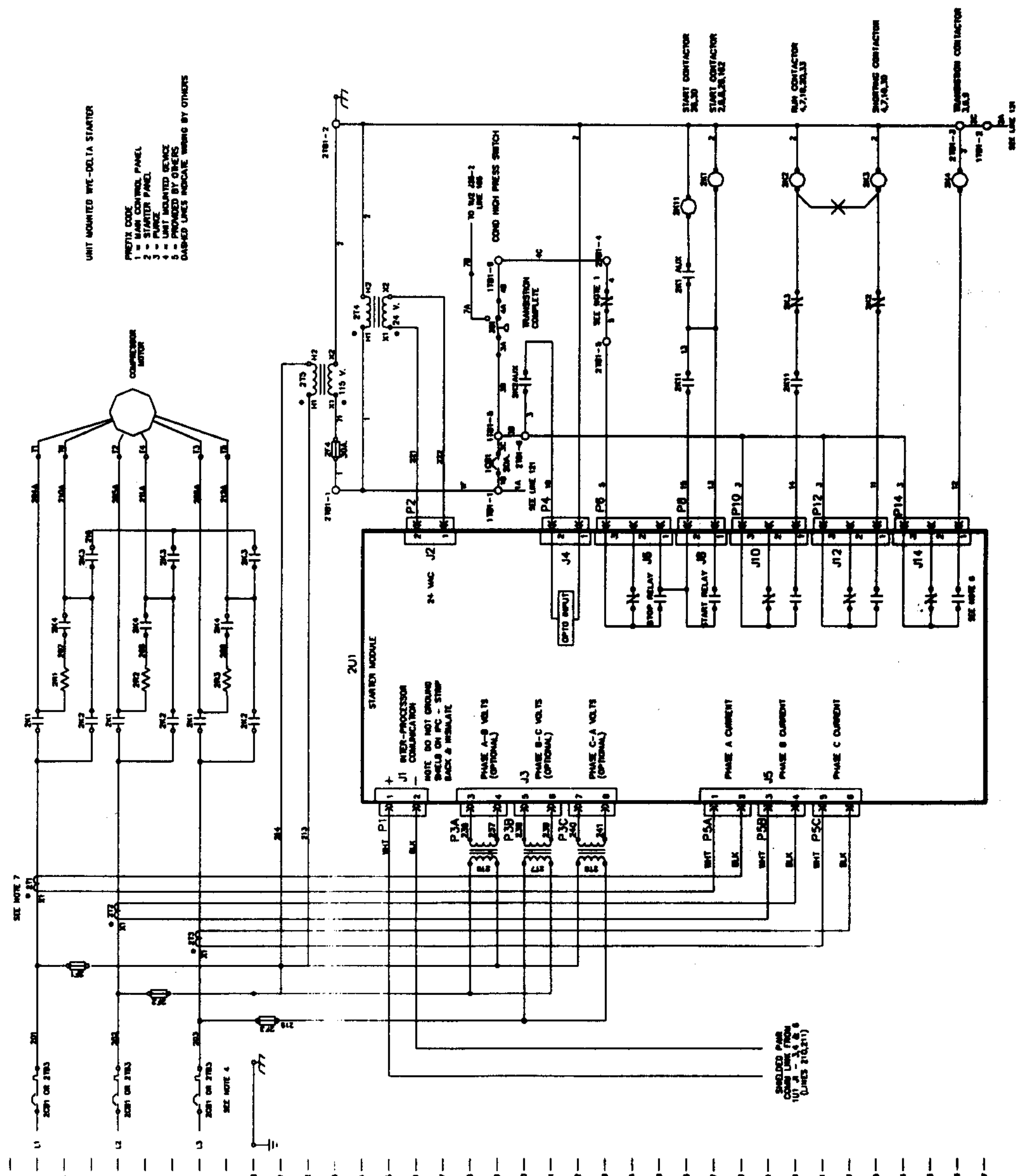


Figure 22 Continued - Starter Module with Factory Mounted Wye-Delta Starter

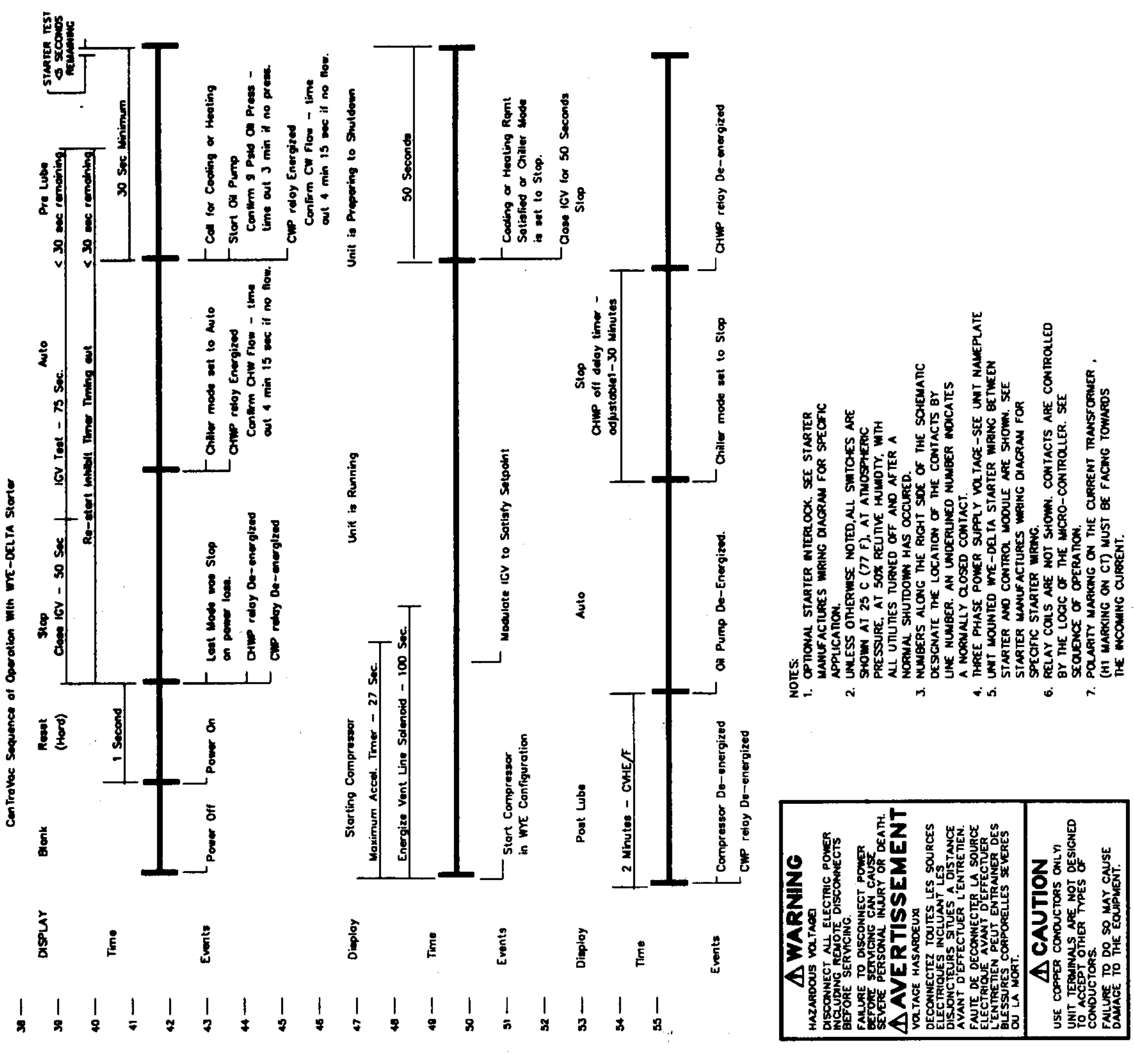
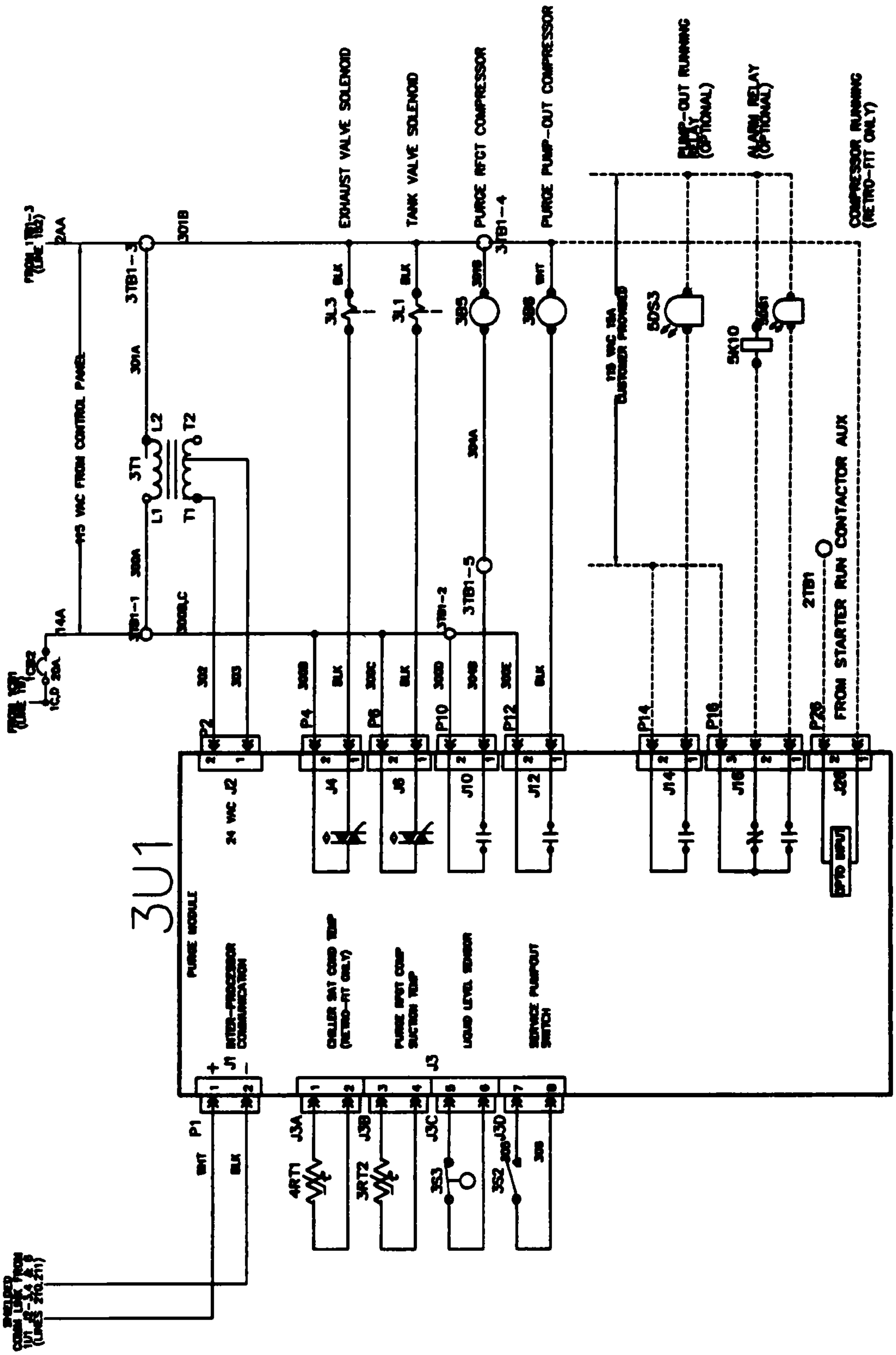


Figure 23 - Purge Module (3U1) - CVHE/F/G



UCP2 Board Dip Switch Settings

Several of the UCP2 modules have dip switch settings on them, used to set up the board for 2-10 VDC or 4-20 MA signal inputs and/or outputs of the boards. The following are the various switch settings.

Chiller Module

External Vane Position	Switch	2-10V	4-20 MA
	SW2-1	OFF	ON (SW2-2 and SW2-3 are not used).

Options Module

External Current Limit	Switch	2-10V	4-20 MA
External Chilled Water	SW2-1	OFF	ON (SW2-2 and SW2-3 are not used).
	SW3-1	OFF	ON (SW2-3 not used)

TCI/IPC Modules

Tracer COM3	Switch	-1	-2	-3
	SW1	OFF	OFF	OFF

Tracer COM4	Switch	-1	-2	-3
	SW1	OFF	ON	OFF

IPC BUFFER	Switch	-1	-2	-3
	SW1	OFF	OFF	ON

PRINTER	Switch	-1	-2	-3
	SW1	OFF	OFF	ON

Setup for External Current Limit Setpoint

The External Current Limit is an option that allows the current limit setpoint to be changed from a remote location. The External Limit Setpoint is found on Option Module terminals J7-11 and J7-12.

UCP2 shall accept either a 2-10 Vdc or 4-20 analog input suitable for customer connection to set the unit external current limit setpoint. 2-10 vdc and 4-20 ma shall each correspond to a 40 to 120% RLA range. CTV UCP2 will limit the maximum ECLS to 100%.

The following must be "SET":

1. SW2-1-OFF for 2-20 Vdc On for 4-20 ma.
2. Current Limit Setpoint Source: External
3. External Current Limit Setpoint: Installed
4. Setpoint Type: 2-10 Vdc or 4-20 ma

The user must also specify the type of External Setpoint Input (4-20 ma or 2-10 VDC) in the Machine Configuration Menu.

Setup for External Chilled Water Setpoint

The External Chilled Water Setpoint allows the chilled water setpoint to be changed from a remote location. The External Chilled Water Setpoint is found on Options Module terminals J9-4 and J9-5.

UCP2 shall accept either a 2-10 Vdc or 4-20 ma analog input suitable for customer connection to set the unit leaving chilled water setpoint. 2-10 vdc and 4-20 ma shall each correspond to a 0 to 65 F (-17.8 to 18.3 C) CWS range.

The following must be "SET":

1. SW3-1 OFF for 2-10 VDC. ON for 4-20 MA.

2. Chilled Water Reset Type: Disable - Operator Settings Group

3. Chilled Water Setpoint : Source External - Operator Settings Group

4. Setpoint Source Override: None - Operator Settings Group

5. External Chilled Water Setpoint: Installed - Service Settings Group - Machine Configuration

6. Setpoint Type: 2-10 Vdc or 4-20 ma. - Service Setting Group-Machine Configuration

Refrigerant Monitor Input

Analog type input 4-20ma input signal to the Circuit module J5-5 and J5-6. This represents 0-100 ppm.

Under **Machine Configuration** "Refrigeration Monitor Type". Direct communication to the CLD via the IPC.

Under **Machine Configuration** "Refrigeration Monitor Type" " 02" for IPC Monitor.

Also allows monitor calibration and setup. Please note that the monitor cannot have a local display, and communicate with the UCP2. If the customer requires a local display, he can connect an RMWD style monitor up like analog type previously described. See Figure 24 for the Refrigerant Monitor Module (4U1).

Load Indication Output

Option Modules J7-3, --4

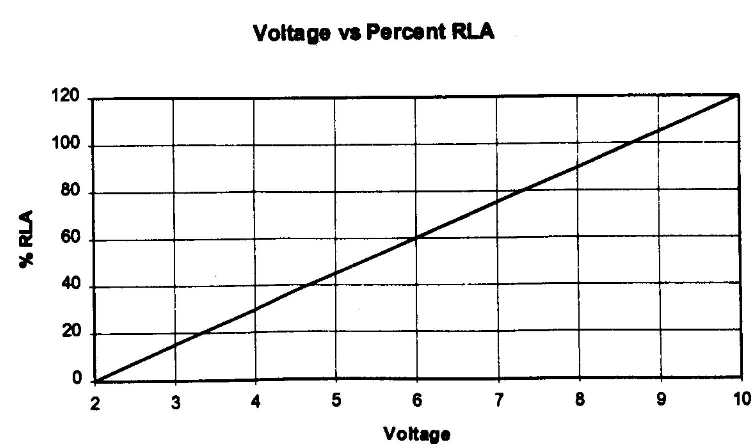
2-10 Vdc

As an option, the UCM shall provide a 0-10 Vdc analog output to indicate % RLA. The transfer function shall be 2 to 10 Vdc corresponding to 0 to 120% RLA.

Percent RLA Output:

UCP2 provides a 2-10 Vdc analog output to indicate % RLA. The transfer function shall be 2 to 10 Vdc corresponding to 0 to 120% RLA. With a resolution of 0.146%.

The following graph illustrates the output:



The % RLA output is found on th Options module terminals J7-3 and J4.

Th % RLA output is polarity sensitive.
J7-3 is+
J7-4 is -

The %RLA output's maximum source capability is 30mA.

P rc nt Condenser Pressure Output:

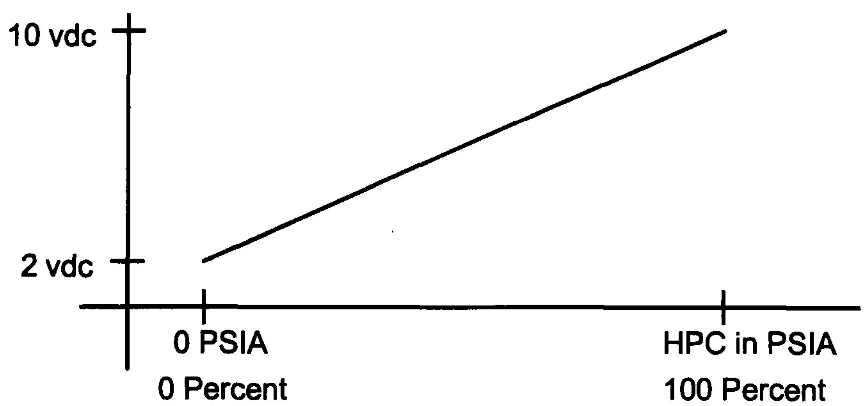
The transfer function is 2 to 10 Vdc corresponding to 0 Psia to the HPC setting (psig) plus the local atmospheric pressure setting or said anoth r way, 0 Psia to HPC in Psia. The Percent Condenser Pressure indication output is based on th Condenser Refrigerant Pressure sensor if the Condenser Pressure Option is selected as 'Installed' at the CLD. The Percent Condenser Pressure indication output is based on the Saturated Condenser Refrigerant Temperature s nsor if the Condenser Pressure Option is selected as "Not Installed' at the CLD.

