5-7 CARLTON GARDENS
LONDON SW1

OPERATING & MAINTENANCE INSTRUCTIONS
for the
MECHANICAL SERVICES

VOLUME 1
1.3.3 – Section H (H23)

THIS FOLDER WAS CHECKED BY ARUP ON

21.3.03

The checking process was to ensure that 3 identical sets of each Volume of the Operating and Maintenance Manuals existed

5-7 CARLTON GARDENS
LONDON SW1

OPERATING & MAINTENANCE INSTRUCTIONS
for the
MECHANICAL SERVICES

VOLUME 1
1.3.3 – Section H (H23)

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Armstrong Via Preussag	HOSEREEL BOOSTERS
Contract Components Ltd.	DUCT ACCESS DOORS
Diffussion Environmental Ltd.	FAN COIL UNITS
ACL Drayton	THERMOSTATIC RADIATOR VALVES
Estec Environmental Ltd.	CHLORINATION & WATER TREATMENT
F.E. Cole & Son Ltd.	DUCTWORK
Fire Protection Ltd.	FIRE DUCTS
Grundfos Pumps Ltd	SUMP PUMPS
Guntner UK	DRY COOLER
Hamworthy	BOILERS
Holden & Brooke Ltd	PUMPS, PRESSURISATION UNITS & COLD WATER BOOSTERS
Holmes	VALVES
Hudevad Britain	RADIATORS
IMI Rycroft Ltd	CALORIFIERS
Liff Industries	WATER CONDITIONERS
McQuay International AAF Ltd.	AIR HANDLERS &CHILLERS
Matthew & Yates	FANS
Minikin & Sons Ltd	FLEXIBLE CONNECTIONS
Noico Ltd.	INERTIA BASES
Preussag Fire Protection Ltd.	SPRINKLERS, HOSEREELS DRY RISERS
SPC	HEATING COILS
Stepspeed Ltd.	THERMAL INSULATION
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1

WATER COOLED, RECIP TYPE, WATER CHILLER

SITE ADDRESS:	Drake & Scull Eng. Ltd Wool House gardens c/o Mace 5-7 Carlton Gardens London, SW1Y 5AD
CONTRACTOR:	Drake & Scull Eng. Ltd One Shenley Pavilions Chalkdell Drive Shenley Wood Milton Keynes MK5 6LB
OFFICE TEL:	01908 506 005
SITE TEL:	0171 930 3369
SITE CONTACTS:	Jerry Starkin
CONTRACTORS ORDER No:	W078242 121 5192
McQUAY MODEL No:	WHS 220.3 ST 407c
QTY:	Two
McQUAY ITALY REF:	98 13 65
McQUAY UK REF:	7908019
McQUAY CONTACT:	L. MALLOWS
McQUAY TEL:	01670 566333
McQUAY COMMISSIONING SUPERVISOR:	G. WYNN
TEL:	0191 257 9421

2

CHILLER DATA SHEET

Model No.		WHS 220.3 ST R407c
Quantity		2
Cooling Duty	KW	700
Coefficient of Performance	C.O.P.	3.54
Absorbed Power	KW	198
Refrigerant		R407c
Compressor Type		Screw, 3 x 167 series
Capacity Steps		Twelve
No. off Refrigerant circuits		Three
Evaporator Details		
Quantity		2
Flow/Return Temps	°C	40/45
Fluid		Water
Design Flow Rate	l/s	44.6
Design Flow Rate Pd	kPa	63
Max. operating pressure, waterside	Bar	16
Condenser Details		
Quantity		2
Flow/Return Temps	°C	40/45
Fluid		Water
Design Flow Rate	l/s	44.6
Design Flow Rate Pd	kPa	63
Max. operating pressure, waterside	Bar	16
Method of Starting Compressors		Series Delta
Compressor Starting Current	Amps	482
Unit Full Load Current	Amps at Design	492
Maximum unit starting current	Amps	810
Number of Electrical Power Supplies		Main Power 415V, 3Ph, 50Hz, 3W
		Heater Supply 240Volt, 1Ph, 50 Hz, 10A
Operating Weight	kg	5218
Overall Dimensions Lg	mm	4620
W	mm	1250
H	mm	2120
Water Pipe Connections, Evaporator	mm	200 Victaulic
Water Pipe Connections, Condenser(s)	mm	4 x 4" Gas Female

CHILLER DATA SHEET, Continued

The chiller includes the following standard accessories and features:-

Door interlocked mains isolator
110V controls transformer
Compressor fuses with thermal trips
Phase failure/reversal/over-under voltage protection
Microtech controller
19mm insulation on evaporator
Chiller water flow switch (supplied loose)
Standard paint finish including base (RAL 7032)
Condenser Water Control Valves
Chiller System Control Panel (CSC) plus two probes
First charge of refrigerant
First charge of oil
Comp suction/discharge shut off valves
Comp thermistor protection
Ammeter/voltmeter kit

Ancillary Items

Dry Air Coolers	(see separate specification sheets)
Condenser Water Control Valves	
Type	Two way, Butterfly electrical opening, spring return Opening time = 1 minute, closing time = 30 secs.
Supplied by	Delta Control Products Ltd
Quantities	Two off type 125L2/AF120 with single actuators Flow rate = 30 L/s @ 4.6 Kpa Line size = 125mm Two off type 125L2/AF120 with tandem actuators Flow rate = 20 L/s @ 2.6 Kpa Line size = 100mm
Actuator Supply	110 Volts, 50 HZ, 1PH

COMMISSIONING METHOD STATEMENT

McQUAY SCREW CHILLERS

Purpose

To check the Mechanical and Electrical operation of the chiller unit and confirm that the chiller as built will meet the available cooling duty.

Before starting

Discuss method statement with client's representative, decide which points the client would like to witness and confirm that a test heat load will be available when required.

Step	Action
1	Verify unit Model and acknowledgement numbers are in accordance with data sheet (see section 2). Record numbers on CCL (commissioning checklist)
2	Check AVM's (if supplied) have been fitted in the correct locations and adjusted as required.
3	Check that the water pipework has been installed in accordance with the recommendations given in the McQuay installation and maintenance manual.
4	Check that the evaporator water flow switch has been fitted in accordance with the data sheet and wired in accordance with the wiring diagram.
5	Use binder test points (supplied by client) to measure pressure drop across evaporator bundle. Check measured value against factory measured value or data sheet (as applicable). Record site measured value on CCL.
6	Check that all incoming supplies to the chiller are isolated and check all the electrical connections on the chiller for good electrical contact and tightness. Check all electrical components for signs of damage.
7	Open all service valves i.e. liquid line shut off valve, discharge valves, suction valves etc and carry out a leak test on every circuit. Record standing pressure of leak test on the CCL. Close liquid line shut off valves after test.
8	Remove the compressor fuses in readiness for a 'dry' run on the chiller.
9	Ask client to switch on the main power supply to the chiller, check and record the voltage and phase rotation of the supply at the chiller. Check and record the value of the clients supply fuse or circuit breaker. The voltage should be as stated on the chiller data sheet and nameplate $\pm$ 3%.

10	Check that the control circuit breakers (CB) F120,130 & Q0 – Q4 and Q11 & Q12 are open. (Refer to wiring diagram). Switch on the main incoming isolator to the 'on' position. Operate switch S2 to check the value of the supply voltage on each phase
11	Close CB F120, check and record the output voltage of transformer TI at terminals 1 and 2. (Nominally 110Volts AC).
12	Replace fuses F130 and check that relay F112 energises.
13	Close Q11, check that 24 volts ac appears across terminals 5 and 20.
14	Closes the Heater supply Isolator and check that 110 Volts ac is being supplied to the compressor heaters.
15	Using ammeter check and record the following heater currents on the commissioning checklist. a) Compressor No1 heater (R1). b) Compressor No2 heater (R2). c) Compressor No3 heater (R3).
16	Manually operate contactor KM2 and check that the heater for compressor No1 de-energises.
17	Manually operate contactor KM4 and check that the heater for compressor No2 de-energises.
18	Manually operate contactor KM6 and check that the heater for compressor No3 de-energises.
19	Temporarily "short out" terminals 58 & 59 (110V ac) and check that relay k12 energises
20	Momentarily open and close fuse F60 and check the following:- a) The LED's follow the proper sequence upon powering up the Microtech controller ie:- The Red LED turns on for approximately 3 seconds after applying power to the controller. During this period, the microprocessor is checking the control software and performing internal hardware tests. After the self-check period, the RESET LED will turn off and the green RUNNING LED will illuminate indicating the controller's circuitry and software are operating correctly. NOTE: If the RESET LED stays on or the RUNNING LED fails to illuminate disconnect the controller power by opening fuse F60 and re-check the field wiring. Observe the controllers LED's while reconnecting power by closing Q18 switch.

20 Contd.

If the RUNNING LED still does not turn on, refer to the troubleshooting section of the operating and maintenance manual.

The amber OUTPUT ACTIVE LED is associated with the external alarm output on the solid-state relay board and will be illuminated during any alarm conditions.

Table 1 Green and red microprocessor status LED's

Green	Red	Indication
Off	Off	No power to controller
Off	On*	Self test failure controller defective
On	Off	Microprocessor operating normally

(*) If longer than 5 seconds

Table 2 Amber microprocessor status LED

LED Status	Indication
On continuously	Normal operation
Off	Loss of power to controller or application
On	Program not executing

b) Check that the display unit illuminates.

c) The Electronic expansion valve boards activate and drive the valves fully closed.

21 Provided that the machine has no faults the following LED's should be lit on the ADI board.

LED	INPUT
0	Mech. high pressure switch, compressor 1.
2	Motor protection devices, compressor 1.
3	(Input not used).
6	Phase Monitor Relay F112
8	Mech. high pressure switch, compressor 2.
10	Motor protection devices, compressor 2.
14	Evaporator water flow switch.

Note LED 14 will only be illuminated if the evaporator flow switch is detecting flow through the chiller at this time.

16	Mech. high pressure switch, compressor 3.
18	Motor protection devices, compressor 3.
19	(Input not used).
21	Phase Monitor Relay F112
22	Phase Monitor Relay F112

22 Check and record the internal microtech settings against those shown on the CCL.

23 Check that the following compressor motor protection relays de-energise when the thermistor circuit is opened.

Compressor No	Remove and refit wire from Terminal No	Relay No	LED No
No1	41	MP1	1
No2	43	MP2	9
No3	141	MP3	17

24 Manually trip the compressor thermal overloads and check the following actions.

Compressor Overload	Relay No drops out	LED No goes out
F51	K2	1
F52	K2	1
F53	K4	9
F54	K4	9
F55	K6	17
F56	K6	17

Reset all compressor thermal overloads.

25 Set and record on the CCL, the tripping point of each compressor overload.

26 Check the action of the low pressure transducer using a hand pump on each compressor circuit.

Record action on CCL.

27 Check the action of the high pressure transducer using a hand pump on each compressor circuit.

Record action on CCL.

28 Check the action of the mechanical high pressure safety cut-out using a hand pump on each compressor circuit.

Record settings on the CCL.
Check the following:-

Compressor No	Switch No	Relay No drops out	LED No illuminates
1	F13	K1	0
2	F23	K3	8
3	F33	K5	16

29 Clear any faults that maybe indicated on the microtech display.

30 Select the local position on switch Q0 and check the following:-

a) LED 13 illuminates.
b) The microtech display changes from "Off": system switch to "Off: pump down switch".

31 Select the remote position on switch QO. Short out terminals 58 & 59 (110V), check that the display changes from Off: Remote switch to Off: pump down switches and LED 13 illuminates.

32 Turn switch QO to the local position.

33 Move Q1 switch to the "ON" position. LED 7 on the ADI Board will illuminate. If none of the "off" conditions are present the microtech controller will initiate a start sequence and energise the chilled water pump output relay (not used). The chiller will remain in the Waiting For Flow mode until the field installed flow switches indicates the presence of chilled water flow. If flow is not proven within 30 seconds the alarm output will be turned on and the chiller will continue to wait for proof of chilled water flow. Once flow is established the controller will sample the chilled water temperature and compare it against the Leaving Chilled Water Setpoint, the Control band and the Load Delay which have been programmed into the controllers memory. If the leaving chilled water temperature is above the Leaving Chilled Water Setpoint plus half of the adjustable Control Band plus Start-up Delta-Temp settings the compressor start sequence will commence as shown below.

The controller will open the liquid line solenoid valve of the refrigerant circuit, (Y1 & Y5), allowing refrigerant to flow through the expansion valve and into the evaporator and compressor
When the evaporator refrigerant pressure rises above the LP Cut- in setpoint the controller will start the compressor.

Observe compressor No. 1 going through its starting sequence.

i.e. Output four illuminates and relay KT14 energises followed by relay K34
Check that the condenser water control valve starts to open
After a set time period (nominally 10 secs) check that contactor KM2 pulls in followed one second later by KM1.
Check that solenoids Y1 & Y5 energise and the heater de-energises
Switch off Q1.
The contactors and solenoids should drop out and the condenser water valve should close

34 Turn switch Q2 to the auto position, observe the microtech going through its starting sequence.

i.e. Output eight illuminates and relay KT24 energises followed by relay K24
Check that the condenser water control valve starts to open
After a set time period (nominally 10 secs) check that contactor KM4 pulls in followed one second later by KM3.
Check that solenoids Y2 & Y6 energise and the heater de-energises
Switch off Q2.
The contactors should drop out and the condenser water valve should close

35 Turn switch Q3 to the auto position, observe the microtech going through its starting sequence.

i.e. Output twenty illuminates and relay K324 energises followed by relay K34
Check that the condenser water control valve starts to open
After a set time period (nominally 10 secs) check that contactor KM6 pulls in followed one second later by KM5.
Check that solenoids Y3 & Y7 energise and the heater de-energises
Switch off Q3.
The contactors should drop out and the condenser water valve should close

36 Check that the compressor heaters have been on for at least 8 hours.

37 Double check that the compressor suction and discharge shut off valves are back seated. Always replace the valve caps.

38 Check that all refrigerant circuit valves are in the correct position for running. Open the main isolator Q10 and replace fuses F1 – F6.

39 Check that switches Q0 to Q3, are in the off position.

40 Turn switch Q10 on, move switch Q0 to the local position. Check that the display reads "Off: pump down switches".

41 Check that the evaporator water pump is running and that the flow switch is made (LED 14).

42 Repeat step 33
The unit will stage up automatically to meet system demand based on the setpoints
After running circuit 1 for a short time check for flashing in the refrigerant sightglass under stable conditions.

43 Check that the compressor No 1 increases capacity as dictated by the microtech controller.

44 With the compressor operating in auto control on a stable load, measure, set and record the superheats etc.

45 Record operating parameters of the circuit on the CCL.

46 Turn switch Q1 to the pump down position the liquid line solenoid Y1 & Y5 will drop out and the compressor should "pump out" the refrigerant from the evaporator and stop.

47 Repeat step 34
The unit will stage up automatically to meet system demand based on the setpoints
After running circuit 1 for a short time check for flashing in the refrigerant sightglass under stable conditions.

48 Check that the compressor No 2 increases capacity as dictated by the microtech controller.

49 With the compressor operating in auto control on a stable load, measure, set and record the superheats etc.

50 Record operating parameters of the circuit on the CCL.

51 Turn switch Q2 to the pump down position the liquid line solenoid Y2 & Y6 will drop out and the compressor should "pump out" the refrigerant from the evaporator and stop.

52 Repeat step 35
The unit will stage up automatically to meet system demand based on the setpoints
After running circuit 1 for a short time check for flashing in the refrigerant sightglass under stable conditions.

53 Check that the compressor No 2 increases capacity as dictated by the microtech controller.

54 With the compressor operating in auto control on a stable load, measure, set and record the superheats etc.

55 Record operating parameters of the circuit on the CCL.

56 Turn switch Q3 to the pump down position the liquid line solenoid Y3 & Y7 will drop out and the compressor should "pump out" the refrigerant from the evaporator and stop.

57 Switch Q0 to the remote position. Turn switches Q1 to Q3 to the auto position.

58 Short out terminals 58 and 59. Check that the chiller starts in the automatic mode. The actual circuit which starts first is dependant on the compressor with the lowest running hours.

59 Check that the chiller control system loads and unloads the compressors in response to the leaving evaporator water temperature.

60 Demonstrates the unit operation to the client.

61 Complete the commission log
Obtain acceptance signature from client.

Control Philosophy

Chiller Control

The BMS will enable the Chiller System Controller (CSC panel) and chilled water pump when cooling is required
The CSC panel will select the chiller with the lowest running hours to become the lead chiller
If the chilled water is above the system set point, the CSC panel will command the lead chiller to run

At this stage only one chiller will be running at minimum capacity, therefore the CSC panel will automatically lower the operating leaving chilled water setpoint to compensate for the mixing water flow through the non-running chiller

The temperature controller mounted in the lead chiller will select the refrigerant circuit with the lowest number of running hours to start.
There are three circuits per chiller
The controller will then increase the number of capacity steps by comparing the chiller leaving water temperature against the setpoint being generated by the CSC panel
When the lead chiller is running at 50% capacity (site adjustable) the CSC will request the lag chiller to start

With both chillers running the chilled water setpoint generated by the CSC panel will rise to the design point and the individual chiller controllers will equalise the steps of capacity in each chiller

As the chilled water temperature rises, each chiller will in turn increase it's capacity to return the leaving water temperature back to the setpoint

As the chilled water temperature falls, each chiller will in turn decrease it's capacity to return the leaving water temperature back up to the setpoint

The chillers will increase and decrease capacity in parallel to meet the system load
When the load falls to a minimum, the CSC panel will stop the lag chiller when both units are running at 25% capacity each (site adjustable)
The chilled water setpoint will again be lowered to allow for the mixed leaving water temperature to the load

Dry Air Cooler Control

The CSC panel will also provide a signal to the BMS to start the cooling water pump once a chiller is commanded to start

Each dry air cooler has a dedicated leaving water temperature controller
This unit controls the number of fans running to maintain a fixed temperature
The temperature setpoint can be switched between two setpoints depending on the capacity of the chillers
A signal from the CSC panel provides the switching between setpoints

Alarms

Common fault alarms are available in the CSC and individual chiller control panels
The CSC panel will also provide an alarm in the event of loss of communications to the chiller controllers

Note, if loss of communications occurs, the individual controllers will revert to local automatic capacity control
A facility is available for the CSC panel to detect a common fault in the dry air cooler system

DRY COOLER TECHNICAL SPECIFICATION

GUNTNER REF	:	E98/7027
MODEL No	:	GFH 091 C/2 X 4 L(S)
QUANTITY	:	1
TOTAL HEAT REJECTION	:	480 kW
GLYCOL ON/OFF TEMPERATURE	:	45/40°C
AMBIENT AIR TEMPERATURE	:	30°C
GLYCOL CONCENTRATION	:	20% Vol
GLYCOL/WATER CHARGE	:	315 Litres
MEDIUM FLOW	:	85.4m/h
MEDIUM PRESSURE DROP	:	72 kPa
CONNECTIONS	:	Inlet 3 x DN100 PN16 Outlet 3 x DN100 PN16
NO OF CIRCUITS	:	1
AIRFLOW	:	145900 M/H
No OF FANS	:	10
FAN SPEED	:	520 rpm
FAN POWER (Each)	:	1.2 kW/2.3A
FAN MOTOR ELECTRICAL SUPPLY	:	400/3/50 Hz
TUBE MATERIAL	:	Copper
FIN MATERIAL	:	Aluminium
OVERALL UNIT SIZE Length	:	8500mm + Con system
Width	:	2385mm
Height	:	1550 mm
Weight	:	2266 kg
NOISE LEVEL dB(A) @ 10m (Sound Pressure Level FREEFIELD)	:	54 dB(A)
SURFACE AREA OF COIL	:	2283m²

DRY COOLER TECHNICAL SPECIFICATION

GUNTNER REF	:	E98/7027 Rev 6
MODEL No	:	GFH 091 C/2 X 4 L(S)
QUANTITY	:	3
TOTAL HEAT REJECTION	:	430 kW
GLYCOL ON/OFF TEMPERATURE	:	43.8/40°C
AMBIENT AIR TEMPERATURE	:	30°C
GLYCOL CONCENTRATION	:	20% Vol
GLYCOL/WATER CHARGE	:	299 Litres
MEDIUM FLOW	:	104m³/h
MEDIUM PRESSURE DROP	:	88 kPa
CONNECTIONS	:	Inlet 2 x DN100 PN16 Outlet 2 x DN100 PN16
NO OF CIRCUITS	:	1
AIRFLOW	:	128500 M/H
No OF FANS	:	8
FAN SPEED	:	520 rpm
FAN POWER (Each)	:	1.2 kW/2.3A
FAN MOTOR ELECTRICAL SUPPLY	:	400/3/50 Hz
TUBE MATERIAL	:	Copper
FIN MATERIAL	:	Aluminium
OVERALL UNIT SIZE Length	:	8000mm + Con system
Width	:	2385mm
Height	:	1550 mm
Weight	:	1907 kg
NOISE LEVEL dB(A) @ 10m (Sound Pressure Level FREEFIELD)	:	53 dB(A)
SURFACE AREA OF COIL	:	2147m²

DRY COOLER TECHNICAL SPECIFICATION

GUNTNER REF	:	E98/7027
MODEL No	:	GFH 091 C/2 X 4 L(S)
QUANTITY	:	3
TOTAL HEAT REJECTION	:	430 kW
GLYCOL ON/OFF TEMPERATURE	:	45/40°C
AMBIENT AIR TEMPERATURE	:	40°C
GLYCOL CONCENTRATION	:	20% Vol
GLYCOL/WATER CHARGE	:	299 Litres
MEDIUM FLOW	:	76.5m/h
MEDIUM PRESSURE DROP	:	55 kPa
CONNECTIONS	:	Inlet 2 x DN100 PN16 Outlet 2 x DN100 PN16
NO OF CIRCUITS	:	1
AIRFLOW	:	128500 M/H
No OF FANS	:	8
FAN SPEED	:	520 rpm
FAN POWER (Each)	:	1.2 kW/2.3A
FAN MOTOR ELECTRICAL SUPPLY	:	400/3/50 Hz
TUBE MATERIAL	:	Copper
FIN MATERIAL	:	Aluminium
OVERALL UNIT SIZE Length	:	8000mm + Con system
Width	:	2385mm
Height	:	1550 mm
Weight	:	1907 kg
NOISE LEVEL dB(A) @ 10m (Sound Pressure Level FREEFIELD)	:	53 dB(A)
SURFACE AREA OF COIL	:	2147m²

OOLER TECHNICAL SPECIFICATION

NER REF	:	E98/7027
EL No	:	GFH 091 C/2 X 4 L(S)
NTITY	:	3
AL HEAT REJECTION	:	430 kW
YCOL ON/OFF TEMPERATURE	:	45/40°C
MBIENT AIR TEMPERATURE	:	40°C
LYCOL CONCENTRATION	:	20% Vol
GLYCOL/WATER CHARGE	:	299 Litres
MEDIUM FLOW	:	76.5m/h
MEDIUM PRESSURE DROP	:	55 kPa
CONNECTIONS	:	Inlet 2 x DN100 PN16 Outlet 2 x DN100 PN16
NO OF CIRCUITS	:	1
AIRFLOW	:	128500 M/H
No OF FANS	:	8
FAN SPEED	:	520 rpm
FAN POWER (Each)	:	1.2 kW/2.3A
FAN MOTOR ELECTRICAL SUPPLY	:	400/3/50 Hz
TUBE MATERIAL	:	Copper
FIN MATERIAL	:	Aluminium
OVERALL UNIT SIZE Length	:	8000mm + Con system
Width	:	2385mm
Height	:	1550 mm
Weight	:	1907 kg
NOISE LEVEL dB(A) @ 10m (Sound Pressure Level FREEFIELD)	:	53 dB(A)
SURFACE AREA OF COIL	:	2147m²

3

McQuay

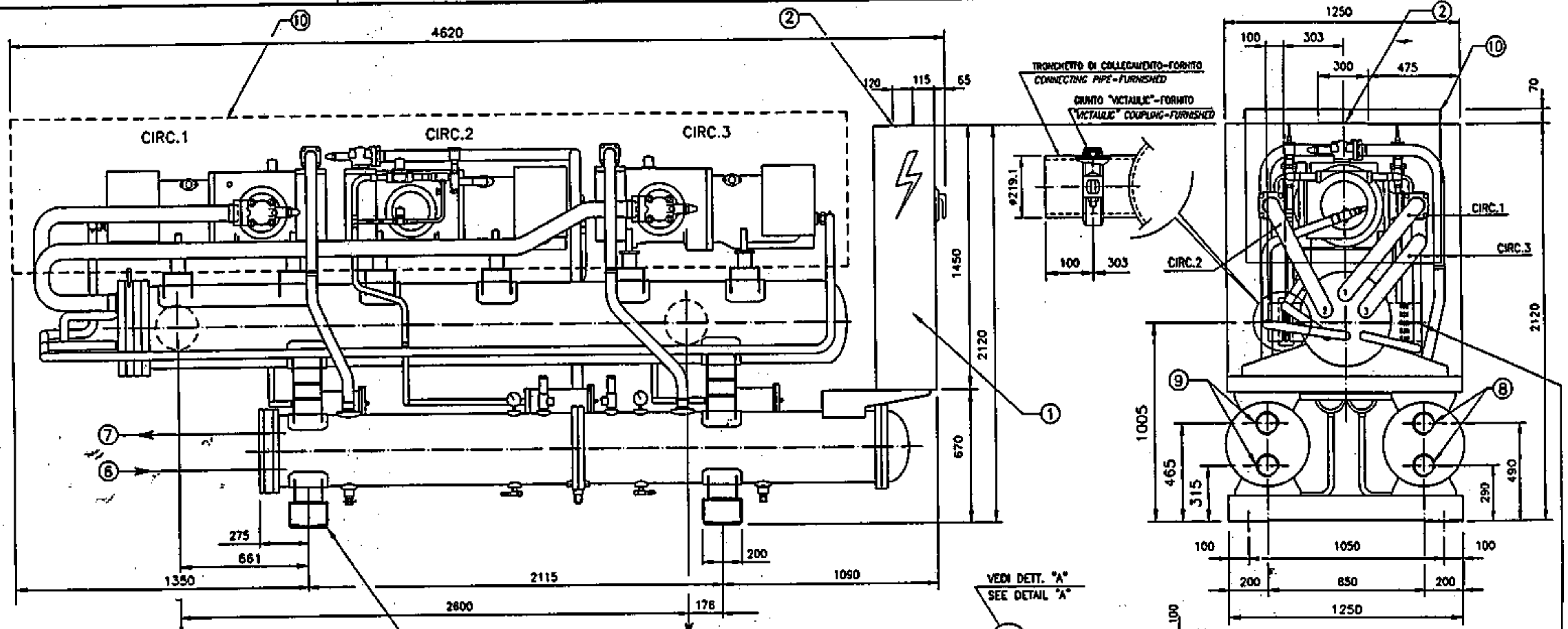
Denominazione / Identification

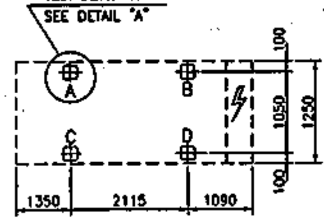
DIMENSIONI WHS 175.3÷250.3

DIMENSION WHS 175.3÷250.3

Dis./Drg.	Ver./Check	Appr./Passed	Codice / Part. No.	Rev.	Data / Date	Scala - Scale	Foglio - Sheet
F.G.	M.B.		892842	A	25-03-1998	--	1/1

Rev.	Data Date	Modifica Alteration	Dis. Drg.	Check	Passed
A	01-06-98	REVISED CKT 2 CONNECT.S	F.G.		





DISPOSIZIONE ANTIVIBRANTI
ISOLATORS LOCATION

LEGENDA - *LEGEND*

1 – PANNELLO ELETTRICO
ELECTRICAL PANEL

2 – ASOLA INGRESSO ALIMENTAZIONE
POWER CONNECTIONS SLOT

3 – N.4 FORI #28 PER FISSAGGIO ANTIVIBRANTI
4 HOLES #28 FOR ISOLATOR MOUNTING

4 – INGRESSO ACQUA EVAPOR. (CONNESSIONE VICTAULIC ø 219,1)
EVAPORATOR WATER INLET (ø 219.1 Victaulic® connection)

5 – USCITA ACQUA EVAPOR.(CONNESSIONE VICTAULIC ø 219.1)
EVAPORATOR WATER OUTLET (ø 219.1 Victaulic® connection)

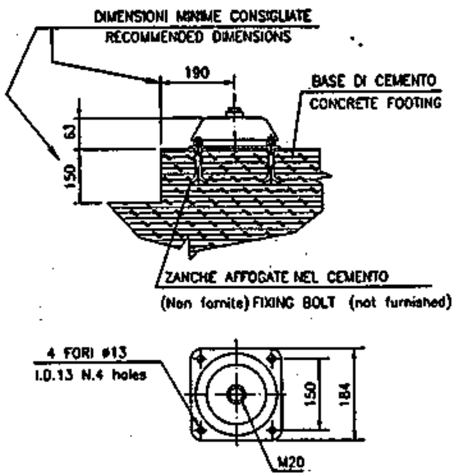
6 – CONNESSIONE INGRESSO ACQUA CONDENSATORE
CONDENSER WATER INLET CONNECTION

7 – CONNESSIONE USCITA ACQUA CONDENSATORE
CONDENSER WATER OUTLET CONNECTION

8 – CONNESSIONI ACQUA CONDENSATORI CIRC. 1-3 (5" GAS FEMM.)
CIRC. 1-3 CONDENSER WATER CONNECTION (5" GAS FEMALE)

9 – CONNESSIONI ACQUA CONDENSATORI CIRC. 2 (4" GAS FEMM.)
CIRC. 2 CONDENSER WATER CONNECTION (4" GAS FEMALE)

10 – CABINA INSONORIZZANTE COMPRESSORI (OPTIONAL)
COMPRESSORS ENCLOUSURE (OPTIONAL)



DETTAGLIO "A" ANTIVIBRANTE IN GOMMA
DETAIL "A" RUBBER ISOLATOR
OPTIONAL

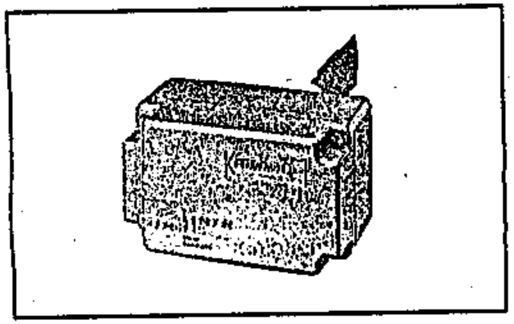
MODELLO UNITA'	WEIGHT Kg.		ISOLATORS LOADS Kg.			
	SHIPPING	OPERATING	A	B	C	D
WHS 175.3	4525	5030	1243	1273	1243	1271
WHS 190.3	4575	5078	1255	1285	1255	1283
WHS 205.3	4645	5150	1273	1303	1273	1301
WHS 220.3	4715	5218	1290	1320	1290	1318
WHS 230.3	4775	5280	1305	1335	1305	1335
WHS 240.3	4815	5320	1315	1345	1305	1345
WHS 250.3	4865	5370	1328	1357	1328	1357

DISEGNATO AL CAD – VIETATO APPORTARE MODIFICHE A MANO. / *DRAWING BY CAD – DO NOT MANUALLY MODIFY THIS DRAWING.*

PSC8929 SHT007N601(003)

JOHNSON CONTROLS

Instruction sheet F61SB/TB



F61SB

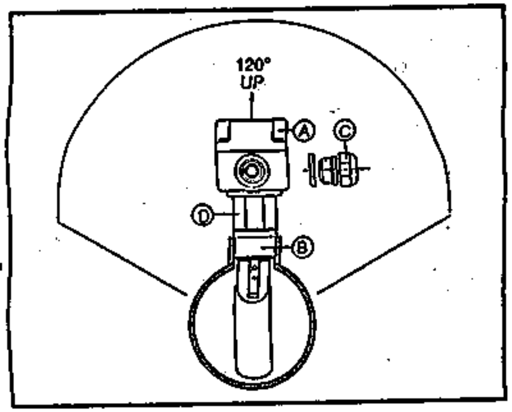


Fig. 1

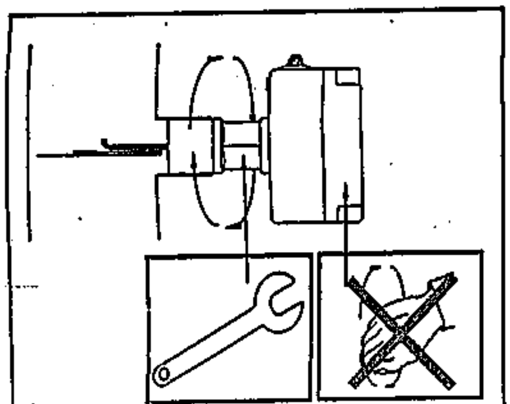


Fig. 2

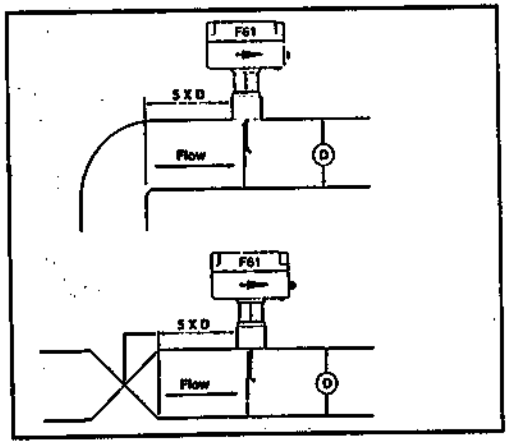


Fig. 3

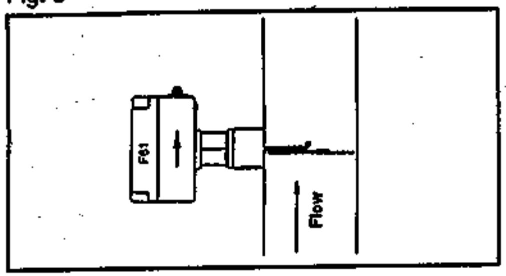


Fig. 4

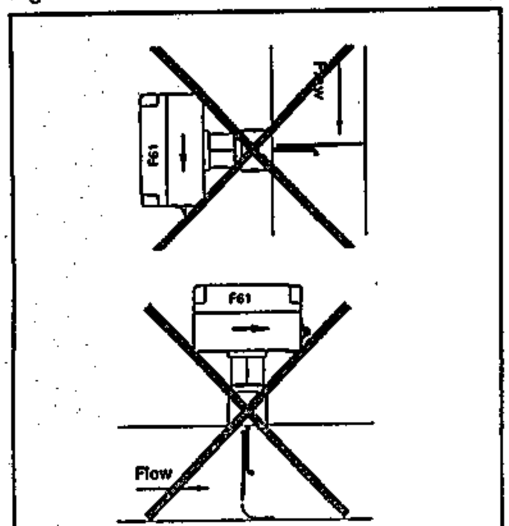


Fig. 5

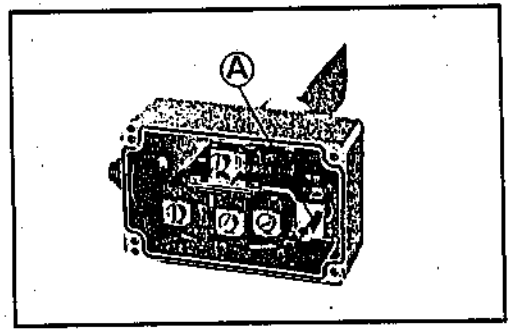


Fig. 6

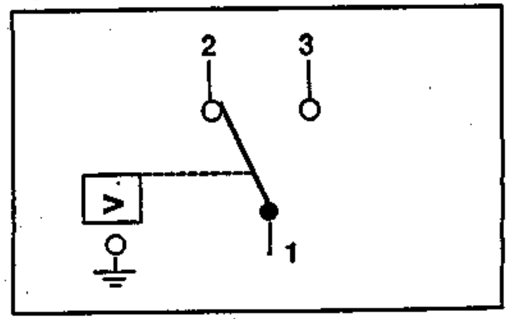


Fig. 7

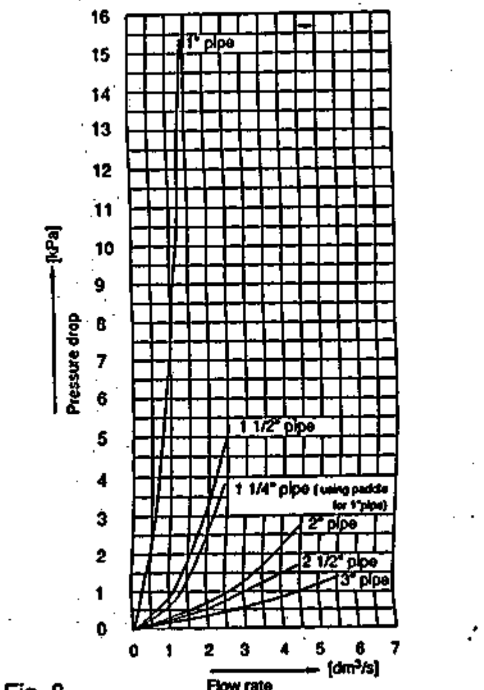


Fig. 8

		Paddle size	Line pipe size									
		1"- 2"- 3"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"*	4"*	5"*	6"*	8"*
Minimum adjustment	Flow increase 1-3 closes		0.3 (1.0)	0.4 (1.3)	0.5 (1.7)	0.9 (3.1)	1.1 (4.1)	1.7 (6.2)	4.2 (15)	7.8 (28)	12 (43)	24 (85)
		6"	:	:	:	:	:	:	2.4 (8.5+)	3.6 (13+)	4.8 (17)	13 (47)
	Flow decrease 1-2 closes	1"-2"-3"	0.15 (0.6)	0.2 (0.8)	0.3 (1.1)	0.6 (2.2)	0.8 (2.8)	1.2 (4.3)	3 (11)	6.4 (23)	10 (36)	20 (73)
		6"	:	:	:	:	:	:	1.7 (6+)	2.5 (9+)	3.4 (12)	11 (39)
Maximum adjustment	Flow increase 1-3 closes	1"-2"-3"	0.6 (2.0)	0.9 (3.0)	1.2 (4.4)	1.8 (6.6)	2.2 (7.8)	3.4 (12)	8.1 (29)	16 (56)	24 (85)	48 (173)
		6"	:	:	:	:	:	:	5.0 (18+)	7.6 (27+)	9.2 (33)	26 (94)
	Flow decrease 1-2 closes	1"-2"-3"	0.5 (1.9)	0.8 (2.8)	1.1 (4.1)	1.7 (6.1)	2.0 (7.3)	3.2 (11.4)	7.8 (28)	15 (53)	23 (82)	43 (116)
		6"	:	:	:	:	:	:	4.8 (17+)	7 (25+)	8.7 (31)	25 (91)

Fig. 9

1 dm³/s = 3.6 m³/h = 15.6 U.S. gal./min. = 13 U.K. gal./min. * Flow rates for these sizes are calculated.
+ For 4" and 5" line pipe the 6" paddle is trimmed.

ENGLISH

READ THIS INSTRUCTION SHEET CAREFULLY BEFORE INSTALLING.
KEEP THIS INSTRUCTION SHEET WITH THE CONTROL.

Figure 1:
Mounting position F61SB to obtain IP43. F61TB may be mounted in any position to obtain IP 66.

A. Cable inlet hole Ø 22.3 mm, grommet is installed on F61SB/TB.
B. Pipe connection.
   1" R Male F61SB-9100/9103/9200
   1" R Male F61TB-9200
   1-11 1/2 NPT F61TB-9100
C. PG-nipple (mounted on F61TB). IP 66 enclosure.
D. 30 mm Hex F61SB/TB
   45 mm ☐ F61TB-9200

Figure 2:
Correct mounting position F61SB/TB

> **Warning**
> Do not tighten by grasping the switch enclosure. Only use the wrench flats provided.

Figures 3/4:
Correct mounting of flow switches.

Figures 5:
Incorrect mounting of flow switches.

Figure 6:
F61SB, cover removed. (A) Range adjustment screw.

Figure 7:
Contact function 1 - 3 closes on flow increase.

Figure 8:
F61SB/TB flow switch pressure drop.
Please note that the curve (fig. 8) approximate data obtained in a laboratory test and are not necessarily representative or accurate when compared with various field applications.

Figure 9:
Flow rate table F61SB/TB
Typical flow rates dm³/s (m³/h) required to actuate switch.

Note
The information provided in this instruction sheet should be sufficient for installation and adjustment of the F61SB/TB. For additional information you could obtain the F61 product data sheet.

Application
These flow switches may be used in liquid flow lines carrying water, ethylene glycol, or any fluid not harmful to brass or phosphor bronze and not classified as a hazardous fluid.
Type F61SB must not be used on lines carrying liquid with temperatures below dewpoint. Type F61TB, when used with cable nipple correctly fitted, may be used for liquid temperatures below dewpoint down to -30 °C.

Note
These controls are designed for interlock purposes or "no flow" protection. Where critical or high value property is to be maintained within specific environmental conditions, a single control should not be applied to function as both an operating and safety device. In such applications a separate back-up control with alarm contacts should be wired to indicate when this control operates.

Ratings
The following operating limits should be observed:
Electrical rating: 15(8) A 220 V~ (all standard models 9100)
(other models, see data plate on control)

INSTALLATION

Location:
This flow switch may be mounted in a horizontal pipe line or a vertical pipe line with upward liquid flow. It should not be used when liquid flow is downwards (see fig. 5).

> **Note**
> When mounted in a vertical pipe line with upward flow the switch will trip at a higher flow than shown in the "flow rate table".

Mount in a section of pipe where there is a straight run of at least five pipe diameters on each side of the flow switch (see fig. 3). Do not locate adjacent to valves, elbows or orifices. The paddle must never touch the pipe or any restrictions in the pipe (see fig. 5). Screw the flow switch in position so the flat of the paddle is at right angles to the flow. The arrows on the cover and in the bottom, inside the case, must point in the direction of the flow. The switch should be mounted so that the terminals are accessible for easy wiring.

Mounting/Paddle selection (see fig. 1)
Flow direction is marked on the control.
Mount in a standard 1" x 1" x 1" tee for 1" pipe application. Use a reducing tee for larger sizes of pipe to keep flow switch close to pipe and provide adequate paddle length in the flow stream.
Example:
Use a 2" x 2" x 1" tee for a 2" pipe. If a standard tee is used install a face or hex bushing in top opening. Adjust the paddle to the size of the pipe in which it will be installed. For 1", 2" or 3" pipe use the paddle segments as supplied.
When a 6" paddle has to be used, the other three paddles should be mounted behind the 6" paddle for added strength. A paddle may be trimmed if necessary to match other pipe sizes.

Note
In applications with possible erosion of the paddle, use a stainless steel paddle. This has to be ordered separately.

> **Caution**
> To prevent electrical shock or damage to equipment, when the cover is removed, ensure the power supply is switched off.

> **Caution**
> When the control is used without cover, precautions must be made against coincidental contact with current carrying parts.

Wiring (see fig. 7)
All wiring should conform to local codes and must be carried out by authorized personnel only. 1-3 closes on flow increase. 1-2 closes on flow decrease.

Note
When replacing terminal screws, use M4 x 6 screws only.

Adjustment (see fig. 6)

> **Caution**
> The switch is factory set to operate at approximately the minimum flow rate (see "Flow rate table"). The switch point must not be set lower than the factory setting because this may result in the switch failing to sense at a "no flow" condition.

For higher switch point - turn range adjustment screw (A) clockwise.

System check
After proper installation and adjustment of the control, the system should be checked by running at least one full cycle of the equipment. If anything appears to operate incorrectly, the wiring and components should be rechecked.

Repair and replacement
The paddles can be replaced. Field repair is not possible. In case of a defective or improperly functioning control, please check with your nearest supplier. For a replacement it is necessary to state the type/model number of the control. This number can be found on the data plate and/or cover label.

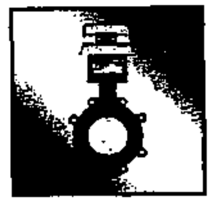
FRANÇAIS

LISEZ ATTENTIVEMENT CETTE NOTICE TECHNIQUE AVANT DE PROCEDER A L'INSTALLATION. CONSERVEZ LA NOTICE AVEC LE REGULATEUR.

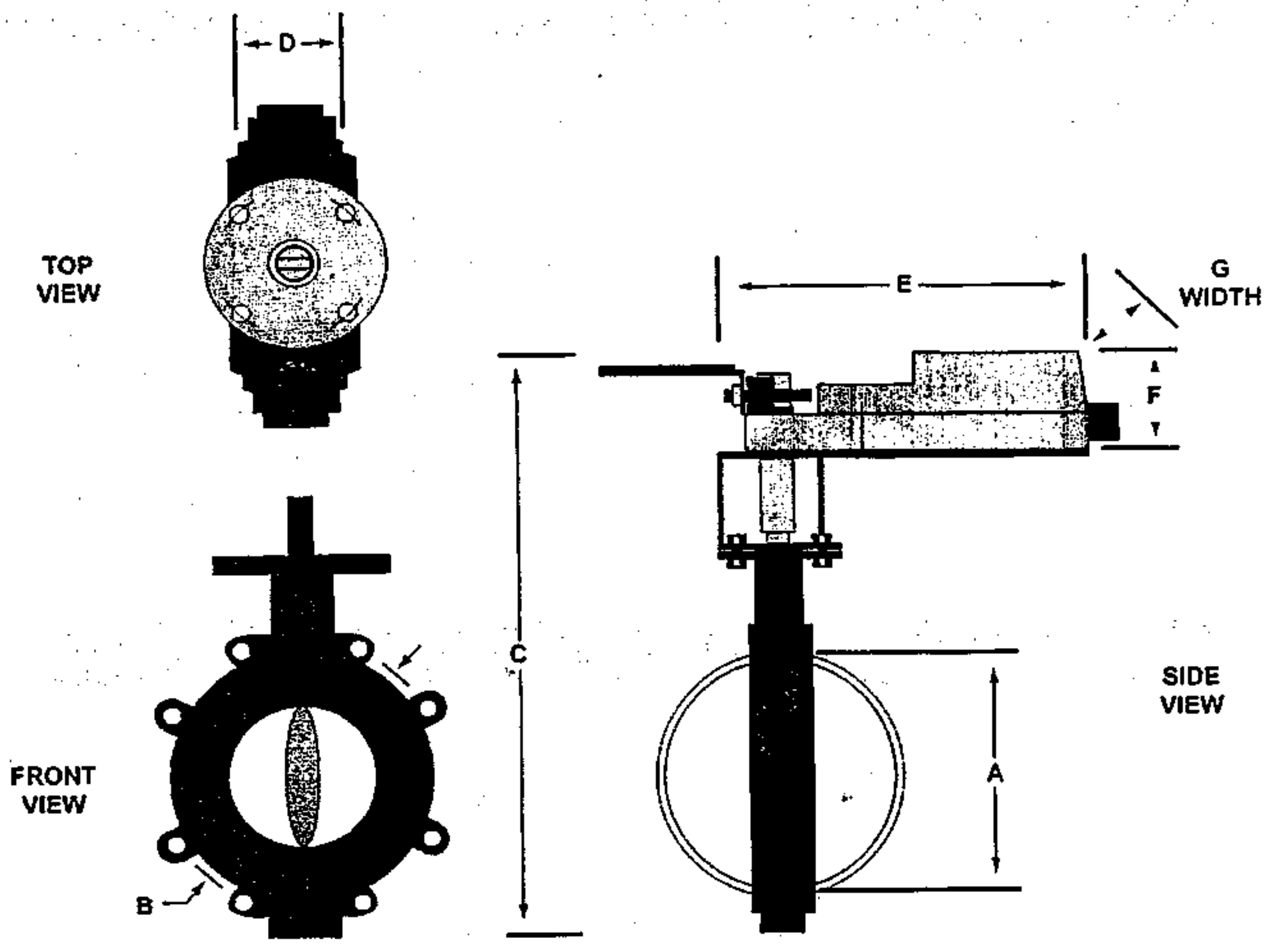
Figure 1:
Position de montage du F61SB pour obtenir IP43. Le F61TB peut être monté dans n'importe quelle position pour obtenir IP 66.

A. Trou de passage du câble ø 22,3 mm; passe-fil installé sur F61SB/TB
B. Raccord de tuyauterie
   1" R mâle F61SB-9100/9103/9200
   1" R mâle F61TB-9200
   1-11 1/2 NPT F61TB-9100
C. PG (monté sur F61TB). Boîtier IP 66.
D. Ecrou hexagonal 30 mm pour F61SB/TB.
   45 mm F61TB-9200

ELECTRONIC BUTTERFLY VALVES



Two Way Valves With GM / AF Actuators



Notes:

1. The valve is rated at 12.07 bar pressure differential in the closed position.
2. Standard valve furnished with lugs tapped as shown to use between BS 4504 PN 10/16 type flanges.
3. 2-way spring return valves set standard as spring return open. Please specify if a different arrangement is needed.