When a T mp rature Sensor Only is Used and a Temperature to Pressure Conversion is Made: If the Condenser Saturated Temperature goes out of range due to an open or short, a pressure sensor diagnostic will be called and the output will also go to the respective out of range value. That is, for an out of range low on the sensor, the output will be limited to 2.0 VDC. For an out of range high on the sensor, the output will be limited to 10.0 VDC.

When a Condenser Pressure Sensor Is Used (Optional): If the Condenser Pressure sensor goes out of range due to an open or short, a pressure sensor diagnostic will be called and th output will go to end of range low. That is, for an out of range low on the sensor, the output will be limited to 2.0 VDC.For an out of range high on the sensor, the output will be limited to 2.0 VDC.

When a Temperature Sensor Only is Used (Optional): If the Temperature Sensor (or Condenser Pressure sensor) goes out of range due to an open or short, a Temperature Sensor (or Pressure Sensor) diagnostic will be called and the output will go to end of range low. That is, for an out of range low on the sensor, the output will be limited to 2.0 VDC. For an out of range high on the sensor, the output will be limited to 2.0 VDC.

Or:



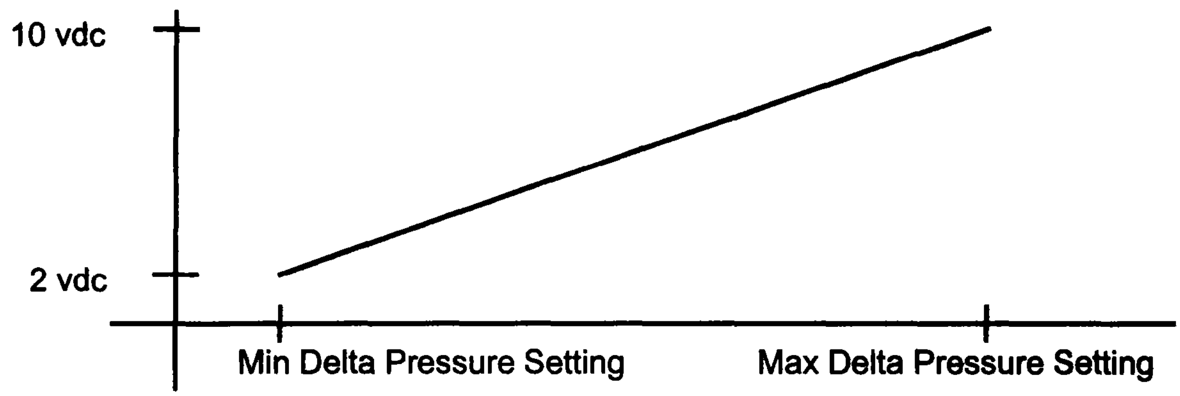
Refrigerant Differential Pressure Indication Output:

(Selectable in Service Settings - Field Start-up Group) The Transfer function is 2 to 10 Vdc corresponding to the menu entered "Min Delta Pressure Calibration" setting to the menu entered "Max Delta Pressure Calibration" setting.

The transfer function is 2 to 10 Vdc corresponding to the menu entered "Min Delta Pressure Calibration" setting to the menu entered "Max D lta Pressure Calibration" setting. The Min Delta Pressure Calibration s tting shall have a range of 0-400 psid (0-2758 kPa) in increments of 1 psid (1kPa).

The Max Delta Pressure Calibration setting shall have a range of 1-400 psid (7-2758 kPa) in increments of 1 psid (1kPa). The condenser refrigerant pressure shall be based on the Condenser Refrigerant Temperatue sensor if the Condenser Pressure Option is selected as "Not Installed" at the CLD.

The evaporator refrigerant pressure shall be based on the Saturated Evaporator Refrigerant Temperature Sensor.



The Percent Condenser Pressure/ Refrigerant Differential Pressure Indication Output is located on the Circuit Module at J7-1,2.

If the saturated condenser temperature is used to determine condenser pressure, it takes about 11.5 seconds for UCP2's % condenser pressure output to respond to a step change in saturated condenser temperature.

The Percent Condenser Pressure output can source a maximum of 30mA of current.

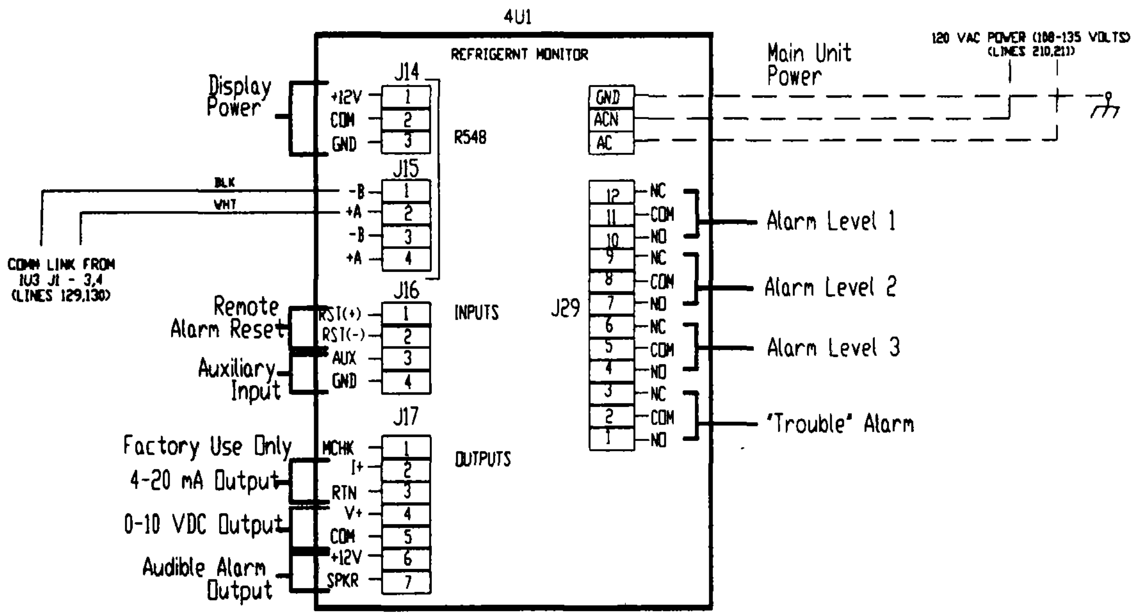
The maximum recommended length to run this signal is included in Table 1.

Table 1 - Recommended Length to Run Percent Condenser Pressure Output

Gauge	Ohms/Foot	Max Length (ft)	Max Length (m)
14	0.002823	1062.7	324.0
16	0.004489	668.3	203.8
18	0.007138	420.3	128.1
20	0.01135	264.3	80.6
22	0.01805	166.2	50.7
24	0.0287	104.5	31.9
26	0.04563	65.7	20.0
28	0.07255	41.4	12.6

Note: The above table is for copper conductors only.

Figure 24 - Refrigerant Monit r (4U1) - CVHE/F/G



Electrical Sequence of Operation

Overview

This section will acquaint the operator with the control logic governing CVHE, CVHF and CVHG chillers equipped with UCP2 based control systems. When reviewing the step-by-step electrical sequences of operation, refer to the typical wiring schematics shown in the installation manual, CVHE-IN-11 or CVHE-W-8A which are shipped with the chiller.

Note: The typical wiring diagrams in CVHE-IN-11 are representative of standard units and are provided only for general reference. They may not reflect the actual wiring of your unit. For specific electrical schematic and connection information, always refer to the wiring diagrams that shipped with the chiller.

With the supply power disconnect switch or circuit breaker (2CB1) closed, 120-volt control power transformer 2T5 and a 30-amp starter panel fuse (2F4) to terminal 1TB1-1 in the UCP2 control panel. From this point, control voltage flows to:

Circuit Breaker 1CB1, supplying power to starter module (2U1) via terminal 2TB1-6 for starter contactors operation and the high condenser pressure switch 3S1.

Circuit Breaker 1CB2, supplying power to the purge module (3U1) and the 24 volt supply transformer 3T1 for the purge module (3U1).

Circuit Breaker 1CB3, Supplying power to:

1. The I/O module (1U10) will operate the Hot Gas Bypass valve, the Vent Line Solenoid valve (4L1), the Oil Heater (4R1), and the oil pump motor through Fuse 1F2.
2. The chiller module (1U1) will operate evaporator (4L2) and condenser (4L3) water pressure transducer solenoids and to the chilled water (5S1) and condenser water (5S2) flow switch circuits.

The starter module (2U1) receives 24 volt power from control power transformer 2T4 in the starter panel.

The Clear Language Display (1U4), Stepper (1U3), Circuit (1U2), Options (1U5), Chiller (1U1), and COMM (1U6), (1U7), (1U8) & (U10) modules obtain 24 volt power from control power transformer 1T1 in the control panel.

Chilled and Condenser Water Flow Interlock Circuits

Proof of chilled water flow for the evaporator is made by the closure of flow switch 5S1 and the closure of auxiliary contacts 5K1 on terminals 1TB1-11 and 1TB1-12.

Proof of condenser water flow for the condenser is made by the closure of flow switch 5S2 and the closure of auxiliary contacts 5K2 on terminals 1TB1-11 and 1TB1-13.

UCP2 and Wye-Delta Starter Control Circuits

Logic Circuits within the various modules will determine the starting, running, and stopping operation of the chiller. If operation of the chiller is required and the chiller mode is set at "Auto", then the Chiller Module's logic decides to start the chiller based on the differential to start setpoint.

The chiller water pump relay (5K1) is energized by the Chiller Module (1U1-J12) and chilled water flow must be verified within 3 minutes by the Chiller Module (1U1-J26).

Based on the restart inhibit timer and the differential to start setpoint, oil pump (4B3) will be energized by the Circuit Module (1U2-J22) and the condenser water pump relay (5K2) will be energized by the Chiller Module (1U2-J14) when the restart inhibit timer is at 30 seconds or less. The oil pressure must be at least 9 PSID for 30 continuous seconds and condenser water flow verified within 3 minutes by the Chiller Module (1U1-J28) for the compressor start sequence to be initiated.

When less than 5 seconds remain before compressor start, a starter test is conducted to verify contactor states prior to starting the compressor. The following test/start sequence is conducted for "Wye-Delta" starters: Also refer to Figure 25 in this manual.

A. Test for transition complete contact open (2K2 AUX at 2U1-J4) - 160 to 240 msec. An MMR diagnostic will be generated if the contact is closed.

B. Delay time - 20 msec.

C. Close start contactor (2K1) and check for no current - 500 msec. If currents are detected, the MMR diagnostic "Starter Fault Type I" is generated.

D. Stop relay (2U1-J6) closes for 1 second for test "C" above.

E. Delay time - 200 msec.(Opens 2K1).

F. Close shorting contactor, (2K3) and check for no current - 1 sec. If currents are detected the MMR diagnostic "Starter Fault Type II" is generated. (Starter Integrity test)

Electrical Sequence of Operation

G. If no diagnostics are generated in the above tests, the Stop Relay (2U1-J6) is closed for 2 seconds and the Start Relay (2U1-J8) is closed to energize the start contactor (2K1). The shorting contactor (2K3) has already been energized from (F) above. The compressor motor (4B1) starts in the "Wye" configuration, an auxiliary contact (2K1-AUX) locks in the start contactor (2K1) coil, the vent line solenoid valve (4L1) is closed by relay 1U2-J16 for 100 seconds, and the acceleration timer begins to time out.

H. After the compressor motor has accelerated and the maximum phase current has dropped below 85% of the chiller nameplate RLA for 1.5 seconds, the starter transition to the "Delta" configuration is initiated.

J. The transition contactor (2K4) is closed through relay 2U1-J14, placing the transition resistors (2R1, 2R2, and 2R3) in parallel with the compressor motor windings.

K. The shorting contactor (2K3) is opened through the opening of relay 2U1-J12 100 msec after the closure of the transition relay 2U1-J14.

L. The run contactor (2K2) is closed through relay 2U1-J10 shorting out the transition resistors 260 msec after the opening of the shorting relay 2U1-J12. This places the compressor motor in the "Delta" configuration and the micro waits to look for this transition for 2.35 seconds through the closure of the transition complete contacts (2K2-AUX) at 2U1-J4.

M. The micro must now confirm closure of the transition complete contact (2K2-AUX) within 2.32 to 2.38 seconds after the run relay (2U1-J10) is closed. Finally, the transition relay (2U1-J14) is opened de-energizing the transition contactor (2K4) and the compressor motor starting sequence is complete. An MMR diagnostic will be generated if the transition complete contacts (2K2-AUX) do not close. A diagram of this test/start sequence is shown in Figure 25.

Now that the compressor motor (4B1) is running in the "Delta" configuration, the inlet guide vanes will modulate, opening and closing to the chiller load variation by operation of the stepper vane motor actuator (4B2) to satisfy chilled water setpoint. The chiller continues to run in its appropriate mode of operation: Normal, Softload, Limit Mode, etc.

If the chilled water temperature drops below the chilled water set point by an amount set as the "differential to stop" setpoint, a normal chiller stop sequence is initiated as follows:

1. The inlet guide vanes are driven closed for 50 seconds.

2. After the 50 seconds has elapsed, the stop relay (2U1-J6) and the condenser water pump relays (1U1-J14) open to turn off the compressor motor (4B3) will continue to run for 2 minutes post lube while the compressor coasts to a stop. The chilled water pump will continue to run while the chiller module (1U1) monitors leaving chilled water temperature preparing for the next compressor motor start based on the "differential to start" setpoint.

If the STOP key is pressed on the human interface, the chiller will follow the same stop sequence as above except the chilled water pump relay (1U1-J12) will also open and stop the chilled water pump after the chilled water pump delay timer has timed out after compressor shut down.

If the STOP key is pressed twice in rapid succession, twice within 5 seconds, a "panic stop" is initiated which follows the same stop sequence as pressing the STOP key once except the inlet guide vanes are not sequence closed and the compressor motor is immediately turned off.

Vane Actuator Control

The 1U3 Stepper Module pulses a DC voltage to the windings of the 4B2 Stepper Module Vane Actuator to control inlet guide vane position.

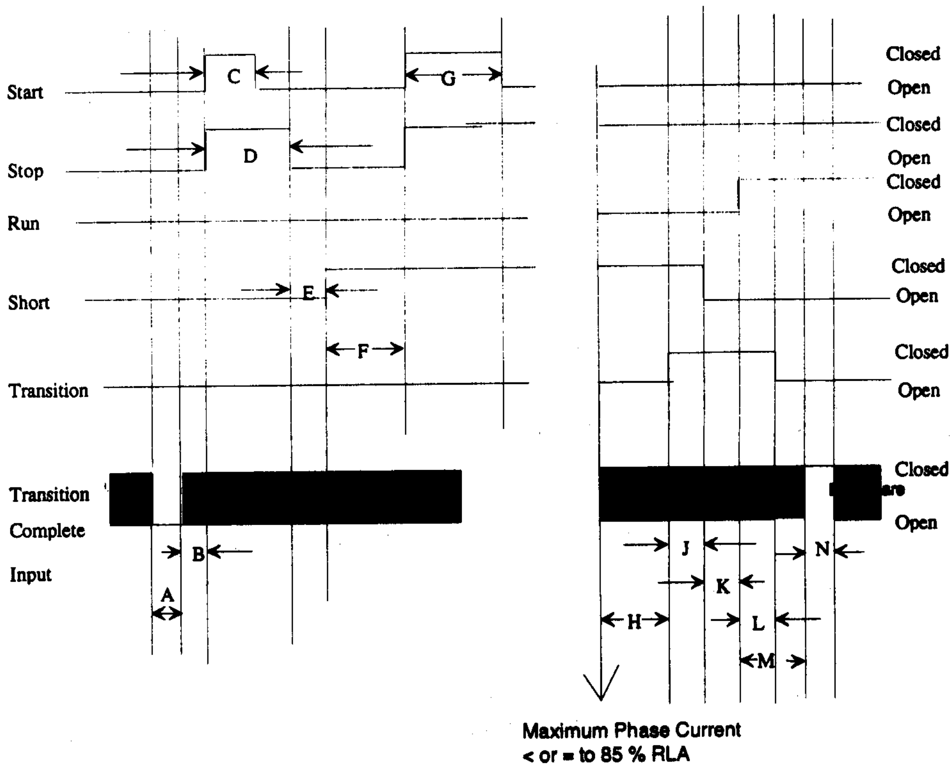
While operation of this stepper motor is automatic, manual control is possible by going to the Vane Control Status/Vane Position While operation of this stepper motor is automatic, manual control is possible by going to the Vane Control Status/Vane Position Commands screen in the Service Tests Menu and changing the "Target" value.

Note: If the chiller is operating in a limit mode (i.e. current limit, condenser limit, evaporator limit, etc.) the limit operation has priority over all manual modes of operation.

On each UCP power-up, the inlet guide vanes are driven full closed to recalibrate the zero position (Steps) of the Stepper motor vane actuator. An inlet guide vane stroke test is conducted for BPI (Binary Position Indicator) position on all resets (hardware and software) if there has not been a Momentary Power Loss.

Figure 25
UCP2 Test/Start Timing Sequence

Timing requirements to operate the "Stop", "Start", "Short", "Transition", and "Run" contact closure outputs are shown below. Prior to closing the "Short" contact, the transition complete input shall be verified to be open, otherwise an MMR diagnostic shall be generated.



Interval	Minimum	Maximum	Units	Actual Design
A (Test for transition complete input open)				160 to 240 msec
B (Just delay time)				20 msec
C (Close 1M (2K1) Contactor and test for no current.)(Starter integrity test)				500 msec
D-				1 sec
E- (Open 1M (2K1) Delay time				200 msec
F- (Close Shorting Contactor (2K3) and and test for no current, then wait for Start command.) (Starter integrity test)	100 (1)		msec	1 sec (Min)
G (Close 1M (2K1)	2.0		sec	2 sec
H- (Wait 1.5 sec after phase currents drop to 85%)	1	2	sec	1.5 sec
J - (Begin Transition sequence)	85	100	msec	100 msec
K- (Open S (Shorting) Contactor)	250	300	msec	260 msec
L- (Close 2M (2K2) Contactor				140 msec
M- (Wait to look for Transition complete)	(2)		msec	2.32 to 2.38 sec
N (Filtering time on Transition complete input)	(2)		msec	160 to 240 msec

(1) This time period must be long enough to verify the absence of phase currents caused by the closing of the "Short" contacts.
(2) The sum of intervals M and N are designed to be 2.5 Seconds.

Note: The transition complete contact closure is expected to be an auxiliary contact to the "Run Contactor" (2K2).

Electrical Sequence of Operation

This is also done if there is a call for cooling or heating condition and it has been 24 hours or more since the last BPI test and there has not been a Momentary Power Loss for 5 minutes. See Figure 26 for BPI operation.

N te: The closed range of the BPI must straddle the factory programmed 90 degree Vane Position.

Circuit Breaker 1CB3 Oil Pump

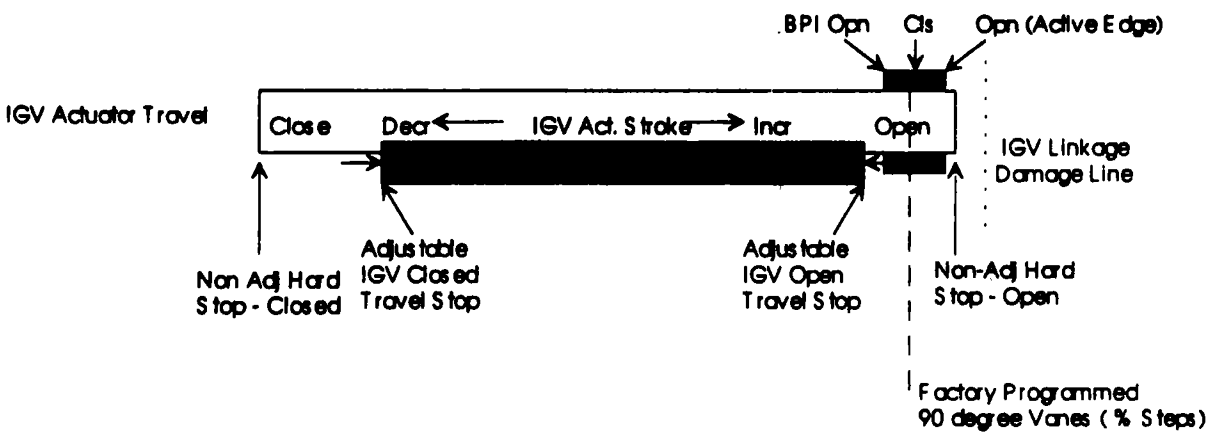
Circuit Breaker 1CB3 115-volt control power from control power transformer 2T5 flows through branch circuit breaker 1CB3 and Terminal 1TB1-6 to a 6.2 amp fuse (1F2). Fuse 1F2 protects the oil pump motor (4B3) from over amperage conditions. Current passing through Fuse 1F2 reaches 2 normally-open, parallel sets of contacts, those of oil pump relay 1U2-J22 and start contactor 2K1-AUX.

Note: While the 1U2-J22 Relay 13 automatically closed by 1U2 as a part of the start sequence, it can also be closed manually by changing the Oil Pump status to "ON" in the Service Tests menu.

Closure of the 1U2-J22 contacts also allows current to pass through the coil of oil pump starter relay 4K8 to the "run" windings of oil pump motor 4B3.

When motor 4B3 first starts, current draw is high; this causes current-sensing relay 4K8 to close its normally-open contacts and "pull in" of pump capacitor 4C1. With this circuit complete, current now flows to the "start" windings of the oil pump motor.

Figure 26
CVHE/CVHF/CVHG-IGV/Actuator Operation and BPI Switch



As the pump motor accel rates, its amps draw eventually falls below the "capacitor-enable" threshold of relay 4K8. Once this occurs, 4K8 reopens its normally-open contacts, and power is supplied only to the "run" windings of motor 4B3.

The normally-open, 2K1-AUX contacts that parallel those of oil pump relay 1U2-J22 are located on start contactor 2K1. As soon as 2K1 energizes, these auxiliary contacts close. Notice that completion of this circuit assures that voltage is provided to the oil pump motor as long as the compressor motor is operating.

Oil pump operation ceases when both the 1U2-J22 and 2K1-AUX contacts open.

Also, during the start sequence the 1U2-J16 contacts close energizing the 4L1 Vent Line Solenoid for 100 seconds. During this period, closure of this valve isolates the oil sump from the compressor to prevent loss of oil pressure while starting the compressor.

When the 100 second interval expires, the 1U2-J16 relay opens and the 4L1 valve reopens for normal compressor operation.

Restart Inhibit

A Restart Inhibit Timer is used to pr vent high frequent chiller ON-OFF cycling and subsequent motor overheating.

The Restart Inhibit (RI) timer is set based on a Background Timer (BT) that is incremental by (XX) minutes at every start and is timed out from the new total only while the chiller is running and is based on the equation: RI = BT-50

The value of XX is based on nominal compressor size to include the motor heating constant as listed in the Table 2 on this pag .

This value of the motor heating constant (XX) must be set in the Machine Configuration Group of the Service Settings Menu based on the unit NTON and motor frequency.

On any UCM Reset (either hardware (e.g. powerup or software), the RI Timer is reset to 30 seconds if the motor winding temperature is less than or equal to 165°F. The maximum value of the RI Timer is 60 minutes, and is adjustable from 25 to 60 minutes in the Field Startup Group of the Service Settings menu.

See Figure 27 for an example of how the RI Timer functions.

Any other pre-start system timers, e.g. prelube = 30 seconds, overlap the RI Timer to anticipate its time out and permit start of the compressor at or shortly after the RI. If the RI Timer value ever reaches 45 minutes an IFW diagnostic is generated.

The RI Timer can be cleared to 30 seconds in the Service Settings Menu.

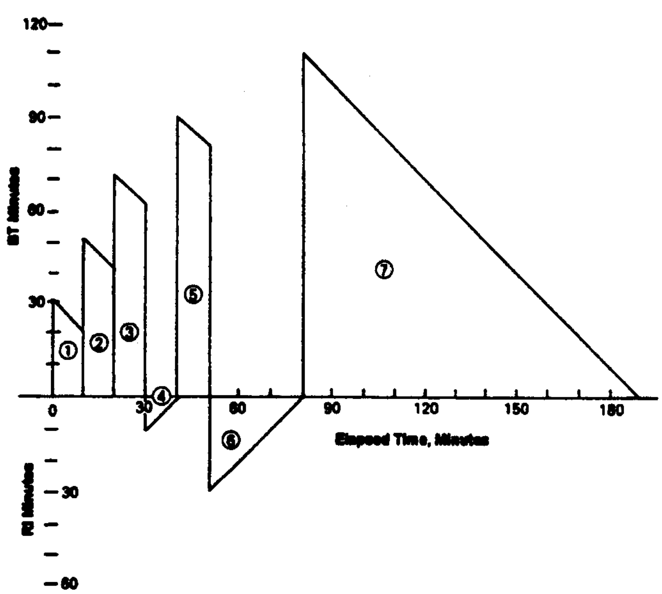
If the RI Timer is the overriding criteria holding the chiller off, this mode will be displayed along with the remaining time, counting down, prior to the chiller starting.

Table 2 - NTON/BT Information

NTON	BT
230-320	30
360-500	35
560-800	40
890 - 1280	50

Figure 27
CVHE/CVHF/CVHG - UCP2 Restart Inhibit Timer

Parameter	CVHE/CVHF
Background Timer Increment on Start (Motor Heating Constant)	Adjustable, 25 Min. Fac. Dflt.
General RI Timer Setting	RI = BT -50 Minutes
Minimum RI Timer Setting	30 Seconds
Maximum RI Timer Setting	60 Minutes
Adjustment Range of Maximum RI Timer Setting	30 to 60 Minutes
Winding Temperature Decision Point/RI Timer Above this Temp. after Reset	165 F (73.8C)/15 Minutes
IFW Diagnostic Threshold	RI Timer = 45 Minutes



1. Unit started and ran 10 min., BT incremented 30 Min., and decreased by 10 min. RI = (30-10) - 50 = -30.
2. Unit restarted RI = -30, BT incremented another 30 min., unit ran 10 min. and BT decreased by 10 min. RI = (50-10) - 50 = -10
3. Unit restarted RI = -10, BT incremented another 30 min., unit ran 10 min. and BT decreased by 10 min., RI = (70-10) - 50 = 10.
4. Unit Restart Inhibit is 10 min. from (3).
5. Unit restarted after 10 min. RI in (4), BT incremented another 30 min., unit ran 10 min. and BT decreased by 10 min. RI = (90-10) -50 = 30.
6. Unit restart is 30 min. from (5).
7. Unit restarted after 30 minute RI min, (6), BT incremented another 30 min., and unit ran for 110 min., and BT goes to zero.

Notes:

1. 30 second/15 minute restart inhibit due to motor winding temperature not included.
2. Example for Motor Heating Constant = 30
3. If calculated RI is negative then RI = 0.

Controls Chilled Water Reset (CWR)

Chilled water reset is designed for those applications where the design chilled water temperature is not required at partload. In these cases, the leaving chilled water temperature setpoint can be reset upward using the CWR features.

When the CWR function is based on return water temperature, the CWR feature is standard.

When the CWR function is based on outdoor air temperature, the CWR feature is an option requiring an outdoor temperature sensor and the Options Module installed in the UCP2 panel.

The type of CWR is selected in the Operator settings Menu along with the Reset Ratio, Start Reset Setpoint, and the Max Reset Setpoint.

The following equations and parameters apply for CWR.

Return

CWS' = CWS + RATIO (START RESET - TWE - TWL) and CWS' > or = CWS' and CWS - CWS < or = Maximum Reset.

Outdoor

CWS' = CWS + RATIO (START RESET - TOD) and CWS' > or = CWS' and CWS - CWS < or = Maximum Reset.

Where

CWS is the new chilled water setpoint.

CWS is the active chilled water setpoint before any reset has occurred RESET RATIO is a user adjustable gain.

START RESET is a user adjustable reference.

TWE is entering evap. water temperature.

MAXIMUM RESET is a user adjustable limit providing the maximum amount of reset. For all types of reset, CWS' - CWS < or = Maximum Reset.

The values for "Start Reset" for each of the reset types are shown in Table 3.

Both Return and Outdoor Reset do not apply to Heat Pump Mode where the UCP2 is controlling the Leaving Water Temperature.

Constant Return Reset will reset the leaving water temperature setpoint so as to provide a constant entering water temperature. The Constant Return Reset equation is the same as the Return Reset equation except on selection of Constant Return Reset, the UCP2 shall automatically set RATIO, START RESET, and MAXIMUM RESET to the following:

The RATIO = 100%
The START RESET = Design Delta Temp.
The MAXIMUM RESET = Design Delta Temp.

The equation for Constant Return is as follows:

Table 3 - Values for Start Reset Types

The values for "RESET RATIO" for each of the reset types are:				
Reset	Reset	Increment	Increment	Factory
Type	Ratio	English	SI Units	Default
	Range	Units		Value
Return	10 to 120%	1%	1%	50%
Outdoor	80 to -80%	1%	1%	10%
The values for "START RESET " for each of the reset types are:				
Reset	Start	Increment	Increment	Factory
Type	Reset	English	SI Units	Default
	Range	Units		Value
Return	4 to 30 F	1 F	0.1 C	10 F (5.6C)
	(2.2 to 16.7C)	1 F	0.1 C	90 F (32.2C)
The values for "MAXIMUM RESET" for each of the reset types are:				
Reset	Maximum	Increment	Increment	Factory
Type	Reset	English	SI Units	Default
	Range	Units		Value
Return	0 to 20 F			
	(0.0 to 11.1C)	1 F	0.1 C	5 F (2.8 C)
	0 to 20 F			

Constant Return

CWS' = CWS + 100% (Design Delta Temp.) - (TWE-TWL) and CWS > or = CWS and CWS - CWS < or = Maximum Reset

Notice that Constant Return is nothing more than a specific case of Return Reset offered for operator convenience.

When any type of CWR is enabled, the UCP2 will step the CWS toward the desired CWS (based on the above equations and setup parameters) at a rate of 1°F every 5 minute until the Active CWS equals the desired CWS'. This applies when the chiller is both running and not running.

The chiller will start at the Differential to Start value above a fully reset CWS or CWS for both Return and Outdoor Reset.

The graph on the next page, shows the reset function for Outdoor Air Temp: **Note:** This graph assumes that Maximum Reset is set to 20 degrees.

Using the Equation for calculating CWR for Outdoor Air Temp

Equation:

Degrees of Reset = Reset Ratio*(Start Reset - TOD)

Degrees of Reset:

Degrees of Reset = Active CWS - Front Panel CWS
or
Degrees of Reset = CWS' - CWS

To obtain Active CWS from Degrees of Reset :
Active CWS = Degrees of Reset + Front Panel CWS

Reset Ratio:

The Reset Ratio on the CLD is displayed as a percentage. To use it in the above equation it must be converted to it's decimal form.

Reset Ratio percent /100 = Reset Ratio decimal

Example of converting Reset Ratio:

If the Reset Ratio displayed on the CLD is 50% then use (50/100)=.5 in the equation

TOD = Outdoor Air Temp

Start Reset = Outdoor Air Start Reset

Example of Calculating Reset for Outdoor Air Temp:

If:
Reset Ratio = 35%
Start Reset = 80
TOD = 65
Maximum Reset = 10.5

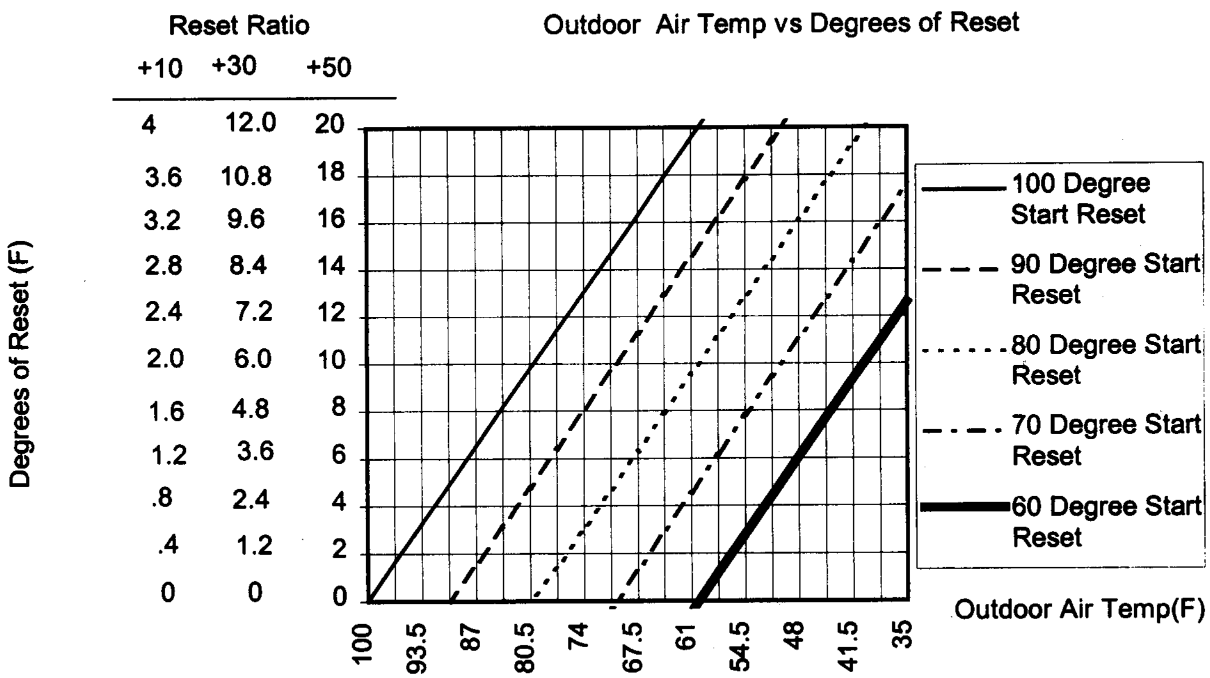
How many Degrees of Reset will there be?

Degrees of Reset = Reset Ratio*(Start Reset - TOD)
Degrees of Reset = .35*(80-65)
Degrees of Reset = 5.25

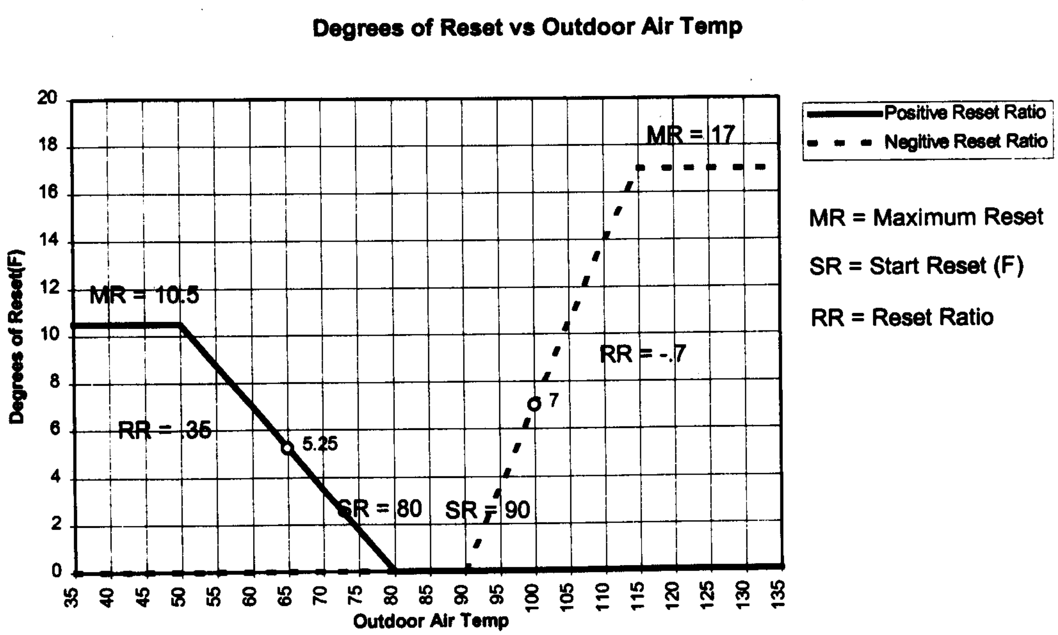
If:
Reset Ratio = -70%
Start Reset = 90
TOD = 100
Maximum Reset = 17

How many Degrees of Reset will there be?