VALVE	SIZE (mm)	A	B	C		D	E		F		G		LUG DATA		
				GM	AF		GM	AF	GM	AF	GM	AF	PCD	NO	NC-2B
50RL2	50	51	94	368.5	387.4	43	247.65	289	79.25	88.9	124.3	101.5	121	4	.62-11
65RL2	65	64	106	391	511.3**	46	247.65	289	79.25	187.2**	124.3	101.5	140	4	.62-11
80RL2	80	76	124	406.4	527.1**	46	247.65	289	79.25	187.2**	124.3	101.5	152	4	.62-11
100RL2	100	102	154	438.2	558.8**	52	247.65	289	79.25	187.2**	124.3	101.5	190	8	.62-11
125RL2	125	127	181	565.2**	590.6**	56	247.65	289	187.2**	187.2**	124.3	101.5	216	8	.75-10
150RL2	150	146	206	590.6**	---	56	247.65	---	187.2**	---	124.3	---	241	8	.75-10

All dimensions in millimetres (mm).
**Tandem Mounted Actuators

Delta
CONTROL PRODUCTS

Butterfly Valves
Two Way and Three Way
Flow Coefficients (KV)

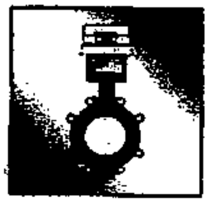
Two Way KVs

Angle of Disc Opening / Valve Size (mm)	MODEL #	10 DEGREES	20 DEGREES	30 DEGREES	40 DEGREES	50 DEGREES	60 DEGREES	70 DEGREES	80 DEGREES	90 DEGREES
50	50RL2	.09	6	14	23	37	53	73	99	125
65	65RL2	1.3	10	21	37	58	93	141	193	716
80	80RL2	2	13	30	53	83	133	231	315	399
100	100RL2	3	23	54	94	148	237	429	606	727
125	125RL2	4	37	85	147	232	370	670	991	1190
150	150RL2	5	48	112	195	306	490	887	1334	1600
200	200RL2	10	88	208	364	588	935	1611	2458	2868
250	250RL2	16	140	330	577	931	1479	2550	3914	4697
300	300RL2	23	203	480	869	1379	2217	3800	5822	6987
350	350RL2	29	259	654	1142	1859	2927	5137	7676	9115
400	400RL2	39	343	866	1513	2463	3878	6805	10173	12081
450	450RL2	50	439	1108	1935	3151	4962	8706	12539	14890
500	500RL2	62	547	1308	2410	3924	6180	10843	16272	19323

Three Way KVs

Angle of Disc Opening / Valve Size (mm)	MODEL #	10 DEGREES	20 DEGREES	30 DEGREES	40 DEGREES	50 DEGREES	60 DEGREES	70 DEGREES	80 DEGREES	90 DEGREES
50	50RL3	99	79	67	61	61	67	79	99	125
65	65RL3	195	151	113	95	95	113	151	195	716
80	80RL3	317	244	163	136	136	163	244	317	399
100	100RL3	609	452	291	242	242	291	452	609	727
125	125RL3	996	708	455	379	379	455	708	996	1190
150	150RL3	1339	935	602	501	501	602	935	1339	1600
200	200RL3	2469	1699	1144	952	952	1144	1699	2469	2868
250	250RL3	3931	2690	1810	1508	1508	1810	2690	3931	4697
300	300RL3	5846	4003	2697	2248	2248	2697	4003	5846	6987
350	350RL3	7705	5396	3581	3001	3001	3581	5396	7705	9115
400	400RL3	10212	7148	4744	3976	3976	4744	7148	10212	12081
450	450RL3	12581	9145	6070	5086	5086	6070	9145	12581	14890
500	500RL3	16335	11389	7559	6334	6334	7559	11389	16335	19323

ELECTRONIC BUTTERFLY VALVES



RUBBERLINED VALVE SELECTION CHART

TWO WAY VALVES

Valve Size (mm)	KV 90°	KV 60°	Available Delta Actuators and Close-Off Pressures (bar) Valve Model #	GM	AF	1024(M) 1015(M)	1524(M) 1515(M)	3024(M) 3015(M)
50	125	53	50RL2	10.34	10.34	10.34		
65	716	93	65RL2	10.34	10.34**	10.34		
80	399	133	80RL2	3.45/10.34**	3.45**	10.34		
100	727	237	100RL2	10.34**	---	10.34		
125	1190	370	125RL2	10.34**	---	10.34		
150	1600	490	150RL2	3.45**		10.34		
200	2868	935	200RL2				10.34	
250	4697	1479	250RL2					10.34
300	6987	2217	300RL2					6.89

THREE WAY VALVES

Valve Size (mm)	KV 90°	KV 60°	Available Delta Actuators and Close-Off Pressures (bar) Valve Model#	GM	AF	1024(M) 1015(M)	1524(M) 1515(M)	3024(M) 3015(M)
50	125	67	50RL3	10.34	10.34	10.34		
65	716	113	65RL3	10.34**	10.34	10.34		
80	399	163	80RL3	3.45/10.34**	---	10.34		
100	727	291	100RL3	3.45/10.34**	---	10.34		
125	1190	455	125RL3	10.34	---	10.34		
150	1600	602	150RL3	3.45	---	10.34		
200	2868	1144	200RL3	---	---	---	10.34	
250	4697	1810	250RL3		---	---	---	10.34

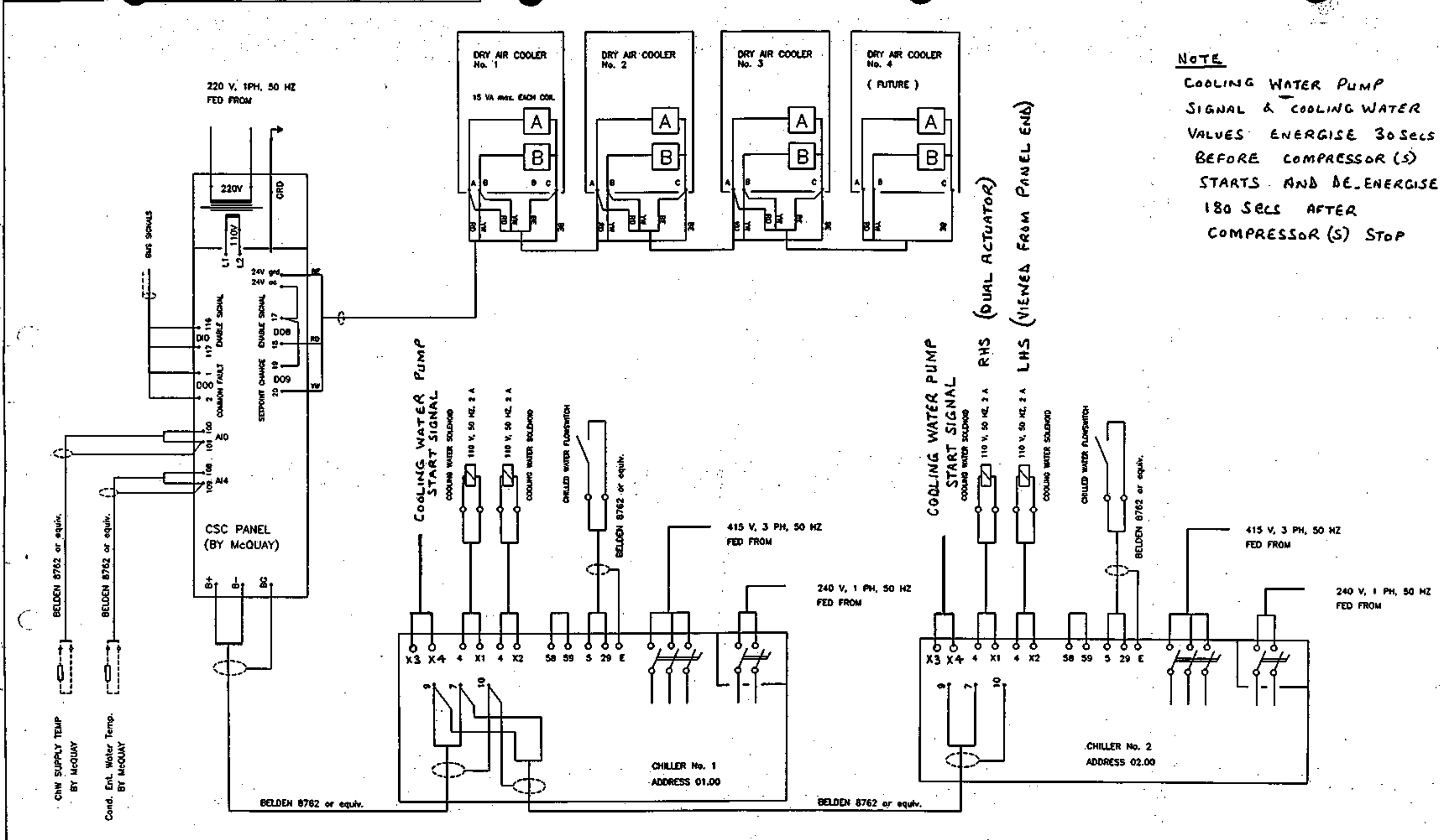
All dimensions in millimetres (mm).

These valves are bubble tight up to 3.45 bar
**Tandem Mounted Actuators

Telefax
To: LES MALLOWS
Fax: 01670 528 206
From: ANDY
Date:
Pages: 3

Post-it® Notes 7569

4



REV	DESCRIPTION	DRAWN BY & DATE	REV	DESCRIPTION	DRAWN BY & DATE

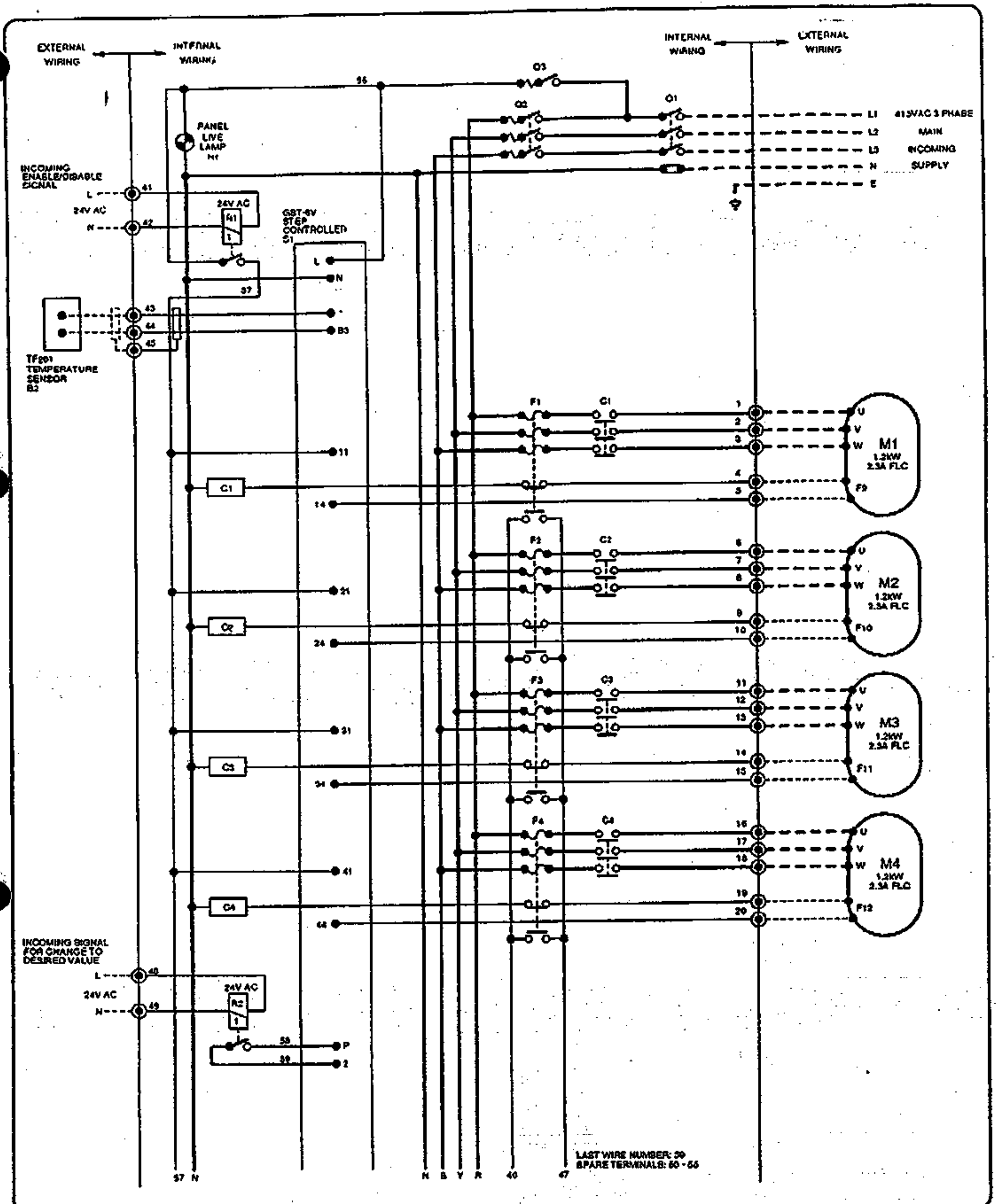
AAF-Ltd.
Bassington Lane
Cramlington
Northumberland
United Kingdom
NE23 8AF
Tel.: 0191 2010412
Fax.: 0191 2010411

JOB No

DRAWN BY: LM — DATE: 03/11/98
CHECKED BY — DATE
APPROVED BY — DATE

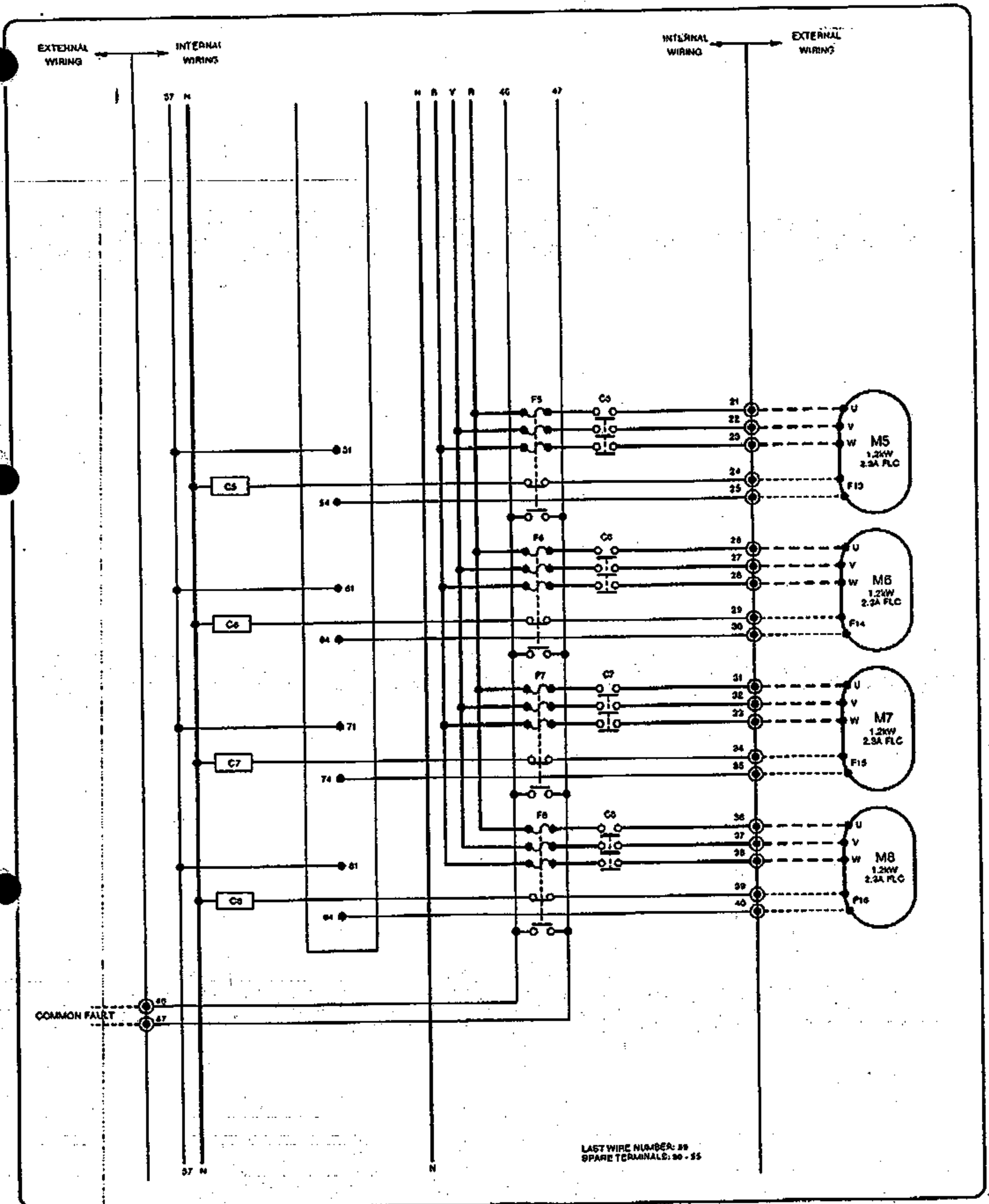
TITLE: CHILLER SEQUENCE CONTROLLER, CHILLERS & DRY AIR COOLER INTERCONNECTIONS DIAGRAM
CARLTON GARDENS

DRAWING No: 7908019-1 — SHT 1 OF 1 — REV:



Güntner United Kingdom

CLIENT		DRAWN BY MJT	DATE SEPT 98
PROJECT CARLTON GARDENS		DRAWING NO. C98/843/MS 781	
TITLE CONTROL PANEL WIRING DIAGRAM		SHEET 1 OF 4	ISSUE B



Güntner United Kingdom	CLIENT	DRAWN BY: MJT / DATE: SEPT 98
	PROJECT: CARLTON GARDENS	DRAWING NO. C98/843/MS 781
	TITLE: CONTROL PANEL WIRING DIAGRAM	SHEET 2 OF 4 / ISSUE B

McQuay International

DESCRIZIONE:
DESCRIPTION:
BESCHREIBUNG:

CONFERMA:
REFEREMENT:
AUFTRAG: 981365

EMET./DISTR. | DATA/DATE | N.: 170982

REVISIONE / REVISIONS: 1

SHEETS: 17 | PAG.: 1

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3	POTENZA COMPRESSORI 3 – COMPRESSOR 3 POWER SUPPLY –VERDICHTERKRAFTKREIS 3
4	ALIMENTAZIONE CIRCUITO DI CONTROLLO – UNIT CONTROL CIRCUIT POWER SUPPLY – STEUERUNG
5	SCHEDA VALVOLE ESPANS. ELETTRONICA–ELECTRONIC EXPANSION VALVE BOARD–ELEKTRONISCHE EXPANSIONVENTILKARTE
6	SCHEDA MICROTECH – MICROTECH BOARD – MIKROPROZESSORKARTE
7	SCHEDA INGRESSI ANALOGICI E DIGITALI – ANALOG–DIGITAL INPUTS BOARD – ANALOGE UND DIGITALE EINGANGE
8	CIRCUITO DI CONTROLLO COMPRESSORE 1 – COMPRESSOR 1 CONTROL – STEUERUNG VERDICHTER 1
9	CIRCUITO DI CONTROLLO COMPRESSORE 2 – COMPRESSOR 2 CONTROL CIRCUIT – STEUERUNG VERDICHTER 2
10	CIRCUITO DI CONTROLLO COMPRESSORE 3 – COMPRESSOR 3 CONTROL CIRCUIT – STEUERUNG VERDICHTER 3
11	MORSETTIERA M1 – TERMINALS M1– KLEMMLISTE M1
12	MORSETTIERA M1 – TERMINALS M1 – KLEMMLISTE M1
13	MORSETTIERA M3 – TERMINALS 3 – KLEMMLISTE M3
14	DISPOSIZIONE APPARECCHIATURE – LAYOUT – ANORDNUNG DER LAYOUT
15	LEGENDA – LEGEND – LEGEND
16	LEGENDA – LEGEND – LEGEND
17	COMPOSIZIONE UNITA' – UNITS COMPOSITION – BESTUCKUNG EINHEIT

SCHEMA ELETTRICO
WIRING DIAGRAM
SCHALTPLAN

WHS 175.3 ÷ 250.3 PWS

175.3 ☐ 190.3 ☐ 205.3 ☐ 220.3 ☒ 230.3 ☐ 240.3 ☐ 250.3 ☐

COLLEGAMENTI A CURA DEL CLIENTE
FIELD WIRING CONNECTIONS
FORORT ANSCHLUSSE

COMPONENTI OPZIONALI
OPTIONAL EQUIPMENTS
SONDERAUSSTATTUNGEN

COMPONENTI INSTALLATI
EQUIPMENTS INSTALLED
EINGESETZTE AUSSTATTUNGEN

REV.	DATE	HISTORY REVISIONS	DIS. DWG.	VER. CHECK.	APPR. PASSED
1	26-10-98	RESI OPTIONAL I RELE' TERMICI E AGGIUNTE LE GDB A PAG. 5	UTE	M.P.	

SCHEMA N.:
DIAGRAM N.: 170982
SCHEMA N.:

File: 170982/1709821

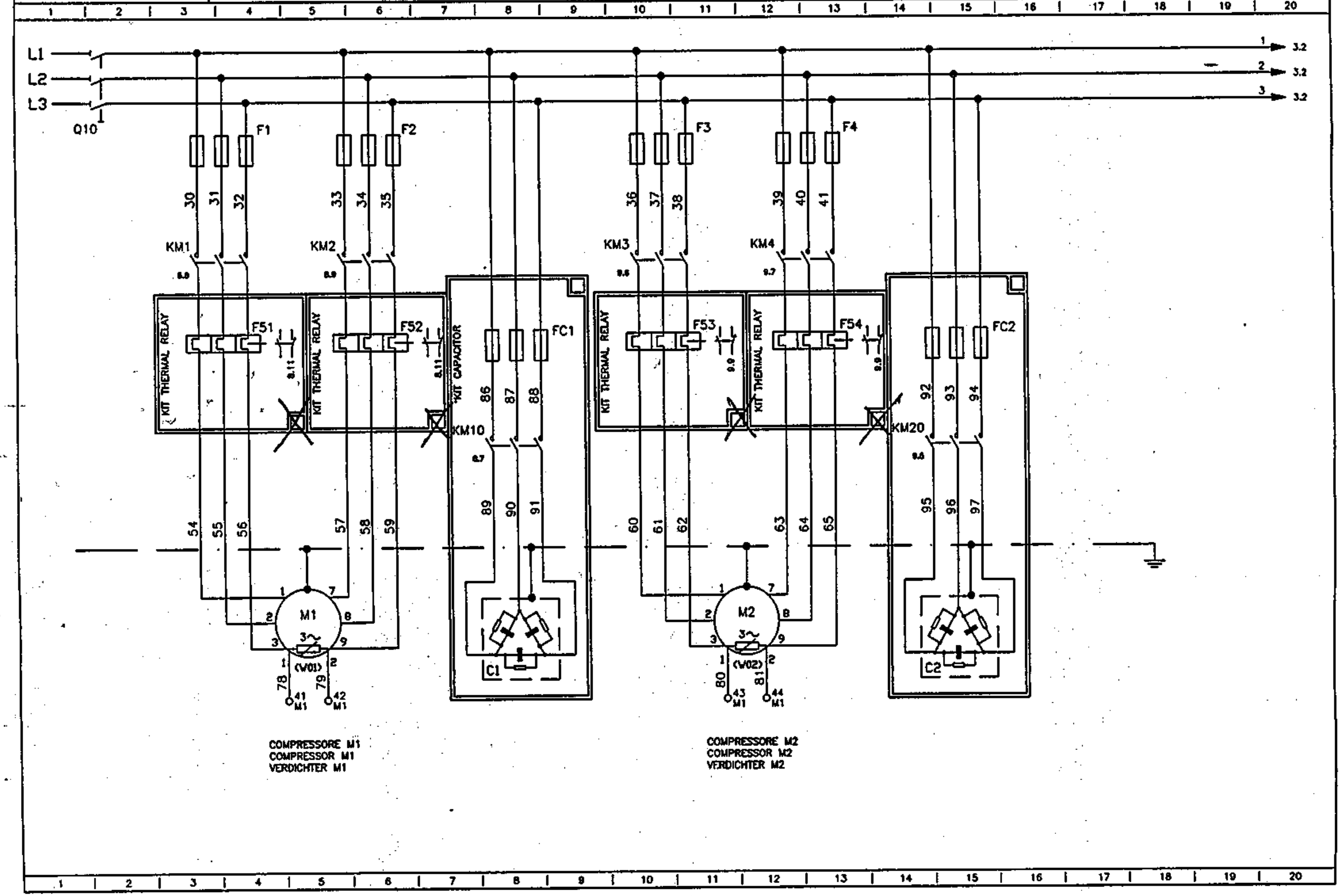
DATA:
DATE: 30-03-98

REV.
REV. 1

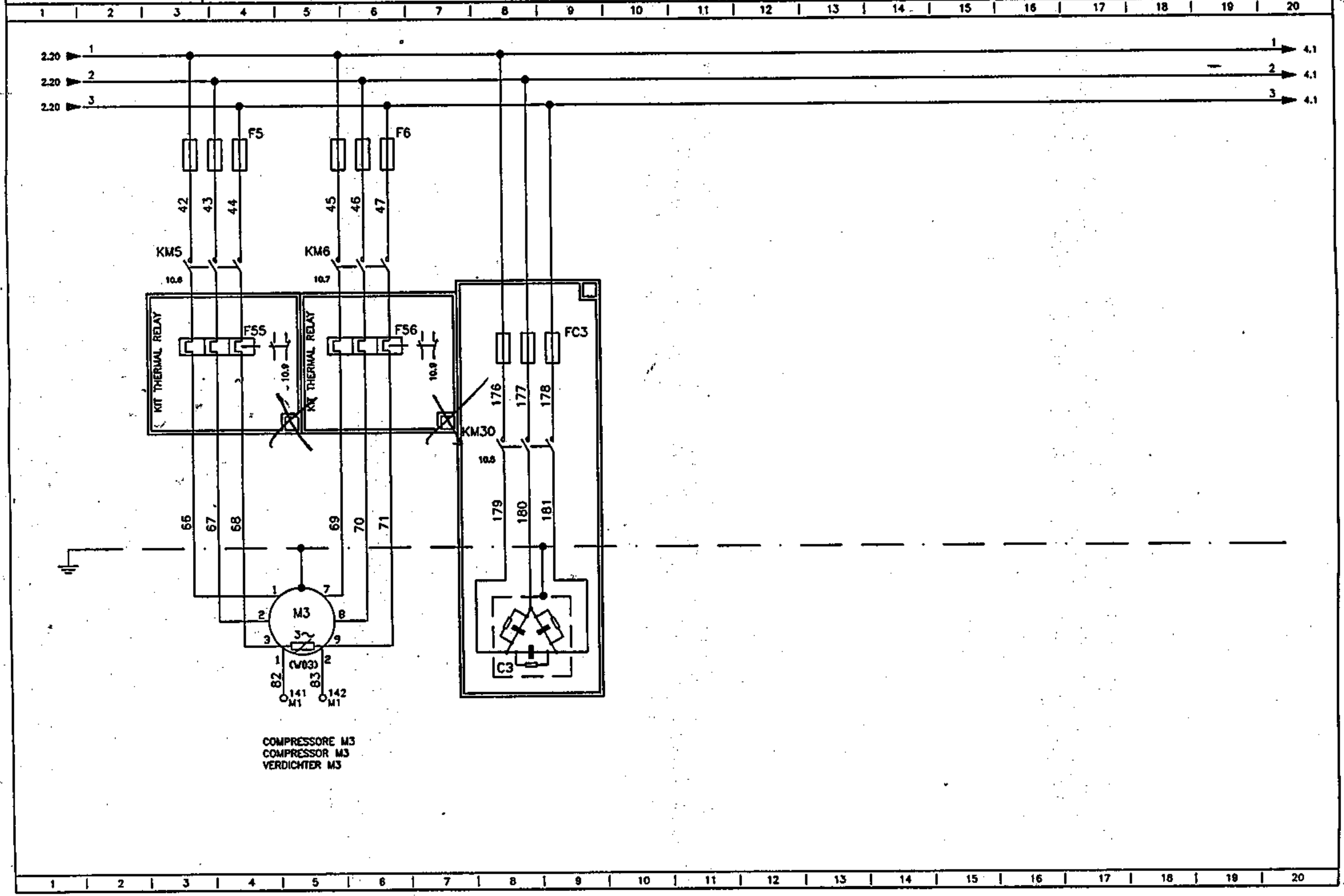
DIS. DWG.
VER. CHECK.
APPR. PASSED.

McQuay® International

DESCRIZIONE:	POTENZA COMPRESSORI 1-2	CONFERMA:	81365
DESCRIPTION:	POWER COMPRESSOR 1-2	REFEREMENT:	N.: 170982
BESCHREIBUNG:	VERDICHTERKRAFTKREIS 1-2	AUFTRAG:	REVISIONE / REVISIONS: 1
			SHEETS: 17 — PAG.: 2



Mc[redacted]ay International	DESCRIZIONE: POTENZA COMPRESSORI 3 DESCRIPTION: POWER COMPRESSOR 3 BESCHREIBUNG: VERDICHTERKRAFTKREIS 3 [redacted]	CONFERMA: REFEREMENT: AUFTRAG: [redacted]81365	N.: 170982 REVISIONE / [redacted]IONS: 1 SHEETS: 17 PAG. : 3



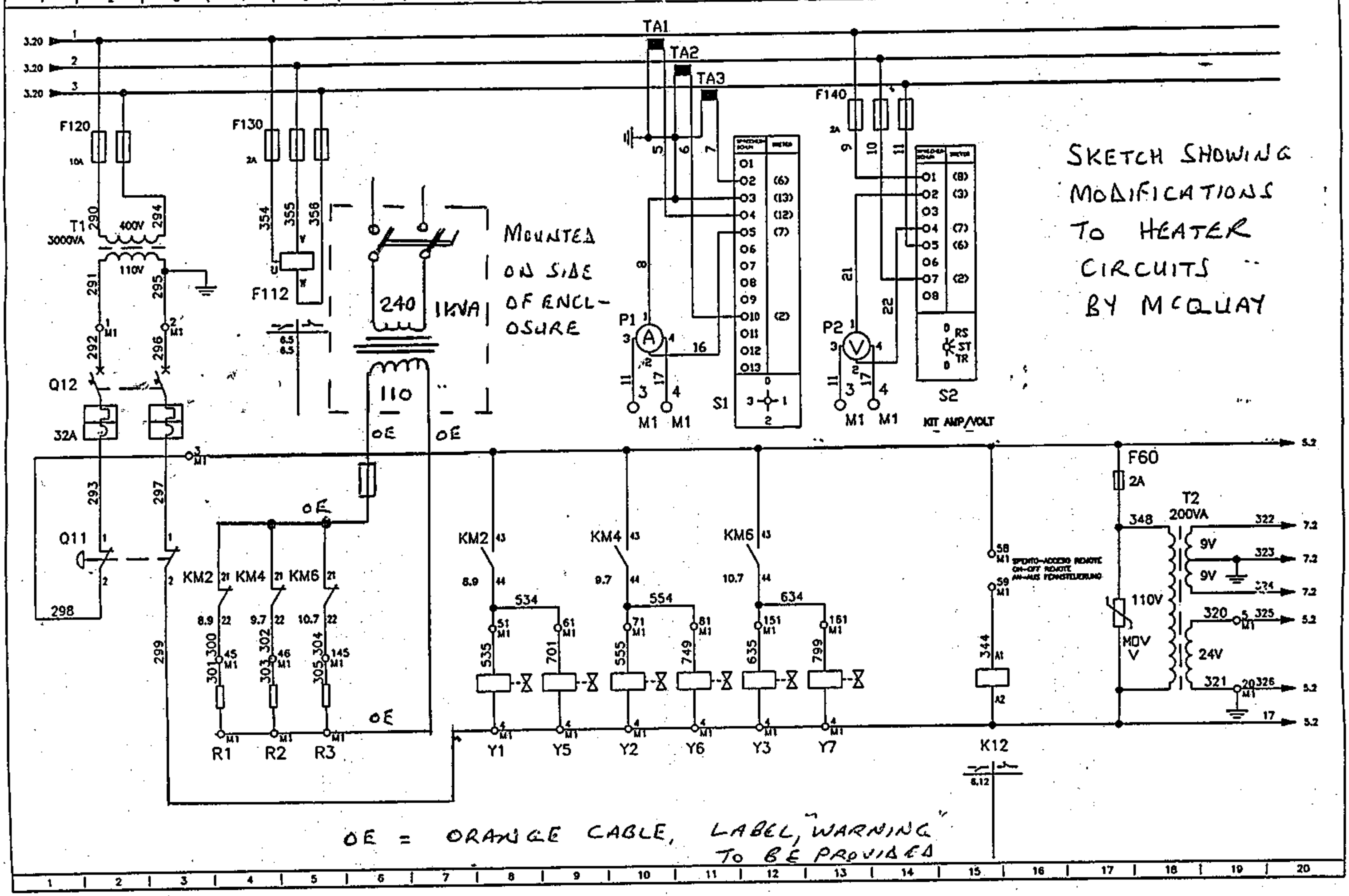
McQuay International

DESCRIPTION: UNIT CONTROL CIRCUIT POWER SUPPLY
BESCHREIBUNG: STEUERUNG

REFEREMENT:
AUFTRAG:

881365

REVISIONE / REVISIONS: 1
SHEETS: 17 . : 4 A



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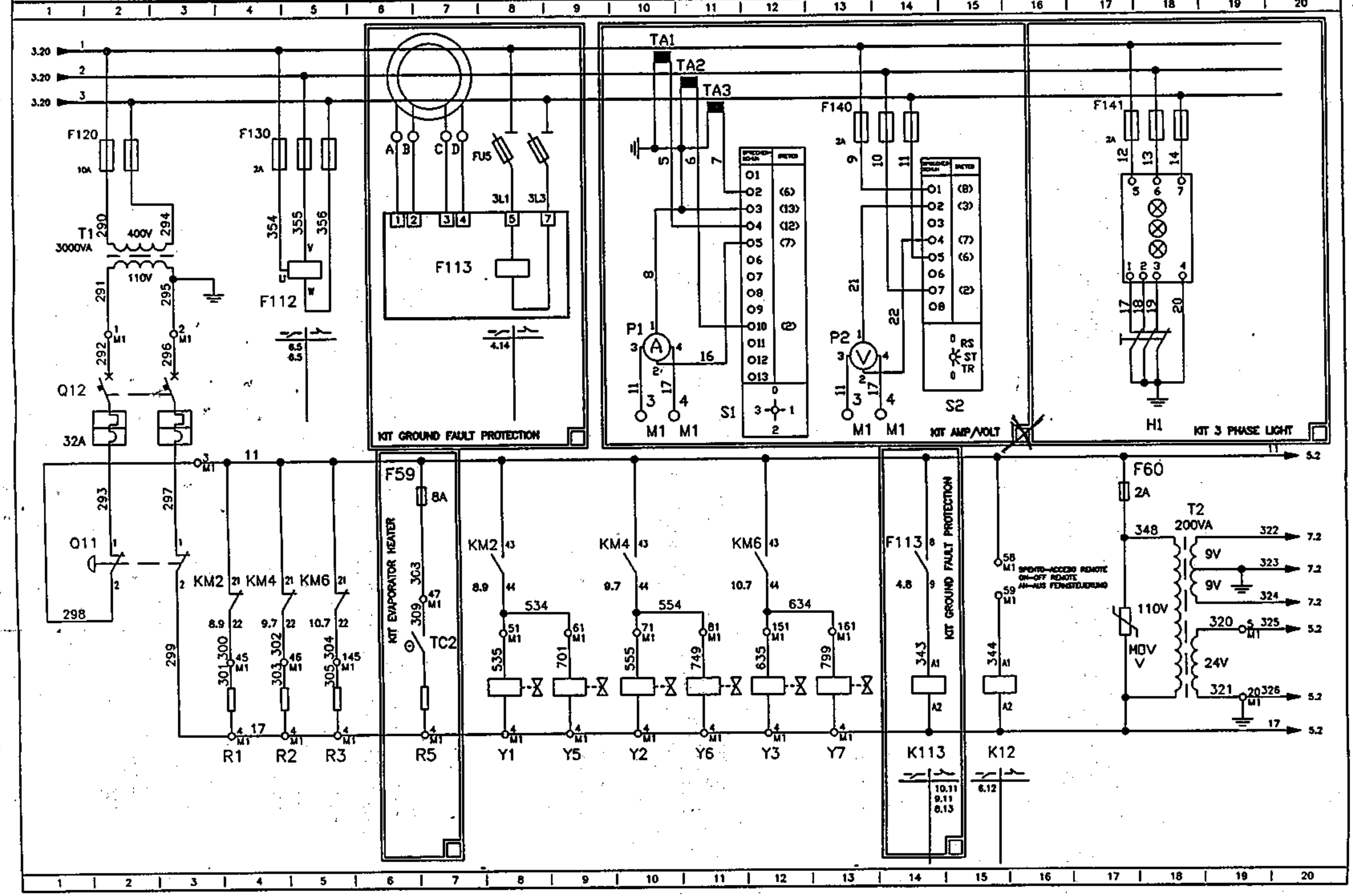
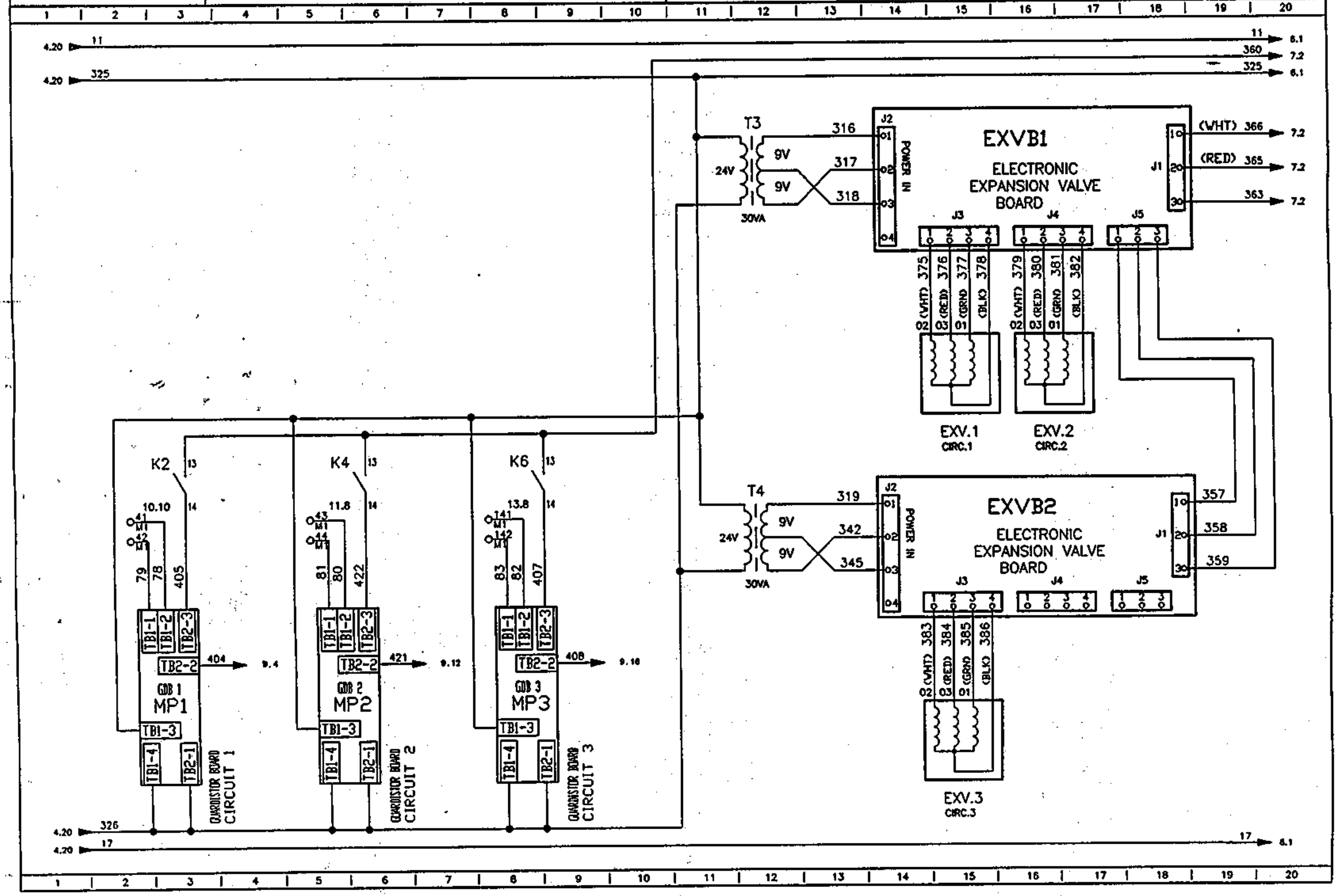


McQuay International

DESCRIZIONE:	SCHEDA VALVOLA ESPANSIONE ELETTRONICA	CONFERMA:	381365
DESCRIPTION:	ELECTRONIC EXPANSION VALVE	REFEREMENT:	
BESCHREIBUNG:	ELEKTRONISCHE EXPANSIONVE...	AUFTRAG:	

N. 170982
REVISIONE / EDITIONS: 1
SHEETS: 17 PAG. : 5



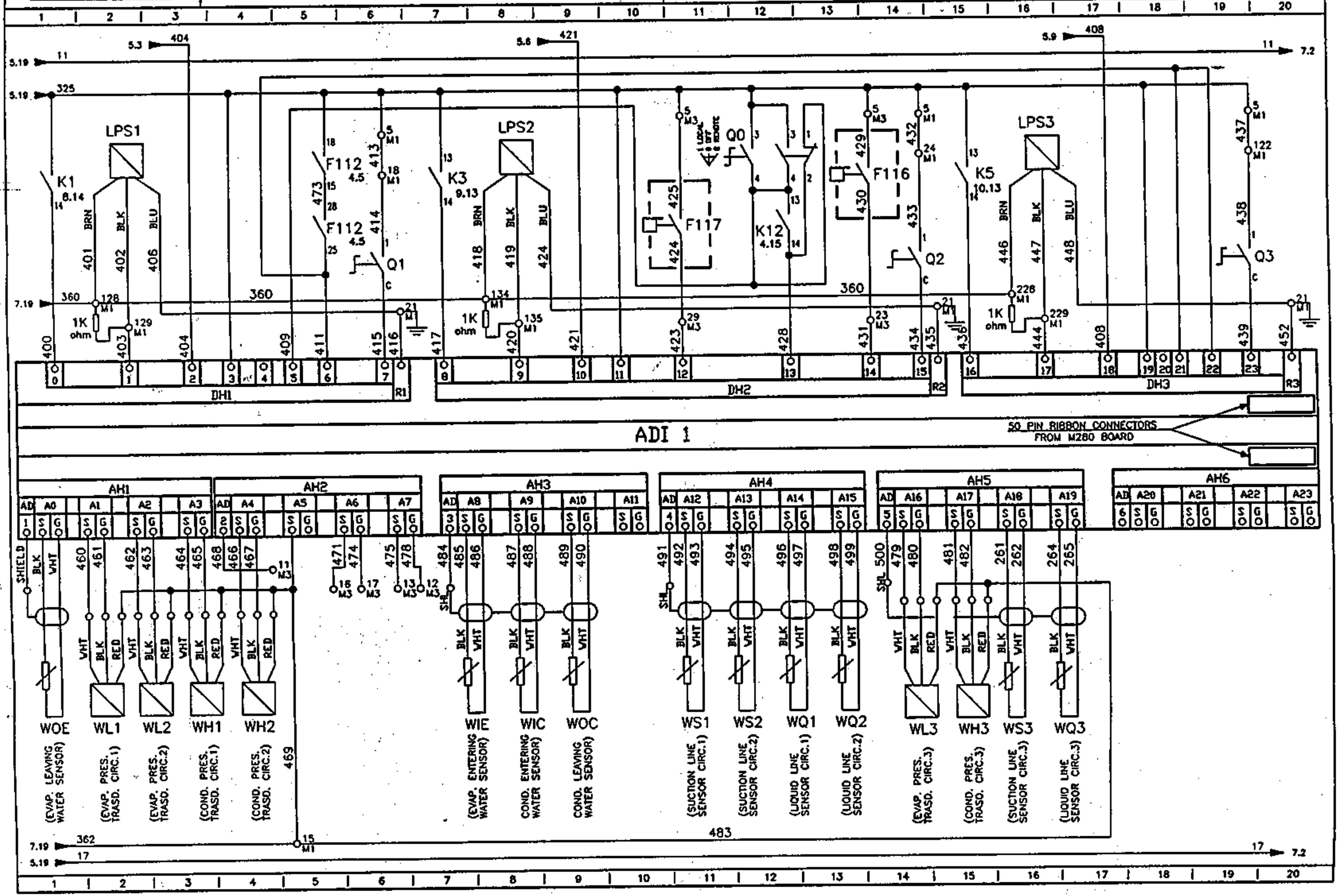
Mc[redacted] International

DESCRIZIONE:	SCHEDA INGRESSI ANALOGICI E DIGITALI	CONFERMA:	
DESCRIPTION:	ANALOG-DIGITAL INPUTS BOAR[redacted]	REFEREMENT:	[redacted]81365
BESCHREIBUNG:	ANALOGE UND DIGITALE EINGA[redacted]	AUFTRAG:	

N.: 170982

REVISIONE / F[redacted]NS: 1

SHEETS: 17 PAG.: 6



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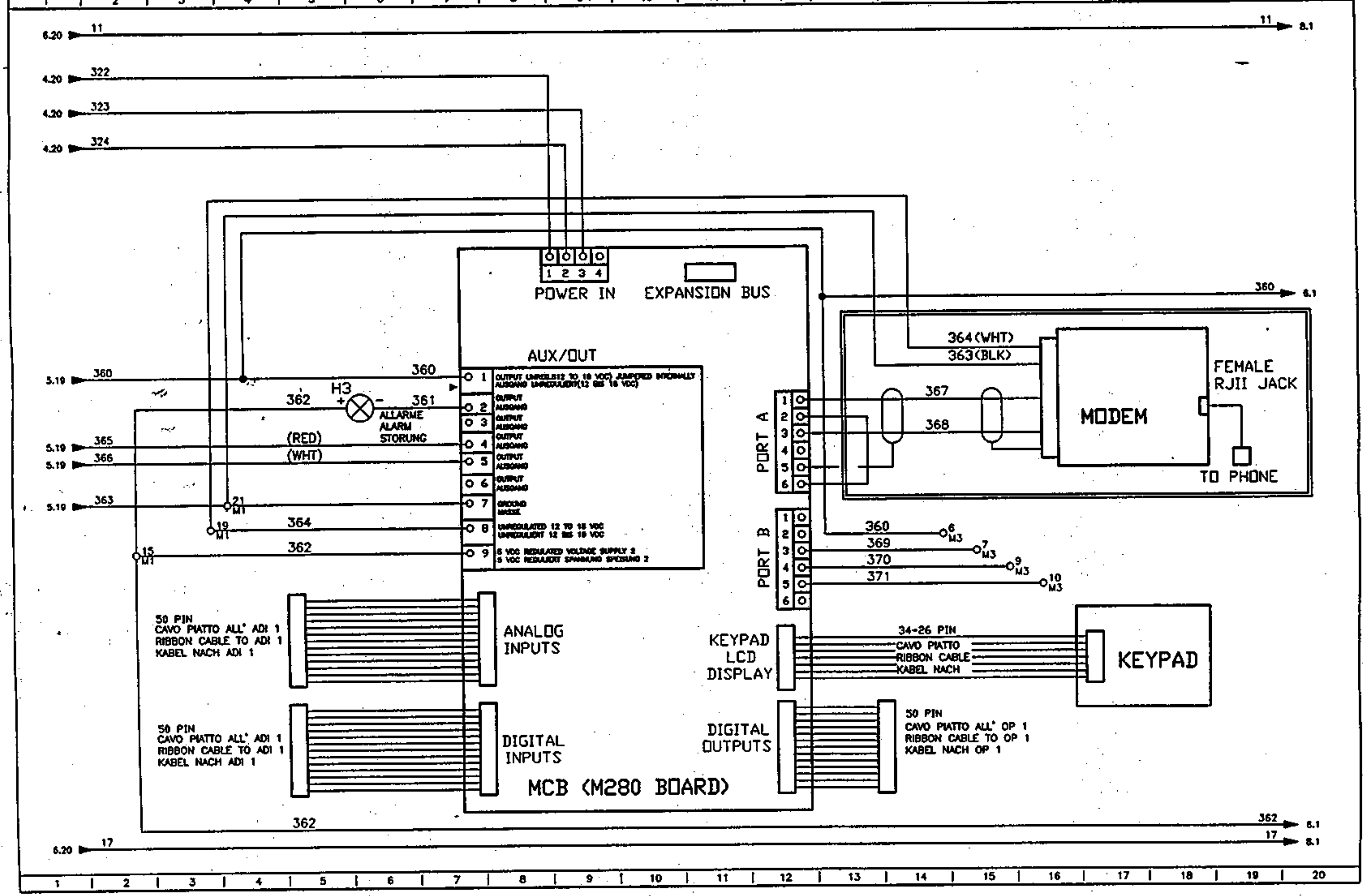


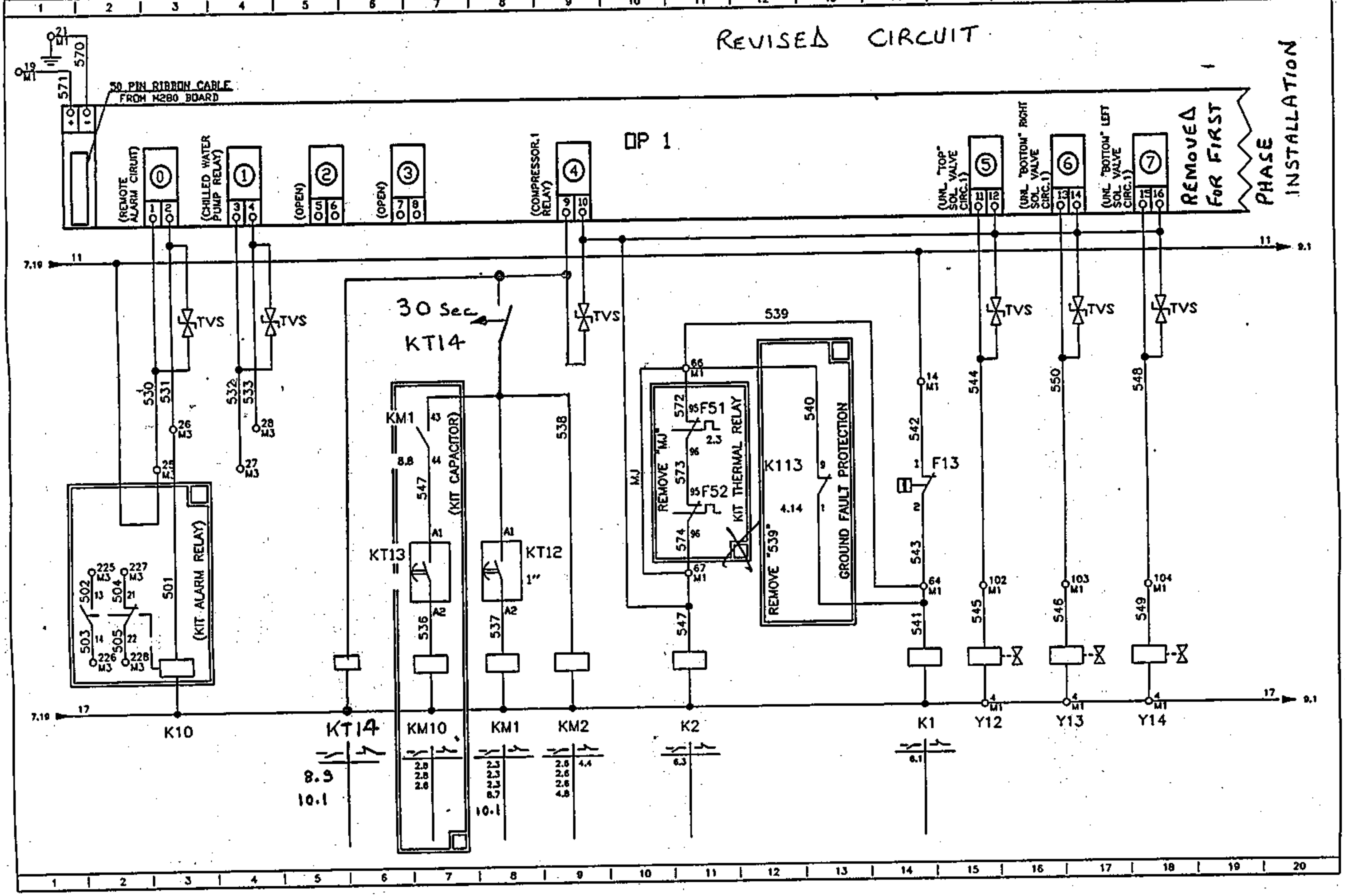
McQuay International

DESCRIZIONE: CIRCUITO DI CONTROLLO COMPRESSORE 1
DESCRIPTION: CONTROL CIRCUIT COMPRESSOR 1
BESCHREIBUNG: STEUERUNG VERDICHTER 1

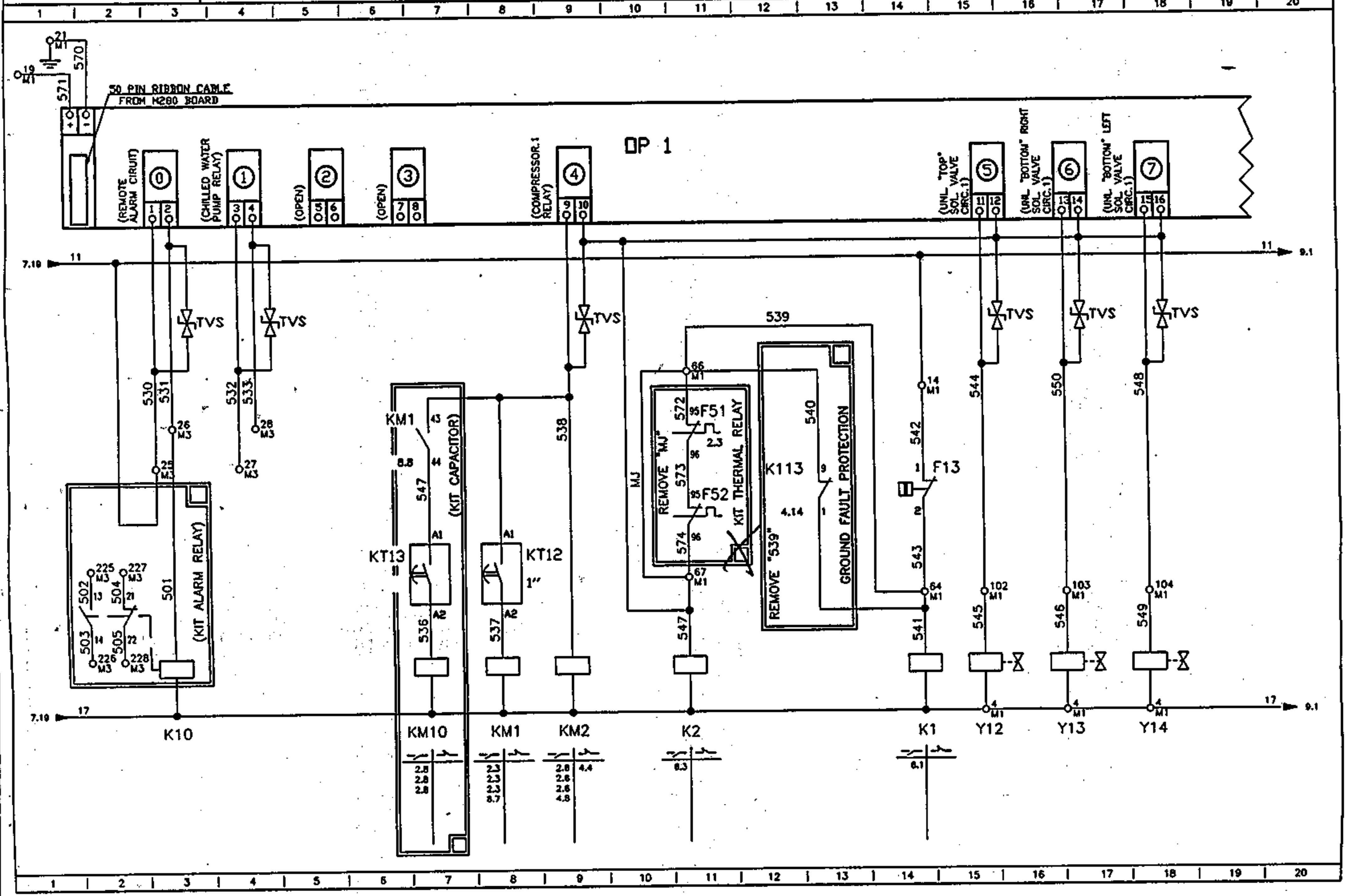
REFEREMENT:
AUFTRAG:

981365

REVISIONE / REVISIONS: 1
SHEETS: 17 : 8



McQuay International	DESCRIZIONE: CIRCUITO DI CONTROLLO COMPRESSORE 1 DESCRIPTION: CONTROL CIRCUIT COMPRESSOR BESCHREIBUNG: STEUERUNG VERDICHTER 1	CONFERMA: REFEREMENT: AUFTRAG: 81365	N.: 170982 REVISIONE / REVISIONS: 1 SHEETS: 17 PAG.: 8



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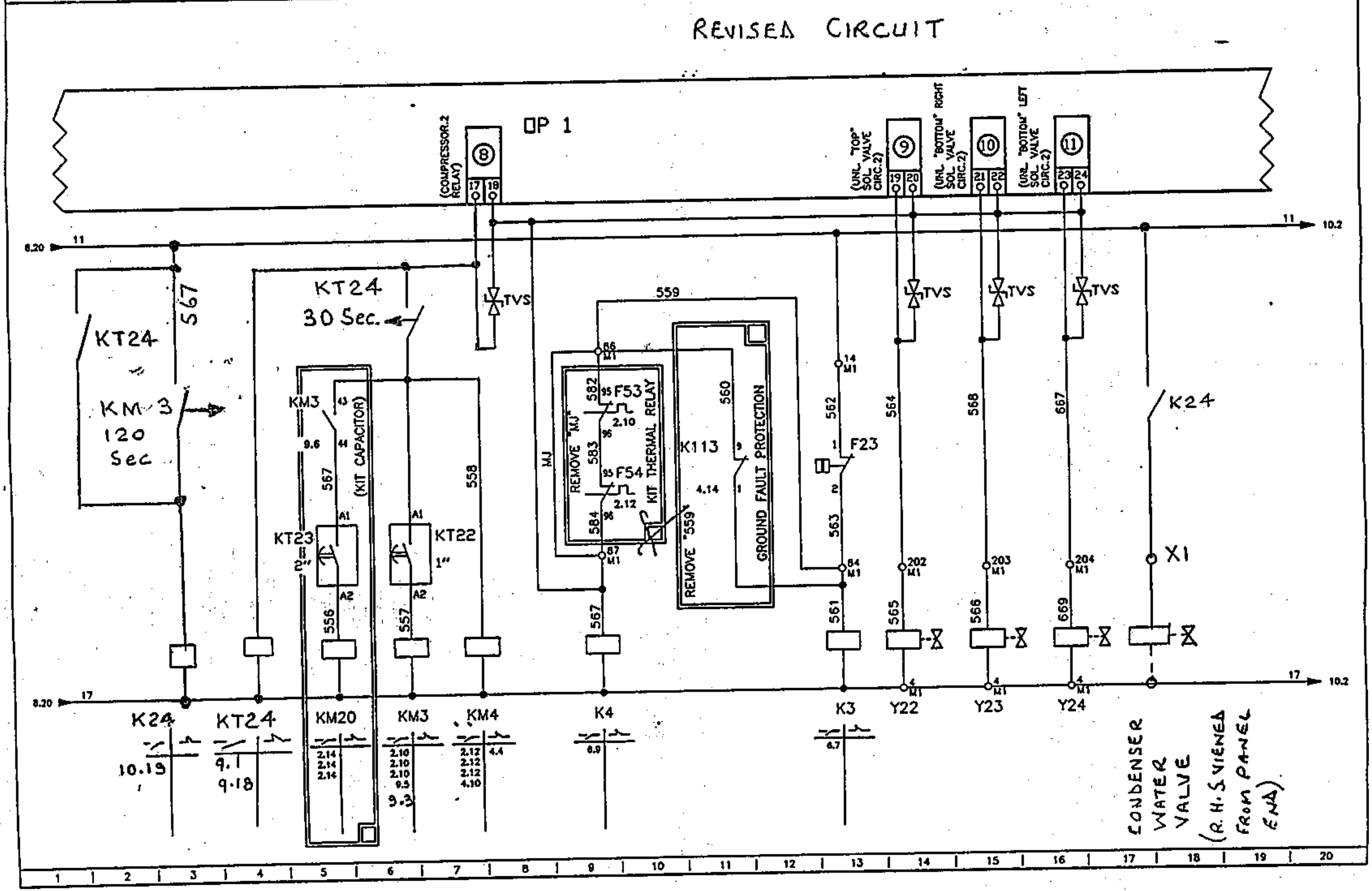

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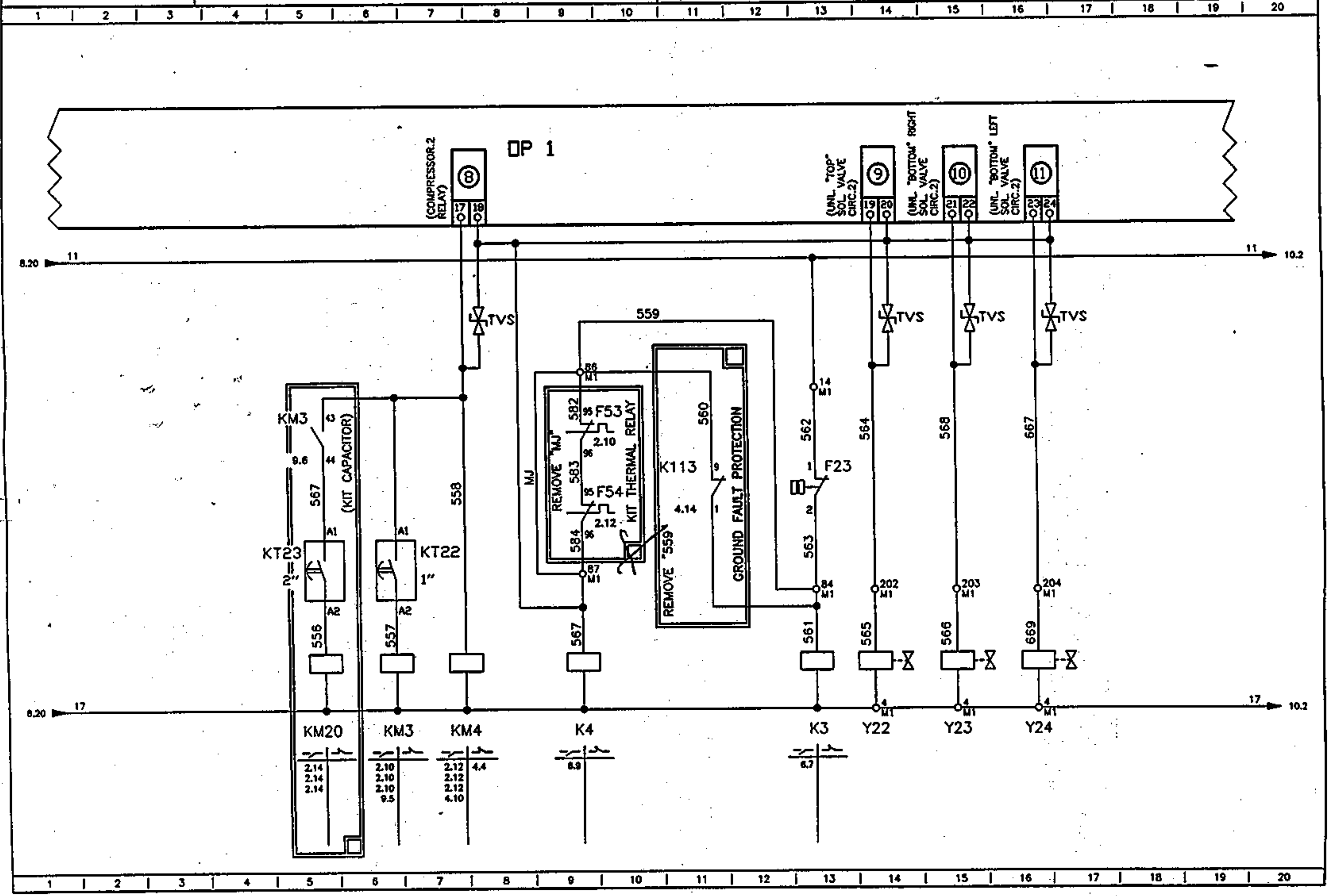

McQuay International

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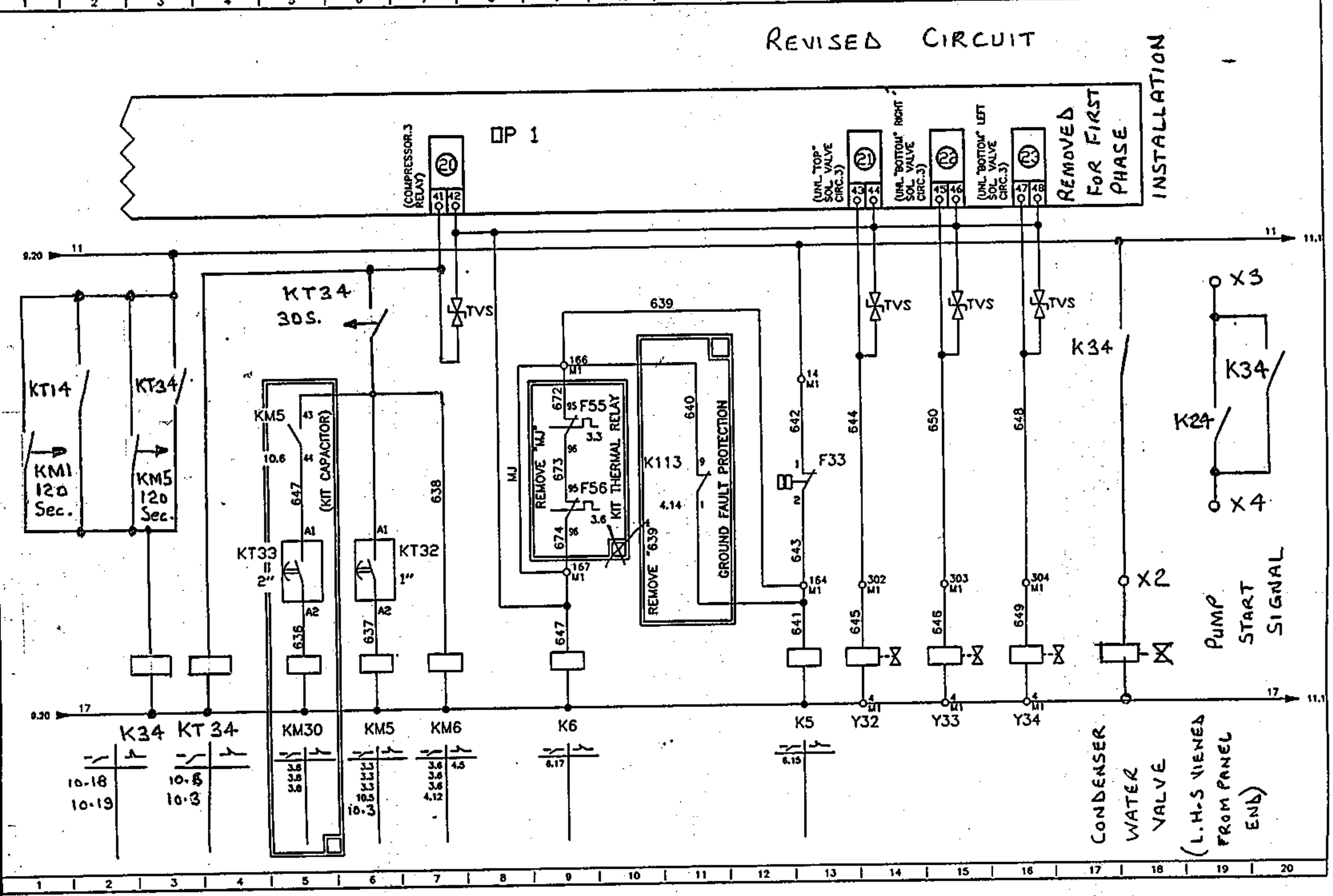
DESCRIPTION:	CONTROL CIRCUIT COMPRESSOR 3		REVISIONE / REVISIONS: 1
BESCHREIBUNG:	STEUERUNG VERDICHTER 3		SHEETS: 17	PAGE: 10



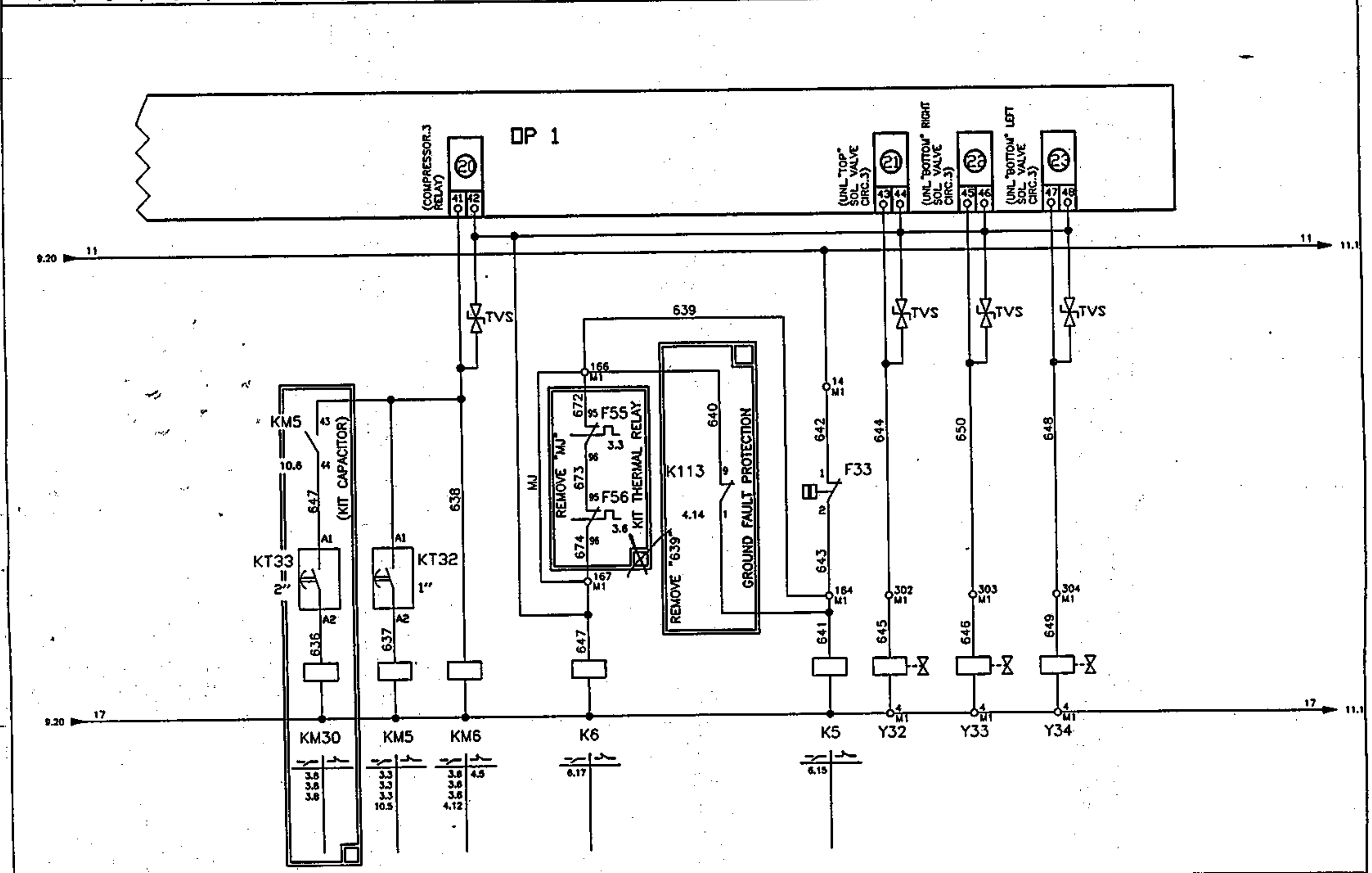
DESCRIZIONE:	CIRCUITO DI CONTROLLO COMPRESSORE 3	CONFERMA:
DESCRIPTION:	CONTROL CIRCUIT COMPRESSOR 3	REFEREMENT:
BESCHREIBUNG:	STEUERUNG VERDICHTER 3 [redacted]	AUFTRAG:

[redacted]81365

N.: 170982

REVISIONE / R[redacted]ONS: 1

SHEETS: 17 [redacted]: 10



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Q7 - M1		291	1	292	TR1 TRANSFOR	4.1
Q7 - M1		295	2	296	TR1 TRANSFOR	4.2
Q7 - M1		298	3	11	AUX. POWER S	4.2
Q7 - M1		17	4	17		8.17
Q7 - M1		17	4	17		8.15
Q7 - M1		17	4	17		8.14
Q7 - M1		17	4	17		9.15
Q7 - M1		17	4	17		9.14
Q7 - M1		17	4	17		9.13
Q7 - M1		17	4	17		10.15
Q7 - M1		17	4	17		10.12
Q7 - M1		17	4	17		10.14
Q7 - M1		17	4	17		4.12
Q7 - M1		17	4	17		4.10
Q7 - M1		17	4	17		4.8
Q7 - M1		17	4	17		4.11
Q7 - M1		17	4	17		4.9
Q7 - M1		17	4	17		4.7
Q7 - M1		17	4	17		4.6
Q7 - M1		17	4	17		4.4
Q7 - M1		299	4	17		4.3
Q7 - M1		17	4	17		4.4
Q7 - M1		320	5	325	TR2 TRANSFOR	4.18
Q7 - M1		325	5	437		6.18
Q7 - M1		325	5	432		6.13
Q7 - M1		325	5	413		6.5
Q7 - M1		293	14	542		8.13
Q7 - M1		11	14	562		9.12
Q7 - M1		11	14	642		10.12
Q7 - M1		362	15	362		7.1
Q7 - M1		362	15	483		6.4
Q7 - M1		414	18	413		6.5
Q7 - M1		364	19	571		8.
Q7 - M1		364	19	571		7.2
Q7 - M1		321	20	326		4.18
Q7 - M1		570	21	TERRA		8.
Q7 - M1		363	21	363		7.3
Q7 - M1		435	21	TERRA		6.19
Q7 - M1		435	21	TERRA		6.14
Q7 - M1		416	21	TERRA		6.5
Q7 - M1		433	24	432		6.13
Q7 - M1		78	41			5.2
Q7 - M1		79	42	313		5.2
Q7 - M1		80	43			5.3
Q7 - M1		81	44	315		5.3
Q7 - M1		300	45	301	R1	4.3
Q7 - M1		302	46	303	R2	4.4
Q7 - M1		308	47	309	R5	4.6
Q7 - M1		534	51	535	CIRC.1 SOL.	4.7
Q7 - M1		11	58			4.14
Q7 - M1		344	59			4.14
Q7 - M1		534	61	701		4.6
Q7 - M1		541	64	543	CIRC.1 H.P.	8.13
Q7 - M1		540	66	444	COMP.1 THERM	8.10
Q7 - M1		540	66	444	COMP.1 THERM	8.10
Q7 - M1		539	67	446	COMP.1 THERM	8.10
Q7 - M1		539	67	446	COMP.1 THERM	8.10
Q7 - M1		554	71	555	CIRC.2 SOL.	4.9
Q7 - M1		554	81	749		4.10
Q7 - M1		643	84	641	CIRC.2 H.P.	9.12
Q7 - M1		560	86	448	COMP.2 THERM	9.8
Q7 - M1		559	86	582	COMP.2 THERM	9.8
Q7 - M1		559	87	450	COMP.2 THERM	9.8
Q7 - M1		584	87	567	COMP.2 THERM	9.8
Q7 - M1		544	102	545	CIRC.1 UNL.	8.14
Q7 - M1		548	103	546	CIRC.1 UNL.	8.15
Q7 - M1		647	104	646	CIRC.1 UNL.	8.17
Q7 - M1		438	122	437		8.18
Q7 - M1		360	128	BRN	CIRC.1 LIQ.P	6.1
Q7 - M1		403	129	BLK	CIRC.1 LIQ.P	6.1
Q7 - M1		360	134	BRN	CIRC.2 LIQ.P	6.7
Q7 - M1		420	135	BLK	CIRC.2 LIQ.P	6.7
Q7 - M1		82	141			5.5
Q7 - M1		83	142	312		5.5
Q7 - M1		300	145	301	R1	4.4
Q7 - M1		634	151	635	CIRC.3 SOL.	4.11
Q7 - M1		634	161	799		4.12
Q7 - M1		643	164	641	CIRC.3 H.P.	10.12
Q7 - M1		639	166	672	COMP.3 THERM	10.8
Q7 - M1		674	167	647	COMP.3 THERM	10.8

International

DESCRIZIONE: MORSETTIERA M1
DESCRIPTION: TERMINALS M1
BESCHREIBUNG: KLEMMLISTE M1

CONFERMA:
REFERENMENT:
AUFTRAG:

881365

N.: 170982
REVISIONE /
SHEETS: 17
PAG.: 11
1

Q7 - M1		
Q7 - M1		
Q7 - M1		
Q7 - M1		
Q7 - M1		
Q7 - M1		
Q7 - M1		
Q7 - M1		

564	202	565
568	203	566
667	204	668
360	228	BRN
403	229	BLK
644	302	645
650	303	646
648	304	649

CIRC.2 UNL	9.13
CIRC.2 UNL	9.14
CIRC.2 UNL	9.15
CIRC.3 LIQ.P	6.15
CIRC.3 LIQ.P	6.15
CIRC.3 UNLOA	10.12
CIRC.3 UNLOA	10.14
CIRC.3 UNLOA	10.15

McQuay International

DESCRIZIONE: MORSETTIERA M1
DESCRIPTION: TERMINALS M1
BESCHREIBUNG: KLEMMLISTE M1

CONFERMA:
REFERENCE:
AUFTRAG:

981365

N.: 170982
REVISIONE / ...ONS: 1
SHEETS: 17 PAG.: 12

Q7 - M3		325	5	429		6.10
Q7 - M3		325	5	429		6.13
Q7 - M3		360	6			7.13
Q7 - M3		369	7		CON. TO RMS	7.14
Q7 - M3		370	9		REMOVE MON.	7.14
Q7 - M3		371	10		TO HMP	7.15
Q7 - M3		468	11			6.3
Q7 - M3		478	12		4-20 MA FOR	6.6
Q7 - M3		475	13		DEMAND LIMIT	6.5
Q7 - M3		471	16		4-20 MA FOR	6.4
Q7 - M3		474	17		CHW RESET	6.5
Q7 - M3		431	23	430	FLOW SWITCH	6.13
Q7 - M3		530	25		ALARM	8.2
Q7 - M3		530	25		ALARM	8.2
Q7 - M3		531	26		CIRCUIT	8.2
Q7 - M3		531	26		CIRCUIT	8.2
Q7 - M3		532	27		CHILL. WATER	8.3
Q7 - M3		532	27		CHILL. WATER	8.3
Q7 - M3		533	28		PUMP RELAY	8.3
Q7 - M3		533	28		PUMP RELAY	8.3
Q7 - M3		431	29	430	FLOW SWITCH	6.10
Q7 - M3		502	225		REMOTE	8.1
Q7 - M3		503	226		ALARM	8.1
Q7 - M3		504	227		REMOTE	8.1
Q7 - M3		505	228		ALARM	8.1

MG International

DESCRIZIONE: DESCRIPTION: BESCHREIBUNG: MORSETTIERA M3 TERMINALS M3 KLEMMLISTE M3

CONFERMA: REFERENCE: AUFTRAG:

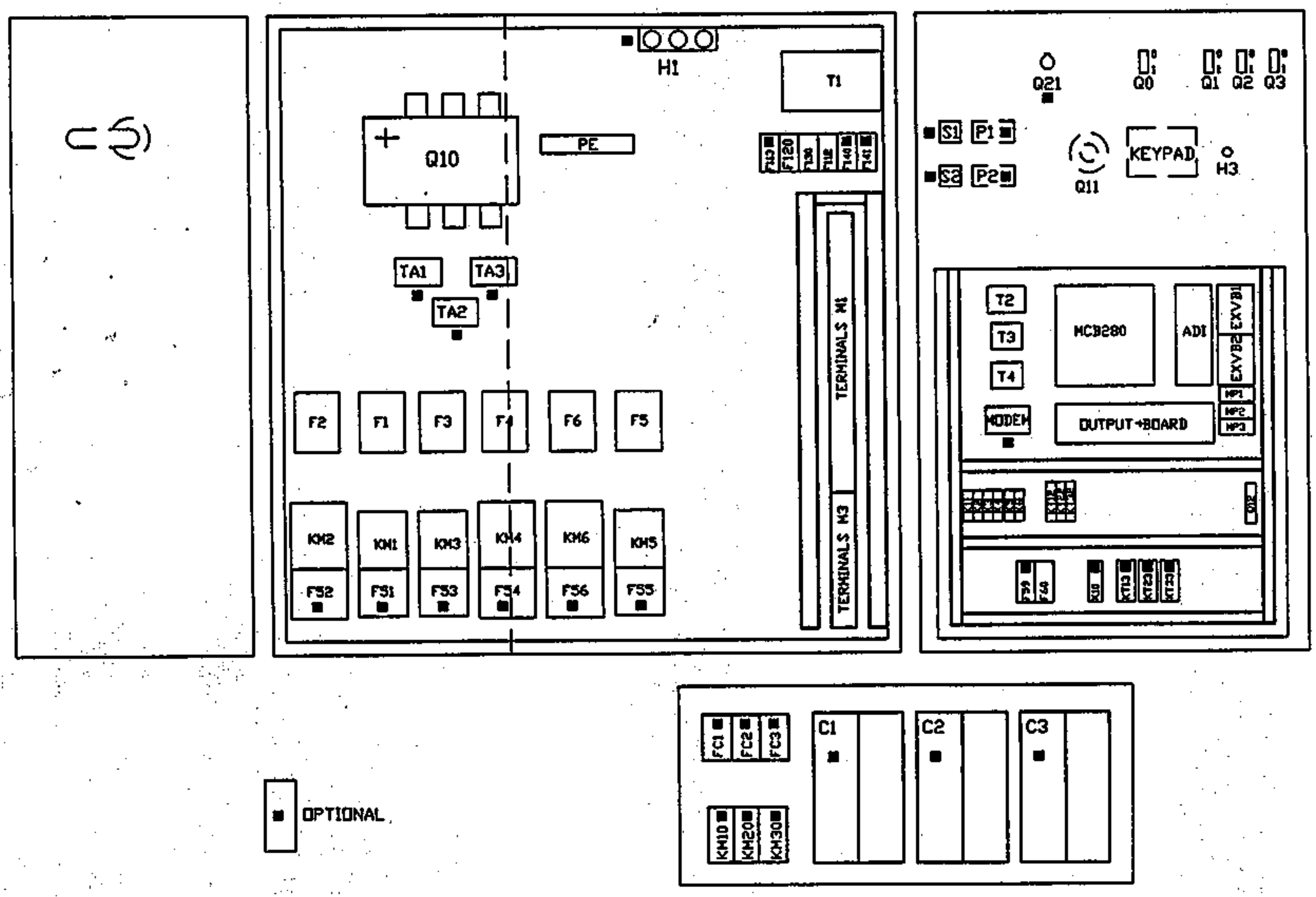
381365

N.: 170982

REVISIONE / ...NS: 1

SHEETS: 17 PAG.: 13

McQuay International	DESCRIZIONE: DISPOSIZIONE APPARECCHIATURE DESCRIPTION: LAYOUT BESCHREIBUNG: ANORDNUNG DER LAYOUT	CONFERMA: REFEREMENT: AUFTRAG: 81365	N.: 170982 REVISIONE / ONS: 1 SHEETS: 17 PAG.: 14



Mc[redacted]uay International	DESCRIZIONE: LEGENDA DESCRIPTION: LEGEND BESCHREIBUNG: LEGEND	CONFERMA: REFEREMENT: AUFTRAG: [redacted]81365
N.: 170982	REVISIONE / [redacted]NS: 1	SHEETS: 17 PAG. : 15

ADI BOARD	ANALOG DIGITAL INPUTS BOARD – SCHEDA INGRESSI ANALOGICI E DIGITALI
C1-2-3	CAPACITORS – CONDENSATORI DI RIFASAMENTO
D1-2-3	DIODE – DIODO
EXV1-2-3	ELECTRONIC EXPANSION VALVE – VALVOLA ESPANSIONE ELETTRONICA
EXB1-2	ELECTRONIC VALVE EXPANSION BOARD – SCHEDA ESPANSIONE VALVOLA ELETTRONICA
F1õ6	COMPRESSORS FUSES – FUSIBILI COMPRESSORI
FC1õ3	CAPACITORS FUSES – FUSIBILI CONDENSATORI DI RIFASAMENTO
F13-23-33	HIGH PRESSOSTAT – PRESSOSTATO ALTA PRESSIONE
F51õ56	COMPRESSOR THERMAL RELAYS – TERMICI COMPRESSORI
F59	EVAPORATOR HEATER FUSE – RESISTENZA EVAPORATORE
F60	PROTECTION AUXILIARI CIRCUIT FUSE – FUSIBILE PROTEZIONE CIRCUITO AUSILIARIO
F112	PHASE VOLT MONITOR – MONITORE DI FASE
F113	GROUND FAULT PROTECTION RELAY – RELE' CONTROLLO POTENZIALE VERSO TERRA
F116	EVAPORATOR FLOW SWITCH (NOT INSTALLED) – FLUSSOSTATO (NON INSTALLATO)
F117	CONDENSATER FLOW SWITCH – FLUSSOSTATO CONDENSATORE
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5

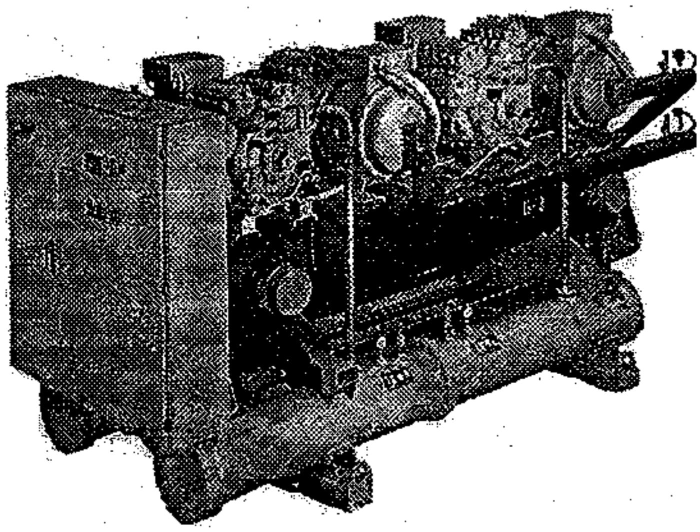
Installation manual

Date: April 1997

Supersedes: None

WHS 100.2÷450.4
Water cooled water chillers
Serial number:

CE



McQuay International

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Chapter 1 - Introduction

Chapter 2 - Manual content

Chapter 1 - Introduction

1.1.0. Purpose of the manual

This manual allows both the installer and the operator to perform correctly all the operations referring to the installation and maintenance of the chiller without provoking any damages to the unit or the qualified personnel.

Therefore the manual is of great help for the qualified personnel that have to arrange the equipment for providing the correct installation in accordance with local codes and regulations.

1.2.0. Resposibilities declined

McQuay Italia declines all present and future resposibilities referring to injuries to people and damage to things and unit, coming from negligence of the operators, from the unrespected installation/maintenance data carried in this manual, the non-persuance of the current regulations referred to the safety of both the equipment and the qualified personnel in charge for the installation and maintenance.

Chapter 2 - Manual content

2.1.0. General description

McQuay WHS water cooled water chillers are manufactured in order to produce chilled water.

Each unit is factory assembled and wired: then it is vacuued, charged with R407 c refrigerant and tested.

Each refrigerant circuit is independent consist a water condenser, Screw compressor, including a subcooler, a replaceable copper tubes dual circuit
shell and tube evaporator.

The standard components of the liquid line are: stop valve, discharge valve, dehydrator filters, solenoid valve, sight glass moisture indicator, electronic expansion valve.

Morever the following components are included: compressor crankcase heater, pump-down system, change over switch for the alternation of the compressor start sequence.

The electrical panel is equipped with all the safety systems that ensure reliable automatic workings. The motors of the compressors are equipped with fuses on three phases and are started by threepole contactors.

2.2.0. Water temperature limits

		HCFC 22		HFC 407C		HFC 134a	
		ISPESL	TÜV	ISPESL	TÜV	ISPESL	TÜV
Min/Max leaving evaporator water temperature	°C	4/9	4/9	6/9	6/9	4/9	4/9
Min/Max entering evaporator water temperature	°C	8/17	8/17	10/15	10/15	4/9	4/9
Min/Max leaving condenser water temperature	°C	30/45	30/50	30/45	30/50	30/45	30/50
Min/Max entering condenser water temperature	°C	25/40	25/45	25/40	25/45	25/45	25/45
Min/Max leaving heat rec. cond. water temp.	°C	25/40	25/45	25/40	25/45	25/55	25/60
Min/Max entering heat rec. cond. water temp.	°C	30/45	30/50	30/45	30/50	30/60	30/65
Min/Max leaving brine evap. water temperature	°C	-7/3	-7/3	-7/3	-7/3	-5/3	-5/3
Min/Max entering brine evap. water temperature	°C	-3/7	-3/7	-3/7	-3/7	-1/7	-1/7

2.2.1. Pressure limits

	EVAPORATOR		CONDENSERS*	
	Max. operat. press. bar	Pressure test bar	Max. operat. press. bar	Pressure test bar
Refrigerant side				
ISPESL	16,0	21,0	24,5	30,7
TÜV	16,0	21,0	30,0	39,0
Water side				
ISPESL	10,5	14,0	10,5	*
TÜV	10,5	14,0	10,5	16,0

2.2.2. Drawings and wiring diagrams

The overall dimensional drawings and electrical drawings are enclosed.

2.3.0. Safety measures

2.3.1. General precautions

The unit must be placed internally arranged for the clamping to heart of the chiller and if necessary must be equipped with anti vibrations shock absorbers. "Warning and Danger" notices are supplied on the following parts: electrical panel, compressors, safety valves, expansion valves, compressors liquid line shutoff valves.

2.3.2. Cautions and specific warnings

DANGER !

Sharp edges are a potential injury hazard.
Avoid contact with them

DANGER !

The unit must be lifted only by using the proper tools able to support the weight of the unit locking it through the lifting holes

DANGER !

No admittance to unauthorized or unqualified personnel.

DANGER !

No operation on electrical components is allowed without having switched off electricity supply.

DANGER !

No operation is allowed without using insulated platforms.
No water or moisture is should be present.

DANGER !

All the operations to refrigerant circuit and vessels, and all pressurised parts are to be performed by qualified personnel only

DANGER !

The substitution or addition of oil in the compressors must be performed by qualified personnel only

DANGER !

Convey the discharge of the safety valves outside the room

WARNING !

Before switching off the power supply performe the stop procedure reported on paragraph 2.5.5.

WARNING !

Avoid unrelated bodies into the water piping during the connection of the unit to the water system

WARNING !

Forsee a mechanical filter for the piping connected to the entry of the exchangers of the unit

2.4.0. Installation

Before any operation please check the instruction for use.

2.4.1. Warning

Installation and maintenance are to be performed only by qualified personnel who are familiar with local codes and regulations, and experienced with this type of equipment. The installation of the unit in places that could be considered dangerous for all the maintenance operations must be avoided

2.4.1.1. Transport

In order to avoid problems it's necessary to be sure of the stability of the unit during transportation. This is why the unit is supplied with a transversal wooden beam placed at the base that have to be removed only when the unit has arrived at final destination. In case the unit has to be moved again, it's necessary to adapt a similar solution.

2.4.1.2. Inspection

All units are factory assembled and equipped. Before shipment, units are charged with the necessary quantity of refrigerant and oil and tested at working conditions requested by the client. When the equipment is received, all items should be carefully checked against the bill of lading to insure a complete shipment. All units should be carefully inspected for damage upon arrival. All shipping damage should be reported to carrier and a claim form should be filled.

2.4.2. Handling

If the unit must be hoisted, it is necessary to lift the unit by attaching cables or chains at the lifting holes in the evaporator tube sheets. Spreader bars must be used to protect the control cabinet and other areas of the chiller (see fig. 1).

Size the cables and spreader bars in conjunction with lifting weight.

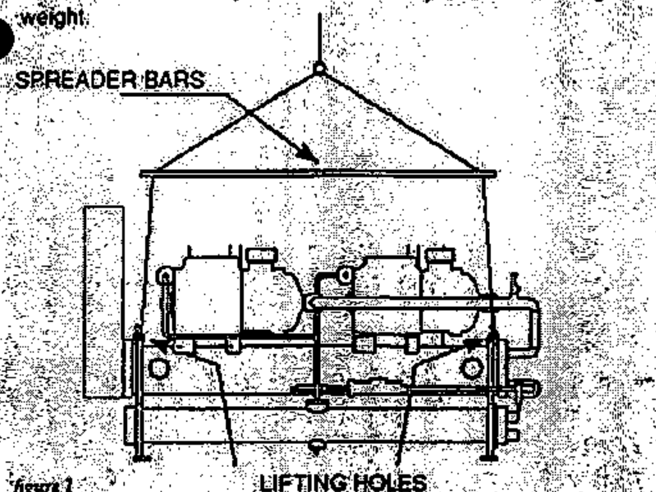


figure 1

2.4.3.0. Location

A reasonably level and sufficiently strong floor is required in order to bear the weight of the chiller. If necessary, additional structural members should be provided to transfer the weight of the unit to the nearest beams. Rubber-in-shear isolator (see enclosure drawings) can be furnished and field placed under each corner of the package. Set the unit in place and level with a spirit level. Vibration eliminators in all water piping connected to the chiller are recommended to avoid straining the piping and transmitting vibrations and noise.

2.4.3.1. Space requirements for servicing

Each side of the unit must be accessible after installation for periodic service work. Clearance should be provided for cleaning condeser tubes or for removing coder tubes. Minimum recommanded clearance requirements (see enclosure drawings).

2.4.4.0. Water piping

2.4.4.1 General

1 - Select piping according to local codes of praticies and security norms.

2 - Shut off valves should be provided at the unit so that normal servicing can be accomplished without draining the system.

3 - It's recommended that temperature and pressure indicators be installed at the inlet and outlet of the heat exchangers to and in the normal checking and servicing the unit.

4 - It's recommended the installation of a wire mesh strainer at the pump suction to protect the pump and the and the exchangers from foreign matter.

5 - Before insulating the piping and filling the system, a preliminary leak check should be made.

6 - Vibration eliminators are recommended in all lines connected to the unit.

7 - Automatic flow control devices, although not furnished with the chiller as they are plant components, must be installed.

8 - Drawings enclosure shows pipe connection sizes

2.4.4.2. Chilled water piping (Evaporator)

The water flow entering the evaporator on the connection close the electrical panel and leaving on opposite connection. Design the piping so that it has a minimum number of elevation changes.

Include manual or automatic vent valves at the high points of the chilled water piping, so that air can be sented from the water circuit. System pressure can be maintened by using an expantion tank or a combination pressure relief and reducing valve. (see par. 2.2.5).

All chilled water piping should be insulated to prevent condensation on the lines. If insulation is not of the self contained vapor barrier type, it should be covered with a vapor seal. Piping should not be insulated until completly leak tested.

2.4.4.3. Condenser water piping

For proper performance, the condenser water must enter the bottom connection of the condenser. Water cooled condensers may be piped for use with cooling towers, well water or heat recovery applications. Cooling tower applications should be made with consideration to freeze protection and sealing problems. For pressure levels please refer to par. 2.2.5.

2.4.5 Testing

Check the proper installation of the unit respecting the regulations referred to safety. Check the proper lead of the piping considering the water inlet/outlet of the evaporator, on the condensers

2.4.6 Electrical Field wiring

2.4.6.1 Field wiring

The unit's electrical panel has a terminal block board to lead a 3-pole cable with ground of adequate gross section for the motor rating, to the main cutout switches. If the main cutout switch is installed the line must be connected to its terminal block board. To provide power to the main cutout, if there is no transformer, it's necessary to provide monophase power to terminal block 1 a 2.

Power inlet must be effected on the upper side of the electrical panel through a plate with references for the cables.

WARNING !

Inside the electrical panel there is a yellow/green terminal block to lead the unit to the ground. Perform the connection in accordance with the local regulations.

WARNING !

The power tension must fluctuate more than ± 10%. The balance between the phases must not be greater than ± .. Condenser and evaporator flow switches must be nnected to the following terminals:
Evaporator flow switch: terminal 305 and 306.
Condenser flow switch: terminal 305 and 306.

2.5.0. Start up and shut down

2.5.1. Control centre layout (see wiring diagram enclosure)

2.5.2. Pre start-up

1 - With main disconnect switch Q10 open, check all the electric connection in control panel and starter to be sure they are tight and provide good electrical contact. Althoughs connections are thightned at the factory, they many have last enough in shipment to cause a malfunction.

2 - Verify that the switches Q10, are to the OFF position.

Check and inspect all water piping. Make sure flow direc- n is correct and piping is made to correct connection on evaporator and condenser.

4 - Check for inlet/outlet piping proper connections as indicated on the exchangers.

5 - Open all water flow valves to the condenser and evaporator.

6 - Start pumps (evaporator) and flush the piping to be sure the system is clear.

7 - Check all pipings for leaks. Vent the air from the evaporator and condenser water circuit. The cooler circuit should contain clean, non corrosive water.

8 - Is water regulating valves are provided, connect their capillary to the manual valves provided on the condensers and open the manual valves.

9 - Check pressure drop across evaporator and condenser, and see that water flow is correct for the design flow rates and date.

- check the actual line voltage to the unit to make sure it the same as called for on the compressor nameplate within ±10% and that the phase voltage unbalance doesn't ex ceed 3%.

11 - Verify that adeguate power supply and capacity is available to handle load.

12 - Make sure all wiring and fuses are of the proper size. Also make sure all interlock wiring is completed per McQuay diagrams.

13 - Make sure all auxiliary load and control equipment is operative and that an adeguate cooling load is available for initial start-up.

2.5.3.0. Start-up

2.5.3.1. Warning

Initial start-up to be performed only by McQuay autorized Service organization. This is a must to obtain full warranty benefits.

WARNING !

Start-up must be performed by specialized personnel.

2.5.3.2. Start-up sequences

2.5.3.3. See Commissioning Statement

2.5.3.4 Microprocessor information

For further informations about all the function and set point available on the microprocessor controller see the operating manual.

2.5.4.0 Emergency stop

A red switch Q11 is provided on control box, to allow the unit emergency stop in case of false alarm, the unit be restarted following this procedure:

1 - Move switch Q10 to the OFF position.
2 - Reset emergency stop switch Q11.
3 - Repeat start-up procedure from beginning.

2.5.5.0. Temporary shut-down

Move switchs Q13 and Q14 to the OFF position. After pump down, turn OFF the chilled water pump.

2.5.5.1.

WARNING !

By this operation compressors heaters de-energized. It is important to complete compressors pump-down cycle prior to close the chiller water flow to avoid freezing.

2.6.0. Maintenance

for maintenance please refer only to the McQuay authorized Service organization.

2.7.0. Trouble shooting: causes and corrective steps

In case the chiller should not work, verify the following:

1 if the power is on
2 if the water flow is on
3 if the cooling capacity is on

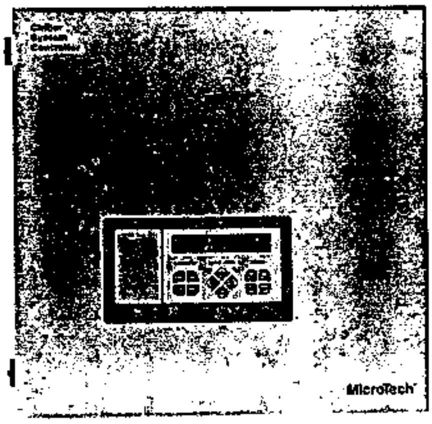
Refer to the authorized personnel is none of the above mentioned points are the cause of the troubleshooting.

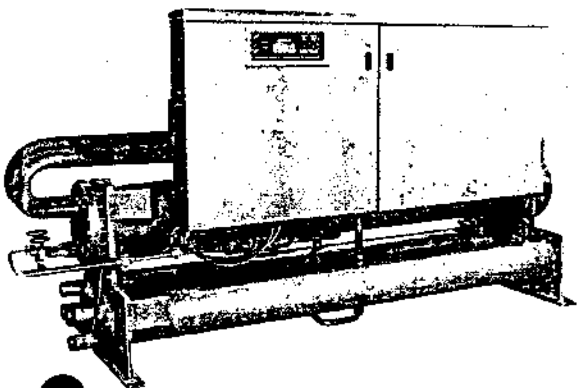
McQuay® International

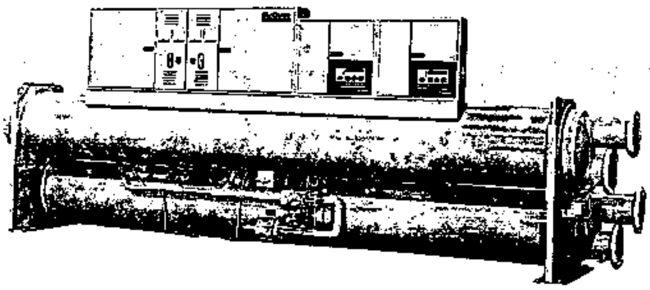
Installation and Maintenance Data

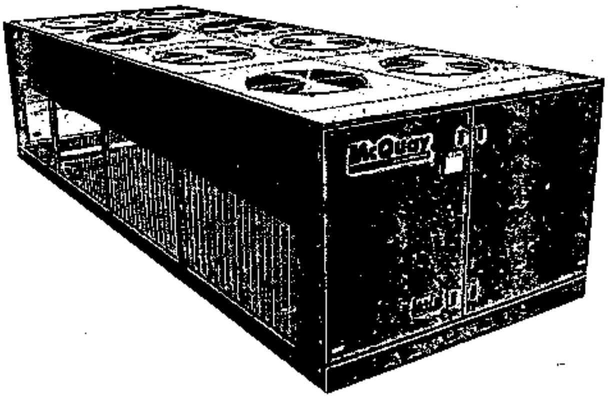
Bulletin No. IM 618
June 1995
Part No. 585519Y-01

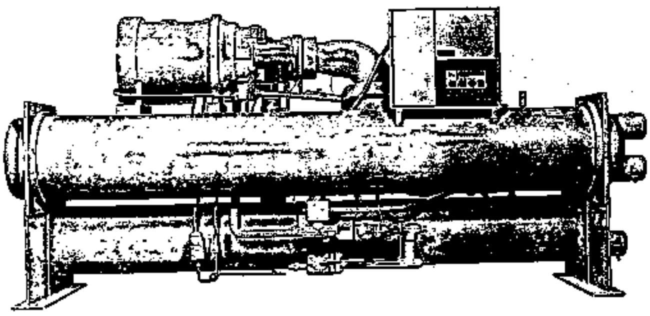
MicroTech® Chiller System Controller











For Use with McQuay Models PEH, PFH, ALR, WHR, ALS & PFS

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Introduction

This manual provides information about the MicroTech® Chiller System Controller (CSC) for McQuay centrifugal (series 100 and 200), reciprocating, and screw chillers. It describes the components, field wiring, network commissioning procedures, and service procedures.

For information about the CSC's features, sequences of operation, and programmable options, refer to Bulletin No. OM 127, *MicroTech Chiller System Controller.* For specific information about the MicroTech chiller controllers, refer to the appropriate MicroTech unit controller installation literature or operation manual (see Tables 1 and 2). For installation and commissioning instructions and general information on a particular unit, refer to its model-specific installation manual (see Table 3).

Table 1. MicroTech Unit Controller Installation Literature

Chiller Type	Bulletin Number
Series 100 Centrifugal	IM 403
Series 200 Centrifugal	IM 616
Reciprocating	IM 493
Screw	IM 549

Table 2. MicroTech Unit Controller Operation Literature

Chiller Type	Bulletin Number
Series 100 Centrifugal	IM 403 & APM 950
Series 200 Centrifugal	OM 125
Reciprocating	IM 493
Screw	IM 549

Table 3. Model-Specific Unit Installation Literature

Chiller Model	Bulletin Number
PEH, PHH	IM 307
ALR (40–195 tons)	IM 499
WHR (40–240 tons)	IM 508
ALS	IM 548
PFS	IM 609

⚠ WARNING

Electric shock hazard. Can cause personal injury or equipment damage.

This equipment must be properly grounded. Connections and service to the MicroTech control panel must be performed only by personnel that are knowledgeable in the operation of the equipment being controlled.

⚠ CAUTION

Static sensitive components. A static discharge while handling electronic circuit boards can cause damage to the components.

Discharge any static electrical charge by touching the bare metal inside the control panel before performing any service work. Never unplug any cables, circuit board terminal blocks, or power plugs while power is applied to the panel.

NOTICE

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause harmful interference in which case the users will be required to correct the interference at their own expense. **McQuay International disclaims any liability resulting from any interference or for the correction thereof.**

Applying the CSC

The CSC has been designed to control several common chiller plant configurations. Figure 1 shows a typical simple chilled water system. Following are descriptions of this typical plant configuration and guidelines for applying the CSC in them. Note that the McQuay chillers in these configurations can be all centrifugal, all reciprocating, all screw, or a combination of centrifugal, reciprocating, or screw.

The CSC may be suitable for applications other than the ones shown. If your application does not match one of the listed configurations, contact your McQuay sales representative for assistance.

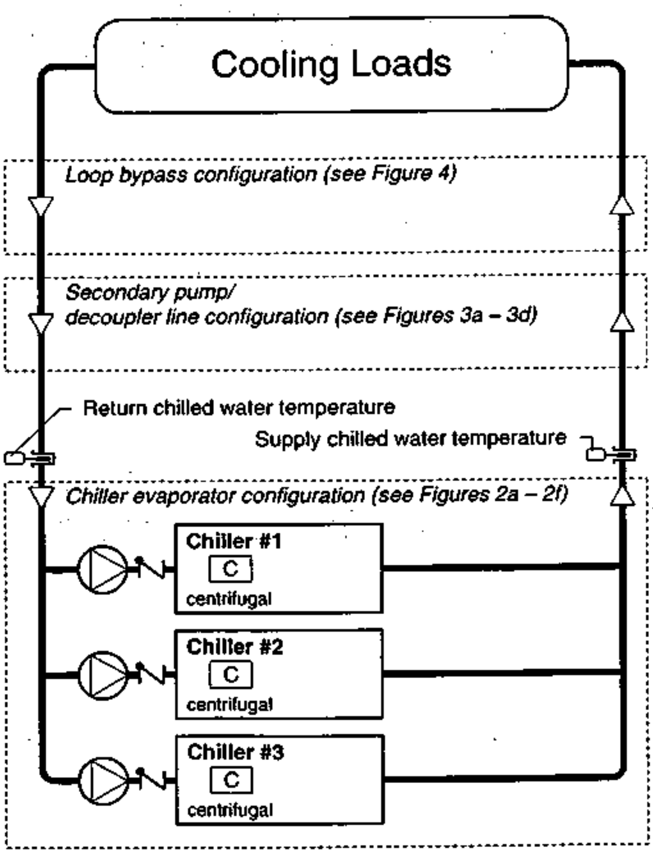
Typical Simple Chilled Water System

The typical chilled water system configuration is shown in Figure 1. The characteristics of this system consist of the following: (1) a set of chillers, usually piped in parallel, (2) each chiller has its own primary chilled water pump, (3) the system may or may not have a bypass line and valve that is controlled by a differential pressure controller, (4) the system may or may not have secondary pump(s) to distribute water to the cooling loads.

To see the various configurations available, Figures 2a–2f, Figures 3a–3d, and Figure 4 can be inserted into the typical simple chilled water system shown in Figure 1.

Note: As used throughout this manual, the word *chiller* means chiller in all cases except for dual-compressor centrifugals. For these machines, each *compressor*—along with its associated MicroTech controller—is considered a "chiller."

Figure 1. Typical Simple Chilled Water System



Chiller Evaporator Configuration

In these systems (Figures 2a through 2d), the temperature of the water entering the loads will always be very close to each chiller's leaving evaporator water temperature setpoint.