Degrees of Reset = Reset Ratio*(Start Reset - TOD)
Degrees of Reset = -.7*(90-100)
Degrees of Reset = 7

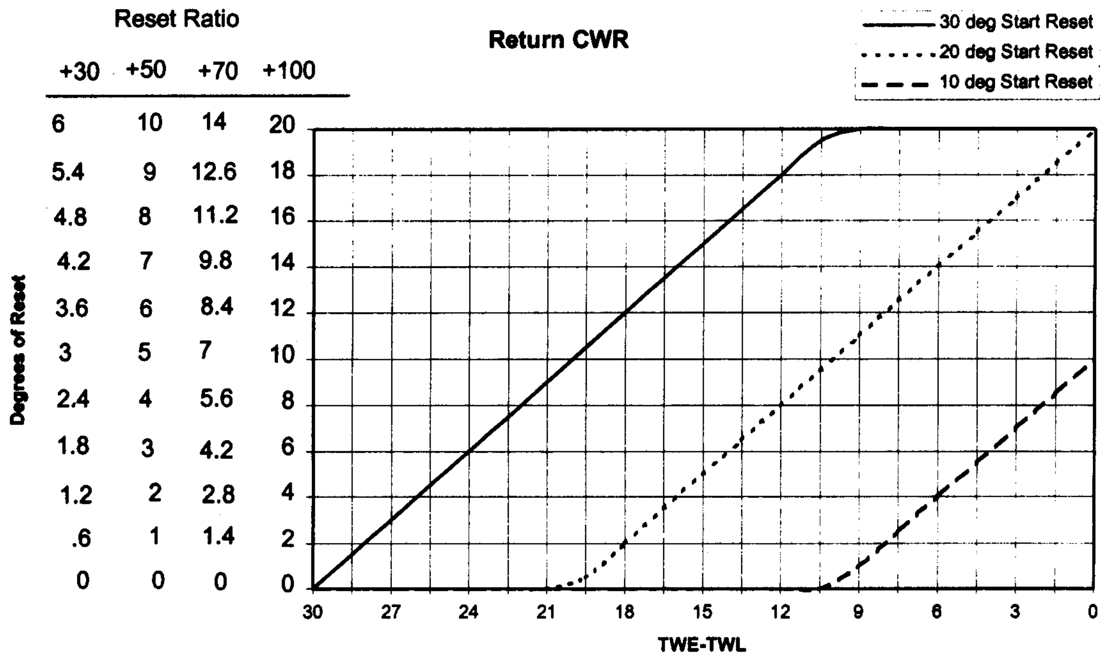


The following graph illustrates the reset functions of the above examples:



Electrical Sequence of Operation

The following graph shows the reset function for Return CWR:



Note: This graph assumes Maximum Reset is set to 20 degrees.

Example of Calculating Return Reset:

If:
Reset Ratio = 50%
Start Reset = 25
TWE = 65
TWL = 45
Maximum Reset = 8

How many Degrees of Reset will there be?

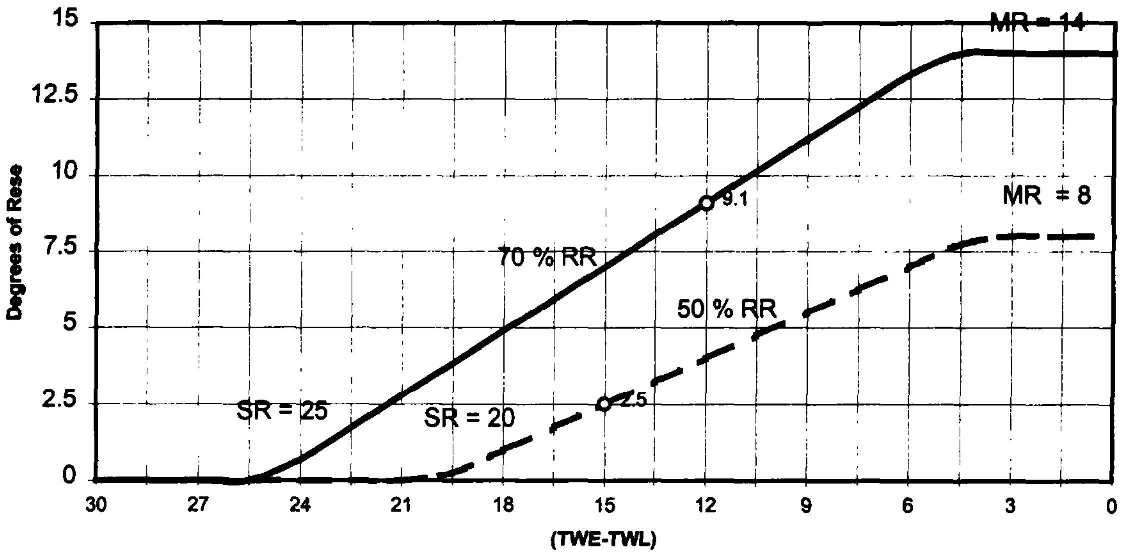
Degrees of Reset = Reset Ratio*(Start Reset - (TWE-TWL))
Degrees of Reset = .5*(25-(65-45))
Degrees of Reset = 2.5

If:
Reset Ratio = 70%
Start Reset = 20
TWE = 60
TWL = 53
Maximum Reset = 14

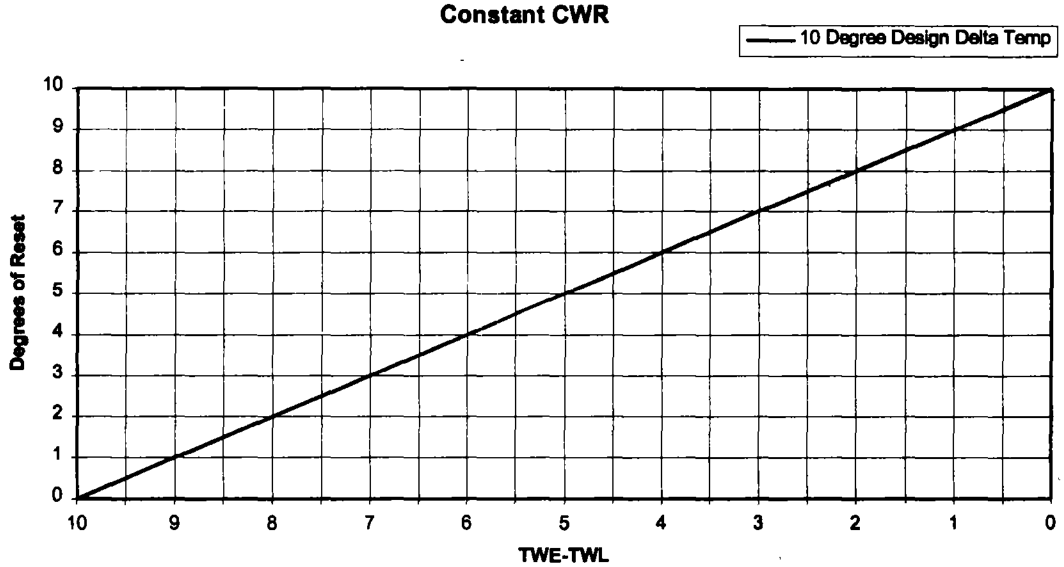
How many Degrees of Reset will there be?

Degrees of Reset = Reset Ratio*(Start Reset - (TWE-TWL))
Degrees of Reset = .7*(20-(60-53))
Degrees of Reset = 9.1

Return CWR



Constant CWR



Th following graph illustrates the Reset Actions of the above examples:

Differential to Start/Stop

The Differential to Start setpoint is adjustable from 1 to 10°F (0.5 to 5.55 C) and the Differential to Stop setpoint adjustable from 1 to 10°F (0.5 to 5.55C). Both setpoints are with respect to the Active Chilled Water Setpoint and are set in the Service Settings menu.

When the chiller is running and the LWT reaches the Differential to Stop setpoint the chiller will go through its shutdown sequence to AUTO.

Leaving Water Temperature Cutout

Leaving water temperature cutout is a safety control that protects the chiller from damage caused by water freezing in the evaporator. The cutout setpoint is adjustable in the Service Settings Menu.

For freeze protection from low leaving water temperatures the UCP2 provides a low leaving water temperature cutout based on leaving water temperature. The "Leaving Water Temperature Cutout Setpoint" is independently adjustable from the chilled water setpoint and factory set. Shutdown of the compressor due to violation of the Leaving Water Temperature Cutout results in an automatically resettable diagnostic (MAR).

The UCP2 indicates when the "Leaving Water Temperature Cutout Setpoint" conflicts with the chilled water temperature setpoint by a message on the display. The "Leaving Water Temperature Cutout Setpoint" and chilled water setpoint, both active and front panel, are separated by a minimum of 1.7°F.

See Cutout Strategy, Figure 28. When either difference is violated, the UCP2 does not permit the above differences to be violated and the display exhibits a message to that effect and remains at the last valid setpoint.

When the chilled water setpoint, both active and front panel, is adjusted downward, it does not violate the above minimum differences and the "Leaving Water Temperature Cutout Setpoint" remains at its current setting. When the "Leaving Water Temperature Cutout Setpoint" is adjusted upward, the above minimum difference is not violated and as the "Leaving Water Temperature Cutout Setpoint" is setpoint, both active and front panel, is raised to maintain the minimum difference.

After violation of the "Leaving Water Temp. Cutout Setpoint" for 30°F seconds the chiller will shutdown and indicate a diagnostic.

Low Refrigerant Temperature Cutout

This is a safety function that prevents water in the evaporator from freezing due to low evaporator refrigerant temperatures. When the trip point is violated, the chiller will shut down and display a latching diagnostic (MMR) indicating the violation. The cutout setpoint is adjustable in the Service Settings Menu.

The UCP2 indicates when the "Low Refrigerant Temp. Cutout Setpoint" conflicts with the chilled water temperature setpoint by a message on the display.

The "Low refrigerant Temp Cutout Setpoint" and chilled water setpoint, both active and front panel, are separated by a minimum of 6°F. See Figure 28.

When either difference is violated, the UCP2 does not permit the above differences to be violated and the display exhibits a message to that effect and remains at the last valid setpoint.

When the chilled water setpoint, both active and front panel, is adjusted downward, it does not violate the above minimum differences, and the "Low Refrigerant Temperature Cutout Setpoint is adjusted upward, the above minimum difference is not violated, and as the "Low Refrigerant Temperature Cutout Setpoint" is adjusted upward, the chilled water setpoint, both active and front panel, are raised to maintain the minimum difference.

After violation of the "Low Refrigerant Temp. Cutout Setpoint" for 30°F - seconds, the chiller will shutdown and indicate a diagnostic.

Enhanced Condenser Limit Control

When the chiller is running Condenser Limit Mode or in Surge Mode, the head relief request relay on the Options Module (1U5-J12) will be energized and can be used to control or signal for a reduction in the entering condenser water temperature.

Designed to prevent high refrigerant pressure trip-outs during critical periods of chiller operation, this UCP2 option consists of:

1. Condenser refrigerant Pressure Transducer (3R3).

2. The Options Module (1U5) with the head relief request relay (1U5-J12).

3. Interconnecting Wiring.

If the unit is not equipped with the Enhanced Condenser Limit Option (3R31U5) the unit will use the condenser refrigerant temperature sensor (input converted to saturated refrigerant pressure) to perform the Standard Condenser Limit function, without the head relief request relay, by limiting inlet guide vane stroke and chiller capacity.

Keep in mind that the UCP2 Condenser Limit Control supplements the protection provided by the condenser pressure high pressure cutout switch 3S1.

Free Cooling

To enable Free Cooling Mode:

1. "Install" Free Cooling in the Machine Configuration Menu.

2. Enable the Free Cooling mode in the Operator Settings Menu to "ON" while the chiller is in "AUTO", or

3. Close the external binary input switch to the Options Module 1U5-J3-5 and -6 if so equipped while the chiller is in "AUTO".

Free Cooling can not be entered if the chiller is in "STOP".

If the chiller is in "AUTO" and not running, the condenser water pump will start. After condenser water flow is proven, relays at 1U5-J16, 1U5-J20, and 1U5-J24 will energize operating the Free Cooling Valves 4B12 and 4B13. The Free Cooling Valves End Switches must open within 3 minutes, or an MMR diagnostic will be generated. Once the Free Cooling Valves End Switches open, the unit is in the Free Cooling mode.

If the chiller is in "AUTO" and running powered cooling, the chiller will do a friendly shut down first, (Run: Unload, Post Lube, and drive vanes closed). After the vanes have been overdriven, closed and condenser water proven, the Free Cooling relays will be energized.

To disable Free Cooling and return to Powered Cooling, either disable the Free Cooling Mode in the Operators Settings menu if used to enable Free Cooling or "OPEN" the external binary input switch to the Options Module if it was used to enable Free Cooling.

Once Free Cooling is disabled, the Free Cooling relays 1U5-J16, and 1U5-J20 and 1U5-J24 will de-energize allowing the Free Cooling valves to close. The Free Cooling valves end switches must close within 3 minutes or an MMR diagnostic is generated.

Once the end switches close the chiller will return to "AUTO" and powered cooling will resume if there is a call for cooling based on the differential to start.

Once powered cooling has resumed and the compressor has started, the inlet guide vanes will be held closed for 3 minutes to allow for temperature/pressure stabilization.

Note: The manual control of the inlet guide vanes is disabled while in the Free Cooling Mode and the compressor is prevented from starting by the control logic.

Note: The relay at 1U5-J20 is a FC auxiliary relay and can be used as required.

Hot Gas Bypass

The hot gas bypass (HGBP) control option is designed to minimize machine cycling by allowing the chiller to operate stably under minimum load conditions. In these situations, the inlet guide vanes are "locked" at a preset minimum position, and unit capacity is governed by the HGBP valve actuator.

Control circuitry is designed to allow both the inlet guide vanes and the HGBP valve to close for unit shutdown.

HGBP is enabled in the Field Startup Group of the Service Settings Menus by enabling the option and setting the HGBP Cut-In Vane Position in the same menu.

After a chiller starts and is running the inlet guide vanes will pass through the HGBP Cut-In-Vane position as the chiller starts to load. As the chiller catches the load and starts to unload, the inlet guide vanes will close to the HGBP Cut-In Vane position. At this point the movement of the inlet guide vanes is frozen and further unloading of the chiller is controlled by the opening of the HGBP Valve 4B5 by the 1U10 module. The 1U10 module modulates the HGBP valve at low loads.

When the control algorithm determines the chiller to be shut down, the inlet guide vanes will be driven fully closed, and the HGBP valve will be driven closed. After the inlet guide vanes are fully closed the chiller will shut down in the Friendly mode.

Chillers with HGBP have a discharge temperature sensor (4RT6) monitoring the discharge gas temperature from the compressor. If this temperature exceeds 200°F, the chiller will shut off on a MAR diagnostic. The chiller will reset automatically when this temperature drops 50°F below the trip-point.

Figure 28
Cutout Strategy

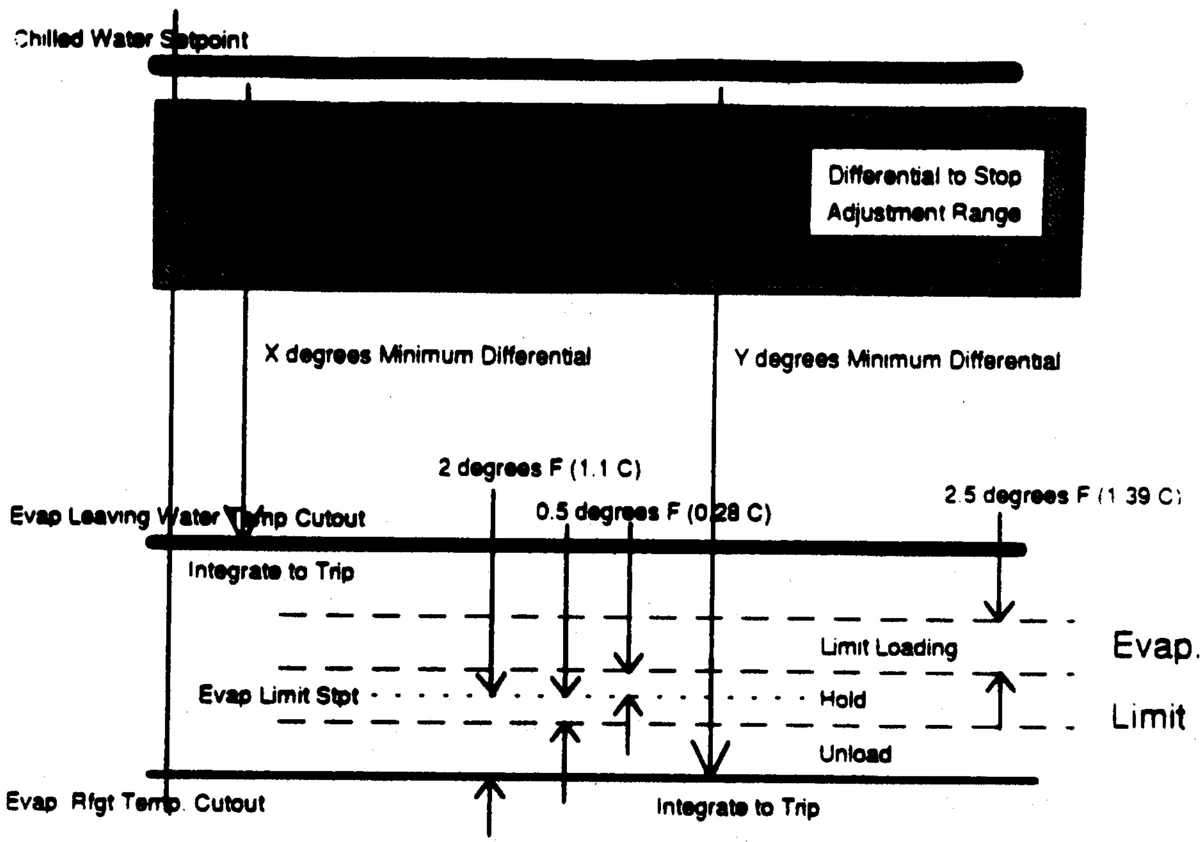


Figure "Cutout Strategy"

Ice Machine Control

UCP2 provides a service level "Enable/Disable" menu entry for the Ice Building feature when the Ice Building option is installed.

UCP2 will accept either an isolated contact closure (J3, 7 & 8 on the options module) or a remote communicated input (Tracer) to initiate the ice building mode where the unit runs fully loaded at all times. Ice building will be terminated either by opening the contact or based on entering evaporator water temperature. UCP2 will not permit the Ice Building mode to be entered again until the unit is switched to the NON-Ice Building mode and back into the Ice Building mode. It is not acceptable to reset the chilled water setpoint low to achieve a fully loaded compressor.

While in the ice building mode, current limit setpoints less than the maximum will be ignored.

Ice Building can be terminated by one of the following means:

1. Operating the external Ice Contacts/Remote communicated input (Tracer).

2. Satisfying an evaporator entering water temperature setpoint.

3. Surging for 15 minutes at full open IGV.

Unit Start-Up Procedures

Daily Unit Start-Up

1. Verify the chilled water pump and condenser water pump starter are in "ON" or "AUTO".

2. Verify the cooling tower is in "ON" or "AUTO".

Note: Refer to Figure 29 for UCP Start-Run-Shutdown sequence and UCP timing functions.

3. Check the oil tank oil level; the level must be visible in or above the lower sight glass. Also, be sure to check the oil tank temperature; normal oil tank temperature before start-up is 140°F to 145°F (60 to 63 C).

Note: The oil heater is energized during the compressor off cycle. During unit operation, the oil tank heater is de-energized.

4. If the chiller is equipped with the free cooling option, ensure that the free cooling option is disabled in the Operator Settings menu.

5. Check the chilled water setpoint and readjust it, if necessary, in the Operator Settings menu.

6. If necessary, readjust the current limit setpoint in the Operators Setting menu.

7. Press "AUTO".

The UCP also checks compressor motor winding temperature, and a minimum 30 second delay is initiated if the winding temperature is less than 165°F. If it is greater than 165°F, however, a 15-minute delay period begins. The chilled water pump relay is energized and evaporator water flow is proven.

Next, the UCP checks the leaving evaporator water temperature and compares it to the chilled water setpoint. If the difference between these values is less than the start differential setpoint, cooling is not needed.

If the UCP determines that the difference between the evaporator leaving water temperature and chilled water setpoint exceeds the start differential setpoint, the unit enters the initiate Start Mode and the oil pump and the condenser water pump are started. If condenser water flow is not proven (i.e. flow switch 5S3 does not close) within 3 minutes, the unit is locked out on a MMR Diagnostic.

Oil pressure must be verified within 3 minutes or a MMR diagnostic is generated.

When less than 5 seconds remain on the restart inhibit, the pre-start starter test is conducted on Y-Delta starters. If faults are detected, the unit's compressor will not start, and a MMR Diagnostic will be generated.

If the compressor motor starts and accelerates successfully, "Unit is Running" appears on the display. At this time the purge unit will start operating on "Automatic" and will continue to operate as long as chiller compressor is running.

Note: Whenever the UCP detects a MMR diagnostic condition during start-up, unit operation is locked out, and manual reset is required before the start-up sequence can begin again. If the fault condition has not cleared, the UCP will not permit restart.

When the cooling requirement is satisfied, the UCP originates a "Shutdown" signal. The inlet guide vanes are driven closed for 50 seconds, and the unit enters a 3-minute post-lube period. The compressor motor and condenser water pump starter are de-energized immediately, but the oil pump continues to run during this 3-minute interval; the evaporator pump will continue to run.

Once the post-lube cycle is done, the unit returns to auto mode.

Electrical Sequence of Operation

Seasonal Unit Start-Up

Note refer to Figure 29 for UCP Start-Run-Shutdown sequence and UCP timing functions.

1. Close all drain valves, and re-install the drain plugs in the evaporator and condenser headers.

2. Service the auxiliary equipment according to the start-up/ maintenance instructions provided by the respective equipment manufacturers.

3. Vent and fill the cooling tower, if used, as well as the condenser and piping. At this point, all air must be removed from the system (including each pass). Then close the vents in the condenser water boxes.

4. Open all of the valves in the evaporator chilled water circuit.

5. If the evaporator was previously drained, vent and fill the evaporator and chilled water circuit. When all air is removed from the system (Including each pass), close the vent valves in the evaporator water boxes.

6. Lubricate the external vane control linkage.

7. Check the adjustment and operation of each safety and operating control.

8. Close all disconnect switches.

WARNING
USE CARE WHEN MEASUREMENTS, ADJUST-MENTS, OR OTHER SERVICE-RELATED WORK IS PERFORMED WITH POWER ON. Failure to do so can result in injury or death due electrical shock or contact with moving parts.

9. Perform instructions listed in "Daily Unit Start-up" section.

CAUTION
PROPER SAFEGUARDS SHOULD BE TAKEN TO ENSURE THE EVAPORATOR WATER PUMP DOES NOT CONTINUE TO RUN LONGER THAN 30 MINUTES AFTER CHILLER SHUTDOWN. Failure to avoid excessive operation of the evaporator water pump with chiller off may cause rupture disc failure and loss of refrigerant charge.

WARNING
IF THE CHILLED WATER LOOP IS USED IN A HEATING MODE, ENSURE THAT THE EVAPORATOR IS ISOLATED FROM THE HOT WATER LOOP BEFORE CHANGEOVER TO HEADING MODE. Failure to do so may cause rupture disc failure and loss of refrigerant charge.

Unit Shutdown Procedures

Daily Unit Shutdown

Note: Refer to Figure 29 for UCP Start-Run Shutdown sequence and UCP timing functions.

1. Press STOP.

2. After compressor shutdown turn Pump Contactors to OFF or open pump disconnects.

Seasonal Unit Shutdown

CAUTION
CONTROL POWER DISCONNECT MUST REMAIN CLOSED TO ALLOW OIL SUMP HEATER OPERATION. Failure to do this will allow refrigerant to condense in the oil pump.

3. Open all disconnect switches except the control power disconnect switch.

4. Drain the condenser piping and cooling tower, if used.

5. Remove the drain and vent plugs from the condenser headers to drain the condenser.

6. Once the unit is secured for winter, the maintenance procedures described under "Annual Maintenance" in the Periodic Maintenance section of this manual should be performed by qualified Trane service technicians.

Note: During extended shutdown, be sure to operate the purge unit for a 2-hour period every two weeks. This will prevent the accumulation of air and non-condensables in the machine. To start the purge, change the purge mode to ON in the Operator Settings Menu. Refer to CVHE-CLD-1. Remember to turn the purge mode to AUTO after the 2-hour run time.

WARNING
DO NOT ALLOW THE CHILLER TO INCREASE IN TEMPERATURE PRESSURE TO A TEMPERATURE ABOVE 110°f (43C) WHILE THE UNIT IS OFF. Failure to do so will cause the rupture disk to relieve and discharge the refrigerant from the machine. Continuous running of pumps while the machine is off may cause this condition to occur. The rupture disk is designed to relieve and discharge the refrigerant from the unit if the pressure in the evaporator exceeds 15 PSIG causing bodily harm and possible death to anyone in contact with refrigerant discharge.

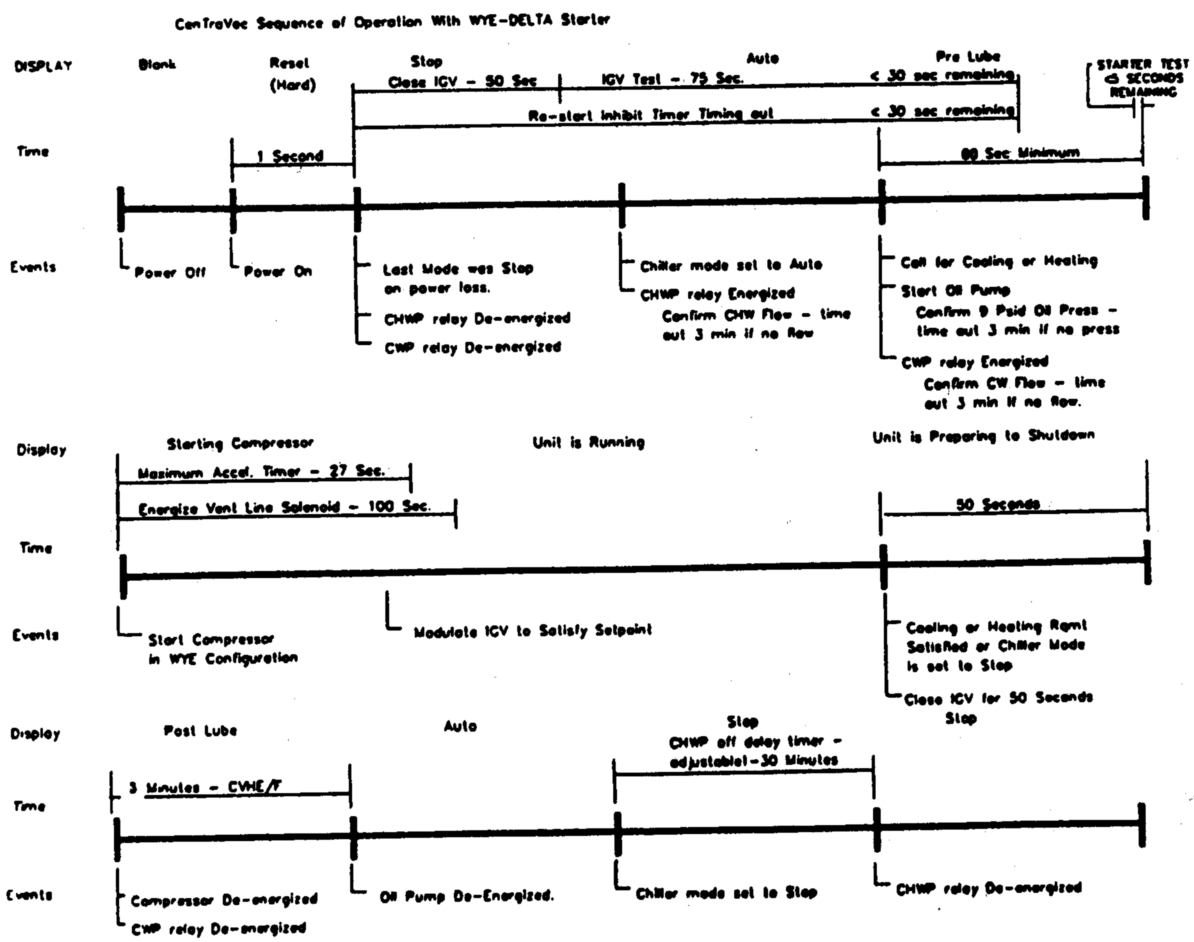
> ⚠ **WARNING**
> **TO ALLOW OIL SUMP HEATER OPERATION, CONTROL POWER MUST REMAIN CLOSED DURING ENTIRE SHUTDOWN PERIOD. Failure to do so will allow refrigerant to condense in the oil sump.**

> **WARNING**
> ⚠ **DO NOT ALLOW CHILLER TO INCREASE IN TEMPERATURE OR PRESSURE WHILE THE UNIT IS OFF. Continuous running of pumps while the chiller is off can increase the temperature or pressure and will result in premature release of refrigerant causing bodily harm and possible death to anyone in contact with refrigerant discharge.**

Trouble Analysis

If the RED light on the control panel is flashing, an MMR diagnostic has occurred. Refer to CVHE-CLD-1 or the latest revision. See the Diagnostic section for trouble shooting information.

Figure 29
CVHE/F/G - UCP Start-Run-Shutdown Sequence and UCP Timing Functions



Procedure for Selecting Current Overload Settings for UCP2

1. Determine the Rated Load Amps (RLA) from the Unit Nameplate

2. Refer to Table 4 or Table 5 as follows:

Select Table 4 if any of the following conditions are met:

a. The unit has a unit mounted starter with an RLA less than 936 Amps.

b. The unit has a 24" wide control panel, no unit mounted starter, and RLA less the 936 Amps.

c. The starter has a single CT/ phase wired directly to the starter module.

Select Table 5 if any of the following conditions are met:

a. The unit has an RLA over 935 Amps.

b. The unit has a 38" wide "Starter By others" control panel.

c. The starter has two CTs/phase wired to the starter module (greater than 600 volts).

3. Using Table 4 or Table 5 (determined from Step 2), determine the CT Meter Scale Rating based on the RLA from Step 1.

4. Calculate the CT factor using one of the following two equations:

If Table 4 was used:
CT Factor = (Motor RLA/CT Meter Scale Rating) x 100

If Table 5 was used:
CT Factor = (Motor RLA/CT Meter Scale Rating) x 139

5. Refer to Table 6. Determine Current Overload Settings #1 and #2 based on the CT Factor calculated in Step 4.

Verify Current Overload Setting #1.
Verify Current Overload Setting #2.

Table 4
CT Factor = (Motor RLA/CT Motor RLA/CT Meter Scale Rating) x 100

Current Transformer Selection Table for Single CT/Phase Systems			
Motor RLA	**CT Part No.**	**Ext**	**CT Meter Scale Rating**
34-50A	X13580253	09	50A
51-67A		10	75A
68-100A		01	100A
101-134A		02	150A
135-184A		03	200A
185-267A		04	275A
268-334A		05	400A
335-467A		06	500A
468-667A		07	700A
668-935A		08	1000A

Table 5
CT-Factor = (Motor RLA/CT Meter Scale Rating) x 139

Current Transformer Selection Table for Two CT/Phase Systems

Line CT Part No.	Ext	Line CT Ratio	CT Ter. Conn	No . of Prim. Turns	RLA Ranges	Meter Scale
X13580272	-01	50:5	X1 to X2	3	8.0 - 11.9	16.7
				2	12.0 - 17.9	25.0
	-02	75:5		2	18.0 - 23.9	37.5
	-01	50:5		1	24.0 - 35.9	50
	-02	75:5			36.0 47.9	75
X13580271	-01	100:5			48.0 -72.0	100
X13580048		150:5			72.0 to 86.3	150
		180:5	X1 to X3		86.4 to 95.9	180
		200:5	X1 to X4		96.0 to 119.9	200
	-02	250:5	X1 to X2		120.0 to 143.9	250
		300:5	X1 to X3		144.0 to 167.9	300
		350:5	X1 to X4		168.0 to 191.9	350
	-03	400:5	X1 to X2		192.0 to 239.9	400
		500:5	X1 to X3		240.0 to 287.9	500
		600:5	X1 to X4		288.0 to 235.9	600
	-04	700:5	X1 to X2		336.0 to 383.9	700
		800:5	X1 to X3		384.0 to 479.9	800
		1000:5	X1 to X4		480.0 to 575.9	1000
	-05	1200:5	X1 to X2		576.0 to 719.9	1200
		1500:5	X1 to X3		720.0 to 863.9	1500
X13580047	-01	1800:5	X1 to X2		864.0 to 1007.9	1800
		2100:5	X1 to X3		1008.0 to 1199.9	2100
		2500:5	X1 to X4		1200.0 to 1800	2500
	-02	1000:5	X1 to X2		480.0 to 575.9	1000
		1200:5	X1 to X3		576.0 to 719.9	1200
		1500:5	X1 to X4		720.0 to 863.9	1500

(For medium and high voltage applications, not to exceed 6600 volts).

Table 6
CT Factor, Current Overload Settings #1 and #2

CT Factor	Current Overload Setting #1	Current Overload Setting #2
66	00	255
67	01	254
68	02	253
69	03	252
70	04	251
71	06	249
72	06	248
73	07	247
74	08	246
75	09	245
76	10	244
77	11	243
78	12	242
79	14	240
80	15	241
81	16	239
82	17	238
83	18	237
84	19	236
85	20	235
86	21	234
87	22	233
88	22	233
89	23	232
90	24	231
91	25	230
92	25	230
93	26	229
94	27	228
95	28	227
96	28	227
97	29	226
98	30	225
99	30	225

Periodic Maintenance

Overview

This section describes the basic chiller preventive maintenance procedures, and recommends the intervals at which these procedures should be performed. Use of a periodic maintenance program is important to ensure the best possible performance and efficiency from a CenTraVac® chiller.

Recommended purge maintenance procedures for the Purifier Purge unit are covered by PRG-OM-6A or the latest revision which can be obtained at the nearest Trane office.

Record Keeping Forms

An important aspect of the chiller maintenance program is the regular completion of records. Provided at the end of this manual are copies of the "Annual Inspection Check List and Report", "CenTraVac with UCP2 Commissioning Checklist and "Start-Up Test Log", a "Start-Up Test Log for Water Cooled CenTraVacs with UCP2 Control Panels" and "UCP2 "Settings Group" Menu Record". When filled out accurately by the machine operator, the completed logs can be reviewed to identify any developing trends in the chiller's operating conditions.

For example, if the machine operator notices a gradual increase in condensing pressure during a month's time, he can systematically check, then correct the possible cause (s) of this condition (e.g., fouled condenser tubes, non-condensable in the system, etc.)

Daily Maintenance and Checks

[ ] Check the chiller's evaporator and condenser pressures, oil tank pressure, differential oil pressure and discharge oil pressure. Compare the readings with the values provided in Table 7.

IMPORTANT: *IT IS HIGHLY RECOMMENDED THAT THE OPERATING LOG BE COMPLETED ON A DAILY BASIS.*

CAUTION
IF FREQUENT PURGING IS REQUIRED, MONITOR PURGE PUMPOUT RATE, IDENTIFY AND CORRECT SOURCE OF AIR OR WATER LEAK AS SOON AS POSSIBLE. Failure to do so can shorten chiller life expectancy, due to moisture contamination caused by leakage.

[ ] Check the oil level in the chiller oil sump using the 2 sight glasses provided in the oil sump head. When the unit is operating, the oil level should be visible in the lower sight glass.

Weekly Maintenance

[ ] Complete all recommended daily maintenance procedures and checks. Complete logs on a daily basis.

WARNING
WHEN SERVICING, LOCK UNIT DISCONNECT SWITCH IN OPEN POSITION. Failure to do so, may result in death or injury due to electrical shock or contact with moving parts.

Every 3 Months

[ ] Complete all recommended weekly maintenance procedures. Refer to the previous sections for details.

[ ] Clean all water strainers in the CenTraVac water piping system.

Table 7
Normal Chiller Operating Characteristcs

Operating Characteristic	Normal Reading
Evaporator Pressure	12" to 18" Hg (Vacuum)
Condenser Pressure (See Notes 1 and 2)	2 to 12 PSIG (Standard Condensers)
Oil Sump Temperature:	
Unit Not Running	140 to 145 F
	(60 to 63)
Unit Running	30° F to 150° F
	(16.7°C to 72°C)
Differential Oil Pressure	12 to 18 PSID

Notes:
1. Condenser pressure is dependent on condenser water temperature, and should equal the saturation pressure of HCFC-123 at a temperature above that of leaving condenser water at full load.
2. Normal pressure readings for ASME condensers exceed 12 PSIG.
3. Oil Tank Pressure 12" to 18" Hg
   Discharge Oil Pressure 7 to 15 PSIG.