Figure 2a. Parallel Configurations

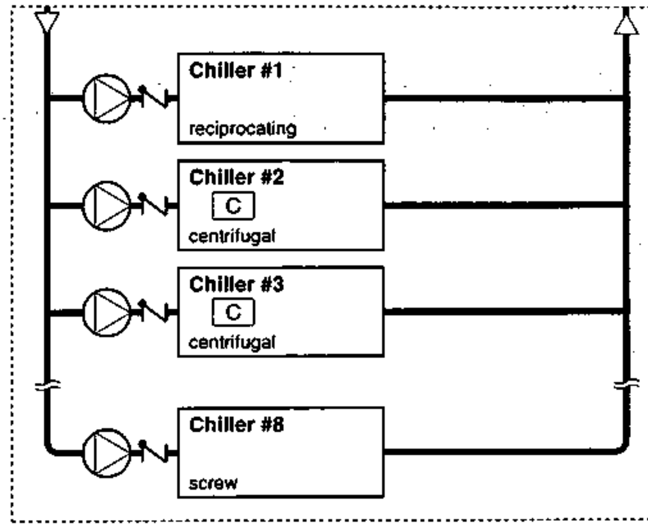


Figure 2b. Series/Parallel Configurations

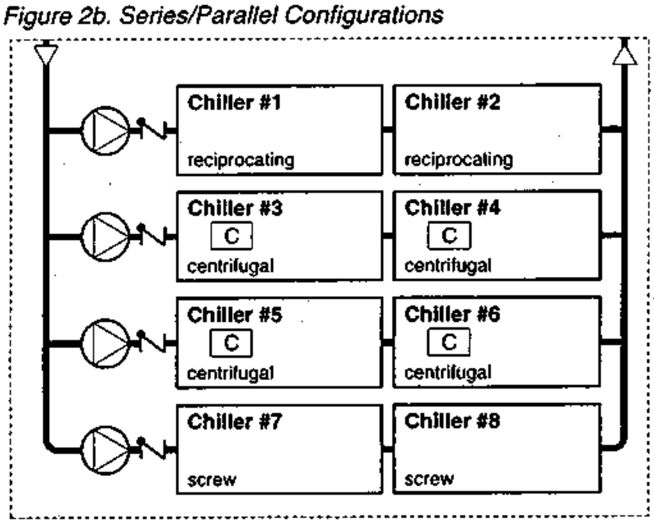


Figure 2c. Dual-Compressor Centrifugal Configurations

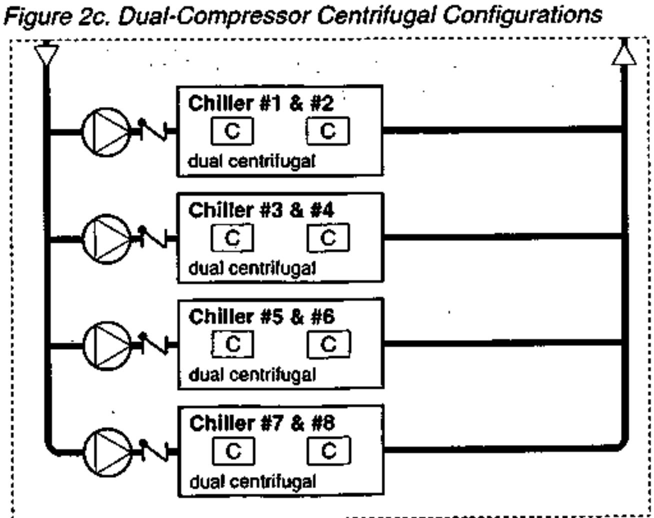
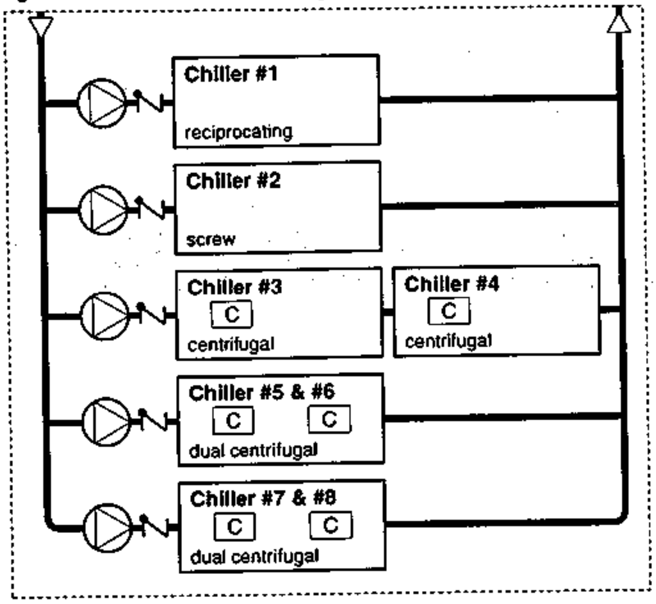
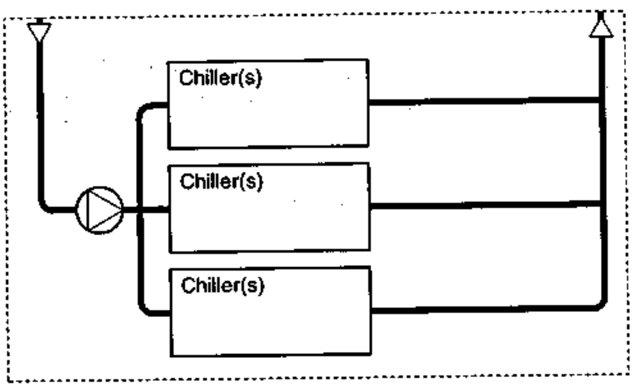


Figure 2d. Combination Configurations



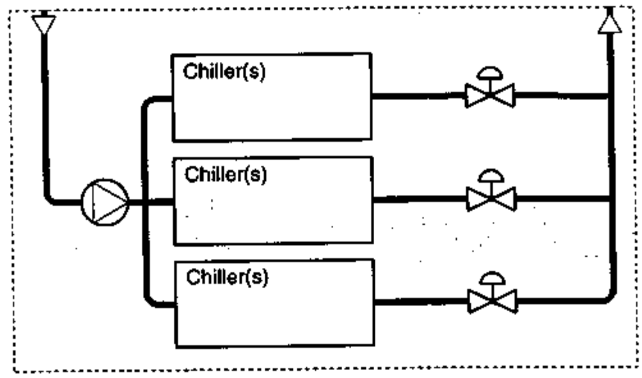
Figures 2e and 2f are the same as the above configurations except (1) all chillers share a common primary pump (Figure 2e) or (2) all chillers share a common primary pump but each chiller has an isolation valve (Figure 2f).

Figure 2e. Above Configurations with Common Primary Pump



In the configuration of Figure 2e, the chilled water supply temperature will be very close to each chiller's leaving evaporator water temperature setpoint if all the chillers are on. If some chillers are on and some are off, the CSC will lower each chiller's leaving evaporator water temperature setpoint to compensate for water mixing.

Figure 2f. Above Configuration with Common Primary Pump and Isolation Valves.



In the configuration of Figure 2f, the chilled water supply temperature will always be very close to each chiller's leaving evaporator water temperature setpoint.

Caution: Significant changes in the chilled water flow rate through the evaporators can result when the chillers in the configuration of Figure 2f are turned on and off. Large flow rate changes can cause erratic chiller control.

Secondary Pump / Decoupler Line Configuration

Figures 3a–3d represent the four secondary pump control options available using the CSC.

Figure 3a. Fixed-Speed Secondary Pump

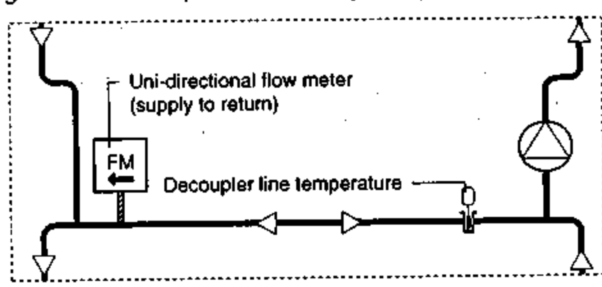
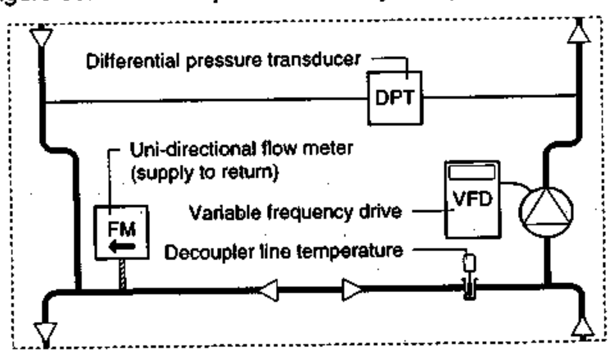


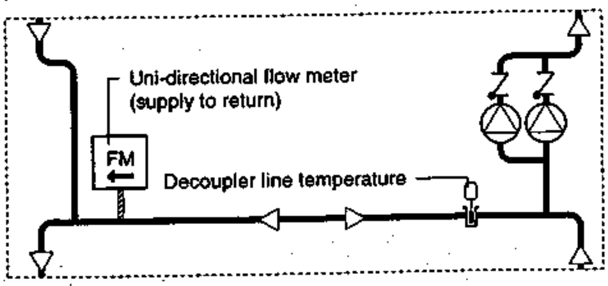
Figure 3b. Variable-Speed Secondary Pump



Using the variable-speed secondary pump will maintain a desired pressure across the chilled water loop.

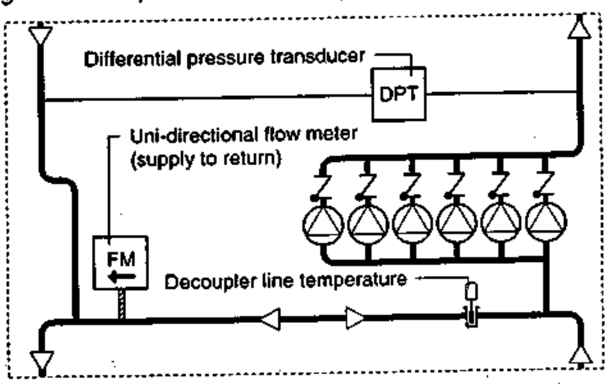
Note: A pressure-controlled loop bypass (Figure 4) may not be used in conjunction with a variable-speed secondary pump.

Figure 3c. Lead/Standby Secondary Pumps



Using the lead/standby secondary pumps enables the CSC or the user to select what pump is the lead pump, and what pump is the standby pump. If the lead pump fails, the standby pump starts automatically. The auto-lead feature automatically swaps the lead and standby pumps based on run time.

Figure 3d. Sequenced Secondary Pumps



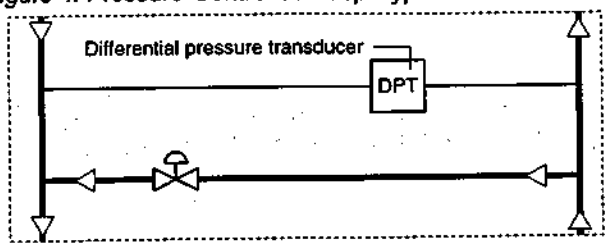
Using sequenced secondary pumps enables the CSC to turn the chilled water pumps on and off to maintain a constant pressure difference between the secondary supply and return lines.

Note: If a pressure-controlled loop bypass (Figure 4) is used in conjunction with sequenced secondary pumps, only one differential pressure transducer is required.

Loop Bypass Configuration

The CSC will modulate the bypass valve as required to maintain an adjustable differential pressure setpoint. The bypass line and differential pressure sensor shall be installed between the chilled water supply and return lines.

Figure 4. Pressure-Controlled Loop Bypass



General Description

The MicroTech® Chiller System Controller (CSC) is a microprocessor-based controller that provides sophisticated monitoring and control capabilities to McQuay chillers. The CSC is designed to monitor and control up to four dual-compressor centrifugal chillers, up to eight single-compressor centrifugal chillers, up to eight non-centrifugal chillers (reciprocating and screw), or any combination that results in eight or fewer unit controllers.

The CSC's design offers full input and output flexibility. The base panel is equipped with an Input Conditioning Module (ICM) that can condition eight analog and eight digital inputs, and keypad/display that provides a user interface to the control panel for the monitoring and control of attached chillers.

The CSC also has accessories that can increase the number of inputs and outputs. Up to two more ICMs can be purchased, increasing the number of analog and digital inputs to 24. Up to three Analog Output Expansion Modules (AOX-4) can be purchased, providing twelve analog outputs. A relay kit is an option that can add eight digital outputs. Each relay kit is equipped with eight AC power rated relays. The relays are plugged into the Output Board (OB). Up to three relay kits can be ordered for a total of 24 digital outputs.

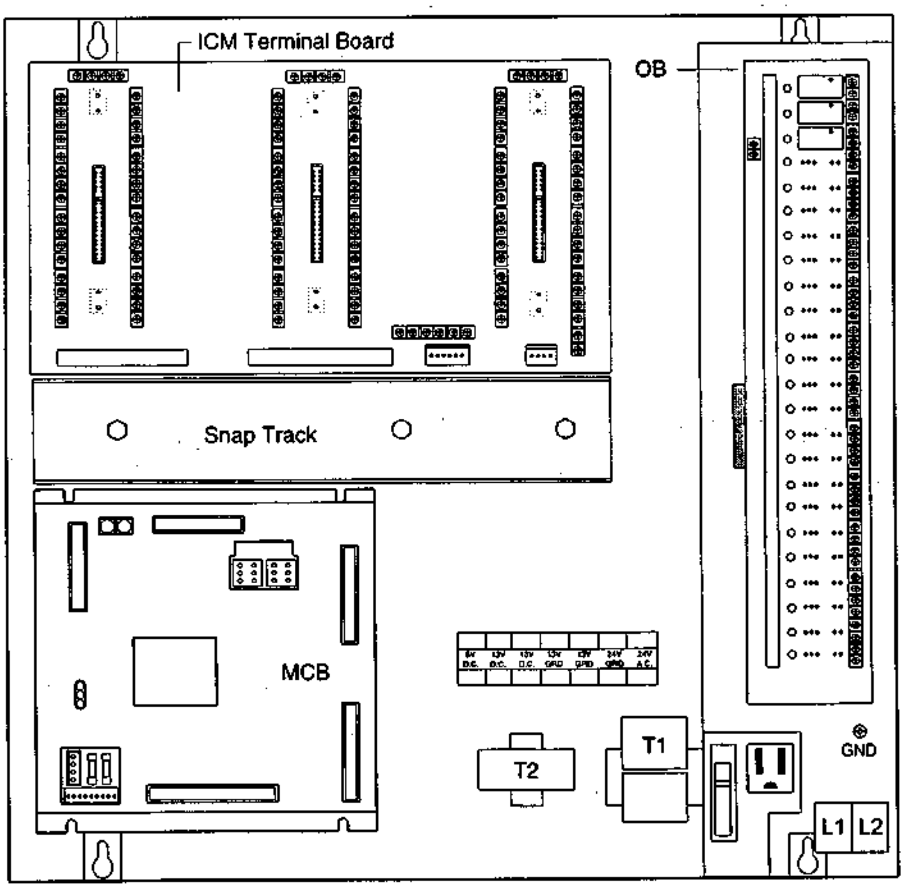
The CSC is capable of performing all network communications required for complete chiller system control. If desired, it can be incorporated into a MicroTech network that includes a Network Master Panel (NMP) and other MicroTech controllers. In either case, an IBM® compatible computer containing MicroTech Monitor™ software can be connected to give you full-screen monitoring and control capability. The computer can be connected directly or remotely via telephone lines with an optional modem.

Component Data

Figure 5 shows the control panel layout for the CSC. The main components of the controller are the Microprocessor Control Board (MCB), the Output Board (OB), the Input Conditioning Module (ICM) Terminal Board, and the Keypad/Display Interface (KDI). All of these major components are mounted inside a standard NEMA 1 enclosure. They are interconnected by ribbon cables, shielded multi-conductor cables, or discrete wiring. Power for the system is provided by transformers T1 and T2.

Following are descriptions of these MicroTech components and their input and output devices.

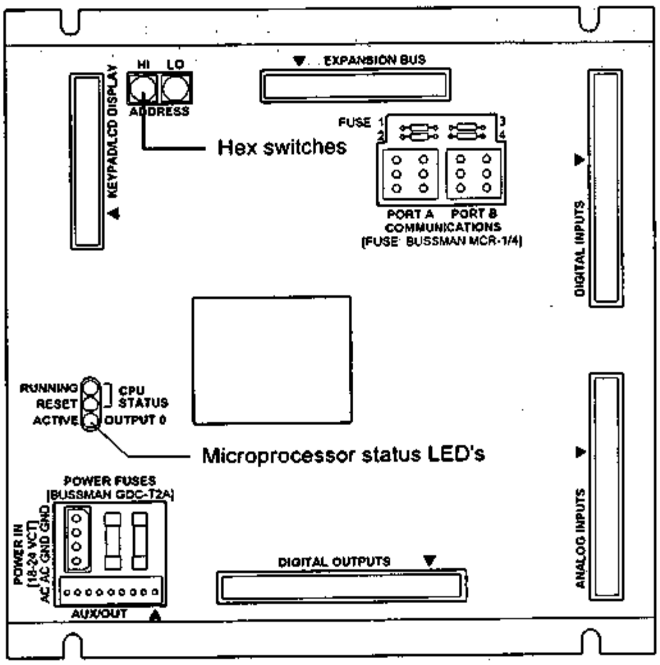
Figure 5. CSC Layout



Microprocessor Control Board

The Microprocessor Control Board (MCB) is shown in Figure 6. It contains a microprocessor that is preprogrammed with the software required to monitor and control chillers that are connected to the CSC. The various MCB connections and components are described below.

Figure 6. Microprocessor Control Board (MCB)



Digital Inputs Connection

The MCB receives digital inputs from the Input Conditioning Module (ICM) Terminal Board through the Digital Inputs connector via a plug-in ribbon cable. These inputs are conditioned by the ICM. See "Input Conditioning Module (ICM)" in the "Accessories" section of this manual for more information on the ICM.

Analog Inputs Connection

The MCB receives conditioned analog inputs from the Input Conditioning Module (ICM) Terminal Board through the Analog Inputs connector via a plug-in ribbon cable. These inputs are conditioned by the ICM. After having been conditioned, all analog inputs enter the MCB through the Analog Inputs port as 0–5 Vdc signals. See "Input Conditioning Module (ICM)" in the "Accessories" section of this manual for more information on the ICM.

Digital Outputs Connection

After processing all input conditions and network data, the MCB sends the appropriate output signals to output devices through the Digital Outputs port via a plug-in ribbon cable.

Aux/Out Terminal Strip

The Aux/Out terminal strip provides 5 Vdc and 13 Vdc to the CSC field wiring terminal strip. The 5 Vdc powers the back light of the LCD or other auxiliary equipment. The 13 Vdc can be used to power a modem or an Analog Output Expansion Module. See the "Accessories" section of this manual for more information on the modem and Analog Output Expansion Module.

Power In Connector

The MCB receives 18 Vac, center-tapped power from transformer T2 through the Power In connector. This power drives all logic and communications circuitry, the Aux/Out terminal strip, and the Keypad/Display Board. Refer to the panel's wiring diagram or Figure 24 for more information.

Power Fuses

Two identical 2-amp fuses are located to the right of the Power In connector. These fuses are in the MCB power supply circuit.

Microprocessor Status LEDs

The green, red, and amber LEDs on the MCB provide information about the operating status of the microprocessor. The amber LED also indicates the existence of alarm conditions.

Following is the normal start-up sequence that the three status LED's should follow when power is applied to the MCB:

1. The red ("Reset") LED turns on and remains on for approximately 5 seconds. During this period the MCB performs a self-test.
2. The red LED turns off and the green ("Running") LED turns on. This indicates that the microprocessor has passed the self-test and is functioning properly.
3. The amber ("Active") LED remains off continually if no alarm conditions exist in the network. If alarm conditions exist, the amber LED will flash as shown in Table 5.

If the above sequence does not occur after power is applied to the controller, there is a problem with the MCB or its power supply. For more information, refer to the "Test Procedures" section of this manual, which is under "Service Information."

Tables 4 and 5 summarize the green, red, and amber status LED indications.

Table 4. Green and Red Status LED Indication

Green LED State	Red LED State	Indication
Off	Off	No power to MCB
Off	On*	Self-test failure or power supply problem
On	Off	MCB operating normally

* For longer than 5 seconds.

Table 5. Amber Status LED Indication

Amber LED State	Indication
Off	Normal operation
On 1/2 second; Off 1/2 second	Alarm condition

Keypad/LCD Display Connection

The MCB receives input commands and operating parameters from the keypad and sends requested information to the display through the Keypad/LCD Display port via a plug-in ribbon cable.

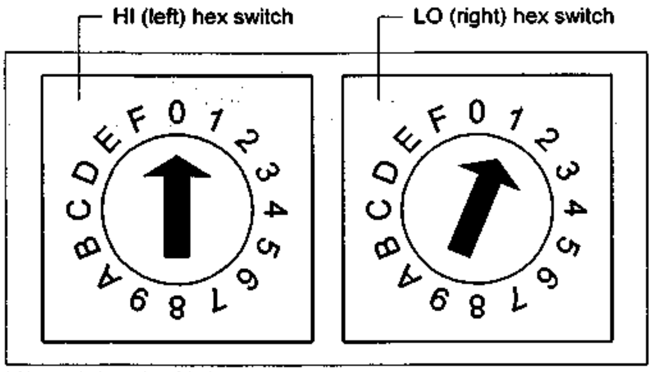
Hex Switches

The MCB includes two hex (hexadecimal) switches that are used to set the CSC network address.

The HI and LO hex switches are shown in Figure 7. A "hex switch setting" is defined as the HI switch digit followed by the LO switch digit. For example, a hex switch setting of 2F would have the HI switch set to "2" and the LO switch set to "F." Refer to "Addressing the Controllers" in the "Network Commissioning" section of this manual for more information.

Note: You can change the setting of a hex switch with a 3/32-inch tip slotted-blade screwdriver. If a hex switch setting is changed, power to the MCB must be cycled in order to enter the new setting into memory. This can be done by turning the panel's power switch off and then back on.

Figure 7. Hex Switches



* Hex switch setting 01 shown

Expansion Bus Connection

The Expansion Bus connector sends output signals to the Analog Output Expansion Module (see the "Accessories" section) via a ribbon cable. The output signals are used by the Analog Output Expansion Module to drive various control devices.

Communication Ports

The MCB has two communication ports: port A and port B. Each port has six terminals and is set up for both the RS-232C and RS-485 data transmission interface standards. The male and female connectors for these ports are manufactured by AMP. Therefore, they are referred to as "AMP plugs" or "AMP connectors" throughout this manual. Socketed fuses located next to the ports protect the communications drivers from voltage in excess of ±12 Vdc. Following are brief descriptions of each port's function.

Port A: Port A is for communications with an IBM compatible PC using the RS-232C interface standard. The PC can be directly connected, over a limited distance, with a twisted, shielded pair cable, or it can be remotely connected via phone lines with a modem. Port A can also be used to connect a licensed building automation system to the MicroTech network via Open Protocol. The default communications rate is 9600 baud. For more information, see "PC Connection" in the "Field Wiring" section of this manual.

Port B: Port B is for MicroTech network communications using the RS-485 interface standard. A twisted, shielded pair cable should be connected to port B via terminals B+, B–, and GND on terminal block T11. The communications rate is 9600 baud. For more information, see "Network Communications" in the "Field Wiring" section of this manual.

Output Board

The Output Board (OB) accepts up to 24 digital outputs from the MCB. Each output has fused sockets and can be used to switch AC or DC power by selecting a particular relay output module. Screw terminals allow for field wiring connections to the output device. Each output has an on-board LED that illuminates when an output socket that contains a relay is activated by the MCB. Following are the Output Board's power ratings:

- 120V ~ 50/60 Hz
- 250V ~ 50/60 Hz

Input Conditioning Module Terminal Board

The Input Conditioning Module (ICM) Terminal Board allows the transfer of up to 24 analog and 24 digital conditioned inputs to the MCB. The ICM Terminal Board has three edge card connectors, field wiring terminals for analog and digital inputs, field wiring terminals for 5 Vdc and 24 Vac, field wiring terminals for communication ports, and ribbon cable connections to the MCB.

The ICM Terminal Board edge card connectors accept up to three Input Conditioning Modules (ICM). Each ICM can condition up to eight analog and eight digital input signals. These input signals come from external devices such as room temperature sensors or dry contacts. The signals enter the ICM through the field wiring terminals labeled AI and DI on the ICM terminal board.

Analog Input (AI)

There are three analog input field wiring terminal strips labeled T1, T3, and T5. Each terminal strip has 16 screw terminals. When an analog signal is connected to the terminal strip, the positive (+) wire connects to the even numbered screw terminal and the ground (–) wire connects to the odd numbered screw terminal (see Table 6).

Table 6. Analog Input Field Wiring Terminal Strip Numbers

Terminal Strip Number	Screw Terminal Range
T1	100–115
T3	132–147
T5	164–179

Digital Input (DI)

There are three digital input field wiring terminal strips labeled T2, T4, T6. Each terminal strip has 16 screw terminals. When a digital signal is connected to the terminal strip, the odd numbered screw terminal sends 24 Vac to the external device. When a contact in the external device closes, the 24 Vac passes through the contact and back through a return wire to the even numbered screw terminal. This return voltage then trips an opto-electric switch allowing the MCB to sense the digital input.

Table 7. Digital Input Field Wiring Terminal Strip Numbers

Terminal Strip Number	Screw Terminal Range
T2	116–131
T4	148–163
T6	180–195

Power

Above each edge card connector are field wiring terminals for 5 Vdc (regulated) and 24 Vac (ground referenced). These terminals can be used to power peripheral devices. The 5 Vdc is also used to power the LEDs in the Output Board.

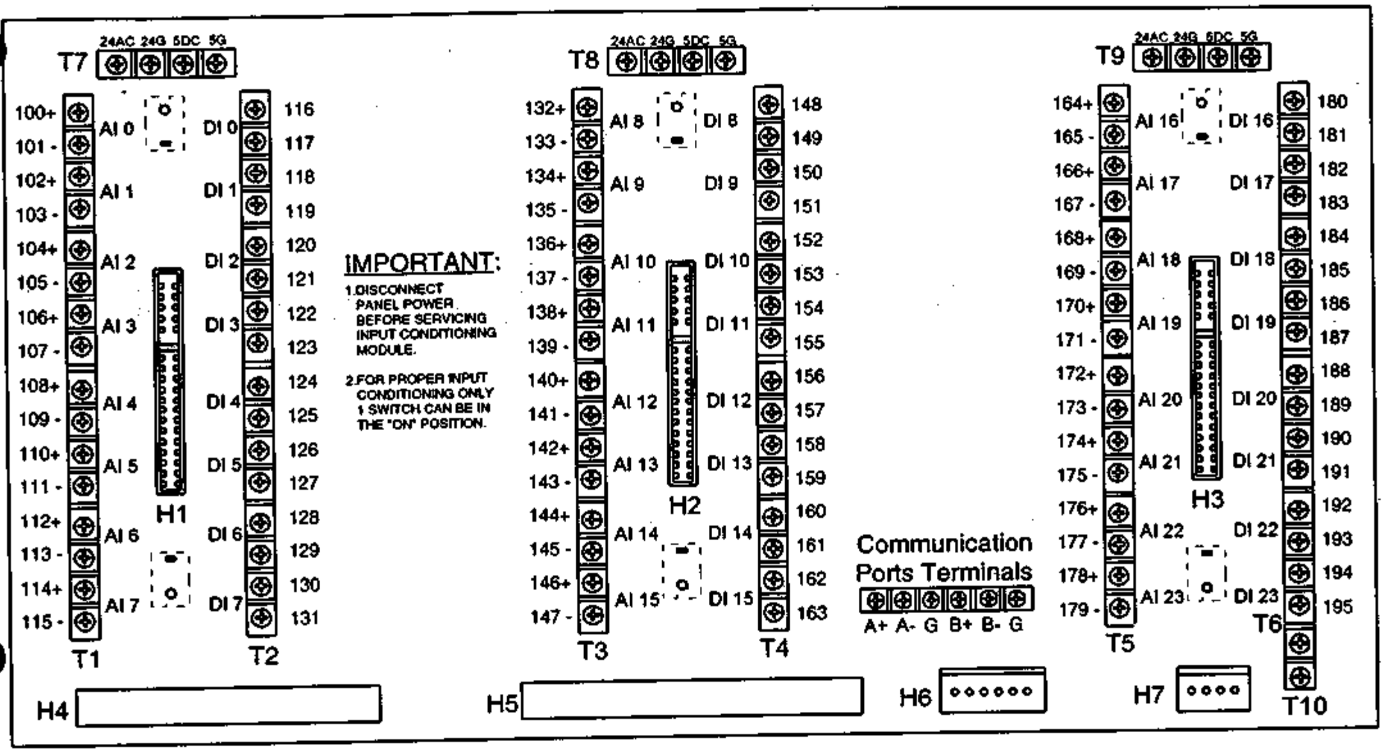
Communications

Located on the ICM Terminal Board are communications field wiring terminals. Terminals B+, B–, and GND connect to the chiller unit controller's communications field wiring terminals. Terminals A+, A–, and GND connect to an optional PC with MicroTech Monitor™ software.

Snap Track

The snap track is a device used to mount circuit boards, in particular, the AOX-4 board, to the CSC. The snap track is located directly below the Input Conditioning Module (ICM) Terminal Board. Ridges on the top and bottom of the snap track hold the circuit board in place.

Figure 8. Input Conditioning Module Terminal Board



Keypad/Display Interface

The Keypad/Display Interface (KDI) (see Figure 9) gives you a local interface with the CSC. All operating conditions, system alarms, control parameters, and schedules can be monitored from the display. If the password has been entered, any adjustable parameter or schedule can be modified with the keypad. Because the display is backlit, the liquid-crystal characters are highly visible regardless of the ambient light level. You can adjust the display contrast with a small pot located on the back of the board. An Alarm LED and Alarm Horn are also located on the KDI. For information on using the keypad/display, refer to the "Getting Started" portion of Bulletin No. OM 127, *MicroTech Chiller System Controller.*

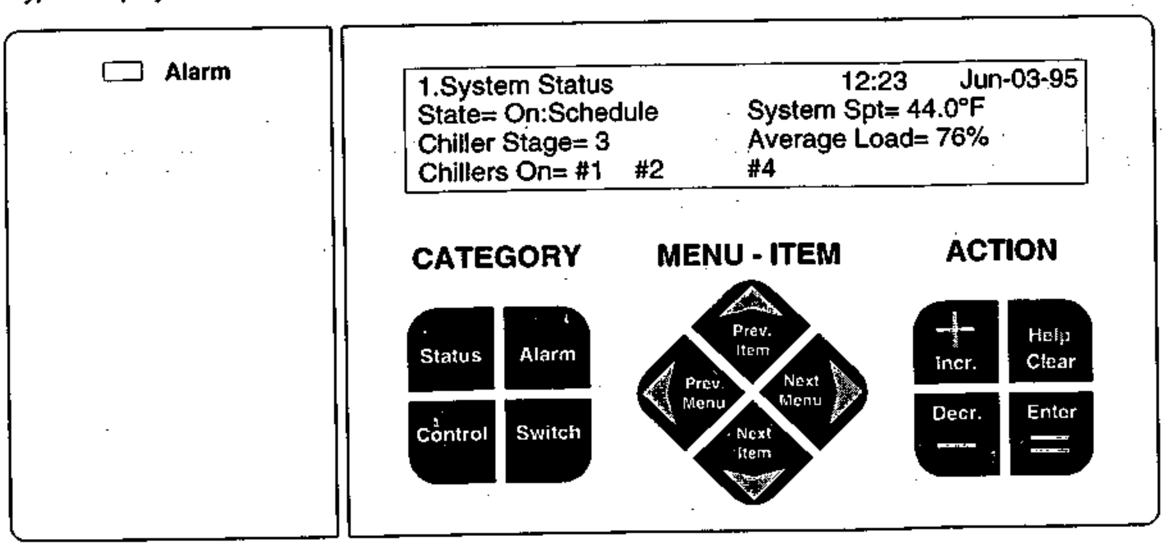
Alarm LED: The red "Alarm" LED will blink whenever there is an alarm in the CSC or any of the chillers.

Alarm Horn

If it is enabled, the piezo alarm annunciator (Alarm Horn) will sound whenever an alarm occurs in the CSC or any of the chillers. To silence the alarm Horn, press the alarm key on the CSC's keypad. You can also set up the horn so that it sounds only when certain types of alarms occur (Comm Loss, Faults, Problems, or Warnings). For more information, refer to the "Alarm Monitoring" section of Bulletin No. OM 127, *MicroTech Chiller System Controller.*

Note: Silencing the Alarm Horn does not clear an alarm. For more information, refer to the "Alarm Monitoring" section of Bulletin No. OM 127.

Figure 9. Keypad/Display Interface – LED Status Board



Software ID

MicroTech CSC software is factory installed and tested in each panel prior to shipment. The software is identified by a program code (also referred to as the "Ident"), which is printed on a small label affixed to the MCB. An example of this label is shown in Figure x. The program code is also encoded in the controller's memory and is available for display on menu 28 of the keypad/display or a PC equipped with MicroTech Monitor™ software. Using menu 28 or Monitor software is the most reliable way of determining the controller's program code.

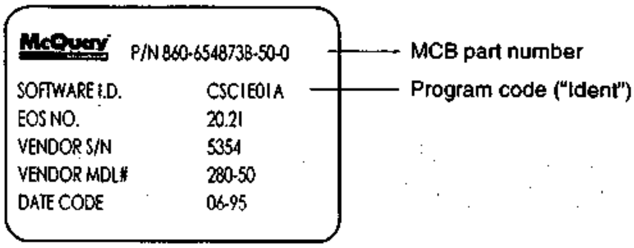
CSC program codification is as follows:

CSC1E01A

- Chiller System Controller
- Program number
  - 1 = Standard software
- Units
  - E = English
  - S = SI
- Version (numeric)
- Version revision (alphabetical)

At the time of this writing, the program codes for standard CSC software are CSC1E01A and CSC1S01A. If your CSC software has a later revision code (for example, CSC1E01B), some of the information in this manual may be inaccurate. However, since only very minor software changes are considered revisions, any inaccuracies should be insignificant.

Figure 10. Software ID Tag



Software Compatibility

Note that CSC1E01A and CSC1S01A are *not* compatible with some earlier versions of MicroTech centrifugal, reciprocating, and screw chiller controller standard software. The current software compatibility is summarized in Table x. The wildcard character (*) can be any letter.

If you want to use a CSC with older chillers that have incompatible standard software, the chiller software must be upgraded. (This applies to all series-100 centrifugal chillers.) If you have a version of chiller software that is later than the compatible programs shown in Table x, it is likely that program CSC1*01* is compatible with it; however, it may not be. To find out for sure, contact McQuayService.

File Names

In all cases, the file names of the compatible programs shown in Table x are the same as the program codes except that they also include a "COD" extension. For example, the file for program PC209A is called "PC209A.COD."

*Table 8. Program Code CSC1*01A Software Compatibility*

Chiller Controller	Compatible Programs	Incompatible Programs
Series-200 Centrifugal	CFG1*01C	CFG1*01A and CFG1*01B
	CFG3*01C	CFG3*01A and CFG3*01B
	CFG5*01C	CFG5*01A and CFG5*01B
Series-100 Centrifugal: Display Proc.	PDR09A	PDR08* and earlier
	PDM09A	PDM08* and earlier
Series-100 Centrifugal: Control Proc.	PC209A	PC208* and earlier
	PC409A	PC408* and earlier
	PC509A	PC508* and earlier
Reciprocating	RCP1*01B	RCP1*01A
	RCP2*01B	RCP2*01A
	none	AWR-*12* and earlier
Screw	SC2-*18D	SC2-*18C and earlier
	SC24*18D	SC24*18C and earlier
	SC3-*18C	SC3-*18B and earlier
	SC34*18C	SC34*18B and earlier

Accessories

The accessories for the CSC allow for additional analog inputs, analog outputs, digital inputs, and digital outputs. The components that make these additional inputs and outputs possible are the Input Conditioning Module (ICM), the Analog Output Expansion Module (AOX-4), and the Solid-State Relay Kit (SSR). The modem kit is an option that allows remote or off-site PC monitoring and control of the CSC when used with Monitor software. See Table 9 for the installation manuals on the different accessories.

Table 9. Accessories Installation Manuals

Accessory	Installation Manual
Input Conditioning Module (ICM)	IM 605
Analog Output Expansion Module (AOX-4)	IM 607
Solid-State Relay Kit (SSR)	IM 606
Modem Kit	IM 564

Input Conditioning Module

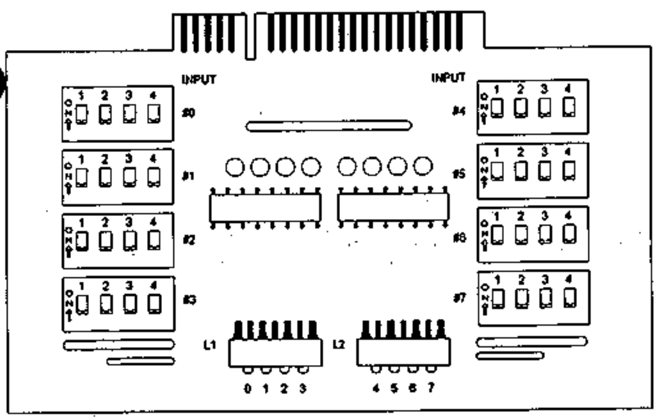
The Input Conditioning Module (ICM) (see Figure 11) allows the user to add eight analog and eight digital inputs to the CSC. The ICM is inserted into the edge card connector on the ICM Terminal Board. A maximum of three ICMs can be used on the CSC providing up to 24 analog and 24 digital inputs. An input conditioning switch on the ICM selects what type of analog input is needed.

Following are the four types of analog inputs available:

- 3K Ω thermistor
- 4–20 mA signal (4-wire type)
- 0–5 Vdc signal (1–5 Vdc actual)
- 0–10 Vdc signal (2–10 Vdc actual)

The digital inputs must be a dry contact closure. When contact closure is made, an LED on the ICM illuminates indicating which input is active. For more information on the Input Conditioning Module (ICM), see Bulletin No. IM 605, *MicroTech Input Conditioning Module.*

Figure 11. Input Conditioning Module (ICM)



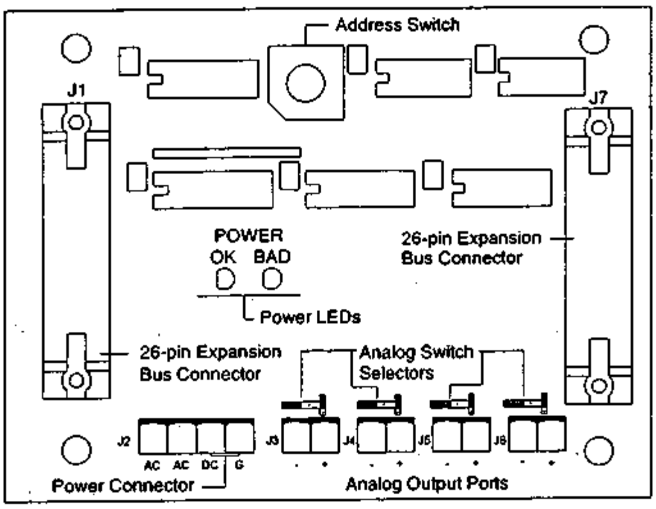
Analog Output Expansion Module

The Analog Output Expansion Module (AOX-4) (see Figure 12) provides variable voltage or current output control signals from the CSC to two different current and voltage ranges. The AOX-4 is inserted into the snap track of the CSC. Up to three AOX-4 boards can be installed providing a maximum of 12 output channels. Jumpers on the AOX-4 allow the user to configure the output ports to one of the following current/voltage selections:

- 0–5 Vdc
- 0–10 Vdc
- 0–5 mA
- 0–20 mA

For more information on the Analog Output Expansion Module, see Bulletin No. IM 607, *MicroTech Analog Output Expansion Module.*

Figure 12. Analog Output Expansion Module (AOX-4)



Solid State Relay Kit

The Solid-State Relay Kit consists of a package of eight AC power rated output relays. The relays plug into the 24-channel Output Board (OB) in the CSC. If other types of relays are needed, such as dry contact or DC power rated, they can be ordered as individual units (see "Parts List"). For more information on the Solid-State Relay Kit, see Bulletin No. IM 606, *MicroTech Solid-State Relay Kit.*

Modem Kit

The Modem Kit allows communications between a MicroTech controller or network of controllers and a remote or off-site PC. The modem kit contains a 14.4K baud rate modem and an interface cable that connects directly to port A of the controller. For more information on the Modem Kit, see Bulletin No. IM 564, *MicroTech Modem Kit.*

MicroTech Monitoring and Networking Options

PC Monitoring

A PC (personal computer) equipped with the appropriate Monitor software can be used to provide a high-level interface with a MicroTech network (see PC specification below). Monitor software features a Windows™-based display, multilevel password access, and advanced trend-logging. The PC can be connected to the CSC controller either directly, via a single twisted, shielded pair cable, or remotely, via phone lines with an optional modem. For more information on connecting the PC to the controller, refer to "PC Connection" in the "Field Wiring" section of this manual.

For the most convenience and best operation, the PC should be considered dedicated to the MicroTech system. However, you can exit the Monitor program to perform other tasks without affecting equipment control. Refer to the user's manual supplied with the Monitor software for additional information.

PC Specification

A direct or remote connected computer can be used for monitoring CSC and unit operation, changing setpoints, scheduling, trend logging, downloading software, and diagnostics. The PC must be an IBM or 100% true compatible. Table 10 shows the preferred and minimum PC specifications.

Network Master Panel

The MicroTech Network Master Panel (NMP) allows the CSC and its associated units to be incorporated into a building-wide network with other MicroTech unit and auxiliary controllers. In conjunction with a PC and Monitor software, it gives the building operator the capability to perform advanced equipment control and monitoring from a central or remote location. The following features are provided by the optional NMP:

- Remote unit monitoring
- Advanced scheduling features
- Advanced alarm management
- Global operator override by unit type
- Demand metering
- Historical electrical data logging

Open Protocol

MicroTech Open Protocol™ provides an interface between the CSC and the building automation system of one of many participating manufacturers. With Open Protocol, the building automation system can do the following:

- Monitor CSC schedule statuses
- Monitor most controller setpoints, parameters, and alarms
- Set most controller setpoints and parameters
- Set up multiple-unit control groups

In an Open Protocol application that includes a CSC, the MicroTech Open Protocol Master (OPM) Panel is not required because the CSC performs its functions. For fur-ther information, contact your McQuay sales representative.

Table 10. PC Specification

Preferred Configuration	Minimum Configuration
486DX processor, 66MHz or better	386SX processor, 16 MHz
8 MB of RAM or better	4 MB of RAM
120 MB hard disk drive or better	60 MB hard disk drive
3½" floppy disk drive	3½" floppy disk drive
Serial port (9 pin male)	Serial port (9 or 25 pin male)
Parallel port	–
Internal time clock, battery backed	Internal time clock, battery backed
Super VGA graphics capability	VGA graphics capability
Super VGA monitor	VGA monitor
Printer	–
Bus mouse or trackball	Serial mouse or trackball*
101 enhanced keyboard	101 enhanced keyboard
9600 baud modem, compatible with the AT command set (optional)	1200 baud modem, compatible with the AT command set (optional)
MS-DOS® 6.2 or higher	MS-DOS® 5.0
Microsoft® Windows™ 3.1 or higher	Microsoft® Windows™ 3.1
MicroTech® Monitor™ *for Windows* software	MicroTech® Monitor™ *for Windows* software

* If a serial pointing device is used, there must be another serial port available for connecting the PC to the MicroTech controller.

Panel Location and Mounting

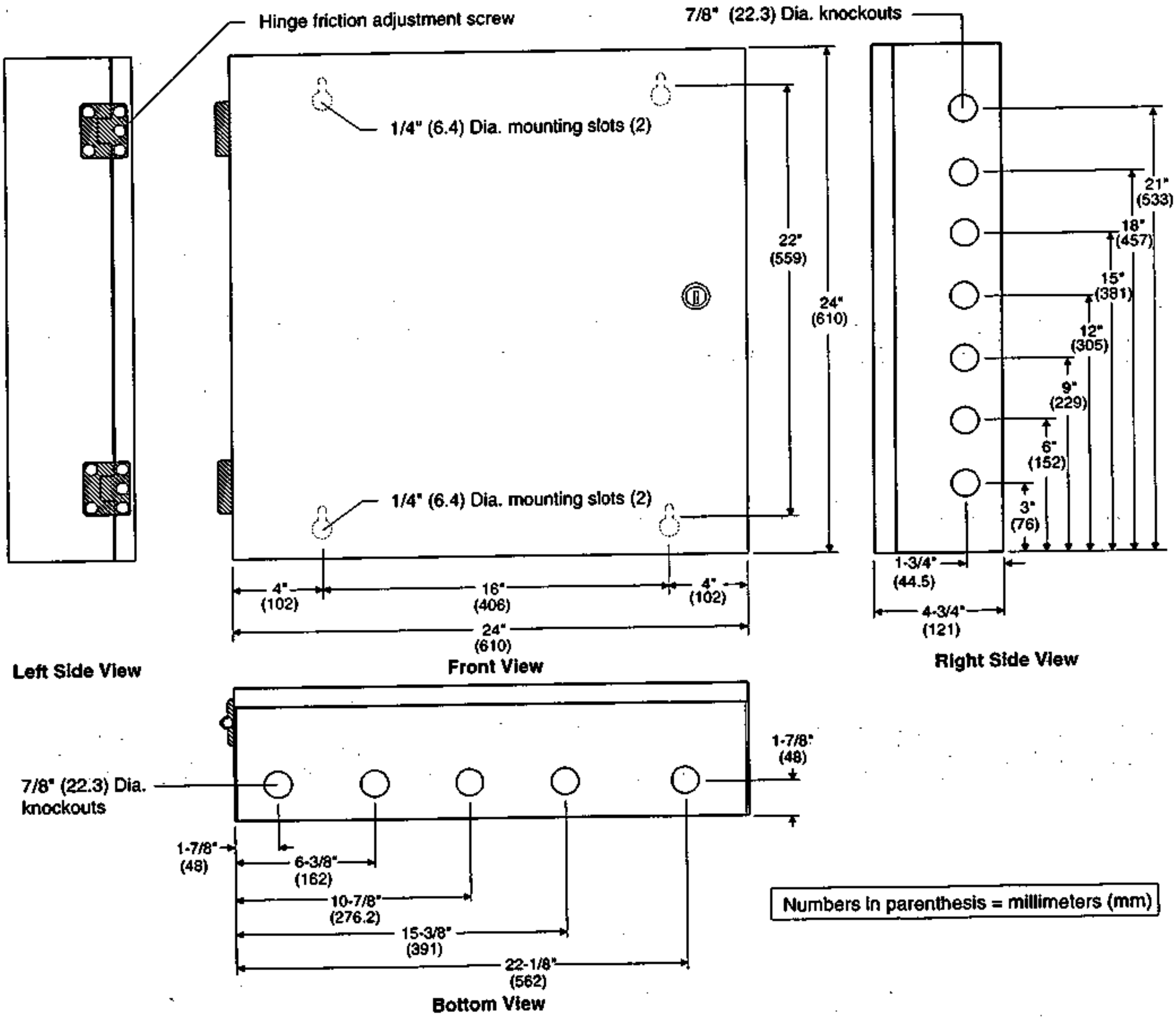
The CSC is suitable for indoor use only. Table 11 lists the allowable temperature and humidity ranges. Locate the panel at a convenient height, and allow adequate clearance for the door swing. Mount the panel to the wall with screws or bolts. Four ¼-inch openings are provided at the corners of the panel. The panel weighs approximately 60 lbs. (27 kg). Figure 13 shows the panel dimensions.

The CSC is equipped with special door hinges that have a friction adjustment screw. By adjusting this screw you can prevent the panel door from swinging open or closed unexpectedly.

Table 11. CSC Environmental Specifications

Panel State	Temperature	Relative Humidity
Operating	30 – 100°F (–1 – 38°C)	10 – 95% (noncondensing)
In storage	0 – 125°F (–18 – 52°C)	10 – 95% (noncondensing)

Figure 13. CSC Dimensions



Sensor Installation

Figures 14 and 15 show the dimensions of the water temperature sensors and thermowell used with the CSC.

All temperature sensors are negative temperature coefficient thermistors.

The brass well screws into ½–inch NPT saddle or Thredolet® fitting furnished by the installing contractor. The brass well will withstand a maximum temperature of 250°F and a maximum static pressure of 250 psig.

Figure 14. Immersion Sensor

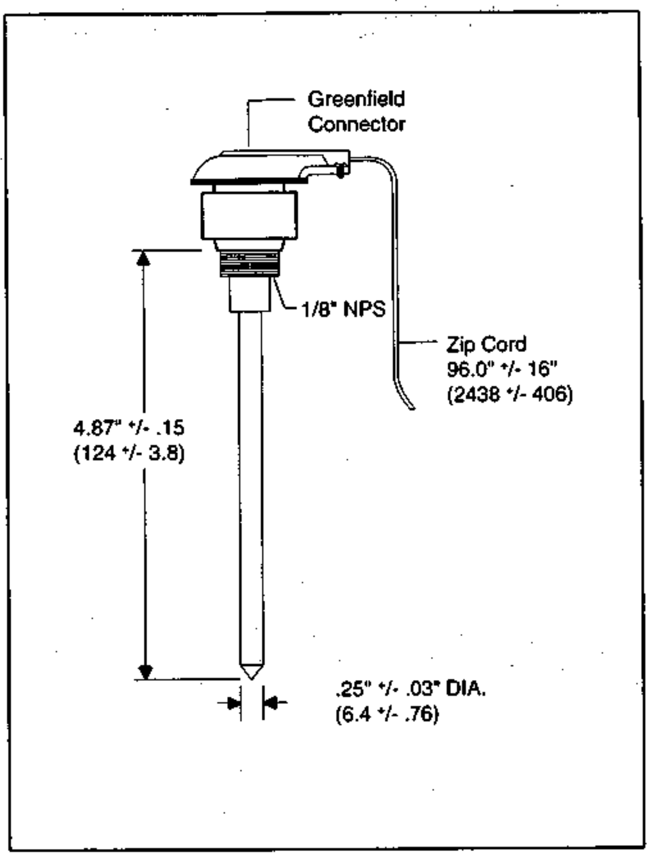
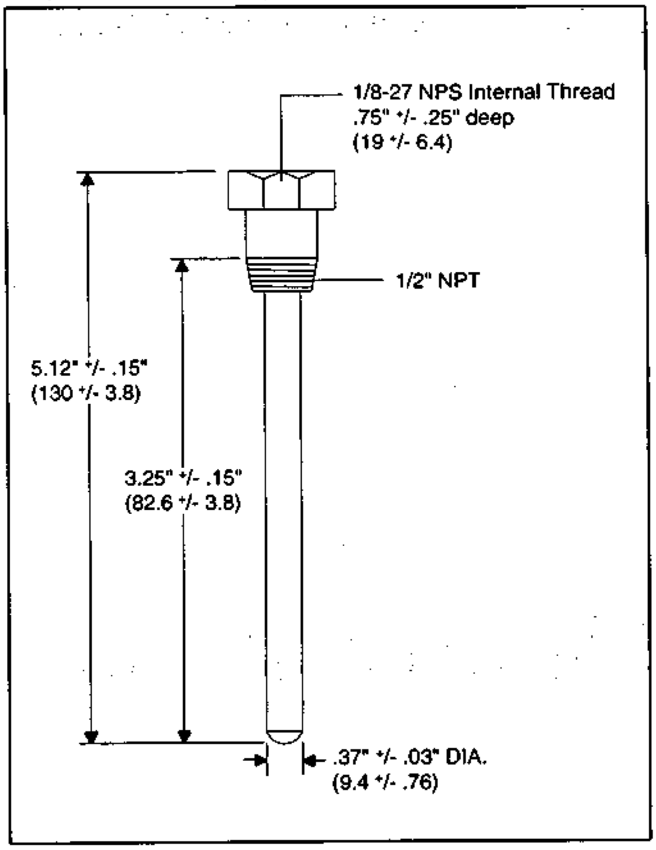


Figure 15. Brass Thermowell



Field Wiring

Following are descriptions of the various field wiring requirements and options. A typical field wiring diagram is shown in Figure 16. Wiring must comply with the National Electrical Code and all local codes and ordinances. The warranty is void if wiring is not in accordance with these instructions.

The panel is separated into high and low voltage sections. The power wiring should enter the bottom knockout on the right side of the panel in the high voltage section. Wiring from the Output Board should enter through one of the ⅞-inch knockouts in the high voltage section. Communications wiring, wiring to the ICM Terminal Board, and wiring to the AOX-4 should enter through the top of the panel in the low voltage section through one of the ⅞-inch knockouts provided.

Note: High voltage wires should not pass through the low voltage section and the low voltage wires should not pass through the high voltage section.

Power

⚠ WARNING

Electric shock hazard.
Can cause personal injury or death.

This equipment must be properly grounded.

All protective deadfront panels must be reinstalled and secured when power wiring is complete.

The CSC requires a 115 Vac power supply. The supply connects to terminals L1 and L2 in the high voltage section of the panel. The panel must be properly grounded by connecting the ground lug (GRD) to earth ground. Refer to Figure 16. Power wiring must be sized to carry at least 5 amps.

To gain access to the high voltage section, remove the deadfront barrier. It is attached to the panel with five 5/16-inch hex screws. Replace this deadfront when the wiring is complete.

Network Communications

For network communications to occur, a twisted, shielded pair cable must be connected between the CSC and its associated MicroTech unit or network controllers. This interconnecting, "daisy-chain" wiring is shown in Figure 16. Network communications is accomplished using the RS-485 interface standard at 9600 baud.