Every 6 Months

WARNING
WHEN SERVICING, LOCK UNIT DISCONNECT SWITCH IN OPEN POSITION. Failure to do so, may result in death or injury due to electrical shock or contact with moving parts.

[ ] Complete all recommended quarterly maintenance procedures.

[ ] Lubricate the vane control linkage bearings, ball joints, and pivot points; a few drops of light machine oil (e.g., SAE-20) is sufficient.

[ ] Lubricate first stage vane operator tang "O" rings by removing the setscrew and adding several drops of Trane Oil 0022. Replace setscrew.

[ ] Lubricate the oil filter shutoff valve "O" rings by removing the pipe plug and adding several drops of Trane Oil 0022. Replace plug.

[ ] Drain the contents of the rupture disc/purge discharge ventline drip-leg, into an evacuated waste container minimally and more often if the purge is operated excessively.

Also, apply 1 or 2 drops of oil on the vane operator shaft and spread it into a very light film; this will protect the shaft from moisture and rust.

Off-Season Maintenance

During those periods of time when the chiller is not operated, be sure the control panel is energized. This is to keep the purge operational, the oil heater warm and will also keep air out of the machine.

Annual Maintenance

Shut down the chiller once each year to check the items listed ; a more detailed inspection checklist is provided on the "Model CVHE/CVHF/CVHG CenTraVac Annual Inspection Checklist and Report" illustrated in this manual.

[ ] Perform the annual maintenance procedures referred to in the Maintenance Section of the purge manual.

[ ] Use and ice water bath to verify that the accuracy of the evaporator refrigerant temperature sensor (4RT5) is still within tolerance (i.e., + at 32°F).

If the evaporator refrigerant temperature displayed on the UCP's read-out is outside this 4-degree tolerance range, replace the sensor.

Note: If the sensor is exposed to temperature extremes outside its normal operating range (0°F to 90°F) (-18°C to 32°C), check its accuracy at 6-month intervals.

Compressor Oil Change on CVHE/CVHF/CVHG

After the first six months of operation it is recommended to have the oil analyzed.

AFTER ONE YEAR OF OPERATION IT IS RECOMMENDED TO CHANGE THE OIL AND FILTER AND HAVE THE REMOVED WASTE OIL ANALYZED.

Note: Use only Trane Oil 0022. A full oil change is 7-1/2 gallons of Oil 0022.

Beyond the first year, recommendations are to subscribe to an annual oil analysis program rather than change the oil automatically every year. This program will reduce the chiller's overall lifetime oil consumption and minimize refrigerant emissions. The oil analysis should be done by a qualified laboratory experienced in refrigerant/oil chemistry and the servicing of Trane centrifugal chillers.

In conjunction with other diagnostics performed by a qualified service technician, oil analyses can provide valuable information on the performance of the chiller to help minimize operating and maintenance costs and maximize it's operating life. A drain fitting is installed in the oil filter top, after the oil filter, for obtaining oil samples.

Oil Change Procedure

When oil analysis indicates the need to change compressor oil, use the following procedure for removing oil.

CAUTION
BE SURE TO OPEN CONTROL PANEL DISCONNECT SWITCH BEFORE DRAINING THE SUMP. Failure to do so could possibly burn out the oil sump heater.

[ ] Draw the oil from the chiller through the oil charging valve on the chiller oil sump into an approved, evacuated tank; or,

[ ] Pump the oil from the chiller through the oil charging valve into an air-tight resealable container, using a magnetically-driven auxiliary pump.

Forcing the oil from the oil sump by pressurizing the chiller (i.e. by raising chiller temperature or adding nitrogen) is not recommended.

Refrigerant dissolved in the oil can be removed and returned to the chiller by using an appropriate deep-vacuum recovery unit and heating/agitating the oil container. Follow all Federal, State and Local regulations with regard to disposal of waste oil.

Replacing Oil Filter

Replace oil filter: (1) annually, (2) at each oil change, (3) or if erratic oil pressure is experienced during chiller operation.

Oil Filter Replacement

Use the following procedure to service the oil filter. Refer to Figure 30.

1. Run the oil pump for two to three minutes to insure that the oil filter is warmed up to the oil sump temperature.

2. Turn the oil pump motor off.

3. Pull the "D" handle on the rotary valve locking pin out of its detent and rotate the valve to the "DRAIN" position. An offset pointer is located on top of the valve with wrench flats to allow turning. the spring force on the locking pin should allow the pin to drop into a detent at this position.

4. Allow at least 15 minutes for the oil to drain from the filter back into the oil sump.

5. Pull the "D" handle to unlock the pin and rotate the valve to the "Change Filter" position. This isolates the filter from the unit. The locking pin should drop into a detent in this position.

6. Remove and replace the filter as quickly as possible. Tighten filter 2/3 to 3/4 turn per instructions written on the filter. Place the used filter in a reusable container. Follow all local, state and federal regulations to dispose of the filter.

Pull the "D" handle to unlock the pin and rotate the valve to the "RUN" position. The locking pin should drop into a detent in this position. The chiller is now ready for operation.

Other Maintenance Requirements

[ ] Inspect the condenser tubes for fouling; clean if necessary.

[ ] Measure the compressor motor winding resistance to ground; a Qualified Service Technician should conduct this check to ensure that the findings are properly interpreted.

Contact a qualified service organization to leak-test the chiller; this procedure is especially important if the system requires frequent purging.

[ ] Use a nondestructive tube test to inspect the condenser and evaporator tubes at 3-year intervals.

Note: It may be desirable to perform tube tests on these components at more frequent intervals, depending upon chiller application. This is especially true of critical process equipment.

[ ] Depending on chiller duty, contact a qualified service organization to determine when to conduct a complete examination of the unit to discern the condition of the compressor and internal components.

Note: (a) Chronic air leaks, which can cause acidic conditions in the compressor oil and result in premature bearing wear; and, (b) Evaporator or condenser water tube leaks. Water mixed with the compressor oil can result in bearing pitting, corrosion, or excessive wear.

[ ] Submit a sample of the compressor oil to a Trane qualified laboratory for comprehensive analysis on an annual basis; this analysis determines system moisture content, acid level and wear metal content of the oil, and can be used as a diagnostic tool.

High Humidity Option

During annual inspections, verify that the heater is operating properly.

During the initial startup of a new chiller with HHOP, verify that the heater in the motor terminal box is operating properly. The heater operates on 120/60/1 power and draws approximately 0.9 amps. Use a clamp-on ammeter to verify proper operation.

Lubrication

The only CVHE/CVHF/CVHG chiller component that requires periodic lubrication is the external vane linkage assembly and Rotary oil valve.

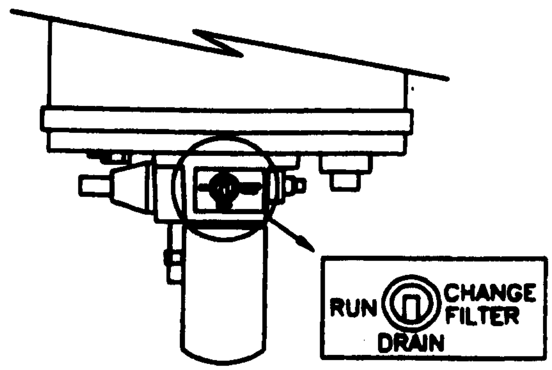
Lubricate the vane linkage shaft bearings and rod end bearings with a few drops of light-weight machine oil.

Lubricate the 1st Stage IGV actuator O-Rings, by removing the pipe plug and adding several drops of Trane Oil 0022. Be sure and reinstall pipe plug.

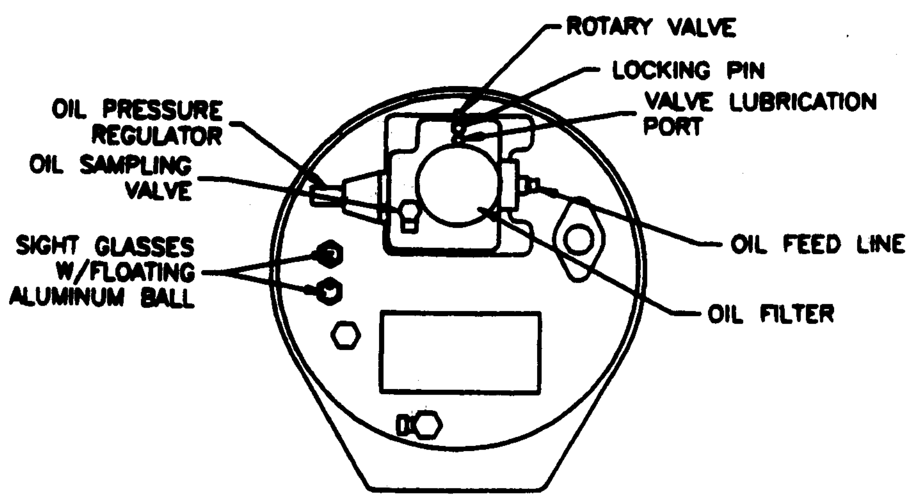
The oil valve block rotary valve uses dual O'Rings to seal to atmosphere. These should be manually lubricated by removing the pipe plug at the valve lubrication port and placing a few drops of Trane Oil 0022 in the cavity. Be sure to reinstall the pipe plug when lubrication is completed.

Figure 30
Rotary Valve in Drain Position

NOTE: ROTARY VALVE SHOWN IN DRAIN POSITION.



TOP VIEW



FRONT VIEW

Optional Dual Oil Filter System

As an option, a dual oil filter assembly is available. This is essentially two complete oil filter assemblies each with its own oil pressure regulator and rotary isolation valve. The following procedure should be followed:

1. Both valves should normally be in the "RUN" position.
2. After the operator throws the toggle switch to switch the active assemblies, the following action should be taken on the inactive assembly (clogged filter):

   a. Pull the "D" handle on the rotary valve locking pin out of its detent and rotate the valve to the 'DRAIN' position. Release the "D" handle and the locking pin should engage a detent in this position.

   b. Allow at least 15 minutes for the oil to drain from the filter into the oil sump.

   c. Pull the "D" handle to unlock and pin and rotate the valve to the "FILTER CHANGE" position. Release the "D" handle and the locking pin should engage a detent in this position.

   d. Remove and replace the filter as quickly as possible. Place the used filter in a resealable container. Follow all local, state and federal regulations to dispose of the filter.

   e. Pull the "D" handle to unlock the pin and rotate the valve to the "RUN" position. Release the "D" handle and the locking pin should engage a detent in this position.

Refrigerant Charge

⚠ WARNING

CERTAIN PROCEDURES COMMON TO REFRIGERANT SYSTEM SERVICE MAY EXPOSE OPERATING AND/OR SERVICING PERSONNEL TO LIQUID AND/OR VAPOROUS REFRIGERANT. CLOSELY FOLLOW ALL SAFETY PROCEDURES DESCRIBED IN THE MATERIAL SAFETY DATA SHEET FOR THE REFRIGERANT CONTAINERS. Failure to do so could result in death or injury due to inhalation of, or skin exposure to refrigerant.

The refrigerant charging procedure for Trane centrifugal chillers is:

1. If water is present in the tubes, break machine vacuum with refrigerant vapor, or circulate water, to avoid tube damage.

2. Always use refrigerant compatible hoses or copper-tubing with self-sealing connections or shut-off valves.

3. Transfer the refrigerant using one of the following (listed in order of preference):

   a. An approved Trane low-pressure refrigerant recovery/recycle unit.

   b. The available pressure differential.

   c. Gravity. (Use a return vent line to refrigerant drums to equalize pressure.)

4. When charging from new drums, use fitting designed for use with 3/4-inch center drum bung of 2-inch bung. Figure 31 shows Drum Bung Fitting with Quick Connect Coupling.

5. Do not use dry nitrogen to push refrigerant into the chiller as was common practice in the past. This will contaminate the charge and require excessive purging, which will result in unnecessary release of refrigerant.

6. Weigh in the proper charge.

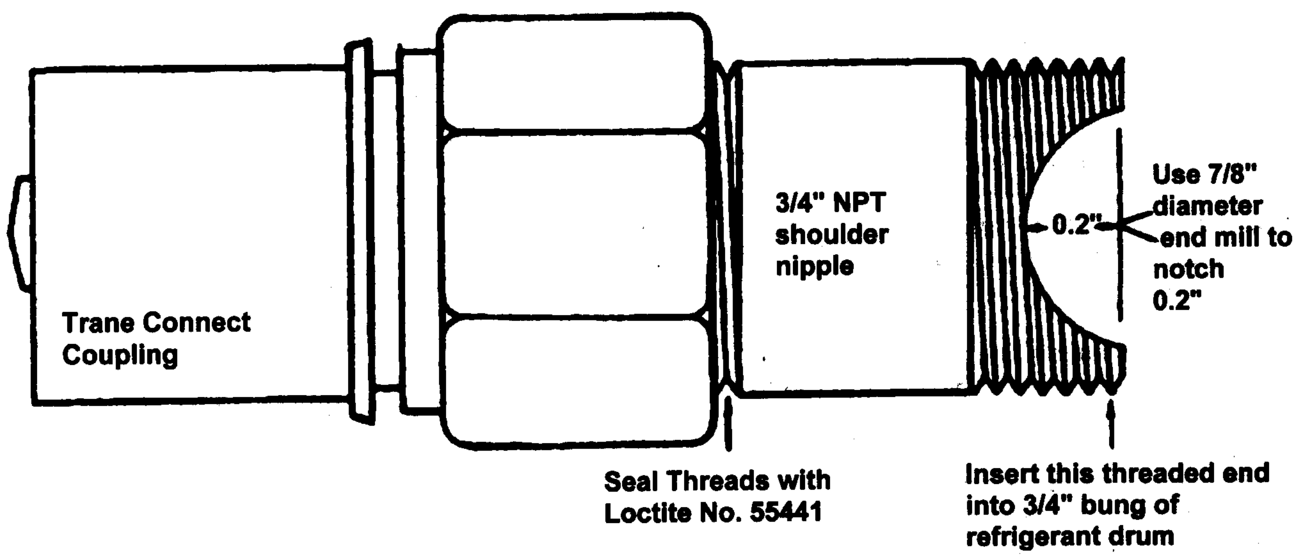
7. Use recovery/recyle unit or vacuum pump to evacuate hoses; discharge outdoors.

8. If refrigerant is supplied in new returnable cylinders, be sure and refer to General Service Bulletin CVHE-SB-48B for information on returning cylinders. This service bulletin is available at the nearest Trane office.

Depending on the chiller duty, contact a qualified service organization to determine when to conduct a complete examination of the unit to discern the condition of the compressor and internal components.

Note: If your chiller is covered by a Trane extended warranty, the terms of that warranty may require that the procedures listed in the Periodic Maintenance section of this manual be followed for your extended warranty to remain in force. The terms may also require that the chiller be inspected by a Trane authorized warranty agent every 4 years or 40,000 operating hours, whichever occurs first. This inspection will include, at a minimum, a review of the annual inspection checklists and the daily operating logs, as well as performance of a leak test and a general inspection of the chiller. The owner is then required to follow the recommendations made as a result of this inspection at the owners expense.

Figure 31
Trane-Designed Drum Bung with Quick-Connect Coupling



Rec very/R cycle Connections

To facilitate refrigerant removal and replacement, newer-design CVHE/CVHF/CVHG units are provided with a 3/4-inch vapor fitting with shutoff valve on the chiller suction and with a 3/4-inch liquid connection with shutoff valve at the bottom of the vaporator shell.

L ak T sting

To leak-test a chiller containing full refrigerant charge, raise chiller pressure using a controlled hot water or electric-resistance system to a maximum of 8 psig. Do not use nitrogen, which will cause excessive refrigerant discharge by the purge system.

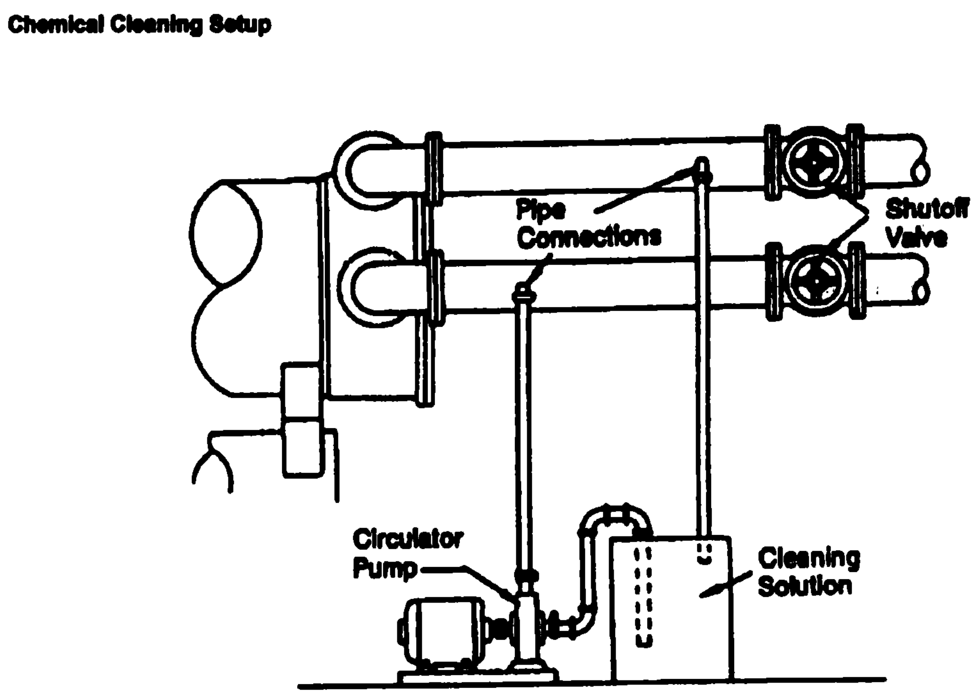
Cl aning the Condenser

CAUTION

DO NOT USE UNTREATED OR IMPROPERLY TREATED WATER. Failure to follow this caution could result in damaged equipment.

See Figure 32 which shows a Typical Chemical Cleaning Setup.

Figure 32
Typical Chemical Cleaning Setup



Condenser tube fouling is indicated when the approach temperature (the difference between the condensing refrigerant temperature and the leaving condenser water temperature) is higher than predicted.

If the annual condenser tube inspection indicates that the tubes are fouled, two cleaning methods, mechanical and chemical, can be used to rid the tubes of contaminants.

Use the mechanical cleaning method to remove sludge and loose material from smooth-bore tubes.

(To clean other types of tubes including internally-enhanced types, consult a qualified service organization for recommendations).

1. Remove the retaining nuts and bolts from the water box covers at each end of the condenser. Use a hoist to lift the covers off the water box. (A threaded connection is provided on each water box cover to allow insertion of an eyebolt).

2. Work a round nylon or brass bristled brush (attached to a rod) in and out of each of the condenser water tubes to loosen the sludge.

3. Thoroughly flush the condenser water tubes with clean water.

Scale deposits are best removed by chemical means. Be sure to consult any qualified chemical house in the area (i.e., one familiar with the local water supply's chemical mineral content) for a recommended cleaning solution suitable for the job. Remember, a standard condenser water circuit is composed solely of copper, cast iron and steel.

CAUTION

USE CARE WHEN CHEMICAL CLEANING THE UNIT. Failure to do so can damage the unit.

IMPORTANT: *ALL OF THE MATERIALS USED IN THE EXTERNAL CIRCULATION SYSTEM, THE QUANTITY OF THE SOLUTION, THE DURATION OF THE CLEANING PERIOD, AND ANY REQUIRED SAFETY PRECAUTIONS SHOULD BE APPROVED BY THE COMPANY FURNISHING THE MATERIALS OR PERFORMING THE CLEANING.*

REMEMBER, HOWEVER, THAT WHENEVER THE CHEMICAL TUBE CLEANING METHOD IS USED, IT MUST BE FOLLOWED UP WITH MECHANICAL TUBE CLEANING, FLUSHING AND INSPECTION.

Cleaning the Evaporator

Since the evaporator is typically part of a closed circuit, it does not accumulate appreciable amounts of scale or sludge. Normally, cleaning every 3 years is sufficient. However, on open CVHE/F/G systems, such as air washers, periodic inspection and cleaning is recommended.

Control Settings and Adjustments

A list of CVHE/F/G time delays and safety control cutout settings is provided in Table 1 in the Chiller Control System section of this manual. For control calibration and check-out, contact a Trane qualified service organization.

Purge System

Because some sections of the chiller's refrigeration system operate at less-than-atmospheric pressure, the possibility exists that air and moisture may leak into the system. If allowed to accumulate, these non-condensibles become trapped in the condenser; this increases condensing pressure and compressor power requirements, and reduces the chiller's efficiency and cooling capacity.

The Trane Purifier Purge is the only purge system available for the CVHE/F/G chiller. The purge is designed to remove non-condensable gases and water from the refrigeration system. Purifier Purge unit operation, maintenance and trouble shooting is covered by a separate operation and maintenance manual, PRG-OM-6A or the latest issue, which may be obtained from the nearest Trane office.

Installed Unit Extended Storage

Overview

This section describes extended storage requirements for UCP2 installed CVHE/F/G chillers to be removed from service for an undetermined length of time.

Unit Preparation

The following steps are necessary in order to properly prepare a unit for storage.

1. Remove all liquid refrigerant if the unit is charge.

WARNING
TO AVOID INJURY OR DEATH DUE TO INHALATION OF, OR SKIN EXPOSURE TO REFRIGERANT, CLOSELY FOLLOW ALL SAFETY PROCEDURES DESCRIBED IN THE MATERIAL SAFETY DATA SHEET. Failure to do so may expose operating and/or servicing personnel to liquid and/or vaporous refrigerant.

2. After the liquid refrigerant is removed, using a recovery/recycle unit or vacuum pump, pull a vacuum to remove remaining refrigerant vapor from the unit.

3. After all traces of refrigerant are out of the unit, a positive nitrogen charge should be put into the unit (6 to 8 PSIG). This positive pressure must be checked monthly to insure no noncondensibles get into the unit. Use a pressure gage on the evaporator shell to verify that the 6 to 8 PSIG dry nitrogen holding charge is still in the chiller. If this charge has escaped, contact a qualified service organization and the Trane sales engineer that handled the order.

4. The refrigerant charge should be stored in proper refrigerant containers. Due to possible leakage, do not store in used drums.

5. Maintain control power to the control panel. This will maintain oil temperature in the oil sump and the capability of the control panel to present report information. The Chiller, Refrigerant and Compressor Reports should be viewed once a week for normal readings. Any abnormal observation must be reported to the Trane Sales Engineer that handled the order.

WARNING
USE CARE WHEN MEASUREMENTS, ADJUSTMENTS OR OTHER SERVICE-RELATED OPERATIONS ARE PERFORMED WITH POWER ON. Failure to do so could result in death due to electrical shock or contact with moving parts.

Installed Unit Extended Storage

6. Remove the factory installed jumper or the field installed wiring on terminals J5-1 and J5-2 on the 1U1 Chiller Module in the unit control panel. This will prevent unwanted chiller operation.

7. Set the purge operating mode to OFF on UCP2 chillers.

8. The oil can be left in the unit.

9. The water side should not cause a problem if shut down and drained. There may be slight scaling inside the tubes, but not enough to cause a problem. Customer should inspect and clean tubes before the unit is returned to service.

IMPORTANT: *DO NOT USE UNTREATED OR IMPROPERLY TREATED WATER, OR EQUIPMENT DAMAGE MAY OCCUR.*

IMPORTANT: *SCALE DEPOSITS ARE BEST REMOVED BY CHEMICAL MEANS. BE SURE TO CONSULT ANY QUALIFIED CHEMICAL HOUSE IN THE AREA (I.E., ONE FAMILIAR WITH THE LOCAL WATER SUPPLY'S CHEMICAL MINERAL CONTENT) FOR A RECOMMENDED CLEANING SOLUTION SUITABLE FOR THE JOB.*

10. Motor bearings: If the motor sits for a long time the bearings could take a set and cause bearing problems/replacement later. Once every six months the chiller oil pump must be started and the compressor motor bump started to rotate the shaft. Contact a qualified service organization to perform this task. If the compressor motor cannot be bump started, then th shaft must be rotated manually by a qualified service organization.

11. Obtain an oil analysis initially after 6 months of storage, and once each succeeding year. If no oil breakdown is evident do not change the oil. If breakdown is evident, the oil must be replaced.

12. If the unit is stored for more than five years, and the storage is expected to be indefinite, the unit should be examined for leaks every five years from the initial storage date.

13. When the unit is to be returned to service, the services of a qualified service organization should be obtained to conduct all activities associated with the startup of a new chiller.

Annual Inspection Check List and Report: CenTraVacs® w/UCP2 Control Panels

Compressor Motor
[ ] Motor continuity check
Good [ ] Open [ ]

[ ] Check and tighten motor terminals

[ ] Meg motor
Phase 1 [ ] Phase 2 [ ] Phase 3 [ ]

[ ] Check nameplate rating
Amps [ ]

Starter
[ ] Check condition of starter contacts
Good [ ] Fair [ ] Replace [ ]

Oil Sump
[ ] Change oil
If oil analysis, refer to program procedures
[ ] Gallons (7) required

[ ] Oil pump motor ground check
Good [ ] Open [ ]

[ ] Check motor terminals
[ ] Change oil filter

Condenser
[ ] Visually inspect for scaling in tubes:
note findings and make recommendations

Control Circuits
[ ] Low refrigerant temperature sensor check-out
__ F set point __ F trip point (ice water)

[ ] Leaving Evaporator water temperature sensor check-out
__ F set point __ F trip point (ice water)

[ ] Condenser High Pressure Switch check-out
__ psig set point
__ psig trip point

[ ] Check Net Oil Pressure

[ ] Check adjustment and operation of inlet guide vane actuator stepper motor. The stroke of the actuator motor is 10,000 steps/in and approximately 46,000 to 54, 000 steps full stroke. (**Note**: each machine is unique and must have the 90' number of steps input.)

Leak Test Chiller
Refrigerant and oil analysis for acid content.

[ ] Sample refrigerant and oil for laboratory analysis (attach copy of analysis to next monthly inspection report)

Purge Unit
[ ] Perform the purge system control check described in"Control Circuit Diagnostics" in the "Troubleshooting" section of the most current Purge operation and maintenance manual.

Comments: ____

____

____

Recommendations: ____

____

____

____

Note: This form is suggested for your use.

TRANE

CenTraVac®
Checksheet And Request For Serviceman

To: ______________________ Trane Service Company

S.O. No.: ______________________ Serial No.: ______________________

Job/Project Name: ______________________

The Following Items Are Being Installed And Will Be Complete By ______________________

1. CenTraVac:
In place and piped. Do not insulate CenTraVac or adjacent piping. The contractor is responsible for any foreign material left in the unit. ☐

2. Piping:
Chilled water piping connected to:
- CenTraVac ☐
- Air handling units ☐
- Pumps ☐

Condenser and heat recovery condenser (as applicable) piping connected to:
- CenTraVac ☐
- Pumps ☐
- Cooling tower ☐
- Heating loop ☐

Make-up water connected to cooling tower ☐
Water supply connected to filling system ☐
Systems filled ☐
Pumps run, air bled from system ☐
Strainers cleaned ☐

3. Flow Balancing Valves Installed:
Leaving chilled water ☐
Leaving condenser water ☐
Heat recovery condenser leaving water ☐

4. Wiring:
Compressor motor starter has been furnished by or approved by The Trane Company, La Crosse, WI ☐
Power available ☐
Interconnecting wiring, starter to control panel ☐
External interlock (flow switches, water pump aux., etc.) ☐

Motors connected on:
- CenTraVac* ☐
- Chilled water pump ☐

Cooling tower fan rotation checked ☐
Condenser water pump ☐
Heat recovery condenser water pump (as applicable) ☐
Power available for vacuum pump ☐
(115V AC) ☐
All controls installed and connected ☐
All magnetic starters installed and connected ☐

*NOTE: Do not make final connections to compressor motor until requested by Trane Service Representative.

5. Testing:
Dry nitrogen available for pressure testing ☐
Refrigerant-22 available for leak testing if necessary (25 lbs.) ☐

6. Refrigerant On Job Site ☐

7. Gauges, Thermometers And Air Vents
Installed on both sides of evaporator ☐
Installed on both sides of condenser and heat recovery condenser (as applicable) ☐

8. System Can Be Operated Under Load Conditions ☐

9. Electrician, Control Man And Contractor's Representative Are Available To Evacuate, Charge And Test The CenTraVac Under Serviceman's Supervision ☐

In Accordance With Your Quotation And Our Purchase Order Number ______________________

We Will Therefore Require Your Serviceman On The Job By** ______________________

This is to certify that the CenTraVac(s) has been properly and completely installed and the applicable items listed above have been completed.

**Advance notification is required to allow scheduling of the start-up as close to the requested date as possible.

1-27.08-6—(1196)
Supersedes 1-27.08-6—(895)

Forms

Compliance To ASHRAE Standard 15

Yes No 1. Does the equipment room have a refrigerant monitor/sensor capable of monitoring and alarming within the acceptable exposure level (AEL) of the refrigerant?

Yes No 2. Does the equipment room have an audible or visual alarm (other than the light on the monitor) which is controlled by the monitor?

Yes No 3. Does the equipment room have mechanical ventilation?†

Yes No 4. Is a self contained breathing apparatus available in close proximity of the equipment room?

Yes No 5. Are the purge discharge and the rupture disk piped to the outdoors?

†The mechanical ventilation consists of two flow requirements i.e., a two-speed fan where the high speed is sized by the formula Cfm = 100 × the square root of the pounds of refrigerant of the largest chiller, and low speed is 0.5 Cfm per square foot of the equipment room space. (This requirement is for chillers located within the building which is the most common.)

Owner Awareness Of Safe Refrigerant Handling Procedures

Yes No 1. Has the owner been fully instructed on the proper use of refrigerant 123?

Yes No 2. Was the owner given a copy of the MSDS sheet for HCFC-123?

Yes No 3. Was the owner given a copy of Trane publication "CFC-GUIDE-2, Refrigerant Handling Guidelines"?

Additional time required to complete the start-up and adjustment due to incompleteness of the installation will be invoiced at prevailing rates.

Serial Number ______________________________

Serial Number ______________________________

Serial Number ______________________________

Serial Number ______________________________

Serial Number ______________________________

Checklist Completed By: ______________________________

____

____

Signed: ______________________________

Dated: ______________________________

Notice To Trane Service Agency:
A copy of this completed form must be submitted to the CenTraVac Technical Service Department in La Crosse, WI prior to the actual start-up date.

1-27.08-6—(1196)
Supersedes 1-27.08-6—(895)

TRANE™	CENTRAVAC WITH UCP2 COMMISSIONING CHECKLIST & START-UP TEST LOG

Job Name________________________ **Location**________________________

Model #________________________ **Serial #**________________________

Sales Order #________________________ **Start-up Date**________________________

NOTE: The Unit Installation, Operation and Maintenance Manuals, Submittals, and Design Specifications must be used in conjunction with this checklist. **(INCLUDING WARNINGS AND CAUTIONS)**

I. PRECOMMISSIONING PROCEDURES

☐**A. Obtain Installation Check Sheet**

This must be prepared by the installer for the particular unit, verifying the unit is ready for commissioning.

☐**B. Obtain Design (order) Specification Data**

This indicates the design criteria of the particular unit. A unit cannot be properly commissioned unless this data is known. It is the responsibility of the selling office to furnish this data.

☐**C. Obtain Wiring Diagrams**

The "as-wired" electrical diagram should be compatable with the recommended Trane submittals and diagrams. Are customer added external/remote control circuits compatable? ☐Yes ☐No

☐**D. General Installation Observations**

☐1. Is there any apparent shipping or rigging damage? ☐ Yes ☐ No

☐2. Record the pressure on the shipping gauge_____PSIG. If there is no pressure on the gauge, a leak test will have to be done before the unit can be evacuated and charged.

☐3. Is the water piping correctly installed? ☐ Yes ☐ No

Flow Switches ☐ Yes ☐No Pressure Gauges ☐ Yes ☐ No

Isolation Valves ☐ Yes ☐ No Flow Balancing Valves ☐ Yes ☐ No

Thermometer Wells ☐ Yes ☐ No Vent Cocks and Drains ☐ Yes ☐ No

☐4. Have proper clearances around the unit been maintained per submittal and/or Installation Manual guidelines? ☐ Yes ☐ No

☐5. Is power wiring of adequate ampacity and correct voltage? ☐Yes ☐No

Are fuses or circuit breakers of the correct value or type? ☐Yes ☐No

☐6. Is the unit base acceptable, level, and is the unit on isolators (rubber as supplied by Trane or spring type)? ☐Yes ☐No

☐7. Have the micro (less than 30 volts) circuits been properly isolated from the higher voltage control and power circuits? ☐ Yes ☐ No

☐ **E. Comments**____

____

____

II. COMMISSIONING PROCEDURES

A. Pre-start operations

1. Holding Charge

☐ _____PSIG. Must be positive pressure or leak test must be done.

☐ Relieve the holding charge.

2. Calibration of High Pressure Cutout

☐Calibrate the HPC to cut out when 15 PSIG is exceeded. The cut in value is approximatly 10 PSIG. CUT OUT______PSIG, CUT IN______PSIG.

3. Meggar the Motor (500 volt Meggar)

☐Compressor motor Megohms- refer to temp/resistance chart for acceptable values. Remove surge suppressors before Megging. Never Meg test with the unit in a vacuum.

T1 to Earth____	T4 to Earth____	T1 to T2____	T1 to T4____
T2 to Earth____	T5 to Earth____	T1 to T3____	T2 to T5____
T3 to Earth____	T6 to Earth____	T2 to T3____	T3 to T6____

4. Evacuation

☐Connect the vacuum pump to start evacuation. Use a 2-stage pump with at least 5 CFM capacity. Connect to the evaporator charging valve with a hose no smaller than 3/4 inch ID.

5. Condenser

☐Isolation and flow balancing valves installed.

☐ Calibrated thermometers and pressure gauges installed in/out of condenser on machine side of any valve or elbow.

☐ If condenser pump controlled by UCP2, is field wiring correct and complete?

☐ Condenser pump(s) run, system and strainers properly cleaned and/or flushed.

☐ Condenser water strainer in close proximity to entering connection of condenser.

☐ Provisions installed to properly maintain water treatment additives.

☐ Initial water treatment added to system.

☐ Flow or differential pressure switch installed and wired in series with auxiliary of pump motor starter. Operation of circuit verified.

☐ Condenser water flow balanced. Ft H2O PD design______, Ft H2O actual______
GPM design______ GPM actual______

6. Evaporator

☐ _____PSIG. Must be positive pressure or leak test must be done.

☐ Calibrated thermometers and pressure gauges installed in/out of evaporator on machine side of any valve or elbow.

☐ If evaporator pump controlled by UCP2, is field wiring correct and complete?

☐ Evaporator pump(s) run 24 hrs. System and strainers properly cleaned and/or flushed.

☐ Evaporator water strainer in close proximity to entering connection of evaporator.

☐ Provisions installed to properly maintain water treatment additives.

☐ Initial water treatment added to system.

☐ Flow or differential pressure switch installed and wired in series with auxiliary of pump motor starter. Operation of circuit verified.

☐ Evaporator water flow balanced. Ft H2O PD design_____, Ft H2O PD actual_____
GPM design______ GPM actual______

7. Electrical and Controls

a. Motor starter panel

☐ All terminals tightened.

☐ Wiring free from abrasion, kinks, and sharp corners.

☐ Contactors and relays have freedom of movement.

☐ All contacts are free of corrosion or dirt. Panel is free of dust, debris etc.

☐ Check the ratio of the current transformers. Record the part #s on the start-up log.

☐ Use only twisted shielded pair for the IPC circuit between the starter and the UCP2 on remote starters. Recommended wire is Beldon 8760, 18 AWG. Polarity is critical.

☐ The low voltage IPC link (< 30 volts) must be in a separate conduit from the 115 volt wiring.

☐ IPC link routing within the starter panel must stay a minimum of 6 inches from higher voltages.

☐ Remote starter to UCP2 connections are complete and comply with Trane requirements.

☐ Check the correctness of the power connections from the starter to the motor.

☐ Check the wiring to the starter for size, voltage, and correct phase rotation (A-L1, B-L2, C-L3).