About MicroTech Network Architecture

All controllers in a MicroTech network are assigned a "level": level 1, level 2, or level 3. All networks must have one level-1 controller to coordinate communications. Multiple level-2 controllers connect to the level-1 controller with a communications "trunk," an isolated section of the daisy-chained network wiring. In Figure 16, the network wiring between all controllers is a trunk. Multiple level-3 controllers can be connected to a level-2 controller with a separate trunk. *The maximum allowable length of a communications trunk is 5000 feet.*

Cable Specification

The network communications cable must meet the following minimum requirements: twisted, shielded pair with drain wire, 300 V, 60°C, 20 AWG, polyethylene insulated, with a PVC outer jacket (Belden 8762 or equivalent). Some local codes or applications may require the use of plenum rated cable. *Do not install the cable in the same conduit with power wiring.*

Note: Ideally, one continuous piece of cable should connect any two controllers. This will reduce the risk of communications errors. If the cable must be spliced, use crimp-type butt connectors (good) or solder (best). Do not use wire nuts.

Wiring Instructions

The network connection to the CSC and unit controllers is at port B on their MCB boards. As shown in Figure 8, field wiring to port B on these controllers can be accomplished by connecting the network cable to terminals B+, B–, and GND in the CSC; terminals 84, 85, and 86, in each 200-series centrifugal chiller, terminals 137, 138, and 139 in each reciprocating chiller, and terminals 53, 54, and 55 in each screw chiller.

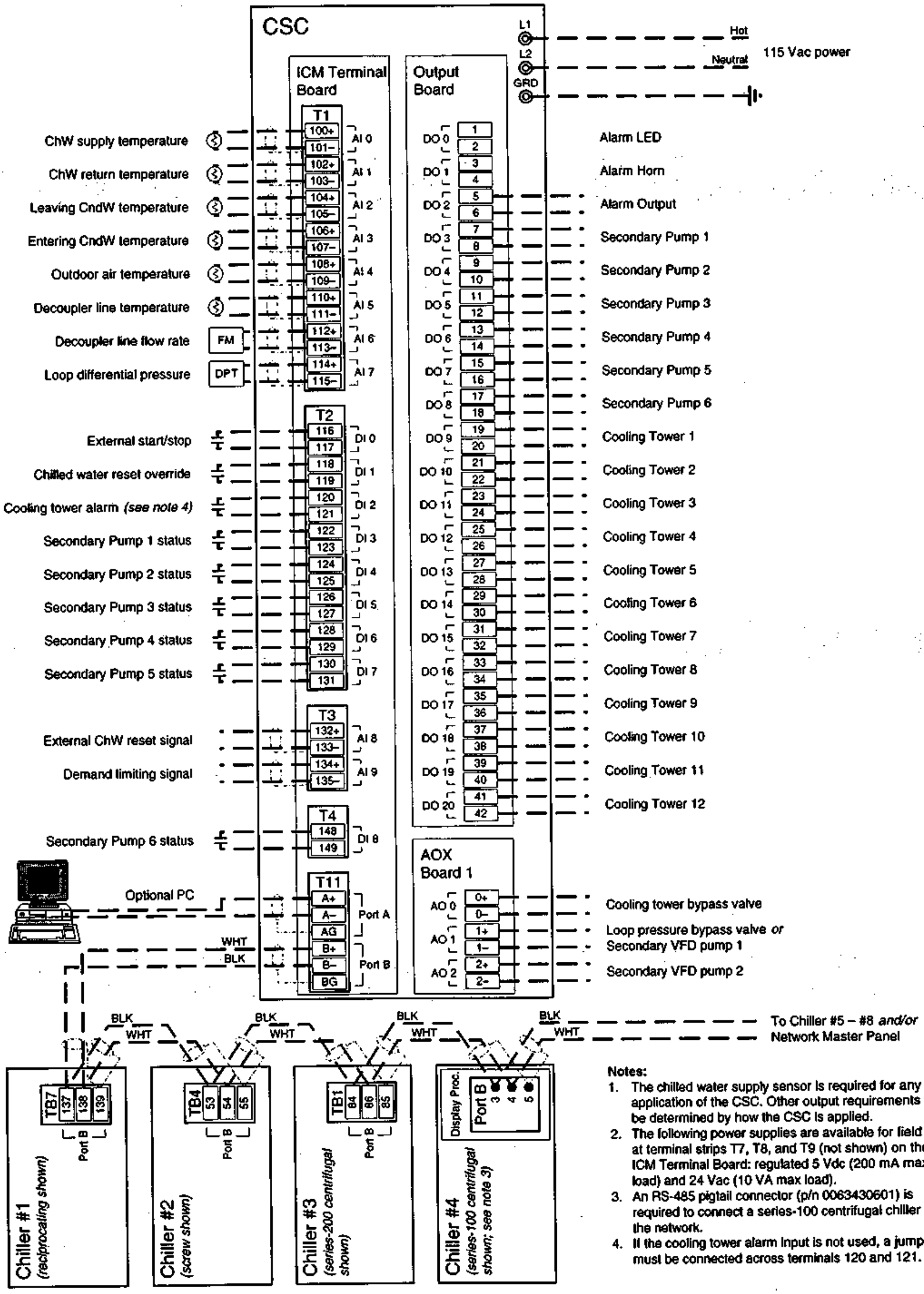
Note that the chiller designations shown in Figure 16 ("Chiller #1" through "Chiller #4"), are established by the network address, not the physical position of the unit in the daisy chain. The networked controllers can be wired in any order. For example, the CSC could be connected between Chiller #1 and Chiller #2. *It is highly recommended that the installing contractor keep track of the physical order of the controllers on the daisy-chained trunk.* This will facilitate troubleshooting any network communications problems that may occur. For more on the network address, see "Addressing the Controllers" in the "Network Commissioning" section of this manual.

Use the following procedure to perform the network wiring:

1. Before beginning, verify that the port B plug is disconnected from every controller on the communications trunk being wired. These plugs will be connected during the commissioning procedure. This precaution prevents stray high voltage from damaging the controllers. Any voltage more than 12 V can damage the board's communications drivers.

2. Connect the network cable in a daisy-chain manner as shown in Figure 16. Use caution to ensure that the correct polarity is maintained at each controller. Be sure to connect each cable's shield to the controllers as shown in the figure. The positive (+), negative (–), and shield (ground) conductor must be continuous over the trunk.

Figure 16. CSC Field Wiring Schematic



Notes:

1. The chilled water supply sensor is required for any application of the CSC. Other output requirements will be determined by how the CSC is applied.
2. The following power supplies are available for field use at terminal strips T7, T8, and T9 (not shown) on the ICM Terminal Board: regulated 5 Vdc (200 mA max load) and 24 Vac (10 VA max load).
3. An RS-485 pigtail connector (p/n 0063430601) is required to connect a series-100 centrifugal chiller into the network.
4. If the cooling tower alarm input is not used, a jumper must be connected across terminals 120 and 121.

PC Connection

Regardless of whether a PC is connected directly or remotely via phone lines, the connection to any MicroTech controller is at port A on the MCB. It is best to connect a PC to a level-1 controller because faster data transmission will result; however, a PC can be connected to any level-2 controller that does not have level-3 controllers associated with it. Either way, the PC will have access to the entire network (see note below). In the typical application, the CSC is a level 1, and the chillers are level 2. See "Network Communications" above for more on network architecture.

It is possible to connect two or more PCs to the network, but only one PC can be connected to any one controller. The PC that is used most often should be connected to the level-1 controller for better performance. For example, you may have one PC at the building that you use during the week and another PC at home that you occasionally use on weekends. In this situation, you may want to connect the on-site PC to the level-1 controller and the modem for the off-site PC to a level-2 controller.

Note: If a PC is connected to a level-2 controller, a level-1 controller must be set up to poll that level-2 controller so that the PC will have access to the entire network. For information on how to set up the level-1 controller to poll the level-2 controller, see the operation manual for the particular controller being used.

Direct Connection

An RS-232 communications cable kit allows a PC to directly connect to any MicroTech controller. It is available from McQuay International. The cable has a female DB9 connector for connection to the PC's 9-pin serial port. (If the PC has a 25-pin serial port, obtain an adapter.) The cable length is 12 feet. If more length is required, a twisted, shielded pair cable can be spliced into the kit cable (see "Cable Specification" below). If this is done, splice the conductors with crimp-type butt connectors (better) or solder (best).

Do not use wire nuts. *The maximum allowable cable length for direct connection between the PC and a controller is 50 feet.* If additional length is needed, an RS-232 Cable Extension Kit (P/N 0065487001) is available from McQuay (see Bulletin No. IM 482).

Remote Connection

An analog, direct-dial telephone line is required for remote or off-site PC access to the network. The phone line should be terminated with a standard RJ-11 modular phone plug. A modem enables a remote or off-site PC to communicate with the networked controllers via phone lines.

A modem kit that can be field installed in a MicroTech controller is available from McQuay International. The kit comes complete with a 14,400 baud modem (set up for 9600 baud) and an interface cable. If a remote PC connection is required, it is recommended that the modem at the MicroTech controller be supplied by McQuay International.

Installation and wiring instructions for the modem kit are included in Bulletin No. IM 564, *MicroTech Modem Kit.* This bulletin is included with the kit.

Cable Specification for Direct PC Connection

A properly terminated, twisted, shielded pair cable is required to directly connect a PC to a MicroTech controller. The cable must meet the following minimum requirements: twisted, shielded pair with drain wire, 300 V, 60°C, 20 AWG, polyethylene insulated, with a PVC outer jacket (Belden 8762 or equivalent). It must also be properly terminated to an AMP plug on one end and a female DB9 or DB25 connector on the other. See Figures 15 and 16 for cable pinouts.

The DB9 or DB25 connector is for connection to a 9-pin or 25-pin serial port on the PC. Note that some local codes or applications may require the use of plenum rated cable. *Do not install the cable in the same conduit with power wiring.*

Note: A factory-assembled cable that meets the above specification is provided with the PC Communications Cable Kit. This cable has a DB9 connector.

Figure 17. RS-232 Cable Pinouts for 9-Pin Serial Ports (AMP Connector)

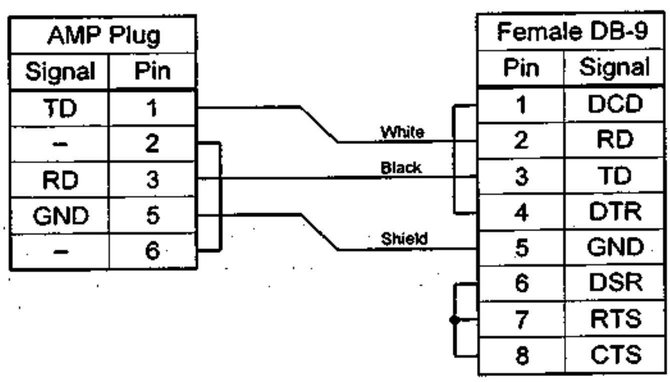


Figure 18. RS-232 Cable Pinouts for 25-Pin Serial Ports (AMP Connector)

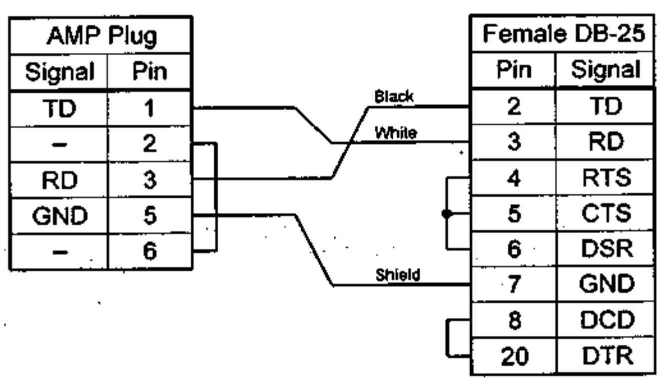


Table 12. Analog/Digital Inputs and Outputs

	AI										DI				AO			DO					
CSC Feature	**Common ChW Supply Temp**	**Common ChW Return Temp**	**Leaving CndW Temp** (1)	**Entering CndW Temp** (1)	**Outdoor Air Temperature** (2)	**Decoupler Temp**	**Decoupler Flow Rate**	**ChW Loop Differential Press**	**Ext ChW Reset Signal**	**Ext Demand Limiting Signal**	**External Start/Stop**	**ChW Reset Override**	**Cooling Tower Alarm**	**Secondary Pump 1–6 Status**	**Cooling Tower Bypass Valve**	**ChW Loop Bypass Valve or Secondary Pump VFD**	**Secondary Pump VFD 2**	**Alarm Output**	**Secondary Pump 1**	**Secondary Pump 2**	**Secondary Pump 3–6**	**Cooling Tower 1**	**Cooling Tower 2–12**
Standard chiller sequencing control	✓																						
Decoupled chiller sequencing control	✓					✓	✓																
External Demand limiting										✓													
Unit leaving chilled water control																							
Common lvg. chilled water control	✓																						
External reset									✓			O											
Outdoor air temperature reset					✓							O											
Return ChW temperature reset		✓										O											
Constant return ChW temp. control		✓										O											
ChW loop bypass valve control								✓								✓							
Secondary pump control: VFD								✓						✓		✓	O		✓	O			
Sec. pump control: Sequenced								✓						✓					✓	✓	O		
Sec. pump control: Lead/standby														✓					✓	O			
Cooling tower staging control			O	O									O									✓	O
Cooling tower bypass valve control			O	O	O										✓								
Optimal start	✓	✓			✓																		
Nontimed schedule override											✓												
External timeclock scheduling											✓												
Remote alarm indication																		✓					

✓ Input or output required
O Input or output optional

Notes:

1. Cooling tower staging and cooling tower bypass valve control require either a leaving condenser water temperature sensor or an entering condenser water temperature sensor.
2. The CSC can also get the outdoor air temperature via network communications from a Network Master Panel or a building automation system with Open Protocol.

Analog Inputs

When connecting any analog input device to the CSC, the field wiring connection is made at the ICM Terminal Board (see "Wiring Instructions" below). Table 12 shows several CSC features and their required analog inputs.

Note: All analog inputs have fixed locations (see Figure 16).

⚠ CAUTION

Ground loop current hazard.
Can cause equipment damage.

External 4-20 mA signals must be isolated from any ground other than the MicroTech controller chassis ground. If they are not, ground loop currents could occur which could damage the MicroTech controller. If the device or system providing the external signal is connected to a ground other that the MicroTech controller chassis, be sure that it is providing an isolated output, or condition the output with a signal isolator.

Chilled Water Supply Temperature Sensor

The common chilled water supply temperature sensor is used when standard chiller sequencing control, decoupled chiller sequencing control, or common leaving chilled water control is required. See Figure 1, *"Typical Chilled Water System"* for the location of the chilled water supply temperature sensor.

When using standard chiller sequencing control, the common chilled water supply temperature sensor is used by the CSC to determine when a system capacity increase by one stage is needed. The increase is determined when the leaving chilled water temperature is greater than the common chilled water supply temperature by more than an adjustable differential.

When using decoupled chiller sequencing control, the common chilled water supply temperature sensor is used by the CSC to determine when a system capacity increase by one stage is needed. The increase is determined when the decoupler line temperature is greater than the common chilled water supply temperature by more than an adjustable differential.

When using common leaving chiller water temperature control, the common chilled water supply temperature sensor is used by the CSC to set the Chiller Setpoint.

Chilled Water Return Temperature Sensor

The common chilled water return temperature sensor is used when return chilled water temperature reset or constant return chilled water temperature reset is required. See Figure 1, "*Typical Simple Chilled Water System*" for the location of the chilled water return temperature sensor.

When using return chilled water temperature reset, the System Setpoint is determined by the common chilled water return temperature.

When using the constant return chilled water temperature reset, the System Setpoint is reset by a constant return Change-and-Wait function to maintain the common chilled water return temperature.

Condenser Water Temperature Sensors

The condenser water temperature sensors are used for cooling tower staging control and cooling tower bypass valve control.

When cooling tower stage control is required, the first tower stage will be turned on when the common entering condenser water temperature exceeds the Stage 1 Setpoint (adjustable on the CSC's keypad menu 18 or using Monitor software).

When cooling tower bypass valve control (optional) is used, the CSC will maintain the common entering condenser water temperature at the Valve Setpoint or Stage Setpoint (adjustable on the CSC's keypad menu 18 or using Monitor software).

Note: Cooling tower staging control and cooling tower bypass valve control each require either a leaving condenser water temperature sensor or an entering condenser water temperature sensor.

Outdoor Air Temperature Sensor

The outdoor air temperature sensor is used to reset each chiller's leaving evaporator water temperature setpoint to equal the common chilled water supply temperature.

Decoupler Temperature Sensor

The decoupler temperature sensor is used when decoupled chiller sequencing control is required. See Figures 3a through 3d for the locations of the decoupler line temperature sensor.

The decoupled chiller sequencing control will increase the system capacity by one stage when the decoupler line temperature is greater than the common chilled water supply temperature by more than an adjustable differential.

Decoupler Flow Rate Sensor

The decoupler flow rate sensor is used by the CSC to determine when the system capacity should be decreased by one stage. See Figures 3a through 3d for the location of the decoupler flow rate sensor.

When the flow rate from supply to return in the decoupler line is greater than the flow rate of the next chiller(s) to be staged off by more than the adjustable differential, the system capacity may be reduced by one stage. Note that since flow is only measured from supply to return, a unidirectional flow meter is sufficient.

Chilled Water Loop Differential Press. Transducer

The chilled water loop differential pressure transducer is used when chilled water loop bypass valve control, secondary pump control, or secondary pump control variable speed is required. See Figure 3b, *Variable-Speed Secondary Pump,"* Figure 3d, *"Sequenced Secondary Pumps,"* and Figure 4, *Pressure-Controlled Loop Bypass"* for the locations of the chilled water loop differential pressure transducer.

When chilled water loop bypass valve control is used, the chilled water loop differential pressure transducer allows the CSC to modulate a bypass valve as required to maintain an adjustable differential pressure setpoint.

When variable speed secondary pump control is used, the chilled water loop differential pressure transducer allows the CSC to maintain a desired pressure across the chilled water loop using PI (proportional-integral) control.

When sequenced secondary pump control is used, the chilled water loop differential pressure transducer allows the CSC to maintain a constant pressure difference between the secondary and return lines.

External Demand Limiting Signal

An external 1–5 Vdc, 2–10 Vdc, or 4–20 mA signal can be used to provide demand limiting for all chillers included in a CSC network.

Demand limiting prevents chillers from operating above a specified capacity (% RLA for centrifugal; stages for reciprocating and screw). As the demand limiting signal varies between 1–5 Vdc, 2–10 Vdc, or 4–20 mA, the %RLA or maximum number of stages available in each chiller varies. For more on demand limiting, refer to "Demand Limiting" in the "Load Limiting Control" section of Bulletin No. OM 127, *MicroTech Chiller System Controller.*

External Chilled Water Reset Signal

The external reset option resets each chiller's leaving evaporator water temperature according to a 1–5 Vdc, 2–10 Vdc, or 4–20 mA signal.

If the external reset signal is less than or equal to 4 mA (1 Vdc), the System Setpoint will equal the Minimum System Setpoint (adjustable on the CSC's keypad Menu 17 or by a PC using Monitor software). If the external reset signal equals 20 mA (5 Vdc), the System Setpoint will equal the Maximum System (adjustable on the CSC's keypad Menu 17 or by a PC using Monitor software). For more on reset, refer to "Reset" in the "Chilled Water Temperature Control" section of Bulletin No. OM 127, *MicroTech Chiller System Controller.*

Analog Inputs Cable Specifications

The cable for analog inputs must meet the following minimum requirements: twisted, shielded with drain wire, 300 V, 60°C, 20 AWG, polyethylene insulated, with a PVC outer jacket. Depending on the application, either two conductors (Belden 8762 or equivalent) or three conductors (Belden 8772 or equivalent) are required. Note that some local codes or applications may require the use of plenum rated cable. *Do not install the cable in the same conduit with power wiring.*

Digital Inputs

When connecting any digital input device to the CSC, the field wiring connection is made at the ICM Terminal Board (see "Wiring Instructions" below). Table 12 shows several CSC features and their required or optional digital inputs.

Note: All digital inputs have fixed locations (see Figure 16).

External Start/Stop

External start/stop is used when nontimed schedule override or external timeclock scheduling is required.

Using nontimed schedule override (manual switch) or external timeclock scheduling, the CSC will begin the Start-Up of the chillers when the external input is closed. The CSC will begin the shutdown of the chillers when the external input is open.

Chilled Water Reset Override (Optional)

Chilled water reset override is an option that allows the CSC to override the any reset method that is being used.

When the chilled water reset override input is closed, the chilled water supply setpoint will be set to an adjustable minimum value.

Cooling Tower Alarm (Optional)

The cooling tower alarm is an option that will notify the CSC that an alarm has occurred on a cooling tower device.

A double pole-double throw (DPDT) relay (minimum power usage of 30 mA) is required for each output device (e.g., fan) that could fail when the cooling tower alarm input is to be used. Note that the relay is field supplied. The DPDT relay is field wired to the CSC's output board (see "Digital Outputs" in this manual for more information about the Output Board).

Figure 19 shows a cooling tower alarm field wiring diagram which will alarm a fail status only. The figure includes two cooling tower outputs. Note that up to twelve cooling tower outputs can be wired for cooling tower alarms.

When a digital output through the Output Board (Digital Output #9) is sent to the DPDT relay, the cooling tower device will be enabled. When the cooling tower device is enabled, a normally closed contact (TC1) will open. Allowing for a 30 second time delay, a normally open contact (TS1) will close, thus completing the circuit. If TS1 does not close within the 30 second time delay, an alarm will occur. These same events occur in each DPDT relay that is connected to a cooling tower digital output.

Note: *If the cooling tower alarm is not going to be used, place a jumper across terminals 120 and 121 (Digital Input #2) on the ICM Terminal Board.*

Secondary Pump #1–#6 Status – Digital Input #3–8

The secondary pump #1–#6 status inputs enable the CSC to monitor the status of the secondary pumps. One input must be connected to each secondary pump used.

Figure 19. Cooling Tower Alarm Field Wiring

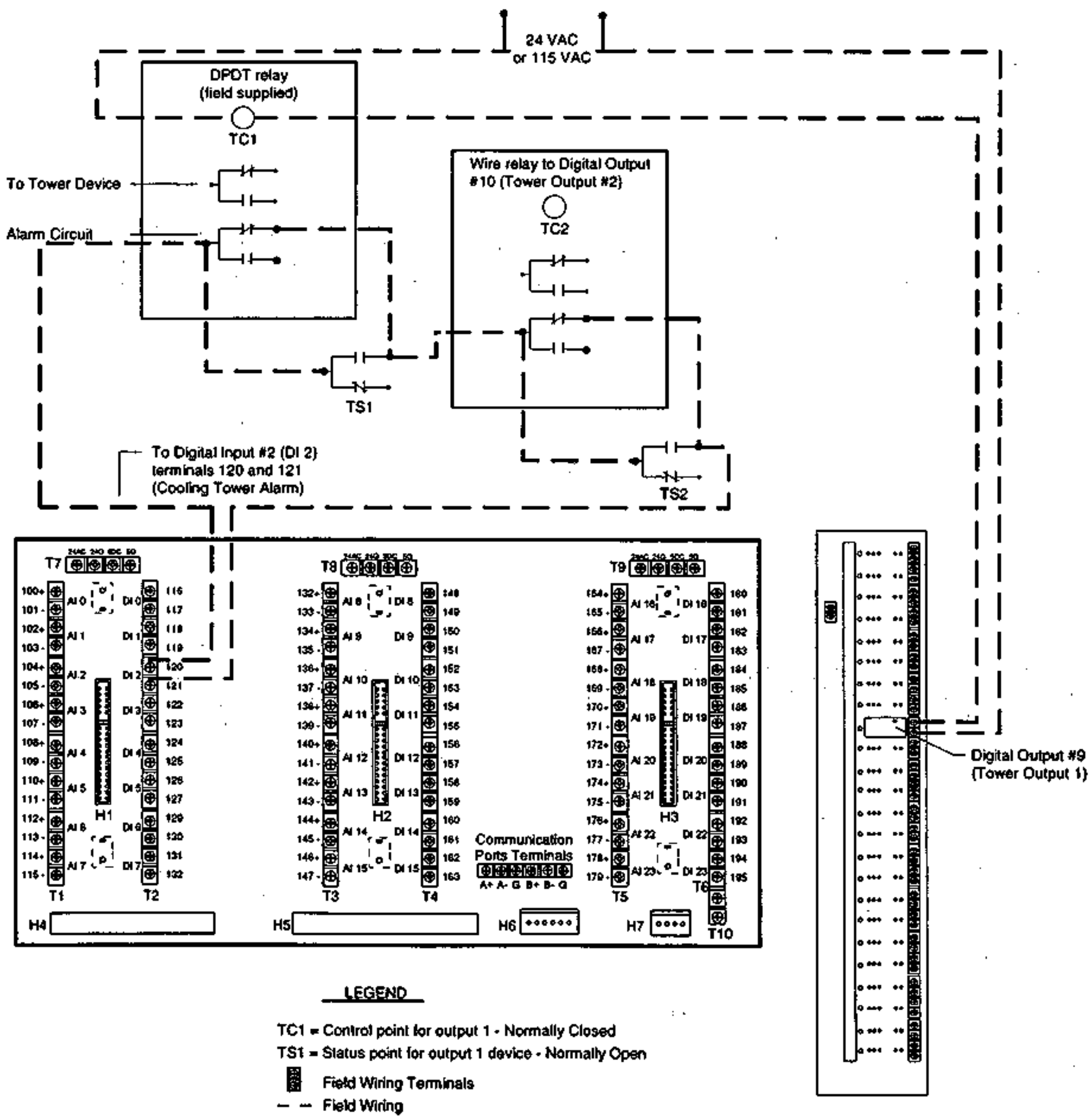
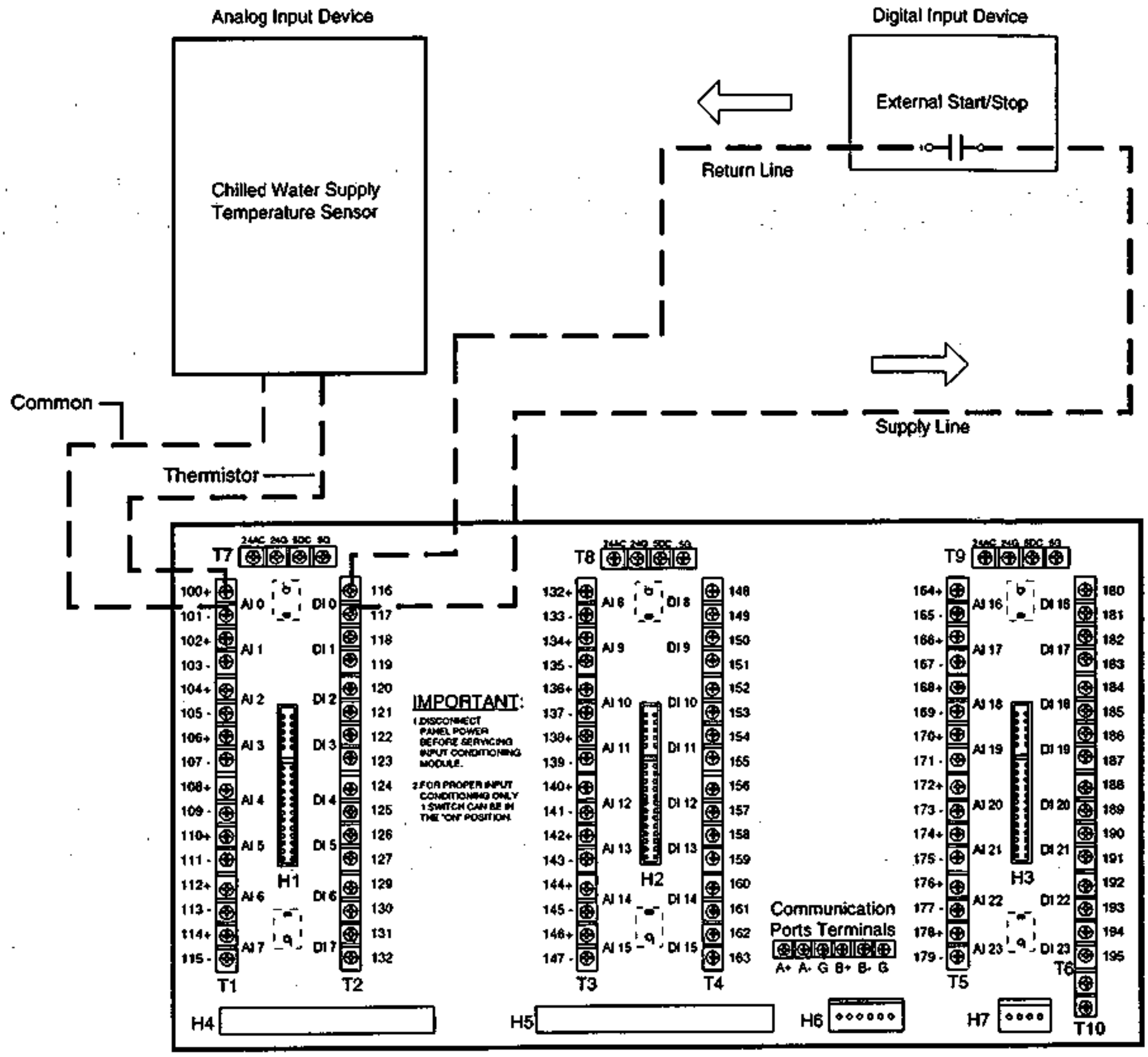


Figure 20. Analog/Digital Input Field Wiring Connection



Analog Outputs

The CSC provides analog output signals from the MCB's Expansion Bus Connector to the Analog Output Expansion Module (AOX-4) via a ribbon cable. The AOX-4 provides a variable voltage or current control signal to the output devices and is powered by the CSC's 13 Vdc power supply. For more information on the AOX-4, see Bulletin No. IM 607, *MicroTech Analog Output Expansion Module*, or refer to the "Analog Output Expansion Module" in the "Accessories" section of this manual.

Note: All analog outputs have fixed locations (see Figure 16).

⚠ CAUTION

Ground loop current hazard.
Can cause equipment damage.

Analog output signals (voltage mode) must be isolated from any ground other than the MicroTech controller chassis ground. If they are not, ground loop currents could occur which could damage the MicroTech controller.

Cooling Tower Bypass Valve

The CSC controls a bypass valve to maintain the either the entering or leaving condenser water temperature at the Valve Setpoint or the Stage Setpoint when condenser flow is confirmed.

Chilled Water Loop Bypass Valve *or* Secondary Pump VFD

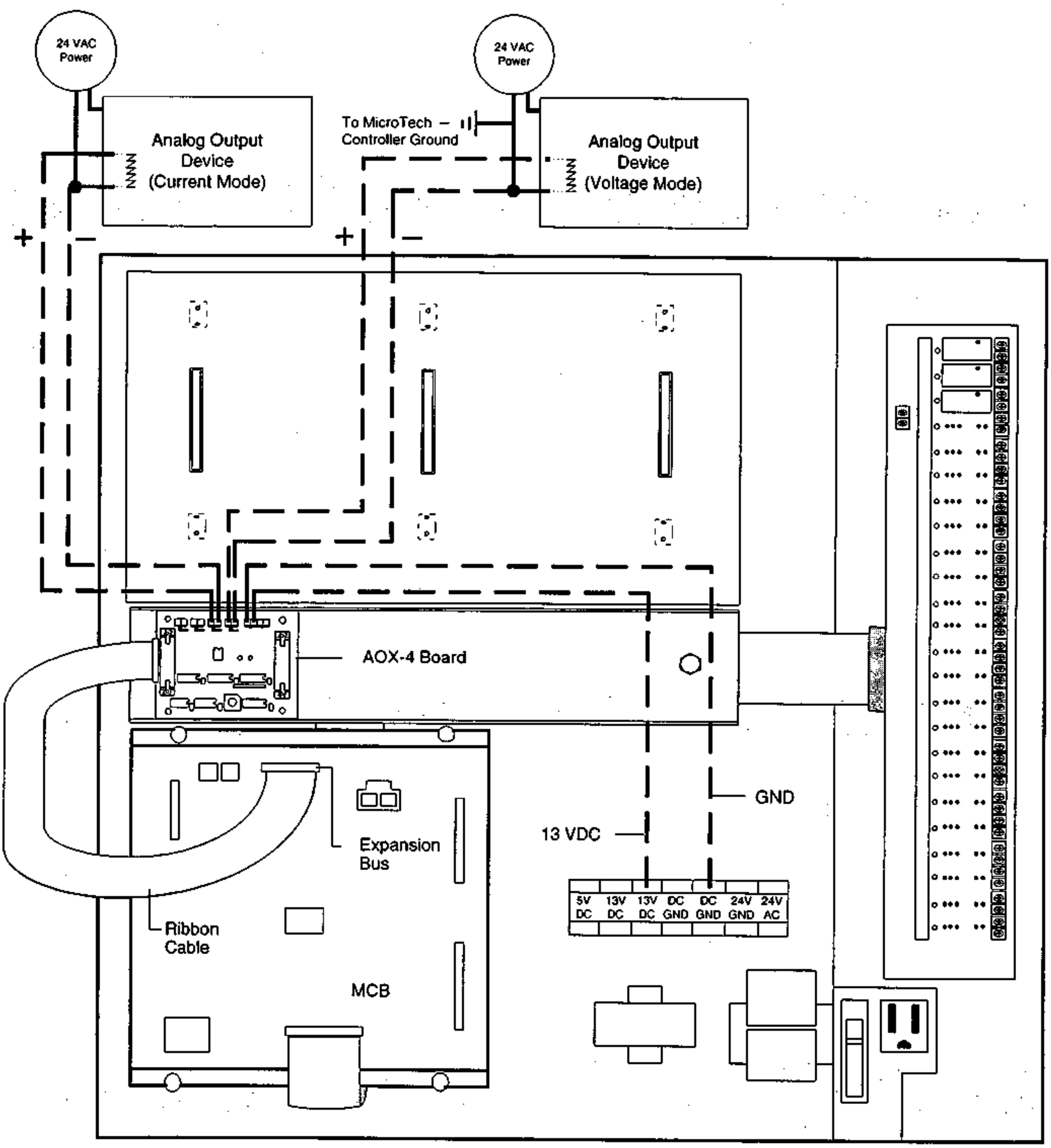
The CSC modulates a chilled water loop bypass valve to maintain an adjustable differential pressure setpoint.

The CSC uses a secondary chilled water pump with variable frequency drive (VFD) to maintain a desired pressure differential across the chilled water loop.

Secondary Pump VFD Pump #2

The CSC can operate two variable speed secondary pumps in either a lead/standby or sequenced control configuration. The output signal at AO2 is always the same as AO1.

Figure 21. Analog Outputs Field Wiring Connections



Digital Outputs

The CSC provides digital output signals from the MCB's Digital Output connector to the Output Board (OB) via a ribbon cable. When the MCB commands a certain output, the designated relay on the OB energizes and drives an AC or DC load. Note that power to loads must be field supplied and the proper relay (AC, DC, or dry contact) must be selected. For more information on the OB, refer to "Output Board" in the "Component Data" section of this manual, or see Bulletin No. IM 606, *MicroTech Solid-State Relay Kit*.

Note: All digital outputs have fixed locations (see Figure 16).

Alarm LED and Alarm Horn

Both the Alarm LED and Alarm Horn are internally wired to DO 0 and DO 1. They are *not intended* for field wiring; however, they can be wired to by installing a relay in the socket.

Alarm Output

The alarm output is used for remote alarm indication (location of an alarm output in a separate location than the CSC).

Secondary Pump 1

The secondary pump 1 digital output is used to start and stop the secondary pump #1. When the proper digital output signal is sent by the CSC through the secondary pump 1 digital output, the secondary pump #1 will start.

Secondary Pump 2–6

The secondary pump 2-6 digital outputs are used (if needed) to start and stop the secondary pumps #2–#6. When the proper digital output is sent by the CSC through the secondary pump 2–6 digital outputs, secondary pumps #2–#6 will start.

Cooling Tower 1

The cooling tower 1 digital output is used to start and stop the cooling tower fan #1 or other device. When the proper digital output is sent by the CSC through the cooling tower 1 digital output, cooling tower fan #1 or other device will start. The CSC will control the tower fan #1 or other device by using the cooling tower staging control feature.

Cooling Tower 2–12

The cooling tower 2–12 digital outputs are used to start and stop the cooling tower fans #2 through #12. When the proper digital output is sent by the CSC through the cooling tower 2–12 outputs, cooling tower fans #2 through #12 will start, depending on what number stage is chosen. The CSC will control the tower stages by using the cooling tower staging control feature.

Network Commissioning

The purpose of network commissioning is to establish and verify communications between the CSC and its associated centrifugal, reciprocating, or screw chillers. (It is not to establish and verify HVAC equipment *operation.*) Network commissioning can be done independently of the unit commissioning procedures; however, *if it is done before the units are commissioned, care should be taken to assure that the chillers do not start.* To do this, see the "CSC and Chiller Controller Initial Setup" section of Bulletin No. OM 127, *MicroTech Chiller System Controller.*

To commission the network, you must be familiar with the operation of the keypad/display. For information, see the "Getting Started" portion of Bulletin No. OM 127.

Before any unit is allowed to operate, it must be commissioned in accordance with the instructions in the MicroTech unit controller installation literature and the model specific unit installation literature (see Tables 1 and 3). In addition, the CSC and its associated unit controllers must be set up so that they work properly together. This setup, which can be done before or after the network is commissioned, is described in Bulletin No. OM 127.

A PC is not required to commission networks that include only CSC(s) and associated chillers because communications can be verified by using the CSC's keypad/display. However, if you want to use a PC to verify network communications, you can. The PC must be equipped with MicroTech Monitor™ software.

Note: The term "HVAC equipment" refers to the different McQuay® and AAF® brand products monitored and controlled in a MicroTech network.

Addressing the Controllers

For network communications to occur, each controller in the network must have a unique network address. A controller's hex switch setting defines its network address. The hex switch setting is determined by the project engineer or the customer. The engineer or customer should prepare a schedule indicating what the hex switch settings on each controller should be. The schedule should then be given to the commissioning technician or engineer so they can set up the software. For more on hex switch settings, see "Microprocessor Control Board" in the "Component Data" section of this manual.

After changing a hex switch setting, power to the MCB must be cycled to set the new address into memory. In the CSC, this can be done by pressing the ON/OFF switch (CB1) to the "OFF" position and back to the "ON" position. In the unit controllers, this can be done in a variety of ways. Refer to the individual installation manuals for more information on cycling power to the MCBs.

A level-1 controller will have a hex switch setting of 00. The level-2 controllers will have hex switch settings between 01 and 40 (64 decimal). There must be no gaps in the level-2 hex switch sequence and no duplicate settings.

The Typical Network

The typical network includes one CSC and one to eight centrifugal, reciprocating, or screw chillers, or a combination of up to eight centrifugal, reciprocating, or screw chillers. It may also include other level-2 unit or auxiliary controllers that could be accessed with a PC via network communications. In this case, the CSC is the level-1 controller and the unit controllers are level-2 controllers. Since the CSC is level 1, its hex switch setting must be 00. The hex switch settings of the level-2 controllers must start at 01 and continue consecutively to a maximum of 40 (decimal 64). There must be no gaps in the sequence and no duplicate settings. As long as these rules are followed, a level-2 controller's hex switches can be set to any value. To keep the system simple, you should consider addressing the chillers according to their designations.

For example, assume that a MicroTech network includes a CSC, two centrifugal chillers, two screw chillers, and one rooftop unit. One possible addressing scheme is as follows:

Hex Switch Setting	Controller
00	CSC
01	Chiller #1 (centrifugal)
02	Chiller #2 (centrifugal)
03	Chiller #3 (screw)
04	Chiller #4 (screw)
05	Rooftop air handling unit

Note: If a PC or modem is connected to a level-2 controller, that controller should have as low an address as possible. This will improve the performance of network communications because it will reduce the required value of the CSC's Total Slaves parameter and thus the amount of polling. For example, if a modem is connected to Chiller #3, you should consider setting Chiller #3's hex switches to "01." See the "CSC and Chiller Controller Initial Setup" section in Bulletin No. OM 127 for more information.

Networks With an NMP

If a CSC is included in a network that has an NMP, the NMP must be the level-1 controller. In this case, a CSC is a level-2 controller and the unit controllers are also level-2 controllers. Since the NMP is level 1, its hex switch setting must be 00. The hex switch settings of the level-2 controllers must start at 01 and continue consecutively to a maximum of 40 (decimal 64). There must be no gaps in the sequence and no duplicate settings. As long as these rules are followed, a level-2 controller's hex switches can be set to any value. Two or more CSCs and multiple units are possible in this type of network.

For example, assume that a MicroTech network includes an NMP, a CSC, two centrifugal chillers, one screw chiller, and one rooftop unit. One possible addressing scheme is as follows:

Hex Switch Setting	Controller
00	NMP
01	CSC
02	Chiller #1 (centrifugal)
03	Chiller #2 (centrifugal)
04	Chiller #3 (screw)
05	Rooftop air handling unit

Networks With Two or More CSCs and No NMP

If two or more CSCs are included in a network that does not include an NMP, one of the CSCs must be the level-1 controller. In this case, the other CSCs are level-2 controllers and the unit controllers are also level-2 controllers. The level-1 CSC's hex switch setting must be 00. The hex switch settings of the level-2 controllers must start at 01 and continue consecutively to a maximum of 40 (64 decimal). There must be no gaps in the sequence and no duplicate settings. As long as these rules are followed, a level-2 controller's hex switches can be set to any value.

For example, assume that a MicroTech network includes two CSCs and ten centrifugal chillers. Each CSC will control and monitor a separate system of five chillers. One possible addressing scheme is as follows:

Hex Switch Setting	Controller
00	CSC "A"
01	CSC "B"
02	Chiller #1 for CSC "A"
03	Chiller #2 for CSC "A"
04	Chiller #3 for CSC "A"
05	Chiller #4 for CSC "A"
06	Chiller #5 for CSC "A"
07	Chiller #1 for CSC "B"
08	Chiller #2 for CSC "B"
09	Chiller #3 for CSC "B"
0A	Chiller #4 for CSC "B"
0B	Chiller #5 for CSC "B"

Note: The only advantage to creating a network like this is to allow a PC access to all networked controllers. If there is no PC, each CSC should be set up as a level-1 controller in a separate network as described above in "The Typical Network."

Note: If a PC or modem is connected to a level-2 controller, that controller should have as low an address as possible. A level-2 CSC should also have as low an address as possible. This will improve the performance of network communications because it will reduce the required value of the level-1 CSC's Total Slaves parameter and thus the amount of polling. For example, if a modem is connected to Chiller #2 for CSC "B" in the above example, you should consider setting the hex switches for CSC "B" to "01" and the hex switches for its Chiller #2 to "02." See the "CSC and Chiller Controller Initial Setup" section in Bulletin No. OM 127.

Minimum Controller Setup

The CSC and the centrifugal, reciprocating, or screw chiller unit controller, require a minimum of setup before the network can be commissioned. For complete information on how to do this, see the "CSC and Chiller Controller Initial Setup" section in Bulletin No. OM 127.

Connecting the Communications Trunk

Use the following three procedures to connect the and chiller controllers to the network.

Communications Cable Check

The network communications cable should have been installed in accordance with the instructions in the "Field Wiring" section of this manual. This procedure will verify that there are no shorts or stray voltages anywhere in the communications trunk.

Before beginning, verify that the port B connectors are disconnected from every controller on the trunk.

1. Verify that there is no voltage between any conductor and ground.

   Use a voltmeter to test for voltage at the field wiring terminal block or directly on the port B connector of the level-1 controller. With one lead on the control panel chassis (ground), check for voltage at the "+," "–," and "ground" terminals. There should be no AC or DC voltage (see the Signal and Terminal columns of Table 13). If the conductors are properly terminated, this check will test for stray voltage throughout the trunk.

   Note: If you get a 2 or 3 Vdc reading, it indicates that one or more powered controllers are connected to the trunk. These controllers should be located and disconnected.

2. Verify that there are no shorts between any two conductors.

   Use an ohmmeter to test for shorts at field wiring terminal block or directly on the port B connector of the level-1 controller. For the three combinations of conductor pairs, there should be infinite resistance between the conductors. If the conductors are properly terminated, this check will test for shorts throughout the trunk.

   Note: If you find a resistance that is high but less than infinite, it indicates that one or more non-powered controllers are connected to the trunk. These controllers should be located and disconnected.

3. Verify that the communications wiring is continuous over the trunk and that the field terminations are correct. (This step is optional but recommended; to do it, you must know the physical layout of the network's communications trunk.)

   Go to the last controller on one end of the daisy-chain and place a jumper across the "+" and "–" terminals. Then go to the last controller on the other end of the daisy-chain and use an ohmmeter to test for continuity across the "+" and "–" terminals.

   Remove the jumper and repeat this step for the other two conductor pairs: "+" to "ground" and "–" to "ground."

   If there is continuity for each conductor pair, the wiring is continuous and it is likely (but not guaranteed) that the terminations are correct throughout the trunk.

   If there is no continuity for one or more conductor pairs, there may be a break in the trunk or the terminations at one or more controllers may have been mixed up.

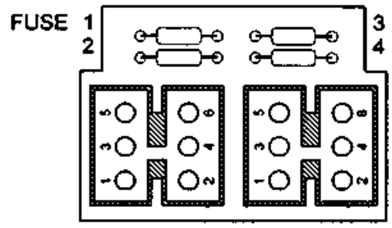
Table 13. Port B Voltages: AMP Type Connector

Port B (RS-485)		
Signal	Terminal	Acceptable Voltage Reading
+	4	3.0 ± 0.3 Vdc
–	3	2.0 ± 0.3 Vdc
Ground	5	0.0 ± 0.2 Vdc

Table 14. Network Communications Field Wiring Terminals

Controller	Network Comm. Field Terminal		
	+	–	Ground
CSC	T11-B+	T11-B–	T11-GND
200-Series Centrifugal Chiller	TB1-86	TB1-84	TB1-85
Reciprocating Chiller	TB7-138	TB7-137	TB7-139
Screw Chiller	TB4-54	TB4-53	TB4-55

Figure 22. AMP Connector Terminal Configuration



PORT A PORT B
COMMUNICATIONS
[FUSE: BUSSMAN MCR-1/4]

Level-1 Controller Connection

In order for the chillers and other level-2 controllers in a network to connect and communicate with the CSC, the CSC is connected first.

1. Set the network address to 00 (level 1). See "Addressing the Controllers" above for more information.

2. Push the circuit breaker (CB1) button to power up the CSC and verify that there is power to the MCB by observing the LEDs.

3. Check the voltages of port B on field wiring terminals (T11).

   Use a DC voltmeter to test for proper voltages. With the ground lead on the control panel chassis (ground), check the voltage at the "+," "–," and "ground" terminals. Refer to Table 13 for the correct voltage levels.

   If no voltage or improper voltage levels are found, verify that the panel is energized.

4. Plug the network communications AMP connector into port B.

Level-2 Controller Connection

This procedure will verify that proper communications have begun for each controller as it is connected to the network. You can connect the level-2 controllers in any order; however, it is better to follow the daisy-chain as you proceed. This will make troubleshooting easier if communications problems occur.

As a result of the previous procedures, the network communications connector should be disconnected from the B port at every controller on the trunk except for the CSC. Be sure that this is true before beginning this procedure.

For communications to occur, each networked controller must have the proper hex switch setting and the proper voltages at its port B terminals.

1. Set the network address (hex switch setting) to match the address on the engineering schedule. Each controller must have a unique address.

2. Turn on power to the level-2 controller. Refer to the controller installation manuals for information on how to turn on power to each controller.

3. Check the voltages of port B directly on the AMP connector. The trunk must not be connected to the controller when you do this.

   Use a DC voltmeter to test for proper voltages. With the ground lead on the control panel chassis (ground), check the voltage at the "+," "–," and "ground" terminals. Refer to Table 13 for the correct voltage levels.

   If no voltage or improper voltage levels are found, verify that the controller is energized.

4. Check for proper communication trunk voltages at the field wiring terminals (if any) or directly on the connector. The trunk must not be connected to the controller when you do this.

   If no voltage or improper voltages are found, check the wiring between the port terminals and the field terminals (if any). Using Table 13 and Figure 22, verify that the three conductors are properly terminated in the network communications connector. If there is still a problem, verify that the level-1 controller is energized and that the communications trunk wiring is intact.

5. Plug the network connector into port B.

6. Verify communications have begun between CSC and the level-2 controller:

   To verify the level-2 controllers are communicating with the CSC, use the CSC's keypad/display or a PC equipped with Monitor™ *for Windows™* software.

   To verify communications using the CSC's keypad/display, go to menu 3, "Chiller Status." Select the chiller number that is being connected to the CSC. If communications is exists, the screen will fill in with information about the chiller. If you get a "Comm Loss" message, communications between the CSC and chiller has not been accomplished. For more information on the keypad/display, refer to "Getting Started" in Bulletin No. OM 127.

   To verify communications using Monitor *for Windows* software, network diagnostics must be performed. To run network diagnostics, select the pull-down menu "Comm." Select "Network Diagnostic," which will then display the "Network Diagnostics Parameters Setup" dialog box. Using the "Network Diagnostics Parameters Setup" dialog box, you can choose to continually loop the diagnostics, or have a single sweep of each controller being connected to the network. You can also perform the following functions:

   - Display Program ID and status
   - Restrict display of level-3s to units with errors
   - Clear communications errors if found
   - Log errors to file

   As the different controllers are connected to the network, their information is displayed on the Network Diagnostic Error Display screen. By looking at the headings labeled "Address" and "Error Codes," network communications to a particular controller can be verified. If there are no error codes, network communications to the controller was successful. If the "Error Code" reads "Does not respond," a communications problem has occurred. For more on network diagnostics, see "Chapter 5 - Comm Menu" in "*MicroTech Monitor for Windows*" user's manual.

   If a communications problem occurred, check the following items:

   - Make sure the hex switches on each controller are set to the correct values.
   - Make sure the controller has power supplied to it.
   - Make sure the communication line is properly connected to port B.
   - Make sure the controller is level 2 by directly connecting the PC to it. (You must know how to change communications passwords to do this.)

7. Go to the next controller and repeat steps 1 through 6. Do this for each controller being connected to the network.

Note: To verify communications more quickly and easily, use two people in the commissioning of the network. Because some jobs have units located throughout a building, having one person perform the commissioning procedure may be difficult. When there are two people, one person can stay at the PC connected to the level-1 controller and the other person can go to each individual unit controller. Using a radio or other two-way communication equipment, they can indicate when a specific controller is connected and whether communications between the controllers is occurring.

Service Information

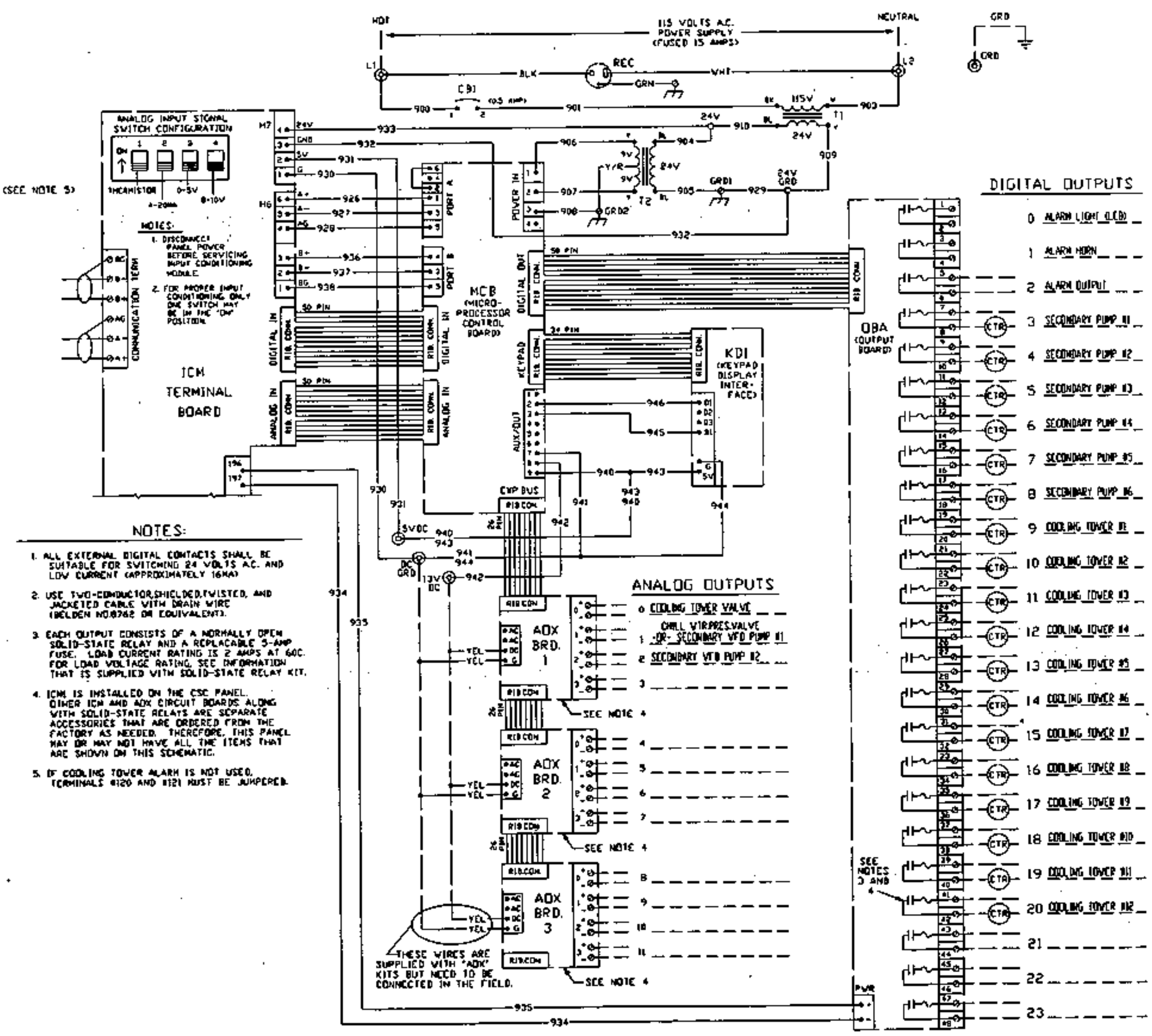
Wiring Diagram

The following wiring diagram is identical to the one in the CSC. It is reproduced here for your convenience. The wiring diagram in the CSC will have the locations of analog inputs and outputs and digital inputs and outputs. It is reproduced here for your convenience. The legend is shown in Figure 23.