☐ Check for equal phase representation in each power wiring conduit.

b. Control panel

☐ All terminals tightened.

☐ Wires free from abrasion, kinks, sharp corners.

☐ Low voltage wires are isolated from high voltage wires.

☐ Panel is free of debris, dust, etc.

☐ "Power up" the control panel.

1. Starter disconnect locked open.
2. Fuse 2F4 must be removed from the starter.
3. Connect auxiliary 115VAC power cord to Terminals 1TB1-1 and 1TB1-2 in the control panel. **MAKE SURE OF THE POLARITY. THE 'HOT' SIDE MUST BE CONNECTED TO TERMINAL 1TB1-1 AND THE 'NEUTRAL' SIDE TO 1TB1-2.**
4. Plug in cord to 115VAC power source. Control panel is now energized.

☐ Record the settings found in the Operator Settings,Service Settings Field Start-up Group, and Machine Configuration Menus in the UCP2.

☐ Using the CVHE Operation and Maintenance manual and the order specification, double check and reset, if required, the settings of Current Overload Setting #1 and Current Overload Setting #2 found in the Machine Configuration menu of the UCP2.

NOTE: DO NOT FORGET TO ADJUST THE RLA RATING TO MATCH THE ACTUAL JOBSITE VOLTAGE IF IT DIFFERS FROM THE DESIGN VOLTAGE.

☐ If Evaporator and/or condenser water pumps are controlled by the UCP2, use the Service Test menu of the UCP2 to manually start and test the control of the pumps.

☐ Check the setting of the oil pressure regulating valve.

1. Use the Service Tests menu of the UCP2 to manually start the oil pump.
2. Proceed to the Compressor Report menu of the UCP2 and observe the Differential Oil Pressure.
3. Adjust the oil pressure regulating valve to maintain 12 to 18 psid. The oil pressure regulating valve may require adjustment as the unit is started.
4. This procedure also checks to ensure correct sensing of oil pressure. The Oil Pressure Cutout setting is a non-adjustable 9 psid within the logic of the UCP2.
5. Return Oil Pump control to 'auto'.

☐ Check vane operator and vanes.

1. Use the Service Tests menu of the UCP2 to manually overide the vane control.
2. Enter targets from 0% to 100% and observe vane operation. At minimum and maximum travel the operator should not exert any force on the vane assembly, adjust as required.
3. Vane movement is smooth to open/close.
4. Vane movement is reported back to the UCP2.
5. Return Vane control to 'auto'.

☐ Dry run the starter

1. Make sure the starter disconnect is safety locked open.
2. Use the Service Tests menu of the UCP2 to initiate the Starter Dry Run.
3. Observe correct operation of starter contactors.
4. Observe correct operation of transition complete signal (if required).
5. Disable Starter Dry Run when complete.

☐ Disconnect and remove the temporary power cord.

B. Preparation for Start-up.

1. Evacuation and charging

☐ Evacuation leak test. When vacuum has been drawn down to .5-1MM Hg (500-1000 microns) secure the vacuum pump. Wait for 12 hours for a valid vacuum leak test. If the rise in vacuum is less than .5 mm (microns) per 12 hours, start-up may proceed.

☐ Charge refrigerant. **MAKE SURE THE CHILLED WATER IS FLOWING THROUGH THE EVAPORATOR.** Charge the prescribed amount of refrigerant through the liquid charging valve at the liquid inlet to the evaporator. Check that all drums contain a full amount of refrigerant. Amount charged ______lbs/kg.

2. Electrical

☐ Disconnect all temporary power cords, replace all fuses, connect motor leads, make final electrical inspection.

☐ Power up the motor starter. Check for control voltage at control panel terminals 1TB1-1 and 1TB1-2. _____volts

☐ Check current to the oil sump heater. ____amperes

☐ As the oil heats up, finish any operations not yet completed in preparation for starting th unit.

C. Chiller Start-up

1. Make all preliminary checks.

☐ Oil temp, oil level, chilled water flow, chilled water load available (cooling units on) etc.

2. Start the unit.

☐ If the phase rotation of the electrical power has not been positivly confirmed, the actual rotation of the motor must be checked. Observe the rotation of the motor shaft through the sight glass on the end of the motor at the moment of start-up. Rotation must be CLOCKWISE. If the phase sequence is incorrect, confirmed by observation of the Phase Reversal diagnostic on the UCP2, then L1 and L3 power leads to the starter must be reversed.

☐ As the unit starts and runs, observe closely all operating conditions.

☐ Adjust the oil pressure regulator if necessary to 12 to 18 psi net.

☐ In the Operator Settings menu of the UCP2, place the Purge Operating Mode to 'on' to allow the removal of non-condensables. It may also be necessary to increase the length of the Purge Service Override timer found in the Field Startup Group menu.

☐ After the unit has the system down to design leaving chilled water temp and is under control, and the purge is no longer relieving non-condensables, begin taking the startup test log. Log the unit a minimum of 3 times at 15 minute intervals.

☐ In the Operator Settings menu of the UCP2, return the purge operating mode to 'Adaptive'.

☐ When the logging is complete, shut the chiller down. Allow the unit to sit idle for 5-10 minutes. Attach a piece of clear plastic hose between the 1/2 inch valve at the bottom of the evaporator and the 1/4 inch valve near the top of the evaporator. Open the valves and record or mark permanently the refrigerant level in the hose.
RECORD THIS LEVEL - IT IS VERY IMPORTANT! At some later time, the refrigerant charge can be easily checked and verified.

☐ Restart the chiller and carefully observe the starting and loading sequence.

3. Instructions to the Chiller Operator.
   ☐ Instructions for starting, operating, and shutting down.

   ☐ Instructions for logging the unit.

   ☐ Instructions for periodic maintenance.

D. After 2 weeks of operation. (International Units Only)

1. Remove the water box covers on both the evaporator and condenser. Mechanically brush clean all the tubes. This is to assure there is no debris blocking any of the tubes. A piece of debris partially blocking a tube may cause that tube to fail prematurely.

2. Replace the oil filter with the spare oil filter included in the control panel at time of shipment.

E. Comments and/or Recommendations:

____

____

____

____

____

____

____

____

____

Service technician **Signature** **Date**

TRANE

Start-Up Test Log
Water Cooled CenTraVac® With UCP2 Control Panel

Job Name ____________________ Job Location ____________________

Model # ____________________ Serial # __________ Start Date __________

Sales Order # __________ Ship Date __________ Job Elevation (Ft. above sea level) __________

STARTER DATA:

Manufacturer ____________________

Type ____________________

(Star-Delta, X-Line, AutoTrans, Primary Reactor, Solid-State, Etc.)

Vendor ID #/Model # ____________________

Volts __________ Amps __________ Hz ______

MOTOR DATA:

Manufacturer ____________________

Type and Frame ____________________

Drawing # ____________________

Serial # ____________________

COMPRESSOR DATA: (RTHB Units Only)

Model # ____________________

Serial # ____________________

NAMEPLATE DATA:

RLA ______ KW ______ VOLTS ______ HZ ______

DESIGN DATA: (From Design Specification)

RLA ______ KW ______ VOLTS ______ HZ ______

HEAT RECOVERY PERFORMANCE:

RLA ______ KW ______ VOLTS ______ HZ ______

CURRENT TRANSFORMER

PART NUMBERS: ("X" Code and 2-Digit Extension)

Primary CT's:

X __________ - ____

X __________ - ____

X __________ - ____

Secondary CT's:

X __________ - ____

X __________ - ____

X __________ - ____

(Note: Secondary CT's are used only on remote starters "by others" and high voltage applications)

START-UP ONLY

CHILLER CONDITION:

On Arrival:

☐ Machine Vacuum = ______ mm (CVHE/F)

Or

☐ Machine Pressure = ______ psig (CVHE/F or RTHB)

At Start-Up:

☐ Machine Vacuum = ______ mm

Or

☐ Machine Pressure = ______ psig

Complete If Pressure Test Is Required:

☐ Vacuum after Leak Check = ______ mm

☐ Standing Vacuum Test = ______ mm Rise in ___ Hours

UNIT REFRIGERANT CHARGE:

__________ lbs. of R- ______

HIGH PRESSURE CUTOUT (3S1):

☐ Cut-In = ______ psig ☐ Cutout = ______ psig

SUMMARY OF UNIT OPTIONS INSTALLED:

☐ Tracer Communications Interface

☐ Remote Clear Language Display Module

☐ Options Module

☐ Outdoor Air Sensor

☐ Entering Condenser Limit Control

☐ Heat Recovery/Aux. Condenser

☐ Free Cooling Control

☐ Hot Gas Bypass Control

☐ Ice Making Control

☐ Monitoring Package

- ☐ Bearing Oil Temp. Sensors
- ☐ Discharge Temp. Sensor
- ☐ Compressor Phase Volt Sensors

☐ Other ____________________

Also complete the Commissioning Checklist, Record Sheet and Start-Up/Operation Log

1-27.90-5—(399)
Supersedes 1-27.90-5—(296)

Forms

CenTraVac®/UCP2 Start-Up and Operating Log

Sales Order # ______________________ Location ______________________

Model # ______________________ Serial # ______________________

DESIGN CONDITIONS**	CHILLER REPORT:	1ST READING	2ND READING	3RD READING
**From design specification	CHILLER OPERATING MODE			
DEG F ________ →	ACTIVE CHILLED WATER SETPOINT			
DEG F ________ →	EVAP LEAVING WATER TEMP			
DEG F ________ →	EVAP ENTERING WATER TEMP			
DEG F ________ →	CONDENSER ENTERING WATER			
DEG F ________ →	CONDENSER LEAVING WATER			
	ACTIVE CURRENT LIMIT SETPOINT			
GPM ________ →	EVAPORATOR WATER FLOW			
GPM ________ →	CONDENSER WATER FLOW			
	OUTDOOR AIR TEMPERATURE			
	REFRIGERANT REPORT:			
	EVAP REFRIGERANT PRESSURE			
	COND REFRIGERANT PRESSURE			
	SATURATED COND TEMP			
	SATURATED EVAP REFRIGERANT TEMP			
	COMPRESSOR REPORT:			
	COMPRESSOR DISCHARGE TEMP (OPT.)			
(12 TO 18 PSID) →	DIFFERENTIAL OIL PRESSURE			
(UNIT 'ON' 30 F ABOVE SAT.	OIL TANK TEMPERATURE			
EVAP. TEMP. TO 150 F)	DISCHARGE OIL PRESSURE			
	OIL TANK PRESSURE			
DESIGN RLA ________ →	COMPRESSOR PHASE AMPS A			
DESIGN KW ________ →	COMPRESSOR PHASE AMPS B			
	COMPRESSOR PHASE AMPS C			
DESIGN VOLTS ________ →	COMPRESSOR VOLTAGE AB			
DESIGN HZ ________ →	COMPRESSOR VOLTAGE BC			
	COMPRESSOR VOLTAGE CA			
	COMPRESSOR WINDING TEMP W1			
	COMPRESSOR WINDING TEMP W2			
	COMPRESSOR WINDING TEMP W3			
	COMPRESSOR STARTS			
	COMPRESSOR RUNNING TIME			
	BEARING TEMPERATURE 1			
	BEARING TEMPERATURE 2			
	OPERATING OIL LEVEL			
	VIBRATION READINGS — HORIZONTAL			
	AT THRUST BEARING — VERTICAL			
	END (OPT.) — AXIAL			

FRONT PANEL CHILLED WATER SETPOINT: ________ DESIGN DELTA TEMP SETPOINT: ________

LEAVING WATER TEMP CUTOUT SETPOINT: ________ LOW REFRIGERANT TEMP CUTOUT SETPOINT: ________

CURRENT OVERLOAD SETTING #1: ________ CURRENT OVERLOAD SETTING #2: ________

EVAPORATOR WATER PRESSURE DROP:	CONDENSER WATER PRESSURE DROP:	PURGE
DESIGN PSIG: ______ GPM: ______	DESIGN PSIG: ______ GPM: ______	RUN HRS ______
ACTUAL PSIG: ______ GPM: ______	ACTUAL PSIG: ______ GPM: ______	SUC TEMP ______ DEG F

UNIT MOUNTED REFRIGERANT MONITOR READOUT (OPT.)

SINGLE POINT ________ 4 CHANNEL SCANNER: 1. ______ 2. ______ 3. ______ 4. ______

MOTOR INSULATION MEG OHMS: @ Megger Voltage ________

TER. 1 TO GND ______	TER. 1-2 ______	TER. 1-4 ______	TECHNICIAN:
TER. 2 TO GND ______	TER. 1-3 ______	TER. 2-5 ______	OWNER'S REP.:
TER. 3 TO GND ______	TER. 2-3 ______	TER. 3-6 ______	DATE:

ACTIVE AND HISTORIC DIAGNOSTICS: ______________________

____

COMMENTS: ______________________

____

Also Complete CVHE/F UCP2 Commissioning Checklist and Record Sheet

1-27.90-5—(Back)—(399)
Supersedes 1-27.90-5—(Back)—(296)

CenTraVac® Adaptive Frequency Drive™ Startup and Operating Log

Sales Order #	Location
Model #	Drive Model #
Serial #	Drive Serial #

Prestart Checklist	✓ When Completed	Comments
Motor is Grounded		
Verified Drive Parameter Settings		
Drive Chassis Grounded		
Control Wiring & Drive Connections Tight		
Water Pump Rotation		
Distilled Water in Primary Water Loop		
Corrosion Inhibitor Installed		

UCP2 Control Settings		
Name	Default	Setting
Starter Type	AFDB	
Condenser Pressure Sensor Option	Installed	
AF Adjustable Speed Control Algorithm Enable	Enable	
AF Leaving Water Standard Deviation	1.0	
AF Pressure Coefficient Constant	800	
AF Re-optimization Factor	0.30	
AF Re-optimization Timer	24	
AF Boundary Pressure Coefficient Y Intercept	0.40	
AF Boundary Pressure Coefficient Y Intercept Maximum	2.00	
AF Pressure Error Deadband	0.030	
AF Proportional Speed Gain	50	

(P) AFDB Parameter Settings: Record Number and Setting			
Number	Setting	Number	Setting
1. P000		11. P010	
2. P001		12. P011	
3. P002		13. P012	
4. P003		14. P013	
5. P004		15. P014	
6 P005		16. P015	
7. P006		17. P016	
8. P007		18. P017	
9. P008		19. P018	
10.P009		20. P019	

(P) AFDB Parameter Settings: Record Number and Setting			
Number	Setting	Number	Setting
21. P020		57. P056	
22. P021		58. P057	
23. P022		59. P058	
24. P023		60. P059	
25. P024		61. P060	
26. P025		62. P061	
27. P026		63. P062	
28. P027		64. P063	
29. P028		65. P064	
30. P029		66. P065	
31. P030		67. P066	
32. P031		68. P067	
33. P032		69. P068	
34. P033		70. P069	
35. P034		71. P070	
36. P035		72. P071	
37. P036		73. P072	
38. P037		74. P073	
39. P038		75. P074	
40. P039		76. P075	
41. P040		77. P076	
42. P041		78. P077	
43. P042		79. P078	
44. P043		80. P079	
45. P044		81. P080	
46. P045		82. P081	
47. P046		83. P082	
48. P047		84. P083	
49. P048		85. P084	
50. P049		86. P085	
51. P050		87. P086	
52. P051		88. P087	
53. P052		89. P088	
54. P053		90. P089	
55. P054		91. P090	
56. P055		92. P091	

(U) AFDB Parameter Settings: Record Number and Setting			
Number	Setting	Number	Setting
1. U000		26. U025	
2. U001		27. U026	
3. U002		28. U027	
4. U003		29. U028	
5. U004		30. U029	
6. U005		31. U030	
7. U006		32. U031	
8. U007		33. U032	
9. U008		34. U033	
10. U009		35. U034	
11. U010		36. U035	
12. U011		37. U036	
13. U012		38. U037	
14. U013		39. U038	
15. U014		40. U039	
16. U015		41. U040	
17. U016		42. U041	
18. U017		43. U042	
19. U018		44. U043	
20. U019		45. U044	
21. U020		46. U045	
22. U021		47. U046	
23. U022		48. U047	
24. U023		49. U048	
25. U024			

(R) AFDB Parameter Settings: Record Number and Setting			
Number	Setting	Number	Setting
1. R030			
2. R035			
3. R036			
4. R037			

TRANE

Rockwell Automation

START-UP PROCEDURES
TRANE LIQUI-FLO VARIABLE FREQUENCY DRIVE
PRE START-UP CHECKLIST AND SERVICE REQUEST

Use this form to check for proper installation of the Rockwell Automation Liqui-Flo VFD. For start-up service, please fax this completed form to: **Rockwell Automation – LaCrosse, WI FAX: 1-608-781-7182** to schedule start-up. Please allow three weeks to arrange for start-up services.

JOB LOCATION____________________ INSTALLING CONTRACTOR______________

STREET__________________________ CONTRACTOR CONTACT______________

CITY____________________________ CONTACT PHONE__________________

PRE START-UP CHECKLIST

PRIOR TO ROCKWELL AUTOMATION BEING ON SITE, CONFIRM THAT THE FOLLOWING ACTIONS HAVE BEEN COMPLETED (OR WILL BE COMPLETED PRIOR TO THE SCHEDULED START-UP):

	YES
1. The Trane Liqui-Flo VFD is mounted and wired per the CVHE-OM-8 Operation & Maintenance manual and/or wiring diagram (if separately supplied).	☐
2. The A-C primary line voltage is the proper voltage.	☐
3. The Trane chiller is ready to start and operate under load conditions. All preliminary start-up checks have been completed as detailed in the appropriate Installation Operation Maintenance manual, such as (evacuation, charging, all wiring & electrical work, chiller and AFD control settings checked, etc...).	☐
4. The Personnel have been selected to assist the Rockwell Automation service representative with the operation of the equipment and the facility layout.	☐

REQUEST FOR SERVICE REPRESENTATIVE

I acknowledge that all four of the above items have been completed. I understand that if upon job inspection these requirements are not met, no start-up work will be performed and travel time and mileage will be charged at current hourly rates.

NAME__________________________ COMPANY__________________________

PHONE_________________________ FAX______________________________

DATE/TIME DESIRED______________ ALTERNATE DATE/TIME_______________

START-UP SERVICE COVERED BY P.O.#________________________________

LIQUI-FLO
LIQUID COOLED AC DRIVE