Figure 23. CSC Schematic Legend

Component Designation	Description
CB1	Circuit Breaker
MCB	Microprocessor Control Board
ICM	Input Conditioning Module
OB	Output Board
AOX BRD	Auxiliary Output Expansion Board
KDI	Keypad Display Interface
T1	Transformer: 115/24 Vac
T2	Transformer: 24 Vac/18 Vac-CT
–911–	Factory Wire Number
-⊕-	Field Wiring Terminal
- - -	Field Wiring
[•]	Printed Circuit Board Terminal
=θ=	Twisted, Shielded Pair Cable

Figure 24. CSC Schematic



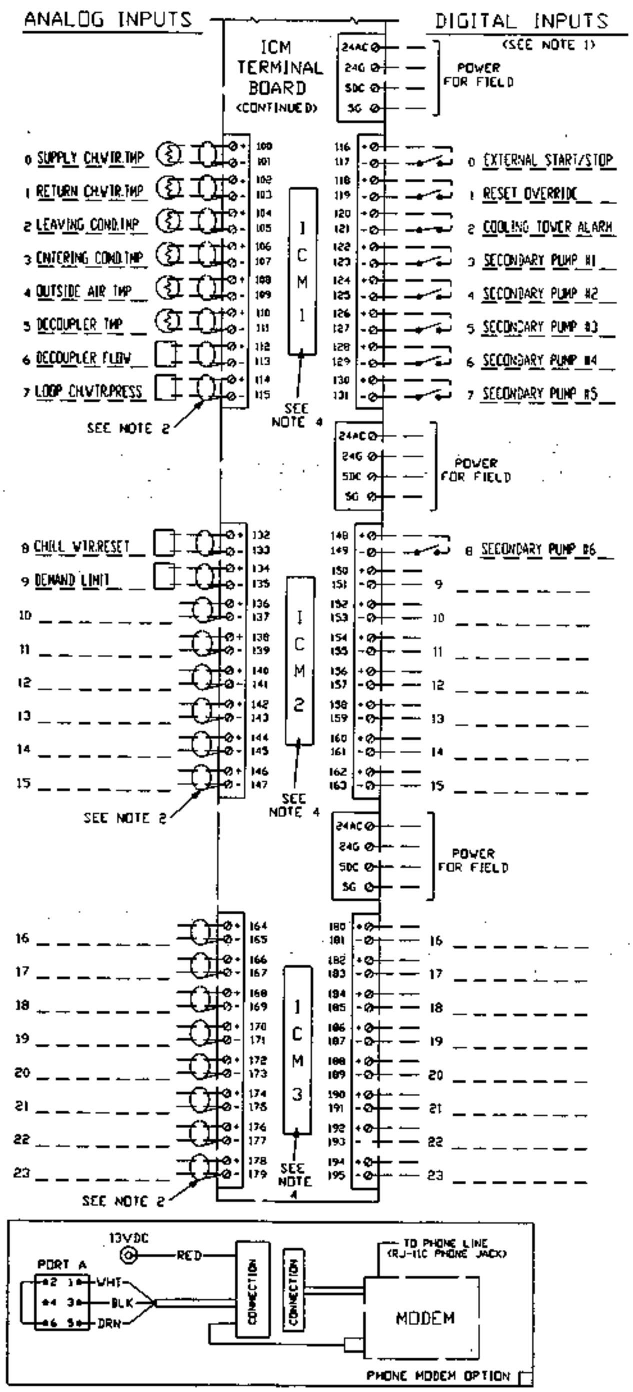
Test Procedures

A listing of MicroTech related part numbers is included in the "Parts List" section of this manual. If the MCB must be replaced, refer to the "MCB Replacement" section of this manual.

Status LED Diagnostics

The MCB status LED indications can aid in controller diagnostics. If the status LEDs do not operate normally as described in the "Component Data" section of this manual (see Table 1), there is a problem with the MCB. Following are troubleshooting procedures for the various symptoms.

Figure 24. CSC Schematic (cont'd)



Red LED Remains On

If the red LED remains on after the 5-second self-test period, it is likely that the MCB is defective. However, this can also occur in some instances if there is a power supply problem. Refer to "Troubleshooting Power Problems" below.

Red and Green LEDs Off

If the red and green LEDs do not turn on after power is applied to the controller, there is likely a defective component or a problem in the controller's power distribution circuits. Refer to "Troubleshooting Power Problems" below.

Troubleshooting Power Problems

The MCB receives 18 Vac, center-tapped power from transformer T2. It then distributes both 5 Vdc and 13 Vdc power to various MicroTech components. A problem that exists in any of these components can affect the MCB and thus the entire control system. Power problems can be caused by an external short, which can either blow a fuse, or a defective component, which can either blow a fuse or create an excessive load on the power supply. An excessive load can lower the power supply voltages to unacceptable levels. Use the following procedure to isolate the problem. Note that this procedure may require two or three spare MCB fuses (see parts list). Refer to the panel wiring diagram or Figure 24 as you proceed.

1. Verify that circuit breaker CB1 is closed.

2. Remove the MCB Power In connector and check for 9 Vac between the terminals on the plug corresponding to terminals 2 and 3 on the board (see Figures 2 and 15). Then check for 9 Vac between the terminals on the plug corresponding to terminals 1 and 3 on the board. (Readings of 9–12 Vac are acceptable.)
   If 9 Vac is present between both sets of terminals, go to step 3.
   If 9 Vac is not present between both sets of terminals, check transformers T2 and T1 and all wiring between the 115 Vac source and the Power In plug.

3. Remove power from the controller by opening circuit breaker CB1. Check the MCB power supply input fuses (F1 and F2) with an ohmmeter. See Figure 25. A good fuse will have negligible resistance through it (less than 2 ohms).
   If either or both fuses are blown, replace them. Go to step 4.
   If the fuses are intact, the MCB is defective.

4. Reconnect the Power In connector and disconnect all other connectors on the MCB. Cycle power to the controller (close and then open CB1) and check the power fuses.
   If both fuses are intact, go to step 5.
   If either fuse blows, the MCB is defective.

5. Reconnect the keypad/display ribbon cable (if equipped with keypad/display door). Cycle power to the controller and check the power fuses.
   If both fuses are intact, go to step 6.
   If either fuse blows, check the keypad/display and the connecting ribbon cable for shorts. Either one may be defective.

6. Reconnect the analog input ribbon cable. Cycle power to the controller and check the power fuses.
   If both fuses are intact, go to step 7.

If either fuse blows, check the ICM Terminal Board, the ICMs (if any), the connecting ribbon cable, and the field wiring for shorts. Any of these may be defective. Try repeating this step after removing or swapping ICMs.

7. Reconnect the digital input ribbon cable. Cycle power to the controller and check the power fuses.
   If both fuses are intact, go to step 8.
   If either fuse blows, check the ICM Terminal Board, the ICMs (if any), the connecting ribbon cable, and the field wiring for shorts. Any of these may be defective. Try repeating this step after removing or swapping ICMs

8. Reconnect the digital output ribbon cable to the MCB. Cycle power to the controller and check the power fuses.
   If both fuses are intact, go to step 9.
   If either fuse blows, check Output Board and the connecting ribbon cable. Either of these may be defective.

9. If there are any AOX-4 boards, reconnect the expansion bus ribbon cable to the MCB; otherwise, go to step 10. Cycle power to the controller and check the power fuses.
   If both fuses are intact, go to step 10.
   If either fuse blows, check the analog output expansion modules (if any), the connecting ribbon cables, and the field wiring for shorts. Any of these may be defective.

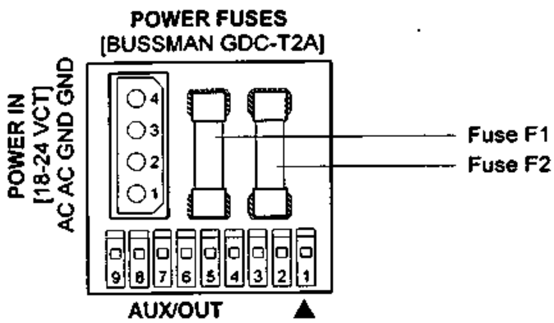
10. With circuit breaker CB1 open, measure the resistance between field terminals "DC-GRD" and "5 Vdc." It should be greater than 20 ohms.
    If the resistance is greater than 20 ohms, go to step 11 if the controller is equipped with at least one AOX-4 board or a modem. Otherwise, the problem is indeterminate. Obtain factory service.
    If the resistance is less than 20 ohms, it is likely that the keypad/display, the Output Board, the ICM Terminal Board, or an external (field supplied) load is excessively loading the MCB's 5 Vdc power supply. Isolate the problem by taking resistance measurements on each of these devices with the wiring disconnected. The resistance across the power input terminals on the keypad/display (G and 5V) should be close to infinite. The resistance across the power input terminals on the Output Board (+ and –) should not be less than 3000 ohms. When the field wiring and the OB are disconnected, the resistance across the power input terminals on the ICM Terminal Board (H7-1 and H7-2) should be infinite. If the component resistances are proper, check the resistance of the field supplied loads (if any) and check the wiring and connections throughout the 5 Vdc power supply circuit.

11. Disconnect the connector plugs from the modem and the power plug from all AOX-4 boards (as applicable). With circuit breaker CB1 open, measure the resistance between field terminals "DC-GRD" and "13 Vdc." It should be infinite.
    If the resistance is infinite, go to step 12.
    If the resistance is not infinite, a short exists somewhere in the 13 Vdc power supply wiring.

12. Reconnect the Aux/Out connector plug to the MCB. If there's a modem, reconnect its AMP plug to port A. With circuit breaker CB1 open, measure the resistance between field terminals "DC-GRD" and "13 Vdc." It should steadily rise to a value greater than 5000 ohms (within approximately 30 seconds).
    If the resistance rises above 5000 ohms, go to step 13.
    If the resistance does not rise above 5000 ohms, the MCB is defective.

13. One at a time, reconnect the modem and each AOX-4 board (as applicable). Each time a component is reconnected, measure the resistance between field terminals "DC-GRD" and "13 Vdc." It should steadily rise to a value greater than 5000 ohms.
    If the resistance rises above 5000 ohms, repeat this step until the modem and all AOX-4 boards (as applicable) have been checked out. If the problem persists, it is indeterminate. Obtain factory service.
    If the resistance does not rise above 5000 ohms, the modem or the AOX-4 board just connected is defective. (With the power plug disconnected, the resistance across an AOX-4 board's "DC" and "G" terminals should not be less than 3 million ohms.)

Figure 25. MCB Power Supply Terminals



Troubleshooting Communications Problems

If a communications problem occurs, check the following items:

- Check the port B voltages
- Check the port B fuses
- Check the network integrity
- Check the network addressing

The best way to accomplish these checks is to perform the start-up procedures in the "Network Commissioning" section of this manual. If these procedures have performed and the problem persists, obtain factory service.

Troubleshooting the Keypad/Display Interface

The Keypad/Display Interface is connected to the MCB via a ribbon cable and discrete wiring for the back light. The MCB provides operating voltages, control signal outputs for the display, and input conditioning for the keypad inputs.

Display is Hard to Read

The clarity of the LCD display can be affected by ambient temperature. Typically, less contrast will result with cooler temperatures. If the display is difficult to read, adjust the contrast trim pot, which is located on the back of the keypad/display assembly.

Back Light Not Lit
The Keypad/Display Interfaces supplied with the CSC is equipped with a back light. If the light does not come on, check for 5 Vdc at terminal 9 on the IDC connector on the KDI and for 5 Vdc on the CSC field wiring terminal strip.

Check for 5 Vdc on the IDC connector on the To check for the 5 Vdc on the IDC connector, pull back the plug about one-eighth of an inch and place the test leads against the exposed pins. If there is no voltage, check the wiring and the connections between the CSC's 5 Vdc field wiring terminal strip and the KDI. If the wiring is intact the MCB is probably defective.

Display is Blank or Garbled
If the MCB appears to be functioning properly and the display is completely blank or garbled, perform the following procedure:

1. Try cycling power to the controller by opening and then closing circuit breaker CB1 (see note below).
2. Try adjusting the contrast trim pot, which is located on the back of the keypad/display assembly. If the contrast trim pot has no effect, it is likely that either the keypad/display or its ribbon cable is defective.
3. After removing power from the controller, check the ribbon cable and connections between the keypad/display and the MCB. Look for bent pins. Restore power after reconnecting the ribbon cable.
4. Try swapping a known good ribbon cable and keypad/display. Swap these components separately to isolate the problem. Remove power from the controller before disconnecting the suspect component, and restore power after connecting the replacement component. If the problem persists, it is likely that the MCB is defective.

Troubleshooting Analog Inputs

An analog input, such as a room temperature sensor, is connected to the Analog Input terminal strip on the Input Conditioning Module Terminal Board. The analog input is then conditioned by the Input Conditioning Module (ICM). The conditioned input is transferred to the MCB via a ribbon cable.

Analog Input not Read by the MCB
If the MCB appears to be functioning properly and the analog input is not being read by the MCB, perform the following procedure:

1. Try cycling power to the controller by opening and then closing circuit breaker CB1.
2. Check the ribbon cable, power wiring connector (H7), and the field wiring connections from the analog input device. Look for bent pins, cable on backwards, or miswires. Restore power after reconnecting all cables and wires.
3. If the problem persists, try swapping a known good ribbon cable, an Input Conditioning Module (ICM), or analog input device. Swap these components separately to isolate the problem. Remove power from the controller before disconnecting the suspect component, and restore power after connecting the replacement component. If the problem persists, it is likely that the MCB is defective.

Troubleshooting Digital Inputs

A digital input device is connected to the Digital Input terminal strip on the Input Conditioning Module Terminal Board. 24 Vac, supplied by the CSC, is sent to the digital input device via a supply wire. When a contact in the digital device makes, a return signal is sent back to the Digital Input terminal strip. The signal is then conditioned by the Input Conditioning Module (ICM). The conditioned digital input is then sent to the MCB via a ribbon cable.

Digital Input not Read by the MCB
If the MCB appears to be functioning properly and the digital input is not being read by the MCB, perform the following procedure:

1. Try cycling power to the controller by opening and then closing circuit breaker CB1.
2. Check the ribbon cable, power wiring connector (H7), and the field wiring connections from the digital input device. Look for bent pins, cable on backwards, or miswires. Restore power after reconnecting all cables and wires.
3. If the problem persists, try swapping a known good ribbon cable, an Input Conditioning Module (ICM), or a digital input device. Swap these components separately to isolate the problem. Remove power from the controller before disconnecting the suspect component, and restore power after connecting the replacement component. If the problem persists, it is likely that the MCB is defective.

Troubleshooting Analog Outputs

Variable voltage or current control signals are sent to analog outputs by the MCB through the Analog Output Expansion Module (AOX-4). The MCB sends a voltage or current signal to the AOX-4 via a ribbon cable. Jumpers on the AOX-4 determine what type of output will be sent to the analog output device. The analog output signals are sent from the AOX-4 by connecting a two-pin Phoenix connector to the Analog Output Ports on the AOX-4. The analog output device also has an external power supply, usually 24 Vac, that is not powered by the CSC.

Analog Output Device is not Operating Correctly
If the MCB appears to be functioning properly and the analog output device is not operating correctly, perform the following procedure:

1. Try cycling power to the controller by opening and then closing circuit breaker CB1.
2. Check the ribbon cable(s), power wiring from CSC to the AOX-4, field wiring connections from the AOX-4 to the analog output device, and the power wiring from the external power supply to the output device. Look for bent pins, cable on backwards, or miswires. Restore power after reconnecting all cables and wires.
   Note: If the analog output signal supplied by the CSC is a voltage signal (0–5, 0–10 Vdc), the external power supply ground must be grounded to the MicroTech Controller's chassis ground.
3. If the problem persists, try swapping a known good AOX-4, ribbon cable(s), analog output device, or external power supply. Swap these components separately to isolate the problem. Remove power from the controller and analog output device before disconnecting the suspect component, and restore power after connecting the replacement component. If the problem persists, it is likely that the MCB is defective.

Troubleshooting Output Boards

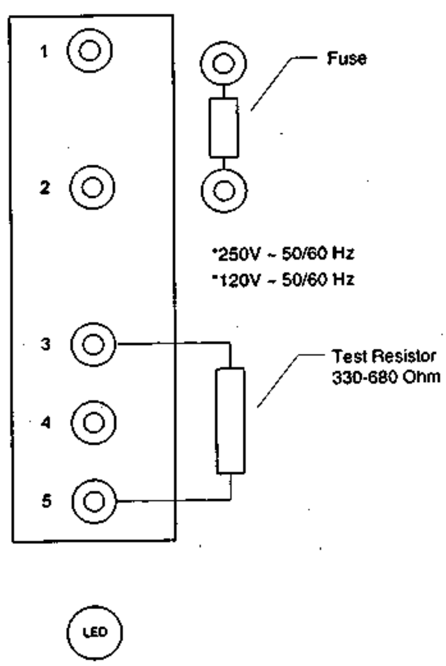
Each output on the Output Board consists of a solid-state relay, an LED, 5-amp fuse, and an MOV (metal oxide varistor).

Normally, when the MCB commands an output to energize, the solid-state relay contacts will close and the LED will glow. The contacts of each solid-state relay are in series with a 5-amp fuse. These fuses resemble small resistors and are located on the board adjacent to the relays they serve (see Figure 26). The fuses are pressed into place. They can be removed with a needle nose pliers. The MOV, which is located on the underside of the output board, protects the solid-state relay from high transient voltages. MOVs are part of the output board and cannot be replaced.

Following are troubleshooting procedures for various symptoms of output board problems

Note: It should be possible to determine whether a solid-state relay is defective by using these procedures. However, if you need more information on troubleshooting them, refer to "Troubleshooting Solid-State relays" below.

Figure 26. Output Board Relay Socket



⚠ WARNING

Electric shock hazard.
Can cause severe injury or death.

Even when power to the panel is off, solid-state relay socket terminals 1 and 2 on the output board could be connected to high voltage (see Figure 26). Avoid them.

One LED Out

If one of the Output Board LEDs fails to illuminate when the MCB is commanding the associated output to energize, perform the following procedure:

1. Remove power from the controller by opening CB1. Swap the suspect relay with a known good relay. Try to choose a relay that will not affect unit operation. Restore power by closing CB1.
   If the LED does not light, go to step 2.
   If the LED lights, the suspect relay is defective.
2. Remove power from the controller. Check the ribbon cable and connections between the OB and the MCB. Look for bent pins.
   If the cable and connections are intact, go to step 3.
3. Remove the relay from the suspect socket. Install a 330-680 ohm resistor between terminals 3 and 5 as shown in Figure 26. Restore power by placing CB1 to the ON position. The LED should light regardless of the controller's command.
   If the output LED illuminates, it is likely that the MCB is defective.
   If the output LED does not illuminate, the output board is defective.

All LEDs Out

If the MCB is commanding at least two outputs to energize and none of the Output Board LEDs are lit, perform the following procedure:

1. Verify that 5 Vdc is present at the Output Board's power terminals.
   If 5 Vdc is not present, go to step 2.
   If 5 Vdc is present, check the ribbon cable and connections between the output board and MCB. Look for bent pins. If the cable and connections are intact, the Output Board or the MCB is defective.
2. Remove power from the controller by placing CB1 to the OFF position. Disconnect at least one wire from the power input terminals of the Output Board. The resistance should not be less than 3000 ohms.
   If the resistance is greater than the acceptable value, go to step 3.
   If the resistance is less than the acceptable value, the Output Board is defective.
3. Check the discrete wiring and connections between the following: Input Conditioning Module Terminal Board (T10) and OB input power field wiring terminals, CSC field wiring terminal strip and Input Conditioning Module Terminal Board (H7), Aux/Out terminal strip and the CSC field wiring terminal strip.
   Note: The MCB Aux/Out connector plug terminals displace wire insulation to make contact with the conductor. If a faulty Aux/Out connections is suspected, try pressing down on the wire in the terminals with a small screwdriver.

LED Lit, Output not Energized

If the LED of a suspect output is lit but the load connected to it is not energized, and everything is intact between the MCB and the coil side of the relay, perform the following procedure to isolate the problem:

1. Verify that 24 or 120 Vac power is present at the suspect output's screw terminal on the Output Board.
2. Remove power from the controller by opening CB1. Pull the 5-amp fuse on the contact side of the relay and check it for continuity with an ohmmeter.
   If the fuse is not bad, reinstall it and go to step 3.
   If the fuse is bad, replace it and inspect the load and associated wiring before restoring power. Note that a fuse from an unused output can be substituted for the bad fuse.
3. Remove power from the controller by opening CB1. Swap the suspect relay with a known good relay. Try to choose a relay that will not affect unit operation. Restore power by closing CB1.
   If the output load energizes, the suspect relay is bad. Replace the relay.
   If the output load does not energize (when LED is lit again), check the load circuit wiring and components.

Output Energized, LED not Lit
If the LED of a suspect output is not lit, but the load connected to it is energized, either the solid-state relay or the MOV is bad. The solid-state relay contacts and the MOV, which are in parallel, can both fail closed. Perform the following procedure to isolate the problem:

1. Remove power from the controller by opening CB1. Pull the solid-state relay from the suspect output's socket.
2. Restore power by closing CB1.
   If the output load remains energized when there is no relay in the socket, the output's MOV has failed and thus the Output Board must be replaced.
   If the output load de-energizes, the relay that was pulled is defective.

Contact Chatter
Contact chatter is very rapid opening and closing of contacts. It is usually caused by low voltage at the electromechanical relay or contactor coil. If contact chatter is occurring on a relay or contactor connected to one of the Output Board solid-state relays, it is also possible that a faulty connection exists on the power supply terminals of the Aux/Out plug connector on the MCB, on the CSC field wiring terminals, on connector H7 of the Input Conditioning Module Terminal Board, or the wiring between the Input Conditioning Module Terminal Board (T10) and the Output Board. In very rare instances, contact chatter can be caused by a faulty solid-state relay. Perform the following procedure to isolate the problem.

1. Verify that the voltage at the load's power supply and at the solid-state relay contacts is adequate.
2. Remove power from the controller by opening CB1. Swap the suspect relay with a known good relay. Try to choose a relay that will not affect unit operation. Restore power by closing CB1.
   If the chatter does not stop, go to step 3.
   If the chatter stops, the suspect relay is defective. Replace the relay.
3. Remove power from the controller by opening CB1. Try to improve the connections in the Aux/Out plug insulation displacement terminals by pressing down on the wires with a small screwdriver.
4. Check all other wiring and connectors for bent pins or miswires.
   If the chatter does not stop, the electromechanical relay or contactor is probably defective.

Troubleshooting Solid-State Relays

As shown on the unit wiring diagrams, the solid-state relays on the Output Boards all have normally open "contacts." Actually, these contacts do not exist as they do in an electromechanical relay. Instead of using contacts to switch the load, the solid-state relay changes its resistance from low (closed), when it is energized, to high (open), when it is de-energized. (This high resistance is approximately 100K ohms.) Because the output circuit through the solid-state relay remains continuous regardless of whether the relay is energized, troubleshooting a solid-state relay with a voltmeter can be tricky.

In a typical circuit, a power source is connected across a single relay output and a load (see Figure 27). In this circuit, a solid-state relay will behave like an electromechanical relay. If the relay is energized, the relay output will be hot. If the relay is de-energized, voltage cannot be measured at the relay output.

The circuit shown in Figure 28 is similar to a typical circuit; the difference is that there is an open set of contacts, or a disconnection between the relay output and the load. In this circuit, a solid-state relay will not behave like an electromechanical relay. If the solid-state relay is energized, the relay output will be hot (as expected). However, if the solid-state relay is de-energized, the relay output will still appear to be hot. This is because the relay output and the voltmeter form a continuous circuit in which the relay's resistance, though high, is insignificant compared to the voltmeter's resistance.

This means that nearly all the voltage is dropped across the voltmeter. Therefore, the voltmeter indicates that voltage is present. If a low wattage light bulb of the appropriate voltage is used instead of a voltmeter, the bulb's low resistance will load the circuit enough to eliminate the false voltage indication. In this situation, an incandescent test lamp is a better tool than a voltmeter.

Figure 27. Testing a Typical Relay Circuit

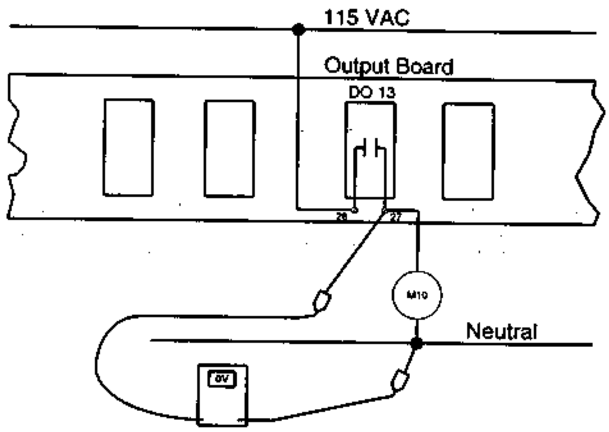
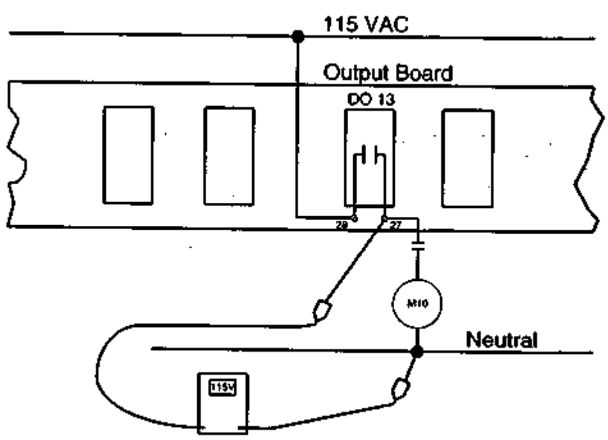


Figure 28. Testing a Relay Circuit with a Disconnection



MCB Replacement

If an MCB board is defective and must be replaced, the proper controller software must be loaded into the replacement MCB. This can be done either at the factory or at the building site—if a PC equipped with appropriate Monitor software is available.

The factory will download the proper controller software into a replacement MCB board before it is shipped if you include the CSC's program code with the replacement MCB part order. If the program code is not provided, the MCB board will be shipped without software.

Job-specific Monitor software includes each unit and auxiliary controller's program. Therefore, it is possible to download the proper controller software to a replacement MCB at the building site if a PC equipped with that job's Monitor software is available. In addition, if the controller's configuration data was stored on the PC hard drive prior to the MCB failure, the exact configuration data (including all keypad programmable setpoints and parameters) can be restored. Refer to the user's manual supplied with the Monitor software for more information.

Parts List

Component Designation		Description	Part No.
MCB	①	Microprocessor Control Board	654873B-50
ICM Term. Brd.		Input Conditioning Module Terminal Board	733849C-01
OB		Output Board	492655B-04
KDI		Keypad/Display Interface	733785B-01
T1		Transformer: 115/24 Vac	606308B-01
T2		Transformer: 24/18 Vac, Center Tapped	467381B-14
CB1		Circuit Breaker	473573B-08
—		Fuse: MCB Input Power, 2 Amp (Bussman No. GDC-2A)	658220A-01
—		Fuse: MCB Communication Ports, 0.25 Amp	658219A-01
—		PC Communications Cable Kit	0057186802
—		RS-232 Cable Extension Kit	0065487001
—		Ribbon Cable Assembly: MCB to Output Board	492652B-07
—		Ribbon Cable Assembly: MCB to Keypad/Display Interface	733665B-01
—		Ribbon Cable Assembly: MCB to ICM Terminal Board Analog Input	733758B-02
—		Ribbon Cable Assembly:MCB to ICM Terminal Board Digital Input	733758B-01
—		Ribbon Cable Assembly (9"): MCB to AOX-4	654997B-02
—		Ribbon Cable Assembly (3"): AOX-4 to AOX-4	654997B-06
—		Modem Kit	0072140601
ICM		Input Conditioning Module	0055323601
AOX-4		Analog Output Expansion Module	0055323701
SSR		Solid-State Relay Kit	0055323901
—		Solid-State Relay (AC)	0049265601
—		Solid-State Relay (DC)	0049265602
—		Dry Contact Relay	0049265603

Notes:

1. If desired, the factory can download the correct software into the replacement MCB prior to shipment. See the "MCB Replacement" section above for more information.

McQuay International

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McQuay® International

Operation Manual

Bulletin No. OM 127
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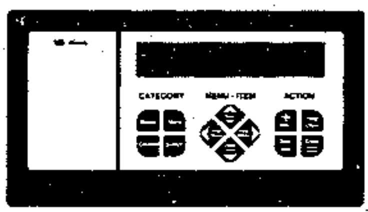
Part No. 585522Y-01

MicroTech®
Chiller System Controller

for
Centrifugal, Reciprocating, and Screw Chillers

Chiller
System
Controller



MicroTech®

For Use With McQuay Models PEH, PFH, ALR, WHR, ALS & PFS

Contents

Introduction

This manual provides information about the MicroTech® Chiller System Controller (CSC) for McQuay® centrifugal (series 100 and 200), reciprocating, and screw chillers. It specifically describes the CSC's features, sequences of operation, and programmable options. It also includes information on how to use the keypad/display to enter and display data.

For information on MicroTech components, field wiring options and requirements, network commissioning procedures, and service procedures, refer to Bulletin No. IM 618, *MicroTech Chiller System Controller.* For specific information about the MicroTech chiller controllers, refer to the appropriate MicroTech unit controller installation or operation manual (see Tables 1 and 2).

Table 1. MicroTech Unit Controller Installation Literature

Chiller Type	Bulletin Number
Series-100 Centrifugal	IM 403
Series-200 Centrifugal	IM 616
Reciprocating	IM 493
Screw	IM 549

Table 2. MicroTech Unit Controller Operation Literature

Chiller Type	Bulletin Number
Series-100 Centrifugal	IM 403 & APM 950
Series-200 Centrifugal	OM 125
Reciprocating	IM 493
Screw	IM 549

⚠ WARNING

Electric shock hazard. Can cause personal injury or equipment damage.

This equipment must be properly grounded. Connections and service to the MicroTech control panel must be performed only by personnel that are knowledgeable in the operation of the equipment being controlled.

NOTICE

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his or her own expense. **McQuay International disclaims any liability resulting from any interference or for the correction thereof.**

Software ID

MicroTech CSC software is factory installed and tested in each panel prior to shipment. The software is identified by a program code (also referred to as the "Ident"), which is printed on a small label affixed to the MCB. The program code is also encoded in the controller's memory and is available for display on menu 28 of the keypad/display or a PC equipped with MicroTech Monitor™ software. (Information on using the keypad/display is included in the "Getting Started" portion of this manual.) Using menu 28 or Monitor software is the most reliable way of determining the controller's program code.

CSC program codification is as follows:

CSC1E01A

- Chiller System Controller
- Program number
  - 1 = Standard software
- Units
  - E = English
  - S = SI
- Version (numeric)
- Version revision (alphabetical)

If the CSC's program code does not match the format shown above, it is likely that a special program has been loaded into the controller. In this case, some of the information in this manual may not be applicable.

At the time of this writing, the program codes for standard CSC software are CSC1E01A and CSC1S01A. If your CSC software has a later revision code (for example, CSC1E01B), some of the information in this manual may be inaccurate. However, since only very minor software changes are considered revisions, any inaccuracies should be insignificant.

Software Compatibility

Note that CSC1E01A and CSC1S01A are *not* compatible with some earlier versions of MicroTech centrifugal, reciprocating, and screw chiller controller standard software. The current software compatibility is summarized in Table 3. The wildcard character (∗) can be any letter.

If you want to use a CSC with older chillers that have incompatible standard software, the chiller software must be upgraded. (This applies to all series-100 centrifugal chillers.) If you have a version of chiller software that has a later revision code than the compatible programs shown in Table 3, it is likely that program CSC1∗01∗ is compatible with it; however, it may not be. To find out for sure, contact McQuayService.

File Names

In all cases, the file names of the compatible programs shown in Table 3 are the same as the program codes except that they also include a "COD" extension. For example, the file for program PC209A is called "PC209A.COD."

Table 3. Program Code CSC1∗01A Software Compatibility

Chiller Controller	Compatible Programs	Incompatible Programs
Series-200 Centrifugal	CFG1∗02A	CFG1∗01∗
	CFG3∗02A	CFG3∗01∗
	CFG5∗02A	CFG5∗01∗
Series-100 Centrifugal: Display Proc.	PDR09A	PDR08∗ and earlier
	PDM09A	PDM08∗ and earlier
Series-100 Centrifugal: Control Proc.	PC209A	PC208∗ and earlier
	PC409A	PC408∗ and earlier
	PC509A	PC508∗ and earlier
Reciprocating	RCP2∗02B *(R-22)*	RCP1∗01∗ *(R-22)* RCP2∗02A *(R-22)*
	RCP3∗02B *(R-134a)*	RCP2∗01∗ *(R-134a)* RCP3∗02A *(R-134a)*
	none	AWR-∗12∗ and earlier
Screw	SC22U19B *(R-22)*	SC2-E18∗ and earlier *(R-22)* SC22U19A *(R-22)*
	SC23U19B *(R-134a)*	SC24E18∗ and earlier *(R-134a)* SC23U19A *(R-134a)*
	SC32U19A *(R-22)*	SC3-E18∗ and earlier *(R-22)*
	SC33U19A *(R-134a)*	SC34E18∗ and earlier *(R-134a)*

Getting Started

The MicroTech Chiller System Controller (CSC) is a self-contained device that is capable of monitoring and controlling up to eight McQuay centrifugal, reciprocating, or screw chillers via network communications (see "Chiller Definition" below). It can also monitor and control a variety of system equipment such as cooling tower fans, bypass valves, and secondary pumps. You can display and modify information in the CSC with either of the following methods:

- Using the keypad/display at the CSC
- Using an optional PC equipped with Monitor software

In addition to system data, the CSC's keypad/display can show a summary of important data for each chiller. To modify information in a chiller controller, you must use either Monitor software or the keypad/display at that chiller.

The following "Getting Started" sections describe how to use the CSC's keypad/display. For information on using the optional Monitor software package, see the user's manual supplied with the Monitor software.

The last "Getting Started" section describes how to set up the CSC and its associated chillers for normal operation.

Chiller Definition
As used throughout this manual, the word "chiller" means chiller in all cases except for dual-compressor centrifugals. For these machines, each *compressor*—along with its associated MicroTech controller—is considered a "chiller."

Using the Keypad/Display

The Keypad/Display Interface, shown in Figure 1, is provided with all MicroTech Chiller System Controllers. With the keypad/display you can monitor operating conditions, system alarms, control variables, and schedules. After the password has been entered, you can edit setpoints, variables, and schedules.

Menu Structure

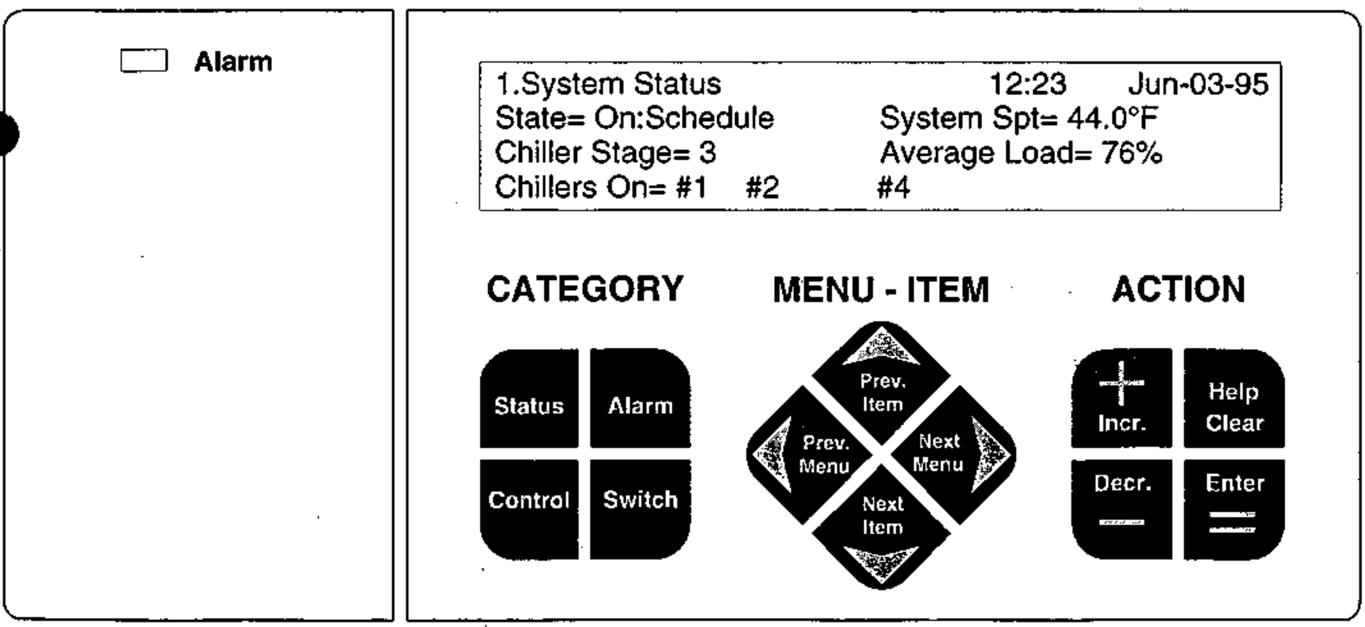
The keypad-accessible information in the MicroTech controller is organized in a menu structure to provide quick access. As shown in Figure 2, this structure is divided into three levels: categories, menus, and items. The category, which is the highest level in the structure, can be "Status," "Control," or "Alarm." The name of each category describes the basic purpose of the menus it contains. Complete information on the contents of each menu is included in the following "Keypad/Display Menu Reference" section.

Status Category
Menus in the Status category contain information about the current overall operation of the chiller system. They also include important information about the current operating conditions in each chiller. The fields in these menu items provide status information only and cannot be changed with the keypad.

Control Category
Menus in the Control category contain variables that define how the CSC operates. After the password is entered, most fields in these menu items can be changed with the keypad.

Alarm Category
Menus in the Alarm category contain current and previous alarm information. They also include variables that allow you to customize the setup of the CSC's Alarm Horn and Alarm Output.

Figure 1. Keypad/Display Interface



Display Format

The information stored in the CSC's menu structure can be viewed on the 4-line by 40-character LCD display. As shown in Figure 3, the current menu is displayed on the top line and the current items are displayed on the three lines below. An item line may contain one full-row item or two half-row items, and each item contains one or more fields that convey varying information. These fields may or may not be adjustable.

In addition to the current menu, the menu line also shows the time, date, and a variety of other messages that help you use the keypad.

The menu line and the three item lines are contained on a *screen*. A menu may contain one or several screens. Each screen of a multi-screen menu (for example, menu 11) shows the same menu line and different item lines. (The item lines do not scroll.) A down arrow in the display indicates that another screen of items can be displayed by pressing the NEXT ITEM (▼) key. An up arrow in the display indicates that a previous screen of items can be displayed by pressing the PREV ITEM key (▲).

Tabular Format

Some menus contain data that is displayed in a tabular format instead of the standard half- or full-row item format shown in Figure 3. In the tabular format (not shown), the column headings are displayed on item line 1 and the data fields are displayed on item lines 2 and 3. If there is a stub, it is shown on the left side of the screen. If there are multiple screens, the menu line and item line 1 (headings) are the same on each screen. The CSC's menu 27, "Optimal Minutes," is an example of a tabular menu.

Password Protection

The MicroTech controller includes password protection to guard against the entry of inadvertent or unauthorized changes. When you attempt to change the value of an adjustable variable with the keypad, the controller prompts you to enter the password. If the correct password is entered, the controller will allow you to make changes as desired. Five minutes after the last keystroke is made, the controller will disallow further changes until the password is re-entered.

The keypad password for all controllers is the following keystroke sequence: ENTER, ENTER, ENTER, ENTER. It is not adjustable. See "Key Functions" below for more information.

Keypad/Display Modes

The keypad/display has two modes of operation: Normal and Change Values. Depending on the keypad/display mode, the function of each key changes. For more information, see "Key Functions" below.

Normal Mode

In the Normal mode, you can use the keypad to move around the menu structure shown in Figure 2. You can also clear alarms and get Help on using the keypad by pressing the CLEAR (Help) key. If you want to edit a certain variable, first display it on the current screen and then go to the Change Values mode by pressing INCR, DECR, or ENTER. If the password has not been entered recently, the controller will prompt you for it. (See "Password Protection" above.) The time and date on the menu line will then be replaced by the message "<Change Values Mode>."

Figure 2. Keypad Accessible Menu Structure

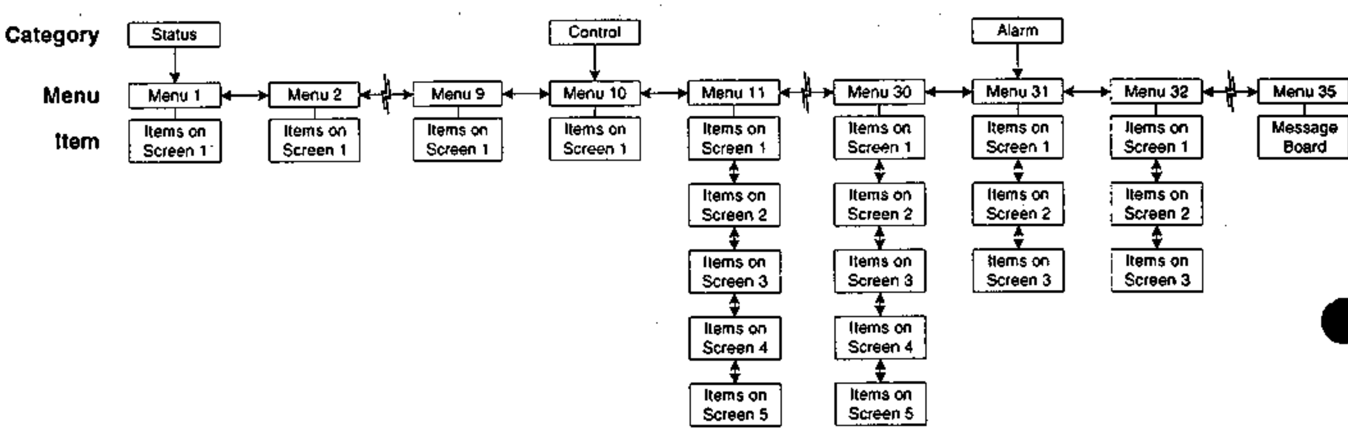
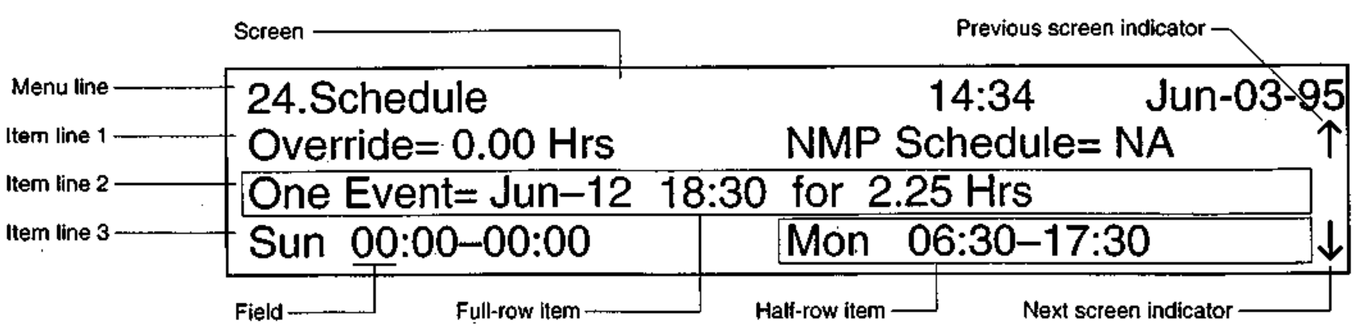


Figure 3. LCD Display Format

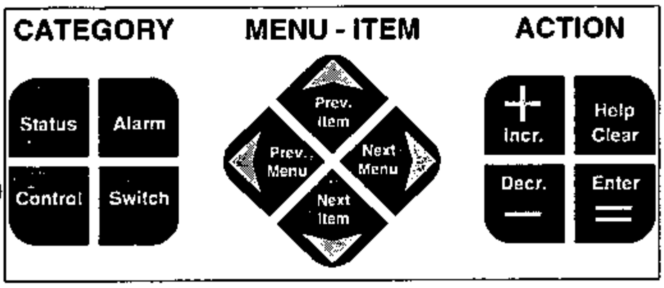


Change Values Mode
In the Change Values mode, you can use the keypad to move around the screen and to change the values of selected (flashing) fields. Any adjustable field on the *current* screen can be changed during a change-values editing session; to edit a field on a different screen, you must first return to the Normal mode and select the new screen. To return to the Normal mode, press the CLEAR key.

Key Functions

The MicroTech controller's keypad consists of 12 pressure sensitive membrane switches, which are divided into 3 groups: "Category," "Menu-Item," and "Action." See Figure 4. Following are descriptions of these groups and the keys they contain.

Figure 4. Keypad



Category Group
Acting like bookmarks in the menu structure, the keys in the Category group provide quick access to the desired menus. Refer to Figure 2. By using these keys, you can minimize scrolling between menus with the keys in the Menu-Item group (see below). Note that the keys in the Category group are active only during the Normal mode.

STATUS Key: Any time the STATUS key is pressed, the first menu in the Status category is displayed. This is menu 1, "System Status."

CONTROL Key: Any time the CONTROL key is pressed, the first menu in the Control category is displayed. This is menu 10, "System Control."

ALARM Key: Any time the ALARM key is pressed, the first menu in the Alarm category is displayed. This is menu 31, "Current Alarms."

SWITCH Key: The SWITCH key allows you to quickly switch between menus that have closely related content. For example, if you're interested in chiller sequencing control, you could go to menu 1, "System Status," and then press the SWITCH key successively to see the following menus, which contain chiller sequencing data:

- Menu 1. System Status
- Menu 3. Chiller Status
- Menu 13. Chiller Sequence Order

The three menus in the above example are called a *browse sequence* (1→3→13→1). The following "Keypad/Display Menu Reference" section lists the SWITCH key destinations and browse sequences for all applicable menus.

Menu-Item Group: Normal Mode
During the Normal mode, the keys in the Menu-Item group allow you to choose the menu and item you want to display. Refer to Figure 2. First use the two menu keys to select the menu you want, and then, if necessary, use the two item keys to display the items you want.

PREV MENU Key (‹): When the PREV MENU key is pressed, the display will scroll to the previous menu in the structure. This action will always occur unless the current menu is the first menu.

NEXT MENU Key (›): When the NEXT MENU key is pressed, the display will scroll to the next menu in the structure. This action will always occur unless the current menu is the last menu.

PREV ITEM Key (˄): When the PREV ITEM key is pressed, the display will scroll to the previous screen of items in the current menu. This action will always occur unless the current screen is the first screen.

NEXT ITEM Key (˅): When the NEXT ITEM key is pressed, the display will scroll to the next screen of items in the current menu. This action will always occur unless the current screen is the last screen.

Menu-Item Group: Change Values Mode
During the Change Values mode, the keys in the Menu-Item group become "cursor control" keys for the current screen, allowing you to quickly get to the field(s) you want to edit. For more on editing, see "Action Group: Change Values Mode" below.

Note: In some instances during the Change Values mode, the flashing "cursor" field will disappear either upon entering the mode or after a keystroke. This is normal. An additional keystroke will usually make the cursor field reappear.

Action Group: Normal Mode
During the Normal mode, the Action group keys allow you to (1) clear alarms, (2) get Help on using the keypad/display, or (3) enter the Change Values mode. To enter the Change Values mode, press the INCR, DECR, or ENTER key.

CLEAR Key (Help): When the CLEAR key is pressed, the display will show Help on using the keypad/display. This action will always occur except when menu 31, "Current Alarms," is in the display. In this instance, pressing CLEAR will clear a current CSC alarm. For more on clearing alarms, see the "Alarm Monitoring" section of this manual.

Action Group: Change Values Mode
During the Change Values mode, the Action group keys allow you to edit values in the fields on the current screen. When you enter the Change Values mode, the first adjustable field in the first item on the current screen will flash, indicating that it can be edited with the INCR or DECR keys. To select different fields on the screen, use the cursor control keys in the Menu-Item group.

INCR Key (+): When the INCR key is pressed, the entry in the item's selected (flashing) field will change to the next higher value or next available selection. After pressing INCR, a new field cannot be selected for editing until the ENTER or CLEAR key is pressed.

DECR Key (–): When the DECR key is pressed, the entry in the item's selected (flashing) field will change to the next lower value or previous available selection. After pressing DECR, a new field cannot be selected for editing until the ENTER or CLEAR key is pressed.

ENTER Key (=): When the ENTER key is pressed after a value has been changed, the new entry will be locked in. A message will appear on the menu line telling you that the change was successful. To select another field for editing, use the cursor control keys in the Menu-Item group. To end the edit, press CLEAR.

CLEAR Key: The CLEAR key has two functions in the Change Values mode: (1) when CLEAR is pressed after a value has been changed (but before the ENTER key is pressed), the new entry will be canceled and the previous entry will be retained; (2) in any other case, pressing CLEAR will end the editing session and return the keypad/display to the Normal mode.

Keypad/Display Exercises

Following are two exercises that will guide you through some typical keypad operations. Note that often there is more than one way to perform an operation. For example, you can use the Menu-Item keys with or without the optional Category keys to quickly find the menu you want to display.

Changing a Setpoint
In this exercise, assume that the common chilled water supply temperature is 47.0°F (8.3°C) and cooler water is required. The water temperature is too warm because not all chillers are on and both the Minimum Chiller Setpoint and the System Setpoint are 44.0°F (6.6°C). (The system layout is such that water from chillers that are off mixes with water from chillers that are on.) Using the following procedure, you will change the Minimum Chiller Setpoint to 41.0°F (4.9°C) and thus lower the common supply temperature.

1. Press CONTROL. The first menu of the Control category is displayed. This is menu 10, "System Control."
2. Press NEXT MENU (›) six times. Menu 16, "Supply Tmp Cntl," is displayed. The first screen of this menu is also displayed.
3. Press NEXT ITEM (⌄) once. The second screen is displayed. The "Min Chil Spt=" item is on the right half of item line 1. This is the Minimum Chiller Setpoint. Assume that it is set to 44.0°F (6.6°C).
4. Press INCR (+), DECR (–) or ENTER (=). The controller prompts you for the password.
5. Press ENTER four times. (This is the password.) The "Password Verified" message is displayed and then the "<Change Values Mode>" message appears on the menu line.
6. Press NEXT MENU (›), which is now a cursor control key, once. The "Min Chil Spt=" item's only field starts flashing.
7. Press DECR (–) until the setpoint is 41.0°F (4.9°C).
8. Press ENTER. The "Change Successful" message appears. This means that the new setpoint is locked in. Now press CLEAR to end the edit and return to the keypad/display's Normal mode.
9. Press SWITCH twice. The actual supply temperature ("Supply ChW=" item under menu 2, "Temperatures") is displayed. With the new setpoint entered, this temperature should now begin to drop.

Clearing a CSC Alarm
In this exercise, assume that a Fault alarm which requires a manual reset occurred in the system. If the conditions that caused the alarm are gone, you can clear the alarm by using the following procedure.

1. Press ALARM. The Alarm Horn is silenced and the first menu of the Alarm category is displayed. This is menu 31, "Current Alarms." The "CSC=" item is also displayed. It probably shows "None," but assume that a Fault exists; for example, "No Sec ChW Flow."
2. Press CLEAR. This clears the alarm and returns the CSC to normal operation. The "CSC=" item automatically changes to "None."

Keypad/Display Menu Reference

The following tables show every menu, item, and field in the menu structure of the CSC. These menus and items can all be displayed with the keypad/display. (Monitor software provides some additional monitoring features and adjustable variables.)

Using the Tables

The menu tables tell you several things:

- The exact location of each item in the menu structure
- The default value of each adjustable field
- The range of possible values for each field
- The variable name for each item
- The SWITCH key destination for each menu

Figure 5 shows an example of a typical CSC screen and its corresponding menu table.

Location
Each menu table has a "Screen" (Scr.) column and a "Line" column. The Screen column tells you which screen a particular item is on. The Line column tells you which item line a particular item is on. For multi-screen menus, this information can be useful because it gives you an idea of the number of times you need to press the NEXT ITEM key upon entering the menu.

Default Value
The tables for menus in the Control and Alarm categories show the default, factory set values of every adjustable field. These are shown in the "Name" column in bold italic. For many variables, the default values are typical values that may not need to be changed; for example, control loop parameters such as deadbands and mod limits. Other variables must be set in accordance with the application, and thus their default values have little meaning; for example, the First On Chiller variable shown in Figure 5.

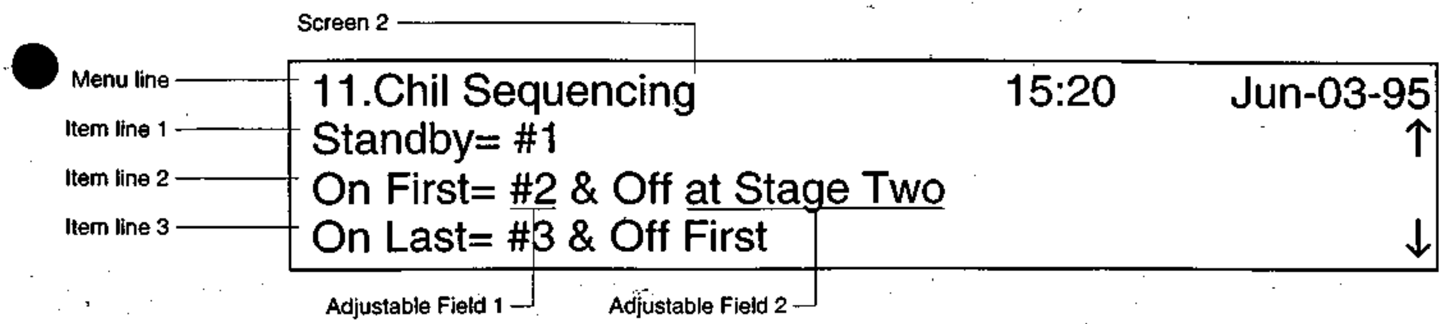
Range
The range of possible values for every field is shown in the "Range" column. Since many items in the Control and Alarm categories have more than one field, the tables for these menus also have a "Field No." column. If there is a number in the Field No. column, it indicates that the field is adjustable and thus it can be selected with the cursor control keys during the Change Values mode. If there is a dash (–) in the Field No. column, it indicates that the field is not adjustable. The range for each field is shown in the adjacent Range column.

Using Figure 5 as an example, notice that all items on the screen have one adjustable field except "On First=," which has two. The "On First=" item's first field can be set to "N/A," "#1," or "#2" through "#8." Its second field can be set to either "at Stage Two" or "Last."

Note: The resolution of all adjustable temperature fields is 0.5°F (0.2–0.3°C).

Variable Name
Every item in the CSC's menu structure represents a variable (adjustable or status only). The item names that appear in the display are usually abbreviations of the variable names, which are listed in the "Variable Name" column. Variable names are used in the text of this manual to describe the operation of the CSC and its associated chillers.

Figure 5. Example of Screen and Corresponding Menu Table (Screen 2 of Menu 11 Shown)



Item					Variable Name
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	
2	1	Standby= ***NA***	1	N/A, #1 – #8	Standby Chiller
	2	On First= ***NA*** & Off ***Last***	1	N/A, #1 – #8	First On Chiller
			2	at Stage Two	
				Last	
	3	On Last= ***NA*** & Off First	1	N/A, #1 – #8	Last On Chiller

SWITCH Key Destination: Menu 3. Chiller Status

SWITCH Key Destination

At the bottom of each menu table, the SWITCH key destination for that menu (if any) is shown. The SWITCH key destination is the menu the CSC will display after the SWITCH key is pressed. For example, if menu 11 is in the display, pressing SWITCH will cause the display to show menu 3.

Browse Sequences

A browse sequence is a series of closely related menus that you can display cyclically by repeatedly pressing the SWITCH key. They allow you to focus on a specific chiller system function—for example, cooling tower control—without having to navigate through unrelated menus. You can enter a browse sequence at any menu, and if you press SWITCH enough times, you will return to the menu you started from.

Browse sequences include only menus that contain information you may need on a day-to-day basis; they do not include menus that contain setup information. The CSC's browse sequences are shown below.

Topic	Browse Sequence Menus
Chiller Sequencing	1→3→13→1
System/Scheduling	10→24→10
Chilled Water Temperatures	2→16→17→2
Cooling Tower	6→18→19→20→6
Load Limiting	5→14→15→5
Chilled Water Flow	7→21→22→7

Not all menus that have SWITCH key destinations are part of a browse sequence. However, if you press SWITCH from one of these menus, it will usually bring you to a related browse sequence. For example, if you press SWITCH while menu 11 is in the display, you will enter the Chiller Sequencing browse sequence at menu 3.

Status Menus

The Status category includes menus 1 through 9. Following are brief descriptions of them.

System Status

Menu 1, "System Status," tells you the current overall status of the CSC and its associated chillers. For more information, see the "Determining Chiller System Status" section in the "Operator's Guide" portion of this manual.

Temperatures

Menu 2, "Temperatures," provides the current system water temperatures and the outdoor air temperature. Except for the chilled water supply sensor, these temperature sensors are optional. If the display shows "Open" or "Short," it is likely that the sensor has not been installed.

Chiller Status

Menu 3, "Chiller Status," tells you whether each chiller is currently starting, on, stopping, or off. If a chiller is off, the chiller status will tell whether it is disabled at the chiller or by the CSC. The load on each chiller and the water temperatures at each chiller are also displayed. The chiller load is in percent of rated load amps (% RLA) for centrifugal and percent of available stages that are active for reciprocating and screw.

Chiller Operating Hours

Menu 4, "Operating Hours," gives you run-time history for each chiller in the system. Run time is accumulated whenever a compressor is actually running.

Load Limiting Status

Menu 5, "Load Limit Status," tells you which of the three percent-of-capacity load limiting functions are currently affecting the chillers: demand limiting, load balancing, or start-up unloading. A value of 100% means that no load limiting is occurring. The current capacity limit on each individual chiller, which is the minimum value produced by the three functions, is also shown on menu 5. For more information, see the "Determining Chiller System Status" section in the "Operator's Guide" portion of this manual.

Cooling Tower Status

Menu 6, "Tower Status," tells you the current status of the cooling tower system. For more information, see the "Determining Chiller System Status" section in the "Operator's Guide" portion of this manual.

Flow To Load

Menu 7, "Flow To Load," tells you the current status of the chilled water distribution system, which may include secondary pumps or a differential pressure bypass valve. For more information, see the "Determining Chiller System Status" section in the "Operator's Guide" portion of this manual.

Miscellaneous Inputs

Menu 8, "Misc Inputs," tells you the flow rate in the decoupler line and the states of the external start/stop, chilled water reset override, and cooling tower alarm inputs. The conditioned (0–5 Vdc) values of the external demand limiting and external chilled water reset signals are also displayed.

Miscellaneous Status

Menu 9, "Misc Status," tells you the current value of the Stage-Up Inhibit Level variable. This signal can be sent to the CSC by a MicroTech Network Master Panel that has a demand meter connected to it or by a building automation system via Open Protocol™. The signal and its corresponding setpoint (menu 11) can be used to prevent further chiller system loading when a certain electrical demand target is reached.

Menu 1. System Status

Item				
Scr.	**Line**	**Name** *(typical values shown italic)*	**Range**	**Variable Name**
1	1	State= *On:Schedule*	Off:Unocc	CSC Operating State
			Off:Manual	
			Off:Ambient	
			Off:Network	
			Off:Alarm	
			Recirculate	
			On:Schedule	
			On:Input	
			On:Manual	
			On:Network	
			Free Clg	
		System Spt= *44.0°F (6.6°C)*	32.0 – 60.0°F	System Setpoint *(chilled water supply)*
			① 0.0 – 20.0°C	
	2	Chiller Stage= *2*	0 – 9	Current Chiller Stage
		Average Load= *67%*	0 – 125%	Average Chiller Load *(operational chillers)*
	3	Chillers On= *#1 #2* _ _ _ _ _ _	② #1 #2 #3 #4 #5 #6 #7 #8	Chiller Status Bitset

Switch Key Destination: Menu 3. Chiller Status

Notes:

1. Program CSC1S01• only.
2. If a chiller is either starting or running, that chiller's number will appear in the item line.

Menu 2. Temperatures

Item				
Scr.	**Line**	**Name** *(typical values shown italic)*	**Range**	**Variable Name**
1	1	Supply ChW= *44.2°F (6.7°C)*	–45.0 – 255.0°F	Chilled Water Supply Temperature *(common)*
			① –40.0 – 125.0°C	
		Return ChW= *54.6°F (12.6°C)*	–45.0 – 255.0°F, N/A	Chilled Water Return Temperature
			① –40.0 – 125.0°C, N/A	
	2	Ent CondW= *79.5°F (26.4°C)*	–45.0 – 255.0°F, N/A	Common Entering Condenser Water Temperature
			① –40.0 – 125.0°C, N/A	
		Lvg CondW= 92.1°F *(33.4°C)*	–45.0 – 255.0°F, N/A	Common Leaving Condenser Water Temperature
			① –40.0 – 125.0°C, N/A	
	3	Decoupler= *45.1°F (7.3°C)*	–45.0 – 255.0°F, N/A	Decoupler Temperature
			① –40.0 – 125.0°C, N/A	
		Outdoor Air= *90.0°F (32.2°C)*	–45.0 – 255.0°F, N/A	Outdoor Air Temperature
			① –40.0 – 125.0°C, N/A	

Switch Key Destination: Menu 16. Chilled Water Supply Temperature Control

Notes:

1. Program CSC1S01• only.

Menu 3. Chiller Status

Item				
Scr.	**Line**	**Name** *(typical values shown italic)*	**Range**	**Variable Name**
1	1	#1 Status= *Running*	Off:Local	Chiller #1 Status
			Off:CSC	
			Starting	
			Running	
			Stopping	
			Comm Loss	
			N/A	
		Load= *54%*	0 – 125%	Chiller #1 Load
	2	Ent Evap= *53.6°F (12.0°C)*	–45.0 – 255.0°F	Chiller #1 Entering Evaporator Water Temperature
			① –40.0 – 125.0°C	
		Ent Cond= *75.7°F (24.3°C)*	–45.0 – 255.0°F	Chiller #1 Entering Condenser Water Temperature
			① –40.0 – 125.0°C	
	3	Lvg Evap= *44.2°F (6.8°C)*	–45.0 – 255.0°F	Chiller #1 Leaving Evaporator Water Temperature
			① –40.0 – 125.0°C	
		Lvg Cond= *85.6°F (29.8°C)*	–45.0 – 255.0°F	Chiller #1 Leaving Condenser Water Temperature
			① –40.0 – 125.0°C	
2	1	#2 Status= *Running*	*(same as Chiller #1 Status)*	Chiller #2 Status
		Load= *57%*	0 – 125%	Chiller #2 Load
	2	Ent Evap= *53.8°F (12.1°C)*	*(same as Chiller #1 temps.)*	Chiller #2 Entering Evaporator Water Temperature
		Ent Cond= *75.9°F (24.4°C)*	*(same as Chiller #1 temps.)*	Chiller #2 Entering Condenser Water Temperature
	3	Lvg Evap= *44.3°F (6.8°C)*	*(same as Chiller #1 temps.)*	Chiller #2 Leaving Evaporator Water Temperature
		Lvg Cond= *85.8°F (29.9°C)*	*(same as Chiller #1 temps.)*	Chiller #2 Leaving Condenser Water Temperature
3	1	#3 Status= *Running*	*(same as Chiller #1 Status)*	Chiller #3 Status
		Load= *55%*	0 – 125%	Chiller #3 Load
	2	Ent Evap= *53.9°F (12.2°C)*	*(same as Chiller #1 temps.)*	Chiller #3 Entering Evaporator Water Temperature
		Ent Cond= *75.5°F (24.2°C)*	*(same as Chiller #1 temps.)*	Chiller #3 Entering Condenser Water Temperature
	3	Lvg Evap= *44.6°F (7.0°C)*	*(same as Chiller #1 temps.)*	Chiller #3 Leaving Evaporator Water Temperature
		Lvg Cond= *85.7°F (29.8°C)*	*(same as Chiller #1 temps.)*	Chiller #3 Leaving Condenser Water Temperature
4	1	#4 Status= *Off:CSC*	*(same as Chiller #1 Status)*	Chiller #4 Status
		Load= *0%*	0 – 125%	Chiller #4 Load
	2	Ent Evap= *56.3°F (13.5°C)*	*(same as Chiller #1 temps.)*	Chiller #4 Entering Evaporator Water Temperature
		Ent Cond= *80.7°F (27.1°C)*	*(same as Chiller #1 temps.)*	Chiller #4 Entering Condenser Water Temperature
	3	Lvg Evap= *56.2°F (13.4°C)*	*(same as Chiller #1 temps.)*	Chiller #4 Leaving Evaporator Water Temperature
		Lvg Cond= *81.0°F (27.2°C)*	*(same as Chiller #1 temps.)*	Chiller #4 Leaving Condenser Water Temperature
5	1	#5 Status= *N/A*	*(same as Chiller #1 Status)*	Chiller #5 Status
		Load= *0%*	0 – 125%	Chiller #5 Load
	2	Ent Evap= *20.0°F (–6.7°C)*	*(same as Chiller #1 temps.)*	Chiller #5 Entering Evaporator Water Temperature
		Ent Cond= *55.0°F (12.8°C)*	*(same as Chiller #1 temps.)*	Chiller #5 Entering Condenser Water Temperature
	3	Lvg Evap= *20.0°F (–6.7°C)*	*(same as Chiller #1 temps.)*	Chiller #5 Leaving Evaporator Water Temperature
		Lvg Cond= *55.0°F (12.8°C)*	*(same as Chiller #1 temps.)*	Chiller #5 Leaving Condenser Water Temperature
6	1	#6 Status= *N/A*	*(same as Chiller #1 Status)*	Chiller #6 Status
		Load= *0%*	0 – 125%	Chiller #6 Load
	2	Ent Evap= *20.0°F (–6.7°C)*	*(same as Chiller #1 temps.)*	Chiller #6 Entering Evaporator Water Temperature
		Ent Cond= *55.0°F (12.8°C)*	*(same as Chiller #1 temps.)*	Chiller #6 Entering Condenser Water Temperature
	3	Lvg Evap= *20.0°F (–6.7°C)*	*(same as Chiller #1 temps.)*	Chiller #6 Leaving Evaporator Water Temperature
		Lvg Cond= *55.0°F (12.8°C)*	*(same as Chiller #1 temps.)*	Chiller #6 Leaving Condenser Water Temperature
7	1	#7 Status= *N/A*	*(same as Chiller #1 Status)*	Chiller #7 Status
		Load= *0%*	0 – 125%	Chiller #7 Load
	2	Ent Evap= *20.0°F (–6.7°C)*	*(same as Chiller #1 temps.)*	Chiller #7 Entering Evaporator Water Temperature
		Ent Cond= *55.0°F (12.8°C)*	*(same as Chiller #1 temps.)*	Chiller #7 Entering Condenser Water Temperature
	3	Lvg Evap= *20.0°F (–6.7°C)*	*(same as Chiller #1 temps.)*	Chiller #7 Leaving Evaporator Water Temperature
		Lvg Cond= *55.0°F (12.8°C)*	*(same as Chiller #1 temps.)*	Chiller #7 Leaving Condenser Water Temperature
8	1	#8 Status= *N/A*	*(same as Chiller #1 Status)*	Chiller #8 Status
		Load= *0%*	0 – 125%	Chiller #8 Load
	2	Ent Evap= *20.0°F (–6.7°C)*	*(same as Chiller #1 temps.)*	Chiller #8 Entering Evaporator Water Temperature
		Ent Cond= *55.0°F (12.8°C)*	*(same as Chiller #1 temps.)*	Chiller #8 Entering Condenser Water Temperature
	3	Lvg Evap= *20.0°F (–6.7°C)*	*(same as Chiller #1 temps.)*	Chiller #8 Leaving Evaporator Water Temperature
		Lvg Cond= *55.0°F (12.8°C)*	*(same as Chiller #1 temps.)*	Chiller #8 Leaving Condenser Water Temperature

SWITCH Key Destination: Menu 13. Chiller Sequence Order

Notes:

1. Program CSC1S01* only.

Menu 4. Chiller Operating Hours

Item				
Scr.	Line	Name (*typical values shown italic*)	Range	Variable Name
1	1	Chil #1= *12345 Hrs*	0 – 49999 Hrs	Chiller #1 Operating Hours
	2	Chil #2= *12345 Hrs*	0 – 49999 Hrs	Chiller #2 Operating Hours
	3	Chil #3= *12345 Hrs*	0 – 49999 Hrs	Chiller #3 Operating Hours
	1	Chil #4= *12345 Hrs*	0 – 49999 Hrs	Chiller #4 Operating Hours
	2	Chil #5= *12345 Hrs*	0 – 49999 Hrs	Chiller #5 Operating Hours
	3	Chil #6= *12345 Hrs*	0 – 49999 Hrs	Chiller #6 Operating Hours
2	1	Chil #7= *12345 Hrs*	0 – 49999 Hrs	Chiller #7 Operating Hours
	2	Chil #8= *12345 Hrs*	0 – 49999 Hrs	Chiller #8 Operating Hours

Switch Key Destination: Menu 13. Chiller Sequence Order

Menu 5. Load Limiting Status

Item				
Scr.	Line	Name (*typical values shown italic*)	Range	Variable Name
1	1	Demand Limit= *100%*	40 – 100%	System Demand Limiting Load Limit
	2	Load Balance= *100%*	30 – 125%	System Load Balancing Load Limit
2	1	Start Grp #1= *100%*	30%, 100%	Start-Up Unloading Group #1 Load Limit
	2	Start Grp #2= *100%*	30%, 100%	Start-Up Unloading Group #2 Load Limit
	1	Start Grp #3= *100%*	30%, 100%	Start-Up Unloading Group #3 Load Limit
	2	Start Grp #4= *100%*	30%, 100%	Start-Up Unloading Group #4 Load Limit
3	1	Chiller #1= *100%*	30 – 100%	Chiller #1 Load Limit
	2	Chiller #2= *100%*	30 – 100%	Chiller #2 Load Limit
	3	Chiller #3= *100%*	30 – 100%	Chiller #3 Load Limit
	1	Chiller #4= *100%*	30 – 100%	Chiller #4 Load Limit
	2	Chiller #5= *100%*	30 – 100%	Chiller #5 Load Limit
	3	Chiller #6= *100%*	30 – 100%	Chiller #6 Load Limit
4	1	Chiller #7= *100%*	30 – 100%	Chiller #7 Load Limit
	2	Chiller #8= *100%*	30 – 100%	Chiller #8 Load Limit

Switch Key Destination: Menu 14. Load Limiting Setup

Menu 6. Cooling Tower Status

Item				
Scr.	Line	Name (*typical values shown italic*)	Range	Variable Name
1	1	Cooling Tower Stage= *2*	0 – 12	Current Cooling Tower Stage
	2	Bypass Valve Position= *95%* To Tower	0 – 100%	Cooling Tower Bypass Valve Position
	3	Ent CndW T= *79.5°F (26.4°C)*	–45.0 – 255.0°F	Common Entering Condenser Water Temperature
			① –40.0 – 125.0°C	
		Lvg CndW T= *92.1°F (33.4°C)*	–45.0 – 255.0°F	Common Leaving Condenser Water Temperature
			① –40.0 – 125.0°C	

Switch Key Destination: Menu 18. Cooling Tower Stages

Notes:

1. Program CSC1S01∗ only.

Menu 7. Flow To Load

Item				
Scr.	Line	Name (typical values shown italic)	Range	Variable Name
1	1	Pressure Bypass Valve or VFD Pump= *30%*	0 – 100%	Differential Pressure Bypass Valve Position *or* Secondary VFD Pump Speed
	2	Press Diff= *19 psi (131 kPa)*	0 – 99 psi	Chilled Water Loop Pressure Difference
			① 0 – 650 kPa	
		Pump Stage= *0*	0 – 9	Current Sequenced Pump Stage
	3	Pump #1= *12345 Hrs*	0 – 49999 Hrs	Secondary Pump #1 Operating Hours
		Pump #2= *12345 Hrs*	0 – 49999 Hrs	Secondary Pump #2 Operating Hours
2	1	Pump #1 Out= *On*	On	Secondary Pump #1 Output State
			Off	
		Pump #1 Status= *On*	On	Secondary Pump #1 Status
			Off	
	2	Pump #2 Out= *Off*	On	Secondary Pump #2 Output State
			Off	
		Pump #2 Status= *Off*	On	Secondary Pump #2 Status
			Off	
	3	Pump #3 Out= *Off*	On	Secondary Pump #3 Output State
			Off	
		Pump #3 Status= *Off*	On	Secondary Pump #3 Status
			Off	
3	1	Pump #4 Out= *Off*	On	Secondary Pump #4 Output State
			Off	
		Pump #4 Status= *Off*	On	Secondary Pump #4 Status
			Off	
	2	Pump #5 Out= *Off*	On	Secondary Pump #5 Output State
			Off	
		Pump #5 Status= *Off*	On	Secondary Pump #5 Status
			Off	
	3	Pump #6 Out= *Off*	On	Secondary Pump #6 Output State
			Off	
		Pump #6 Status= *Off*	On	Secondary Pump #6 Status
			Off	

SWITCH Key Destination: Menu 21. Load Flow Control

Notes:
1. Program CSC1S01∗ only.

Menu 8. Miscellaneous Inputs

Item				
Scr.	Line	Name (typical values shown italic)	Range	Variable Name
1	1	External Start/Stop= *Auto*	Auto *(input open)*	External Start/Stop Status
			Occupied *(input closed)*	
	2	Supply ChW Reset Override= *Auto*	Auto *(input open)*	Chilled Water Reset Override Status
			Override *(input closed)*	
	3	Cooling Tower Alarm= *Normal*	Fail *(input open)*	Cooling Tower Alarm Input Status
			Normal *(input closed)*	
2	1	Decoupler Flow Rate= *500 gpm (31.5 L/s)*	0 – 5000 gpm	Decoupler Flow Rate *(supply to return)*
			① 0 – 300.0 L/s	
	2	External Demand Limit Signal= *0.0 VDC*	0.0 – 5.0 VDC	External Demand Limiting Signal *(conditioned)*
	3	External ChW Reset Signal= *0.0 VDC*	0.0 – 5.0 VDC	External Chilled Water Reset Signal *(conditioned)*

SWITCH Key Destination: None

Notes:
1. Program CSC1S01∗ only.

Menu 9. Miscellaneous Status

Item				
Scr.	Line	Name (typical values shown italic)	Range	Variable Name
1	1	Stage-Up Inhibit Level= *2*	None	Stage-Up Inhibit Level *(via network comm.)*
			1 – 7	

SWITCH Key Destination: Menu 11. Chiller Sequencing

Control Menus

The Control category includes menus 10 through 30. Following are brief descriptions of them.

System Control
Menu 10, "System Control," contains the CSC Control Mode variable, which allows you to set up the CSC for automatic or manual operation. It also contains the low ambient lockout variables that are used to prevent chiller system operation when the outdoor air temperature is below a set temperature. For more information, see the "Auto/Manual Operation" section in the "Operator's Guide" portion of this manual.

Chiller Sequencing
Menu 11, "Chil Sequencing," can be used to designate whether the chiller sequence order will be set manually or automatically and whether certain chillers will be designated as standby, first on, or last on. It can also be used to set up the CSC's chiller sequencing control logic. For more information, see the "Chiller Sequencing Control" section in the "Description of Operation" portion of this manual.

Chiller Staging Factors
Menu 12, "Chil Stg Factors," contains the variables that cause the active chiller stage number to increase or decrease as the cooling load varies. Individual variables are provided for each chiller stage. Chiller staging is based on the average load of all operational chillers, an adjustable time delay, and in some applications, flow rate through the decoupler (bypass) line.

In addition to the chiller staging variables, a limit on the number of cooling tower stages can be specified for each chiller stage. For more information, see the "Chiller Sequencing Control" section in the "Description of Operation" portion of this manual.

Chiller Sequence Order
Menu 13, "Chiller Order," shows the order in which the CSC will sequence chillers as the cooling load varies. When the CSC is set up to change the sequence order automatically, the variables in menu 13 are status only (non-adjustable). When the CSC is set up to allow manual sequence order changes, the variables in menu 13 are used to set a fixed sequence order.

In either case, the sequence order is organized according to chiller *stages* rather than individual chillers. A chiller stage is a defined set of chillers; for example, stage 1 might consist of Chiller #2, and stage 2 might consist of Chiller #1 and Chiller #2. (In this instance, Chiller #2 would be "lead" and Chiller #1 would be "lag.") This approach provides more sequencing flexibility because chillers can be either started or stopped in sets of one or more as the cooling load either increases or decreases. For more information, see the "Chiller Sequencing Control" section in the "Description of Operation" portion of this manual.

Load Limiting Setup
Menu 14, "Load Limiting," contains variables that allow you to set up the two system-wide, percent-of-capacity load limiting functions: load balancing and demand limiting. Both of these functions are optional.

Load balancing causes all centrifugal chillers to operate at about the same capacity (% RLA). It is typically used when there are dual-compressor chillers or chillers piped in series.

Demand limiting prevents chillers from operating above a specified capacity (% RLA for centrifugal; stages for reciprocating and screw). The demand limiting signal can be either an external input (4–20 mA, 1–5 Vdc, 2–10 Vdc) or a network input received via Open Protocol. For more information, see the "Load Limiting Control" section in the "Description of Operation" portion of this manual.

Start-Up Unloading
Menu 15, "Start-Up Unload," contains variables that allow you to set up the start-up unloading load limiting function. Start-up unloading is different from load balancing and demand limiting in that it works on separate *groups* of chillers (centrifugal only) rather than *all* chillers. Start-up unloading causes all operational compressors in a group to unload when another compressor in the same group starts up. It is typically used only for dual-compressor chillers. For more information, see the "Load Limiting Control" section in the "Description of Operation" portion of this manual.

Chilled Water Supply Temperature Control
Menu 16, "Supply Tmp Cntl," can be used to specify whether the CSC will perform common (system supply) chilled water temperature control or unit (leaving evaporator) chilled water temperature control. Either control method can be used with any of the reset options (see below). For more information, see the "Chilled Water Temperature Control" section in the "Description of Operation" portion of this manual.

Chilled Water Supply Temperature Reset
Menu 17, "Supply Tmp Reset," contains variables that are used to reset the chilled water supply temperature setpoint. Four types of reset are available. For more information, see the "Chilled Water Temperature Control" section in the "Description of Operation" portion of this manual.

Cooling Tower Stages
Menu 18, "Clg Tower Stages," contains variables that allow you to set up the staging control for the cooling tower system. Twelve stages are possible, and each stage has a separate setpoint. For more information, see the "Cooling Tower Control" section in the "Description of Operation" portion of this manual.

Cooling Tower Output Order
Menu 19, "Twr Output Order," can be used to set the order in which the CSC will stage tower outputs as the heat rejection requirement varies. Like a chiller stage, a tower stage is a defined set of tower outputs; for example, stage 1 might consist of Fan #1, stage 2 of Fan #2, and stage 3 of Fan #1 and #2. For more information, see the "Cooling Tower Control" section in the "Description of Operation" portion of this manual.

Cooling Tower Bypass Valve
Menu 20, "Clg Tower Valve," contains variables that allow you to set up the bypass valve control for the cooling tower system. The valve can be set up to modulate either before tower stage 1 is activated or between tower stages. In either case, you can set up an initial valve position function, which sets the bypass valve position as appropriate for the outdoor air temperature during system start-up. For more information, see the "Cooling Tower Control" section in the "Description of Operation" portion of this manual.

Load Flow Control
Menu 21, "Load Flow Cntl," contains variables that can be used to set up the chilled water system flow control. Bypass valve control and three types of secondary pump logic are possible. Secondary pumps can be fixed or variable speed. For more information, see the "Chilled Water Flow Control" section in the "Description of Operation" portion of this manual.

Secondary Pump Sequence Order

Menu 22, "Sec Pump Order," can be used to set the order in which the CSC will sequence secondary pumps to maintain the differential pressure across the supply and return lines. Like a chiller stage, a pump stage is a defined set of pumps; for example, stage 1 might consist of Pump #1, stage 2 of Pump #1 and #2, and stage 3 of Pump #1, #2, and #3. For more information, see the "Chilled Water Flow Control" section in the "Description of Operation" portion of this manual.

Time/Date

Menu 23, "Time/Date," allows you to adjust the current time, day, and date. For more information, see the "Scheduling" section in the "Operator's Guide" portion of this manual.

Schedule

Menu 24, "Schedule," contains the CSC's internal scheduling variables. It also includes an operator override timer and a one-event schedule that can be used to enable chiller system operation for a specified time period. For more information, see the "Scheduling" and "Auto/Manual Operation" sections in the "Operator's Guide" portion of this manual.

Holiday Date

Menu 25, "Holiday Date," allows you to schedule 12 holiday dates. Each date can be assigned a duration from 1 to 31 days. On each day of the holiday period, the holiday schedule entered under menu 24 is used. For more information, see the "Scheduling" section in the "Operator's Guide" portion of this manual.

Optimal Start

Menu 26, "Optimal Start," contains variables that are used to set up the CSC's adaptive optimal start feature. Optimal start uses the scheduled start time, the outdoor air temperature, and the chilled water loop temperature to determine the best possible time to enable chiller system operation. For more information, see the "Scheduling" section in the "Operator's Guide" portion of this manual.

Table of Optimal Start Time Increments

Menu 27, "Optimal Minutes," contains a table of time increments (in minutes) that are subtracted from the CSC's normal scheduled start time to get the optimal start time. The table value that is used for any particular day is based on the outdoor air and chilled water loop temperatures. For more information, see the "Scheduling" section in the "Operator's Guide" portion of this manual.

Service

Menu 28, "Service," contains CSC setup and service related items. For more information, see the following "CSC and Chiller Controller Initial Setup" section. The last item on screen 1, "IDENT=," displays the CSC's program code.

Chiller Setup

Menu 29, "Chiller Setup," contains variables that define each chiller associated with the CSC. For more information, see the following "CSC and Chiller Controller Initial Setup" section.

Service Testing

Menu 30, "Service Testing," contains variables that allow a service technician to manually control the CSC's digital and analog outputs. This would normally be done only during system commissioning or when service is required. For more information, see Bulletin No. IM 618 and the "Auto/Manual Operation" section in the "Operator's Guide" portion of this manual.

Menu 10. System Control

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	CSC Control Mode= ***Manual Off***	1	Manual Off	CSC Control Mode
				Automatic	
				Manual On	
				Service Testing	
	2	Rapid Restart Time= ***10 Sec***	1	0 – 60 Sec	Rapid Restart Time
				1 – 60 Min	
				1 – 60 Hr	
	3	Low Amb Lockout= ***No***	1	No	Low Ambient Lockout Flag
				Yes	
		Low Amb Spt= ***50.0°F (9.9°C)***	1	15.0 – 99.5°F	Low Ambient Lockout Setpoint
				① -9.5 – 37.4°C	

SWITCH Key Destination: Menu 24. Schedule

Notes:

1. Program CSC1S01• only.

Menu 11. Chiller Sequencing

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Option= ***Automatic***	1	Fixed	Chiller Sequence Order Option
				Automatic	
	2	Control Type= ***Standard***	1	Standard	Chiller Sequencing Control Type
				Decoupled	
2	1	① Standby= ***NA***	1	NA, #1 – #8	Standby Chiller
	2	② On First= ***NA*** & Off ***Last***	1	NA, #1 – #8	First On Chiller
			2	at Stage Two	
				Last	
	3	② On Last= ***NA*** & Off First	1	NA, #1 – #8	Last On Chiller
3	1	Resequence Day/Time= ***N/A 00:00***	1	N/A	Chiller Resequence Day/Time
				Sun – Sat	
				Dly	
				Hol	
				③ Now	
			2	0 – 23	
			3	0 – 59	
	2	Inhibit Stage-Up After ***23:59***	1	0 – 23	Inhibit Stage-Up After Time
			2	0 – 59	
	3	Stage-Up Inhibit Setpoint= ***None***	1	None	Stage-Up Inhibit Setpoint
				1 – 7	
4	1	Number Of Chillers= ***3***	1	1 – 8	Number Of Chillers
	2	④ Number Of Stages= ***3***	1	1 – 9	Number Of Chiller Stages
	3	Stage-Up Differential= ***+1.0°F (+0.5°C)***	1	0.0 – 9.5°F	Chiller Stage-Up Differential
				⑤ 0.0 – 5.2°C	
5	1	Decoupler Temperature Diff= ***+2.0°F (+1.1°C)***	1	0.0 – 9.5°F	Decoupler Stage-Up Temperature Differential
				⑤ 0.0 – 5.2°C	
	2	Decoupler Flow Factor= ***1.10***	1	0.75 – 1.50	Decoupler Stage-Down Flow Rate Factor

Switch Key Destination: Menu 3. Chiller Status

Notes:

1. If a standby chiller is designated, it will automatically be placed only in the highest stage (menu 13) regardless of the Chiller Sequence Order Option setting. If the Chiller Sequence Order Option is set to "Automatic," the Last On Chiller variable is automatically set equal to the Standby Chiller variable.
2. The First On Chiller and Last On Chiller variables have meaning only when the Chiller Sequence Order Option is set to "Automatic." The controller will not allow the same chiller to be designated both first on and last on.
3. The "Now" selection will automatically change to "N/A" after the resequence day/time function is executed.
4. The Number Of Chiller Stages variable is adjustable only when the Chiller Sequence Order Option is set to "Fixed." If the Chiller Sequence Order Option is set to "Automatic," the Number Of Chiller Stages variable is automatically set equal to the Number Of Chillers variable.
5. Program CSC1S01• only.

Menu 12. Chiller Staging Factors

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Stage 1:	*(screen name)*		
	2	Stage-Up Load= ***95%***	1	NA, 1 – 99%	Chiller Stage 1 Stage-Up Setpoint
		① Stage-Dn Load= ***NA%***	–	–	–
	3	Time Delay= ***5 Min***	1	2 – 60 Min	Chiller Stage 1 Delay Time
		Max Tower Stage= ***1***	1	NA, 1 – 12	Chiller Stage 1 Max Tower Stage
2	1	Stage 2:	*(screen name)*		
	2	Stage-Up Load= ***95%***	1	NA, 1 – 99%	Chiller Stage 2 Stage-Up Setpoint
		Stage-Dn Load= ***50%***	1	NA, 1 – 99%	Chiller Stage 2 Stage-Down Setpoint
	3	Time Delay= ***5 Min***	1	2 – 60 Min	Chiller Stage 2 Delay Time
		Max Tower Stage= ***2***	1	NA, 1 – 12	Chiller Stage 2 Max Tower Stage
3	1	Stage 3:	*(screen name)*		
	2	Stage-Up Load= ***95%***	1	NA, 1 – 99%	Chiller Stage 3 Stage-Up Setpoint
		Stage-Dn Load= ***67%***	1	NA, 1 – 99%	Chiller Stage 3 Stage-Down Setpoint
	3	Time Delay= ***5 Min***	1	2 – 60 Min	Chiller Stage 3 Delay Time
		Max Tower Stage= ***3***	1	1 – 12	Chiller Stage 3 Max Tower Stage
4	1	Stage 4:	*(screen name)*		
	2	Stage-Up Load= ***95%***	1	NA, 1 – 99%	Chiller Stage 4 Stage-Up Setpoint
		Stage-Dn Load= ***75%***	1	NA, 1 – 99%	Chiller Stage 4 Stage-Down Setpoint
	3	Time Delay= ***5 Min***	1	2 – 60 Min	Chiller Stage 4 Delay Time
		Max Tower Stage= ***4***	1	1 – 12	Chiller Stage 4 Max Tower Stage

Continued

Menu 12. Chiller Staging Factors (cont'd)

Item					
Scr.	Line	Name (default adjustable values shown bold italic)	Field No.	Range	Variable Name
5	1	Stage 5:	(screen name)		
	2	Stage-Up Load= ***95%***	1	NA, 1 – 99%	Chiller Stage 5 Stage-Up Setpoint
		Stage-Dn Load= ***80%***	1	NA, 1 – 99%	Chiller Stage 5 Stage-Down Setpoint
	3	Time Delay= ***5 Min***	1	2 – 60 Min	Chiller Stage 5 Delay Time
		Max Tower Stage= ***5***	1	1 – 12	Chiller Stage 5 Max Tower Stage
6	1	Stage 6:	(screen name)		
	2	Stage-Up Load= ***95%***	1	NA, 1 – 99%	Chiller Stage 6 Stage-Up Setpoint
		Stage-Dn Load= ***80%***	1	NA, 1 – 99%	Chiller Stage 6 Stage-Down Setpoint
	3	Time Delay= ***5 Min***	1	2 – 60 Min	Chiller Stage 6 Delay Time
		Max Tower Stage= ***6***	1	1 – 12	Chiller Stage 6 Max Tower Stage
7	1	Stage 7:	(screen name)		
	2	Stage-Up Load= ***95%***	1	NA, 1 – 99%	Chiller Stage 7 Stage-Up Setpoint
		Stage-Dn Load= ***80%***	1	NA, 1 – 99%	Chiller Stage 7 Stage-Down Setpoint
	3	Time Delay= ***5 Min***	1	2 – 60 Min	Chiller Stage 7 Delay Time
		Max Tower Stage= ***7***	1	1 – 12	Chiller Stage 7 Max Tower Stage
8	1	Stage 8:	(screen name)		
	2	Stage-Up Load= ***95%***	1	NA, 1 – 99%	Chiller Stage 8 Stage-Up Setpoint
		Stage-Dn Load= ***80%***	1	NA, 1 – 99%	Chiller Stage 8 Stage-Down Setpoint
	3	Time Delay= ***5 Min***	1	2 – 60 Min	Chiller Stage 8 Delay Time
		Max Tower Stage= ***8***	1	1 – 12	Chiller Stage 8 Max Tower Stage
9	1	Stage 9:	(screen name)		
	2	Stage-Up Load= ***95%***	1	NA, 1 – 99%	Chiller Stage 9 Stage-Up Setpoint
		Stage-Dn Load= ***80%***	1	NA, 1 – 99%	Chiller Stage 9 Stage-Down Setpoint
	3	Time Delay= ***5 Min***	1	2 – 60 Min	Chiller Stage 9 Delay Time
		Max Tower Stage= ***9***	1	1 – 12	Chiller Stage 9 Max Tower Stage

SWITCH Key Destination: Menu 3. Chiller Status

Notes:

1. This item is not used.

Menu 13. Chiller Sequence Order

Item					
Scr.	Line	Name (default adjustable values shown bold italic)	Field No.	Range	Variable Name
1	1	① Stage 1= ***#1 xx xx xx xx xx xx xx***	1	xx, #1	Chiller Stage 1 Bitset
			2	xx, #2	
			3	xx, #3	
			4	xx, #4	
			5	xx, #5	
			6	xx, #6	
			7	xx, #7	
			8	xx, #8	
	2	① Stage 2= ***#1 #2 xx xx xx xx xx xx***	(same as Stage 1 Bitset)		Chiller Stage 2 Bitset
	3	① Stage 3= ***#1 #2 #3 xx xx xx xx xx***	(same as Stage 1 Bitset)		Chiller Stage 3 Bitset
2	1	① Stage 4= ***#1 #2 #3 #4 xx xx xx xx***	(same as Stage 1 Bitset)		Chiller Stage 4 Bitset
	2	① Stage 5= ***#1 #2 #3 #4 #5 xx xx xx***	(same as Stage 1 Bitset)		Chiller Stage 5 Bitset
	3	① Stage 6= ***#1 #2 #3 #4 #5 #6 xx xx***	(same as Stage 1 Bitset)		Chiller Stage 6 Bitset
3	1	① Stage 7= ***#1 #2 #3 #4 #5 #6 #7 xx***	(same as Stage 1 Bitset)		Chiller Stage 7 Bitset
	2	① Stage 8= ***#1 #2 #3 #4 #5 #6 #7 #8***	(same as Stage 1 Bitset)		Chiller Stage 8 Bitset
	3	① Stage 9= ***xx xx xx xx xx xx xx xx***	(same as Stage 1 Bitset)		Chiller Stage 9 Bitset

SWITCH Key Destination: Menu 1. System Status

Notes:

1. The fields for this item are adjustable when the Chiller Sequence Order Option (menu 11) is set to "Fixed." They are not adjustable when the Chiller Sequence Order Option is set to "Automatic"; in this case they will show the current values set by the CSC.

Menu 14. Load Limiting Setup

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Load Balancing= ***No***	1	No	Load Balancing Flag
				Yes	
	2	Capacity Difference Limit= ***5%***	1	2 – 20%	Load Balancing Capacity Difference Limit
	3	Demand Limiting Type= ***None***	1	None	Demand Limiting Type
				External	
				Open Protocol	

Switch Key Destination: Menu 15. Start-Up Unloading

Menu 15. Start-Up Unloading

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Chiller #1 Group= ***NA***	1	NA, 1 – 4	Chiller #1 Group
	2	Chiller #2 Group= ***NA***	1	NA, 1 – 4	Chiller #2 Group
	3	Chiller #3 Group= ***NA***	1	NA, 1 – 4	Chiller #3 Group
	1	Chiller #4 Group= ***NA***	1	NA, 1 – 4	Chiller #4 Group
	2	Chiller #5 Group= ***NA***	1	NA, 1 – 4	Chiller #5 Group
	3	Chiller #6 Group= ***NA***	1	NA, 1 – 4	Chiller #6 Group
2	1	Chiller #7 Group= ***NA***	1	NA, 1 – 4	Chiller #7 Group
	2	Chiller #8 Group= ***NA***	1	NA, 1 – 4	Chiller #8 Group

Switch Key Destination: Menu 5. Load Limiting Status

Menu 16. Chilled Water Supply Temperature Control

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Control= ***Unit***	1	Unit	Chilled Water Temperature Control Option
				Common	
	2	① System Setpoint= ***44.0°F (6.6°C)***	1	0.0 – 80.0°F	System Setpoint *(chilled water supply)*
				② –17.8 – 26.6°C	
	3	③ Chiller Setpoint= *44.0°F (6.6°C)*	–	0.0 – 80.0°F	Chiller Setpoint *(leaving evaporator water)*
				② –17.8 – 26.6°C	
2	1	Deadband= ***±0.5°F (±0.2°C)***	1	0.5 – 9.5°F	Common Supply Deadband
				② 0.2 – 5.2°C	
		④ Min Chil Spt= ***40.0°F (4.4°C)***	1	0.0 – 80.0°F	Minimum Chiller Setpoint
				② –17.8 – 26.6°C	
	2	Mod Limit= ***±6.0°F (±3.3°C)***	1	1.0 – 60.0°F	Common Supply Mod Limit
				② 0.5 – 33.3°C	
		Sample Time= ***30 Sec***	1	1 – 60 Sec	Common Supply Sample Time
				1 – 60 Min	
	3	Max Change= ***2.0°F (1.1°C)***	1	0.5 – 20.0°F	Common Supply Max Change
				② 0.2 – 11.1°C	
		PA Time= ***0 Sec***	1	0 – 240 Sec	Common Supply Project Ahead Time
				0 – 240 Min	

Switch Key Destination: Menu 17. Chilled Water Supply Temperature Reset

Notes:

1. The System Setpoint is adjustable only when the Chilled Water Temperature Reset Type variable (menu 17) is set to "None." Otherwise, the System Setpoint is automatically set by the CSC and is status only. The actual range of System Setpoint values is defined by the Minimum System Setpoint and Maximum System Setpoint (menu 17).
2. Program CSC1S01* only.
3. The Chiller Setpoint is not adjustable; it is automatically set by the CSC and is thus status only. When the Chilled Water Temperature Control Option is set to "Unit," the Chiller Setpoint will always be equal to the System Setpoint.
4. The Minimum Chiller Setpoint can be set below 40.0°F (4.4°C) only when the Glycol Flag (menu 28) is set to "Yes." It cannot be set above the Minimum System Setpoint (menu 17).

Menu 17. Chilled Water Supply Temperature Reset

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Reset Type= ***None***	1	None	Chilled Water Temperature Reset Type
				External	
				OAT	
				RChWT	
				Constant RChWT	
	2	① Min Sys Spt= ***44.0°F (6.6°C)***	1	0.0 – 80.0°F	Minimum System Setpoint
				② –17.8 – 26.6°C	
		① Max Sys Spt= ***54.0°F (12.2°C)***	1	0.0 – 80.0°F	Maximum System Setpoint
				② –17.8 – 26.6°C	
	3	③ MinSysSptAt ***90.0°F (32.2°C)***	1	0.0 – 99.5°F	Minimum System Setpoint At
				② –17.8 – 37.4°C	
		③ MaxSysSptAt ***70.0°F (21.0°C)***	1	0.0 – 99.5°F	Maximum System Setpoint At
				② –17.8 – 37.4°C	
2	1	RChWT Spt= ***54.0°F (12.2°C)***	1	20.0 – 80.0°F	Constant Return Setpoint
				② –6.7 – 26.6°C	
		Deadband= ***±0.5°F (±0.2°C)***	1	0.5 – 9.5°F	Constant Return Deadband
				② 0.2 – 5.2°C	
	2	Mod Limit= ***±6.0°F (±3.3°C)***	1	1.0 – 60.0°F	Constant Return Mod Limit
				② 0.5 – 33.3°C	
		Sample Time= ***45 Sec***	1	1 – 60 Sec	Constant Return Sample Time
				1 – 60 Min	
	3	Max Change= ***2.0°F (1.1°C)***	1	0.5 – 10.0°F	Constant Return Max Change
				② 0.2 – 11.1°C	
		PA Time= ***30 Sec***	1	0 – 240 Sec	Constant Return Project Ahead Time
				0 – 240 Min	
3	1	External Signal= *0.0 VDC*	–	0.0 – 5.0 VDC	External Chilled Water Reset Signal *(conditioned)*
	2	Return ChWT= *54.6°F (12.6°C)*	–	–45.0 – 255.0°F, N/A	Chilled Water Return Temperature
				① –40.0 – 125.0°C, N/A	
	3	OAT= *90.0°F (32.2°C)*	–	–45.0 – 255.0°F, N/A	Outdoor Air Temperature
				① –40.0 – 125.0°C, N/A	

Switch Key Destination: Menu 2. Temperatures

Notes:

1. This setpoint can be set below 40.0°F (4.4°C) only when the Glycol Flag (menu 28) is set to "Yes."
2. Program CSC1S01∗ only.
3. The default value for this item is typical for the "OAT" reset method.

Menu 18. Cooling Tower Stages

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Tower Control= ***Yes***	1	No	Tower Control Flag
				Yes	
		Cntl Temp Src= ***Ent***	1	Ent	Control Temperature Source
				Lvg	
	2	Number Of Stages= ***6***	1	NA, 1 – 12	Number Of Tower Stages
		Stage Diff= ***–3.0°F (–1.6°C)***	1	0.0 – 9.5°F	Tower Stage Differential
				① 0.0 – 5.2°C	
	3	StageUp Time= ***2 Min***	1	1 – 60 Min	Tower Stage-Up Delay Time
		StageDn Time= ***5 Min***	1	1 – 60 Min	Tower Stage-Down Delay Time
2	1	Stg 1 Spt= ***74.0°F (23.3°C)***	1	40.0 – 99.5°F	Tower Stage 1 Setpoint
				① 4.4 – 37.4°C	
	2	Stg 2 Spt= ***76.0°F (24.4°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 2 Setpoint
	3	Stg 3 Spt= ***78.0°F (25.5°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 3 Setpoint
	1	Stg 4 Spt= ***78.0°F (25.5°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 4 Setpoint
	2	Stg 5 Spt= ***78.0°F (25.5°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 5 Setpoint
	3	Stg 6 Spt= ***78.0°F (25.5°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 6 Setpoint
3	1	Stg 7 Spt= ***78.0°F (25.5°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 7 Setpoint
	2	Stg 8 Spt= ***78.0°F (25.5°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 8 Setpoint
	3	Stg 9 Spt= ***78.0°F (25.5°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 9 Setpoint
	1	Stg 10 Spt= ***78.0°F (25.5°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 10 Setpoint
	2	Stg 11 Spt= ***78.0°F (25.5°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 11 Setpoint
	3	Stg 12 Spt= ***78.0°F (25.5°C)***	*(same as Tower Stage 1 Spt.)*		Tower Stage 12 Setpoint

Switch Key Destination: Menu 19. Cooling Tower Output Sequence Order

Notes:

1. Program CSC1S01∗ only.

Menu 19. Cooling Tower Output Sequence Order

Item					
Scr.	Line	Name (default adjustable values shown bold italic)	Field No.	Range	Variable Name
1	1	Stage 1= ***x 2 x x x x x x x xx xx xx***	1	x, 1	Tower Stage 1 Bitset
			2	x, 2	
			3	x, 3	
			4	x, 4	
			5	x, 5	
			6	x, 6	
			7	x, 7	
			8	x, 8	
			9	x, 9	
			10	xx, 10	
			11	xx, 11	
			12	xx, 12	
	2	Stage 2= ***1 x x x x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 2 Bitset
	3	Stage 3= ***1 2 x x x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 3 Bitset
2	1	Stage 4= ***1 x 3 x x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 4 Bitset
	2	Stage 5= ***1 2 3 x x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 5 Bitset
	3	Stage 6= ***1 x 3 4 x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 6 Bitset
3	1	Stage 7= ***x x x x x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 7 Bitset
	2	Stage 8= ***x x x x x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 8 Bitset
	3	Stage 9= ***x x x x x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 9 Bitset
4	1	Stage 10= ***x x x x x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 10 Bitset
	2	Stage 11= ***x x x x x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 11 Bitset
	3	Stage 12= ***x x x x x x x x x xx xx xx***	*(same as Tower Stage 1 Bitset)*		Tower Stage 12 Bitset

SWITCH Key Destination: Menu 20. Cooling Tower Bypass Valve

Menu 20. Cooling Tower Bypass Valve

Item					
Scr.	Line	Name (default adjustable values shown bold italic)	Field No.	Range	Variable Name
1	1	Valve Control= ***None***	1	None	Tower Valve Control Option
				Valve Spt	
				Stage Spt	
	2	Valve Spt= ***70.0°F (21.0°C)***	1	40.0 – 99.5°F	Tower Valve Setpoint
				① 4.4 – 37.4°C	
		Valve Db= ***±2.0°F (±1.1°C)***	1	0.0 – 9.5°F	Tower Valve Deadband
				① 0.0 – 5.2°C	
	3	Min Position= ***20%***	1	0 – 100%	Minimum Tower Valve Position
		Max Position= ***80%***	1	0 – 100%	Maximum Tower Valve Position
2	1	Valve Type= ***NO To Tower***	1	NC To Tower	Tower Valve Type
				NO To Tower	
	2	Mod Limit= ***±7.5°F (±4.1°C)***	1	1.0 – 60.0°F	Tower Valve Mod Limit
				① 0.5 – 33.3°C	
		Sample Time= ***15 Sec***	1	1 – 60 Sec	Tower Valve Sample Time
				1 – 15 Min	
	3	Max Change= ***4%***	1	1 – 50%	Tower Valve Max Change
		PA Time= ***5 Sec***	1	0 – 240 Sec	Tower Valve Project Ahead Time
3	1	Min Start Pos= ***0%***	1	0 – 100%	Minimum Tower Valve Start-Up Position
		Max Start Pos= ***100%***	1	0 – 100%	Maximum Tower Valve Start-Up Position
	2	Min Pos At ***60.0°F (15.5°C)***	1	0.0 – 120.0°F	Minimum Tower Valve Start-Up Position At
				① –17.8 – 48.8°C	
		Max Pos At ***90.0°F (32.2°C)***	1	0.0 – 120.0°F	Maximum Tower Valve Start-Up Position At
				① –17.8 – 48.8°C	

SWITCH Key Destination: Menu 6. Cooling Tower Status

Notes:

1. Program CSC1S01• only.

Menu 21. Load Flow Control

Item					
Scr.	Line	Name (*default adjustable values shown bold italic*)	Field No.	Range	Variable Name
1	1	Pump Control= ***None***	1	None	Secondary Pump Control Option
				One Pump	
				Auto Lead	
				#1 Lead	
				#2 Lead	
				Sequencing	
	2	Pump Delay= ***30 Sec***	1	1 – 60 Sec	Pump Status Check Delay Time
		Mod Control= ***None***	1	None	Modulation Control Option
				Valve	
				VFD	
	3	Reseq= ***N/A 00:00***	1	N/A	Pump Resequence Day/Time
				Sun – Sat	
				Dly	
				Hol	
				① Now	
			2	0 – 23	
			3	0 – 59	
		Setpoint= ***10 psi (69 kPa)***	1	2 – 99 psi	Loop Differential Pressure Setpoint
				② 13 – 683 kPa	
2	1	Deadband= ***±2 psi (±13 kPa)***	1	0 – 9 psi	Loop Differential Pressure Deadband
				② 0 – 62 kPa	
	2	Mod Limit= ***±10 psi (±69 kPa)***	1	1 – 99 psi	Loop Differential Pressure Mod Limit
				② 6 – 683 kPa	
		Sample Time= ***15 Sec***	1	1 – 60 Sec	Loop Differential Pressure Sample Time
	3	Max Change= ***5%***	1	1 – 50%	Loop Differential Pressure Max Change
		PA Time= ***5 Sec***	1	1 – 240 Sec	Loop Differential Pressure Project Ahead Time
3	1	Pump Stages= ***6***	1	1 – 9	Number Of Sequenced Pump Stages
		Diff= ***+2 psi (+13 kPa)***	1	0 – 9 psi	Pump Stage Differential
				② 0 – 62 kPa	
	2	StageUp Time= ***2 Min***	1	1 – 60 Min	Pump Stage-Up Delay Time
		StageDn Time= ***5 Min***	1	1 – 60 Min	Pump Stage-Down Delay Time
	3	Min Valve Pos= ***20%***	1	0 – 100%	Minimum Loop Bypass Valve Position
		Max Valve Pos= ***90%***	1	0 – 100%	Maximum Loop Bypass Valve Position

Switch Key Destination: Menu 22. Secondary Pump Sequence Order

Notes:
1. The "Now" selection will automatically change to "N/A" after the resequence day/time function is executed.
2. Program CSC1S01∗ only.

Menu 22. Secondary Pump Sequence Order

Item					
Scr.	Line	Name (*default adjustable values shown bold italic*)	Field No.	Range	Variable Name
1	1	Stage 1= ***P1 xx xx xx xx xx***	1	xx, P1	Pump Stage 1 Bitset
			2	xx, P2	
			3	xx, P3	
			4	xx, P4	
			5	xx, P5	
			6	xx, P6	
	2	Stage 2= ***P1 P2 xx xx xx xx***	*(same as Pump Stage 1 Bitset)*		Pump Stage 2 Bitset
	3	Stage 3= ***P1 P2 P3 xx xx xx***	*(same as Pump Stage 1 Bitset)*		Pump Stage 3 Bitset
2	1	Stage 4= ***P1 P2 P3 P4 xx xx***	*(same as Pump Stage 1 Bitset)*		Pump Stage 4 Bitset
	2	Stage 5= ***P1 P2 P3 P4 P5 xx***	*(same as Pump Stage 1 Bitset)*		Pump Stage 5 Bitset
	3	Stage 6= ***P1 P2 P3 P4 P5 P6***	*(same as Pump Stage 1 Bitset)*		Pump Stage 6 Bitset
3	1	Stage 7= ***xx xx xx xx xx xx***	*(same as Pump Stage 1 Bitset)*		Pump Stage 7 Bitset
	2	Stage 8= ***xx xx xx xx xx xx***	*(same as Pump Stage 1 Bitset)*		Pump Stage 8 Bitset
	3	Stage 9= ***xx xx xx xx xx xx***	*(same as Pump Stage 1 Bitset)*		Pump Stage 9 Bitset

Switch Key Destination: Menu 7. Flow To Load

Notes:
1. Program CSC1S01∗ only.

Menu 23. Time/Date

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Time= ***hh:mm:ss***	1	0 – 23	Current Time
			2	0 – 59	
			3	0 – 59	
	2	Day= ***Day***	1	Sun – Sat	Current Day
	3	Date= ***Mth-dd-yy***	1	Jan – Dec	Current Date
			2	1 – 31	
			3	00 – 99	

Switch Key Destination: None

Menu 24. Schedule

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Override= ***0.00 Hrs***	1	① 0.00 – 60.00 Hrs	Override Time
		NMP Schedule= ***NA***	1	NA, 1 – 32	NMP Schedule Number
	2	One Event= ***N/A-01 18:00*** for ***2.00 Hrs***	1	N/A, Jan – Dec	One Event Schedule
			2	1 – 31	
			3	0 – 23	
			4	0 – 59	
			5	① 0.00 – 60.00 Hrs	
	3	Sun ***00:00–00:00***	1	0 – 23	Sunday Schedule
			2	0 – 59	
			3	0 – 23	
			4	0 – 59	
		Mon ***00:00–00:00***	*(same as Sunday Schedule)*		Monday Schedule
2	1	Tue ***00:00–00:00***	*(same as Sunday Schedule)*		Tuesday Schedule
		Wed ***00:00–00:00***	*(same as Sunday Schedule)*		Wednesday Schedule
	2	Thu ***00:00–00:00***	*(same as Sunday Schedule)*		Thursday Schedule
		Fri ***00:00–00:00***	*(same as Sunday Schedule)*		Friday Schedule
	3	Sat ***00:00–00:00***	*(same as Sunday Schedule)*		Saturday Schedule
		Hol ***00:00–00:00***	*(same as Sunday Schedule)*		Holiday Schedule

Switch Key Destination: Menu 10. System Control

Notes:
1. The resolution is 0.25 hour (15 minutes).

Menu 25. Holiday Date

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	#1 Date= ***Dec 25***	1	N/A, Jan – Dec	Holiday Date #1
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #1 Duration
	2	#2 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #2
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #2 Duration
	3	#3 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #3
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #3 Duration
2	1	#4 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #4
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #4 Duration
	2	#5 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #5
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #5 Duration
	3	#6 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #6
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #6 Duration

Continued

Menu 25. Holiday Date (cont'd)

Item					Variable Name
Scr.	Line	Name (*default adjustable values shown bold italic*)	Field No.	Range	
3	1	#7 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #7
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #7 Duration
	2	#8 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #8
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #8 Duration
	3	#9 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #9
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #9 Duration
4	1	#10 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #10
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #10 Duration
	2	#11 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #11
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #11 Duration
	3	#12 Date= ***N/A 01***	1	N/A, Jan – Dec	Holiday Date #12
			2	1 – 31	
		Duration= ***1 Days***	1	1 – 31 Days	Holiday Date #12 Duration

Switch Key Destination: None

Menu 26. Optimal Start

Item					Variable Name
Scr.	Line	Name (*default adjustable values shown bold italic*)	Field No.	Range	
1	1	Optimal Start= ***No***	1	No	Optimal Start Flag
				Yes	
		Auto Update= ***No***	1	No	Auto Update Flag
				Yes	
	2	Recirc At ***04:00***	1	00 – 23	Optimal Start Begin Recirculate Time
		Recirc Time= ***10 Min***	1	0 – 59 Min	Optimal Start Recirculation Period
	3	Calculated Start Time= *06:45*	–	00:00 – 23:59	Today's Optimal Start Time

Switch Key Destination: None

Menu 27. Table of Optimal Start Time Increments (in Minutes; default adjustable values shown bold italic)

			Return Chilled Water Temperature				
Scr.	Line	Outdoor Air Temperature	50°F (10°C)	60°F (15°C)	70°F (21°C)	80°F (26°C)	90°F (32°C)
1	2	50°F (10°C)	***5***	***10***	***15***	***20***	***25***
	3	60°F (15°C)	***10***	***15***	***20***	***25***	***30***
2	2	70°F (21°C)	***15***	***20***	***25***	***30***	***35***
	3	80°F (26°C)	***20***	***25***	***30***	***35***	***40***
3	2	90°F (32°C)	***25***	***30***	***35***	***40***	***45***
	3	100°F (38°C)	***30***	***35***	***40***	***45***	***50***

Switch Key Destination: None

Note: Each element of the table is an adjustable field with a range of 0 – 240 minutes. If the Auto Update Flag (menu 26) is set to "Yes," the CSC will automatically update these fields (if necessary) as it adapts to the cooling system's unique characteristics.

Menu 28. Service

Item					
Scr.	Line	Name (default adjustable values shown bold italic)	Field No.	Range	Variable Name
1	1	① Level= ***1***	1	1	Controller Level
				2	
		① Port A Baud= ***9600***	1	1200	Port A Baud Rate
				2400	
				9600	
	2	Total Slaves= ***0***	1	0 – 64	Total Slaves
		Glycol= ***No***	1	No	Glycol Flag
				Yes	
	3	IDENT= *CSC1E01A (CSC1S01A)*	–	–	Program Code (*"Ident"*)
2	1	Decoupler Flow Calibration:	*(Screen name)*		
	2	Flow At 4mA/1VDC/2VDC= ***0 gpm (0.0 L/s)***	1	0 – 5120 gpm	Decoupler Flow Meter Low Cal Rate
				② 0.0 – 322.5 L/s	
	3	Flow At 20mA/5VDC/10VDC= ***1000 gpm (63.0 L/s)***	1	0 – 5120 gpm	Decoupler Flow Meter High Cal Rate
				② 0.0 – 322.5 L/s	
3	1	Differential Pressure Calibration:	*(Screen name)*		
	2	Pressure At 4mA/1VDC/2VDC= ***0 psi (0 kPa)***	1	0 – 150 psi	Loop DP Sensor Low Cal Pressure
				② 0 – 1035 kPa	
	3	Pressure At 20mA/5VDC/10VDC= ***30 psi (207 kPa)***	1	0 – 150 psi	Loop DP Sensor High Cal Pressure
				② 0 – 1035 kPa	
4	1	Analog Output Zero Setup:	*(Screen name)*		
	2	Tower Bypass Valve= ***4mA/1VDC/2VDC***	1	0mA/0VDC	Tower Bypass Valve AO Zero
				4mA/1VDC/2VDC	
	3	Load Bypass Valve or VFD= ***4mA/1VDC/2VDC***	1	0mA/0VDC	Load Bypass Valve AO Zero *or* VFD AO Zero
				4mA/1VDC/2VDC	
5	1	Ret ChW Sensor= ***No***	1	No	Return Chilled Water Sensor Present Flag
				Yes	
		Decouple Sensor= ***No***	1	No	Decoupler Sensor Present Flag
				Yes	
	2	Ent CndW Sensor= ***No***	1	No	Entering Condenser Water Sensor Present Flag
				Yes	
		Lvg CndW Sensor= ***No***	1	No	Leaving Condenser Water Sensor Present Flag
				Yes	
	3	OAT Sensor= ***None***	1	None	Outdoor Air Temperature Source
				Local	
				Remote	

Switch Key Destination: None

Notes:

1. After changing the value of this variable, you must reset the controller to cause the change to go into effect. You can reset the controller by cycling power to the panel.
2. Program CSC1S01• only.

Menu 29. Chiller Setup

Item					
Scr.	Line	Name (default adjustable values shown bold italic)	Field No.	Range	Variable Name
1	1	***#1= Centrif-200***	1	N/A	Chiller #1 Type
				Centrif-200	
				Centrif-100	
				Reciprocating	
				Screw	
	2	Address= ***01.00***	1	NA, 01 – 40 *(hex)*	Chiller #1 Address
	3	Flow Rate= ***1200 gpm (75.6 L/s)***	1	0 – 5120 gpm	Chiller #1 Flow Rate
				① 0 – 322.5 L/s	
	1	***#2= Centrif-200***	*(same as Chiller #1 Type)*		Chiller #2 Type
	2	Address= ***02.00***	1	NA, 01 – 40 *(hex)*	Chiller #2 Address
	3	Flow Rate= ***1200 gpm (75.6 L/s)***	1	0 – 5120 gpm	Chiller #2 Flow Rate
				① 0 – 322.5 L/s	
2	1	***#3= Centrif-200***	*(same as Chiller #1 Type)*		Chiller #3 Type
	2	Address= ***03.00***	1	NA, 01 – 40 *(hex)*	Chiller #3 Address
	3	Flow Rate= ***1200 gpm (75.6 L/s)***	1	0 – 5120 gpm	Chiller #3 Flow Rate
				① 0 – 322.5 L/s	
	1	***#4= N/A***	*(same as Chiller #1 Type)*		Chiller #4 Type
	2	Address= ***NA.00***	1	NA, 01 – 40 *(hex)*	Chiller #4 Address
	3	Flow Rate= ***1200 gpm (75.6 L/s)***	1	0 – 5120 gpm	Chiller #4 Flow Rate
				① 0 – 322.5 L/s	

Continued

Menu 29. Chiller Setup (cont'd)

Item					
Scr.	Line	Name (default adjustable values shown bold italic)	Field No.	Range	Variable Name
3	1	#5= ***N/A***	*(same as Chiller #1 Type)*		Chiller #5 Type
	2	Address= ***NA .00***	1	NA, 01 – 40 *(hex)*	Chiller #5 Address
	3	Flow Rate= ***1200 gpm (75.6 L/s)***	1	0 – 5120 gpm	Chiller #5 Flow Rate
				① 0 – 322.5 L/s	
	1	#6= ***N/A***	*(same as Chiller #1 Type)*		Chiller #6 Type
	2	Address= ***NA .00***	1	NA, 01 – 40 *(hex)*	Chiller #6 Address
	3	Flow Rate= ***1200 gpm (75.6 L/s)***	1	0 – 5120 gpm	Chiller #6 Flow Rate
				① 0 – 322.5 L/s	
4	1	#7= ***N/A***	*(same as Chiller #1 Type)*		Chiller #7 Type
	2	Address= ***NA .00***	1	NA, 01 – 40 *(hex)*	Chiller #7 Address
	3	Flow Rate= ***1200 gpm (75.6 L/s)***	1	0 – 5120 gpm	Chiller #7 Flow Rate
				① 0 – 322.5 L/s	
	1	#8= ***N/A***	*(same as Chiller #1 Type)*		Chiller #8 Type
	2	Address= ***NA .00***	1	NA, 01 – 40 *(hex)*	Chiller #8 Address
	3	Flow Rate= ***1200 gpm (75.6 L/s)***	1	0 – 5120 gpm	Chiller #8 Flow Rate
				① 0 – 322.5 L/s	

SWITCH Key Destination: None

Notes:

1. Program CSC1S01∗ only.

Menu 30. Service Testing

Item					
Scr.	Line	Name (default adjustable values shown bold italic)	Field No.	Range	Variable Name
1	1	DO 0= ***Off***	1	Off	Digital Output 0 Service Test State
				On	
	2	DO 1= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 1 Service Test State
	3	DO 2= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 2 Service Test State
	1	DO 3= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 3 Service Test State
	2	DO 4= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 4 Service Test State
	3	DO 5= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 5 Service Test State
2	1	DO 6= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 6 Service Test State
	2	DO 7= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 7 Service Test State
	3	DO 8= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 8 Service Test State
	1	DO 9= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 9 Service Test State
	2	DO 10= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 10 Service Test State
	3	DO 11= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 11 Service Test State
3	1	DO 12= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 12 Service Test State
	2	DO 13= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 13 Service Test State
	3	DO 14= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 14 Service Test State
	1	DO 15= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 15 Service Test State
	2	DO 16= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 16 Service Test State
	3	DO 17= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 17 Service Test State
4	1	DO 18= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 18 Service Test State
	2	DO 19= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 19 Service Test State
	3	DO 20= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 20 Service Test State
	1	DO 21= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 21 Service Test State
	2	DO 22= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 22 Service Test State
	3	DO 23= ***Off***	*(same as DO 0 Svc. Test State)*		Digital Output 23 Service Test State
5	1	AO 0= ***0%***	1	0 – 100%	Analog Output 0 Service Test Setpoint
	2	AO 1= ***0%***	1	0 – 100%	Analog Output 1 Service Test Setpoint
	3	AO 2= ***0%***	1	0 – 100%	Analog Output 2 Service Test Setpoint
	1	AO 3= ***0%***	1	0 – 100%	Analog Output 3 Service Test Setpoint

SWITCH Key Destination: None

Note: To use the Service Testing menu, set the CSC Control Mode variable (menu 10) to "Service Testing."

Alarm Menus

The Alarm category includes menus 31 through 35. Following are brief descriptions of them.

Current Alarms

Menu 31, "Current Alarms," tells you whether a CSC alarm or chiller alarm exists in the network. The first item identifies the current CSC alarm and the time and date it occurred. Each of the remaining items identifies the current chiller alarm *type* (Fault, Problem, or Warning) and the time and date the alarm occurred in each chiller. If there is no current alarm, the "None" message is displayed. When the current CSC alarm clears, it moves to the CSC Alarm Buffer menu. For more information, see the "Alarm Monitoring" section in the "Operator's Guide" portion of this manual.

CSC Alarm Buffer

Menu 32, "CSC Alarm Buffer," tells you what the previous CSC alarms were and when they occurred. When the current CSC alarm clears, it moves to this menu. The buffer holds nine alarms. For more information, see the "Alarm Monitoring" section in the "Operator's Guide" portion of this manual.

Alarm Horn Setup

Menu 33, "Alarm Horn Setup," allows you to specify whether or not a certain type of CSC or chiller alarm will cause the CSC's Alarm Horn to sound. For more information, see the "Alarm Monitoring" section in the "Operator's Guide" portion of this manual.

Alarm Output Setup

Menu 34, "Alarm Out Setup," allows you to specify the states of the CSC's Alarm Output for the four types of CSC and chiller alarms. The options for each alarm type are open, closed, fast pulse, and slow pulse. For more information, see the "Alarm Monitoring" section in the "Operator's Guide" portion of this manual.

Message Board

Menu 35, "Message Board," is a special menu that you can use to annotate any information that you or other operators may need. For example, you may want to post an after-hours phone number that an operator could call in case of trouble with the chiller system.

To enter information onto the Message Board, you must have a PC equipped with MicroTech Monitor software.

Menu 31. Current Alarms

Item					Variable Name
Scr.	**Line**	**Name** *(typical values shown italic)*	**Field No.**	**Range**	
1	1	CSC= *Sec Pump 1 Fail* At *17:55 Jul-01*	–	Lvg CndW T Fail	Current CSC Alarm
				Ent CndW T Fail	
				No Sec ChW Flow	
				① No Comm Chil #*	
				Decouple F Fail	
				① Sec Pump * Fail	
				Outside T Fail	
				Decouple T Fail	
				Ret ChW T Fail	
				Sup ChW T Fail	
				ChW Press Fail	
				Clg Tower Fail	
				Lvg CndW T Warn	
				Ent CndW T Warn	
				Chiller Offline	
				None	
			–	*(any time and date)*	
	2	Chil #1= *Fault* At *14:21 Jul-02*	–	Fault	Current Chiller #1 Alarm Type
				Problem	
				Warning	
				None	
			–	*(any time and date)*	
	3	Chil #2= *None* At *00:00 N/A-00*	*(same as Chiller #1 Alarm Type)*		Current Chiller #2 Alarm Type
2	1	Chil #3= *None* At *00:00 N/A-00*	*(same as Chiller #1 Alarm Type)*		Current Chiller #3 Alarm Type
	2	Chil #4= *None* At *00:00 N/A-00*	*(same as Chiller #1 Alarm Type)*		Current Chiller #4 Alarm Type
	3	Chil #5= *None* At *00:00 N/A-00*	*(same as Chiller #1 Alarm Type)*		Current Chiller #5 Alarm Type
3	1	Chil #6= *None* At *00:00 N/A-00*	*(same as Chiller #1 Alarm Type)*		Current Chiller #6 Alarm Type
	2	Chil #7= *None* At *00:00 N/A-00*	*(same as Chiller #1 Alarm Type)*		Current Chiller #7 Alarm Type
	3	Chil #8= *None* At *00:00 N/A-00*	*(same as Chiller #1 Alarm Type)*		Current Chiller #8 Alarm Type

Switch Key Destination: None

Notes:

1. The wildcard character (*) indicates the number of the unit with the alarm.

Menu 32. CSC Alarm Buffer

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	1. *Ret ChW T Fail* At *08:09 Jun-30*		*(same as Current CSC Alarm)*	Buffer Alarm #1 *(most recent)*
	2	2. *None* At *00:00 N/A-00*		*(same as Current CSC Alarm)*	Buffer Alarm #2
	3	3. *None* At *00:00 N/A-00*		*(same as Current CSC Alarm)*	Buffer Alarm #3
2	1	4. *None* At *00:00 N/A-00*		*(same as Current CSC Alarm)*	Buffer Alarm #4
	2	5. *None* At *00:00 N/A-00*		*(same as Current CSC Alarm)*	Buffer Alarm #5
	3	6. *None* At *00:00 N/A-00*		*(same as Current CSC Alarm)*	Buffer Alarm #6
3	1	7. *None* At *00:00 N/A-00*		*(same as Current CSC Alarm)*	Buffer Alarm #7
	2	8. *None* At *00:00 N/A-00*		*(same as Current CSC Alarm)*	Buffer Alarm #8
	3	9. *None* At *00:00 N/A-00*		*(same as Current CSC Alarm)*	Buffer Alarm #9

SWITCH **Key Destination:** None

Menu 33. Alarm Horn Setup

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Comm Loss= ***No Horn***	1	No Horn	Horn On Comm Loss Flag
				Horn	
		Faults= ***Horn***	1	No Horn	Horn On Fault Flag
				Horn	
	2	Problems= ***Horn***	1	No Horn	Horn On Problem Flag
				Horn	
		Warnings= ***No Horn***	1	No Horn	Horn On Warning Flag
				Horn	

SWITCH **Key Destination:** None

Menu 34. Alarm Output Setup

Item					
Scr.	**Line**	**Name** *(default adjustable values shown bold italic)*	**Field No.**	**Range**	**Variable Name**
1	1	Normal= ***Open***	1	Open	Alarm Output Normal State
				Closed	
	2	Comm Loss= ***Fast***	1	Open	Alarm Output Comm Loss State
				Closed	
				Slow	
				Fast	
		Faults= ***Fast***	1	Open	Alarm Output Fault State
				Closed	
				Slow	
				Fast	
	3	Problems= ***Slow***	1	Open	Alarm Output Problem State
				Closed	
				Slow	
				Fast	
		Warnings= ***Slow***	1	Open	Alarm Output Warning State
				Closed	
				Slow	
				Fast	

SWITCH **Key Destination:** None

CSC and Chiller Controller Initial Setup

This section explains the setup variables in the CSC and chiller controllers that must be set to integrate the CSC, its associated chillers, and a PC (if used) into a working network. It also explains the setup variables that are related to the CSC's analog inputs and outputs. Once set in accordance with the job requirements and characteristics, most of these variables should never need to be changed. Note that most of this CSC and chiller controller setup is necessary to commission the network. For more information on network commissioning, see Bulletin No. IM 618, *MicroTech Chiller System Controller.*

After a working network has been established, further setup will likely be necessary to adapt the CSC and chiller controllers to your particular application's requirements. For complete information on how to do this, see the "Operator's Guide" and "Description of Operation" portions of this manual. Until this application setup is done, *the chiller system should remain disabled.* See "Control Mode" in "Setting Up the CSC" below for information on how to disable the chiller system.

Dual-Compressor Centrifugal Chillers
If the CSC will be controlling any dual-compressor centrifugal chillers (series 100 or 200), *load balancing and start-up unloading control must be set up before the system is started.* For more information, see the "Load Limiting Control" section in the "Description of Operation" portion of this manual.

Setting Up the CSC

Variable Name	Keypad (*Menu-Scr.*)
CSC Control Mode	10-1
Number Of Chillers	11-4
Controller Level	28-1
Port A Baud Rate	28-1
Total Slaves	28-1
Decoupler Flow Meter Low Cal Rate	28-2
Decoupler Flow Meter High Cal Rate	28-2
Loop DP Sensor Low Cal Pressure	28-3
Loop DP Sensor High Cal Pressure	28-3
Tower Bypass Valve AO Zero	28-4
Load Bypass Valve AO Zero *or* VFD AO Zero	28-4
Tower Valve Type	20-2
Outdoor Air Temperature Source	28-5
Return Chilled Water Sensor Present Flag	28-5
Decoupler Sensor Present Flag	28-5
Entering Condenser Water Sensor Present Flag	28-5
Leaving Condenser Water Sensor Present Flag	28-5
Chiller #* Type	29-1 to -4
Chiller #* Address	29-1 to -4

Note: The wildcard character (*) could be 1 through 8.

Control Mode
Until the CSC and chiller controllers are set up properly for the chiller system applications, the chiller system should remain disabled. You can disable the chiller system by setting the CSC Control Mode variable to "Manual Off." This will prevent chillers from starting when communications between the CSC and the chillers begin.

Number Of Chillers
The Number Of Chillers variable tells the CSC how many chillers are connected to it. Starting at Chiller #1 and proceeding consecutively, the CSC will attempt to communicate to the number of chillers specified. For example, if the Number Of Chillers variable is set to "3," the CSC will attempt to communicate with Chiller #1, Chiller #2, and Chiller #3.

Controller Level
The Controller Level variable defines the CSC's level in the network. For the typical CSC network in which there is one CSC and no Network Master Panel, the CSC is the level-1 controller, and any chillers are level-2 controllers. If a Network Master Panel is included in a network with one or more CSCs, the CSC(s) and any chillers are level-2 controllers. If there are two or more CSCs in the same network but no Network Master Panel, one of the CSCs is the level-1 controller, and the other CSC(s) and any chillers are level-2 controllers. For more information, see "Network Communications" in the "Field Wiring" section of Bulletin No. IM 618.

▶ **To change the controller level**

1. Set the hex switches as required. A level-2 controller's hex switch setting cannot be 00. A level-1 controller's hex switch setting must be 00.
2. At the keypad/display, set the Controller Level variable "1" or "2" as required. When the ENTER key is pressed, the CSC will automatically correct its checksums. The display will show the new controller level, but the level will not actually change until the controller is reset.
3. Reset the controller by doing one of the following:
   - Cycle power to the panel with the circuit breaker (CB1).
   - Execute a soft reset at a PC equipped with Monitor software.

Port A Baud Rate
A direct or remote connected PC equipped with Monitor software can be connected to the CSC at port A on the Microprocessor Control Board. You can set the CSC's port A data transmission speed with the Port A Baud Rate variable (default is 9600 baud). Typically, a PC will communicate with the CSC at 9600 baud regardless of whether it is connected directly or remotely (via modem). For more information, see "PC Connection" in the "Field Wiring" section of Bulletin No. IM 618.

▶ **To change the port A baud rate**

1. Set the Port A Baud Rate variable as required. After changing it, the display will show the new baud rate, but the baud rate will not actually change until the controller is reset.
2. Reset the controller by doing one of the following:
   - Cycle power to the panel with the circuit breaker (CB1).
   - Execute a soft reset at a PC equipped with Monitor software. (If you use this method and your PC is connected to the CSC, you will lose communications.)

Total Slaves
The Total Slaves variable tells the level-1 CSC how many level-2 controllers (slaves) it needs to poll. (When a level-1 controller polls one of its level-2 slaves, it actively "asks" the slave if it has any requests for information from other controllers.) The Total Slaves variable defines this number.

The Total Slaves variable should be kept as low as possible to reduce unnecessary network communications and thus improve network performance. If a level-2 controller needs to be polled, set the Total Slaves variable just high enough to include that controller. For example, assume there are nine level-2 controllers connected to a level-1 CSC, and the controllers at addresses 02 and 06 need to be polled. In this case, the Total Slaves variable should be set to "6."

The typical chiller system network includes one CSC (level 1) and up to eight chillers (level 2). A PC might be directly or remotely connected to the CSC, but not to any of the chillers. In this situation, none of the chillers need to be polled and thus the Total Slaves variable should be set to "0."

Following are two examples of situations in which the Total Slaves variable should be changed:

1. If a PC is directly or remotely connected to one of the level-2 slaves, that slave needs to be polled so the PC can access controllers throughout the network. Set the

level-1 CSC's Total Slaves variable high enough to include that slave.

2. If one or more level-2 CSCs are in the same network with a level-1 CSC, the level-2 CSCs need to be polled so they can monitor and control their chillers. Set the level-1 CSC's Total Slaves variable high enough to include all level-2 CSCs. A level-2 CSC's Total Slaves variable should always be set to "0."

Decoupler Flow Meter Calibration
If the chiller system has a flow meter installed in the decoupler line, the flow rates that correspond to the low and high transducer signals must be entered into the CSC. Note that the flow rate in the decoupler line is always measured in the supply-to-return direction.

Use the Decoupler Flow Meter Low Cal Rate variable to enter the flow rate when the transducer signal is one of the following:

- 4 mA for 4–20 mA transducers
- 1 Vdc for 1–5 Vdc transducers
- 2 Vdc for 2–10 Vdc transducers

Use the Decoupler Flow Meter High Cal Rate variable to enter the flow rate when the transducer signal is one of the following:

- 20 mA for 4–20 mA transducers
- 5 Vdc for 1–5 Vdc transducers
- 10 Vdc for 2–10 Vdc transducers

Note: In addition to these calibration constants, dip switches on the Input Conditioning Module must be set as required for the type of transducer being used. See Bulletin No. IM 605, *MicroTech Input Conditioning Module*, for more information.

Loop Differential Pressure Sensor Calibration
If the chiller system has a differential pressure sensor installed across the supply and return lines, the pressures that correspond to the low and high transducer signals must be entered into the CSC.

Use the Loop DP Sensor Low Cal Pressure variable to enter the differential pressure when the transducer signal is one of the following:

- 4 mA for 4–20 mA transducers
- 1 Vdc for 1–5 Vdc transducers
- 2 Vdc for 2–10 Vdc transducers

Use the Loop DP Sensor High Cal Pressure variable to enter the flow rate when the transducer signal is one of the following:

- 20 mA for 4–20 mA transducers
- 5 Vdc for 1–5 Vdc transducers
- 10 Vdc for 2–10 Vdc transducers

Note: In addition to these calibration constants, dip switches on the Input Conditioning Module must be set as required for the type of transducer being used. See Bulletin No. IM 605, *MicroTech Input Conditioning Module*, for more information.

Analog Output Zero Setup
If the chiller system has a cooling tower bypass valve, a cooling load bypass valve, or a secondary pump with a variable frequency drive (VFD), the low value of the device's input signal range must be entered into the CSC. Use the Tower Bypass Valve AO Zero, Load Bypass Valve AO Zero, or VFD AO Zero variables to do this. (Since a cooling load bypass valve and secondary pump VFDs are mutually exclusive, these last two are really one variable with two names.)

Set the variable to "0mA/0VDC" for the following actuator or VFD input ranges:

- 0–20 mA
- 0–5 Vdc
- 0–10 Vdc

Set the variable to "4mA/1VDC/2VDC" for the following actuator or VFD input ranges:

- 4–20 mA
- 1–5 Vdc
- 2–10 Vdc

Note: In addition to these range zeros, jumper plugs on the Analog Output Expansion Module must be set as required for the type of actuator or VFD being used. See Bulletin No. IM 607, *MicroTech Analog Output Expansion Module*, for more information.

Valve Types
If you are using a cooling load bypass valve, it must be a normally closed (NC) valve. (A closed valve prevents any flow from bypassing the cooling loads.) When the CSC opens the valve it increases the voltage or current signal to the valve. When there is no control signal, the valve should be closed.

If you are using a cooling tower bypass valve, it can be either type: normally open (NO) to the tower or normally closed (NC) to the tower. You can specify which type it is with the Tower Valve Type variable.

NC Tower Valve: If the valve type is NC, the CSC increases the voltage or current signal to the valve as it opens the valve to the tower. When there is no control signal, the valve should be closed to the tower (full bypass).

NO Tower Valve: If the valve type is NO, the CSC decreases the voltage or current signal to the valve as it opens the valve to the tower. When there is no control signal, the valve should be open to the tower.

Outdoor Air Temperature Source
The CSC can get the outdoor air temperature from one of three sources: (1) a CSC input, (2) a MicroTech Network Master Panel (NMP), or (3) a building automation system (BAS) communicating via Open Protocol. The Outdoor Air Temperature Source variable tells the CSC where to find the temperature.

If the outdoor air temperature sensor is connected to the CSC, set the Outdoor Air Temperature Source variable to "Local." If it is connected to an NMP or a BAS, set the variable to "Remote." If the outdoor air temperature is not available, set the variable to "None" to prevent nuisance sensor failure alarms from occurring.

Temperature Sensor Flags
In addition to the outdoor air sensor, the following temperature sensors are optional:

- Return chilled water
- Decoupler water
- Entering condenser water
- Leaving condenser water

The CSC needs to know whether these sensors are connected so that it can generate or suppress sensor failure alarms. If one of the above sensors is connected, set its associated sensor flag to "Yes." Otherwise, set the flag to "No." For example, if there is a return chilled water temperature sensor connected to AI 1, set the Return Chilled Water Sensor Present Flag to "Yes."

Chiller Type

The Chiller #* Type variables tell the CSC what types of chillers are connected to it. (The wildcard character in the variable name could be a number from 1 to 8.) The CSC can communicate with and control four types of MicroTech-equipped McQuay chillers:

1. Series-200 centrifugal (new style controller)
2. Series-100 centrifugal (old style controller)
3. Reciprocating
4. Screw

Unused Chiller #* Type variables should be set to "N/A."

Note: The Chiller #* Type variables must be set consecutively, starting with Chiller #1. For example, if there are three chillers associated with a CSC, the following variables must be set: Chiller #1 Type, Chiller #2 Type, and Chiller #3 Type.

Chiller Address

The Chiller #* Address variables tell the CSC what its associated chillers' level-2 network addresses are. (The wildcard character in the variable name could be a number from 1 to 8.) The first two digits of these variables must match the hex switch setting at the corresponding chiller. For example, if the hex switch setting at Chiller #2 is 04, the Chiller #2 Address variable must be set to "04.00."

Setting Up Series-200 Centrifugal Chiller Controllers

Following are guidelines for setting up series-200 centrifugal chiller controllers so that the CSC can properly supervise their operation. For more information on the series-200 centrifugal chiller controller, refer to Bulletin Nos. IM 616 and OM 125.

Unit Setup Variables

Three unit setup variables must be set in all chiller controllers associated with a CSC. These variables, which are summarized in Table 4, must be set to the values shown in italic. *This is true regardless of whether the chiller has a single compressor or dual compressors.* You can find them at the chiller controller's keypad/display under menu 26, "Unit Setup."

Table 4. Unit Setup Variables

Chiller Controller Variable	Keypad/Display ID	
	Menu	Item
Port Configuration	26	Config= *L2-TTY-Slave*
Chiller Type	26	Chiller *Only*
Master/Slave Type	26	Master/Slave= *Slave*

Control Mode

Each chiller's Control Mode variable must be set to "Auto: Network" to allow the CSC to enable it. You can find this variable at the chiller controller's keypad/display under menu 11, "Control Mode." The item name is "Mode=."

Note: During the network commissioning process, it is recommended that the chillers be shut down by setting their control modes to "Manual Off." *If the network is being commissioned before a particular chiller has been commissioned, that chiller's control mode must be set to "Manual Off" to prevent it from starting.* For more on network commissioning, see Bulletin No. IM 618.

Setting Up Series-100 Centrifugal Chiller Controllers

Following are guidelines for setting up series-100 centrifugal chiller controllers so that the CSC can properly supervise their operation. For more information on the series-100 centrifugal chiller controller, refer to Bulletin Nos. IM 403 and APM 950.

Note: No series-100 centrifugal chillers were shipped with software that is compatible with the CSC. Therefore, all series-100 controllers associated with a CSC must have new software downloaded to them in the field. Be sure that this has been done before proceeding. See the "Software ID" section of this manual for more information.

Start Mode

Each chiller's Start Mode variable must be set to "Remote" to allow the CSC to enable it. You can get to the Start Mode variable by pressing the chiller controller's SET-UP OPTIONS key five times.

Note: When the Start Mode is set to "Remote," the chiller controller checks its remote start/stop input. This input must be closed before the CSC can enable the chiller. If the Start Mode had been set to "Local" and a remote start/stop switch is not being used, a jumper must be installed across the remote start/stop input (field terminals 9 and 64 in the control box).

Setting Up Reciprocating/Screw Chiller Controllers

Following are guidelines for setting up reciprocating and screw chiller controllers so that the CSC can properly supervise their operation. For more information on the chiller controllers, refer to the appropriate MicroTech unit controller installation or operation manual (see Tables 1 and 2).

Control Mode

Before the CSC controller can enable a chiller, that chiller's control mode must be set for automatic operation (all circuits or at least one circuit). The normal setting is "Automatic." You can set a chiller's control mode with the Control Mode variable. At the chiller controller's keypad/display, this is the first item under the "Control Mode" menu (menu 13 on 2-circuit chillers; menu 16 on 3-circuit chillers).

Note: During the network commissioning process, it is recommended that the chillers be shut down by setting their control modes to "Manual Unit Off." *If the network is being commissioned before a particular chiller has been commissioned, that chiller's control mode must be set to "Manual Unit Off" to prevent it from starting.* For more on network commissioning, see Bulletin No. IM 618.

The following "Operator's Guide" sections provide information on the day-to-day operation of the Chiller System Controller. They tell you how to perform such common tasks as scheduling, displaying and clearing alarms, and setting the controller for manual operation. Any programmable variables that can affect the controller operation being described are listed at the beginning of each applicable sub-section.

For detailed information on the CSC's control processes and their programmable variables, see the "Description of Operation" portion of this manual.

Determining Chiller System Status

The CSC provides a variety of information that you can use to determine the overall status of the chiller system. At the keypad/display, you can find most of this information under menus 1 through 9. The following are available:

- CSC operating state
- Current chiller stage
- Chiller load
- Chiller status (generalized operating state)
- Water temperatures
- Chiller run time
- Load limiting status
- Chilled water distribution system status
- Cooling tower status

The CSC summarizes the most important chiller *system* information; you can get detailed information about any chiller by using its keypad/display or the Monitor program. For your convenience, each chiller's operating state (generalized), load, run time, and local water temperatures are included in the CSC's keypad/display menus.

CSC Operating State

Variable Name	Keypad *(Menu-Scr.)*
CSC Operating State	1-1

The CSC Operating State variable tells you what state the CSC—and thus the chiller system—is currently in. (The chiller system includes everything under the CSC's supervision; for example, chillers, cooling towers, and secondary pumps.) At the keypad, it can be displayed by pressing the STATUS key. Four operating states are possible: Off, Recirculate, On, and Free Cooling.

Off

When the operating state is Off, all chillers, cooling tower fans, and secondary pumps will be disabled. The Off state has five sub-states:

1. Off:Alarm
2. Off:Manual
3. Off:Ambient
4. Off:Network
5. Off:Unoccupied

The sub-state name tells you why the CSC is in the Off state.

Off:Alarm Sub-state: The Off:Alarm state indicates that a CSC Fault alarm exists. In this state, the CSC will not start for any reason. To get the CSC out of Off:Alarm, you must clear any Fault alarms that exist. The Off:Alarm state will override any On state.

Off:Manual Sub-state: The Off:Manual state indicates that the CSC's control mode (menu 10) is either Manual Off or Service Testing. In this state, the CSC will not start for any reason. To get the CSC out of Off:Manual, you must set the control mode to "Automatic" or "Manual On." The Off:Manual state will override any On state.

Off:Ambient Sub-state: The Off:Ambient state indicates that the CSC's low ambient lockout feature is enabled and the outdoor air temperature is below the Low Ambient Lockout Setpoint (menu 10). In this state, the CSC will not start for any reason. Before the CSC can leave Off:Ambient, the outdoor air temperature must rise above the setpoint by a fixed differential of 2°F (1.0°C). Or you could also disable the feature by setting the Low Ambient Lockout Flag (menu 10) to "No." The Off:Ambient state will override any On state.

Off:Network Sub-state: The Off:Network state indicates that the CSC's control mode (menu 10) is Automatic and the CSC is receiving a shutdown command from a MicroTech Network Master Panel (NMP) or a building automation system (BAS) communicating via Open Protocol. In the case of an NMP, the shutdown command can only be issued by an operator at a PC equipped with Monitor software. The Off:Network state will override the On:Schedule, On:Input, and On:Network states.

Off:Unoccupied Sub-state: The Off:Unoccupied state indicates that the CSC is ready to operate whenever it receives a start command. Off:Unoccupied is different from the other Off states in that it is not caused by any one stop condition; for example, a Manual Off control mode. Instead, it is caused by the *absence* of a start condition. If the CSC's control mode (menu 10) is Automatic, any of the following start conditions will override the Off:Unoccupied state and start the system:

- An occupied daily or holiday schedule (CSC or NMP)
- An occupied one-event schedule
- A pre-occupancy optimal start
- An Override Time setting other than zero
- A closed external start/stop input
- A network override from an NMP or BAS

Conversely, Off:Unoccupied can occur only when the CSC's control mode is Automatic and none of the above conditions exist.

Recirculate

In systems that have at least one secondary pump, the Recirculate state is used (1) to verify secondary water flow during the transition between the Off and On states and (2) to obtain an accurate secondary loop water temperature reading before optimal start operation. During Recirculate, the secondary pump system operates normally. The chillers and cooling tower systems are disabled.

On

When the operating state is On, the CSC supervises chiller system operation, deciding which chillers and auxiliary equipment should operate based on the chiller sequence order and the cooling load. The On state has four sub-states:

1. On:Manual
2. On:Network
3. On:Input
4. On:Schedule

The sub-state name tells you why the CSC is in the On state.

On:Manual Sub-state: The On:Manual state indicates that the CSC has started because the control mode is Manual On and low ambient lockout is not in effect. The On:Manual state will override the Off:Unoccupied, Off:Network, and Off:Manual states.

On:Network Sub-state: The On:Network state indicates that the CSC has started because the control mode is Automatic, low ambient lockout is not in effect, and at least one of the following start conditions exists:

- A Global CSC Control Mode setting of "Manual On" at an NMP (set by an operator at a PC)
- A Start network command sent by a BAS

The On:Network state will override the Off:Unoccupied and Off:Network states.

On:Input Sub-state: The On:Input state indicates that the CSC has started because the control mode is Automatic, low ambient lockout is not in effect, and the external start/stop input is closed. The On:Input state will override the Off:Unoccupied state. At the keypad/display, the status of the external start/stop switch is shown on the first screen of menu 8 ("Auto" is open; "Occupied" is closed).

On:Schedule Sub-state: The On:Schedule state indicates that the CSC has started because the control mode is Automatic, low ambient lockout is not in effect, and at least one of the following start conditions exists:

- An occupied daily or holiday schedule (CSC or NMP)
- An occupied one-event schedule
- A pre-occupancy optimal start period
- An Override Time setting other than zero

The On:Schedule state will override the Off:Unoccupied state.

Free Cooling

During the Free Cooling state, the CSC's chilled water flow and cooling tower systems operate normally. The chillers are disabled. Note that this alone is not enough to create free cooling. The Free Cooling state is provided so that an external controller can implement a *custom* free cooling strategy in conjunction with the CSC's *standard* chiller system control strategies. Unless it has special software, *the CSC is not capable of coordinating an entire free cooling strategy by itself.*

Unlike the other operating states, Free Cooling can only occur as a result of a network command the CSC receives from a MicroTech Application Specific Controller (ASC) or a building automation system (BAS) communicating via Open Protocol. In addition to sending the Free Cooling network command, the ASC or BAS would typically perform many others tasks as part of a free cooling strategy. For example, it might send different cooling tower setpoints to the CSC via network communications, open two-position bypass valves via digital outputs, and override chiller pumps via digital outputs.

Note: All free cooling strategies must be approved by personnel in McQuay International's chiller applications group. Contact your McQuay representative for information.

Current Chiller Stage

Variable Name	Keypad *(Menu-Scr.)*
Current Chiller Stage	1-1
Chiller Status Bitset	1-1

In the CSC, a *chiller stage* is defined as a set of chillers. As the CSC sequences chillers on and off, it "stages up" and "stages down." If the sequence order is set properly, each successive stage will have more capacity than the preceding stage. Additional capacity could be in the form of one added chiller (typical), two or more added chillers, a chiller swap (in which the replacement chiller has more capacity than the one that is stopped), or any combination of these. Thus the Current Chiller Stage variable gives you an indication of how large the cooling load is.

Chillers On

At the keypad/display, the chillers that are on (see note) are shown on menu 1, and the chillers that make up each stage are shown on menu 13. The chillers that are on should match the chillers that make up the current stage. If not all of the current-stage chillers are on, the CSC will generate the Chiller Offline alarm.

Note: *On chillers* are defined as chillers that have a chiller status of Starting or Running. See "Chiller Status (Generalized Operating State)" below for more information.

Chiller Load

Variable Name	Keypad *(Menu-Scr.)*
Average Chiller Load	1-1
Chiller #* Load	3-1 to -8

Note: The wildcard character (*) could be 1 through 8.

For any given chiller, the *chiller load* is the percent of available capacity currently being used. The way the chiller load is calculated depends on the type of chiller. See below.

The CSC uses the *average* chiller load in its sequencing control processes. When it calculates the average chiller load, the CSC uses only the chiller load values from operational chillers.

Load Calculation: Centrifugal Chillers

The chiller load for centrifugal chillers is the percent of rated load amps (% RLA).

Load Calculation: Reciprocating and Screw Chillers

The chiller load for reciprocating and screw chillers is the percent of available compressor stages that are active. If a refrigeration circuit is shut down for some reason, the number of available compressor stages is reduced and thus the load value will increase for a particular stage. Calculating chiller load in this way allows the CSC's chiller sequencing logic to work properly when there are partially disabled chillers in the system.

As an example, consider a two-circuit, eight-stage reciprocating chiller. If the chiller is operating at stage 3 and both circuits are enabled (8 available stages), the chiller load will be 38%. If the chiller is operating at stage 3 and one circuit is disabled (4 available stages), the chiller load will be 75%.

Note: The method described above is always used to calculate the chiller load—even when the chiller is equipped with the optional percent-of-unit-amps monitoring package.

Chiller Status (Generalized Operating State)

Variable Name	Keypad (Menu-Scr.)
Chiller #* Status	3-1 to -8

Note: The wildcard character (*) could be 1 through 8.

The chiller status tells you what general state a chiller is currently in. The following chiller status states are possible:

- Off
- Starting
- Running
- Stopping
- Comm Loss

Each chiller status at the CSC corresponds to one or more operating states (or other conditions) at a chiller. For example, the Running chiller status occurs when a series-200 centrifugal chiller's operating state is "Running Ok" or when a reciprocating chiller's operating state is "Stage 2." For information on specific chiller operating states, refer to the appropriate MicroTech unit controller operation manual (see Table 2).

Off

When the chiller status is Off, the chiller is disabled. The Off chiller status has two sub-states:

1. Off:Local
2. Off:CSC

The sub-state name tells you why the chiller status is Off.

Off:Local Sub-state: The Off:Local chiller status indicates that something at the chiller has it disabled and thus the CSC is not able to start it. The cause might be, for example, a Fault alarm, an open remote start/stop switch, or a start-to-start timer that has not expired. Table 5 lists the possible Off:Local conditions. Throughout this manual, a chiller whose chiller status is Off:Local will be called "locally disabled."

Note: A chiller may go through some transient Off:Local conditions just after the CSC enables it. For this reason, the CSC will ignore a chiller's status for 60 seconds after that chiller is enabled.

Off:CSC Sub-state: The Off:CSC chiller status indicates that the chiller is available, but the CSC has it disabled. This is the normal chiller status of a chiller that is not part of the current stage. If the chiller status of a chiller that is part of the current stage is Off:CSC, it is likely that the CSC tried to start that chiller but was unable to. In this instance, the CSC will keep the chiller off and—in most cases—stage up. This situation might occur, for example, if the CSC tried to start a chiller that had a Fault alarm (Off:Local condition), which was subsequently cleared. Table 6 lists the possible Off: CSC conditions.

Starting

The Starting chiller status indicates that a chiller is going through its start-up sequence after being enabled either locally or by the CSC. Table 7 lists the possible Starting conditions.

Running

The Running chiller status indicates that a chiller is operational. For centrifugal chillers, it means the compressor is on. For reciprocating and screw chillers, it means at least one compressor is on. Table 8 lists the possible Running conditions.

Table 5. Off:Local Conditions at the Chiller

Chiller Controller	Off:Local Condition at Chiller
Series-200 Centrifugal	Off:Alarm state
	Off:Ambient state
	Off:Front Panel Switch state
	Off:Manual state
	Off:Remote Contacts state
	① Waiting Low Sump Temp state
	① Start-to-start timer not expired when CSC enables chiller (Waiting Cycle Timers state is displayed)
	① Stop-to-start timer not expired when CSC enables chiller (Waiting Cycle Timers state is displayed)
	② Off:Time Schedule state
Series-100 Centrifugal	Off:Due To Fault state
	Off:Manual Switch state
	① Waiting Low Sump Temp state
	Remote start/stop input open (Off:Remote Signal state is temporarily displayed)
	① Start-to-start timer not expired when CSC enables chiller (Will Start In *xx* Min state is displayed)
	① Stop-to-start timer not expired when CSC enables chiller (Will Start In *xx* Min state is displayed)
	Start Mode set to "Local"
Reciprocating/Screw	Off:Alarm state
	Off:Manual Mode state
	Off:Remote Switch state
	Off:System Switch state
	Off:Pumpdown Switches state
	Off:Time Clock state
	① Waiting For Flow state

Notes:

1. This operating state—and the resultant Off:Local chiller status at the CSC—is temporary. It only occurs during a chiller's start-up sequence. If a chiller fails to start because of this condition, its operating state will return to Off:Ready To Start (series-100 centrifugal) or Off:Remote Comm (series-200 centrifugal, reciprocating, or screw). As a result, the cause of the failure, which may still exist, will not be obvious.
2. This operating state can only occur when the chiller's Control Mode variable is set to "Auto:Local."

Table 6. Off:CSC Conditions at the Chiller

Chiller Controller	Off:CSC Condition at Chiller
Series-200 Centrifugal	Off:Remote Comm state
Series-100 Centrifugal	Off:Ready To Start state (Off:System Control state is temporarily displayed)
Reciprocating/Screw	Off:Remote Comm state

Stopping

The Stopping chiller status indicates that a chiller is going through its shutdown sequence after being disabled either locally or by the CSC. Table 9 lists the possible Stopping conditions.

Comm Loss

The Comm Loss chiller status indicates that the CSC has lost communications with a chiller. The CSC will generate a Comm Loss alarm whenever this happens. See the "Alarm Control" section for more information about what happens when a loss of communications occurs.

Note: A chiller that is running when it loses communications with the CSC will not automatically stop.

Table 7. Starting Conditions at the Chiller

Chiller Controller	Starting Condition at Chiller
Series-200 Centrifugal	Evap Pump On–Recirculate state
	Start-to-start timer not expired after load recycle shutdown (Waiting Cycle Timers state is displayed)
	Stop-to-start timer not expired after load recycle shutdown (Waiting Cycle Timers state is displayed)
	Waiting For Load state
	Pre-Lube state
	Cond Pump On state
	Start-Up Unloading state
	MCR Started state
Series-100 Centrifugal	Start-to-start timer not expired after load recycle shutdown (Will Start In *xx* Min state is displayed)
	Stop-to-start timer not expired after load recycle shutdown (Will Start In *xx* Min state is displayed)
	Evap Pump Is On *xx* state
	Waiting For Load state
	Oil Pump Is On *xx* state
	Cond Pump Is On *xx* state
	Start, Unloading *xx* state
	MCR Is On *xx* state
Reciprocating/Screw	Starting state
	Wait For Load state

Table 8. Running Conditions at the Chiller

Chiller Controller	Running Condition at Chiller
Series-200 Centrifugal	Running Ok state
Series-100 Centrifugal	Unit Is Running Ok state
Reciprocating/Screw	Stage *x* state
	① Manual Stage *x* state

Notes:
1. This operating state indicates that the chiller is being controlled locally.

Table 9. Stopping Conditions at the Chiller

Chiller Controller	Stopping Condition at Chiller
Series-200 Centrifugal	Shutdown Unloading state
	MCR Off:Routine Shutdown state
	MCR Off:Rapid Shutdown state
	Cond Pump Off–Shutdown state
	Evap Pump Off–Shutdown state
	Post-Lube state
	Oil Pump Off–Shutdown state
Series-100 Centrifugal	Stop, Unloading *xx* state
	MCR Off, Unloading *xx* state
	Waiting, High Amps *xx* state
	MCR Off, Post-Lube *xx* state

Water Temperatures

Variable Name	Keypad *(Menu-Scr.)*
Chilled Water Supply Temperature	2-1
Chilled Water Return Temperature	2-1
Common Entering Condenser Water Temperature	2-1 and 6-1
Common Leaving Condenser Water Temperature	2-1 and 6-1
Decoupler Temperature	2-1
Chiller #* Entering Evaporator Water Temperature	3-1 to -8
Chiller #* Entering Condenser Water Temperature	3-1 to -8
Chiller #* Leaving Evaporator Water Temperature	3-1 to -8
Chiller #* Leaving Condenser Water Temperature	3-1 to -8

Note: The wildcard character (*) could be 1 through 8.

The CSC provides both system water temperatures and, for your convenience, local water temperatures (at each chiller). Figures 6 and 7 show the locations of these temperature sensors.

Figure 6. Chilled Water Temperature Sensor Locations

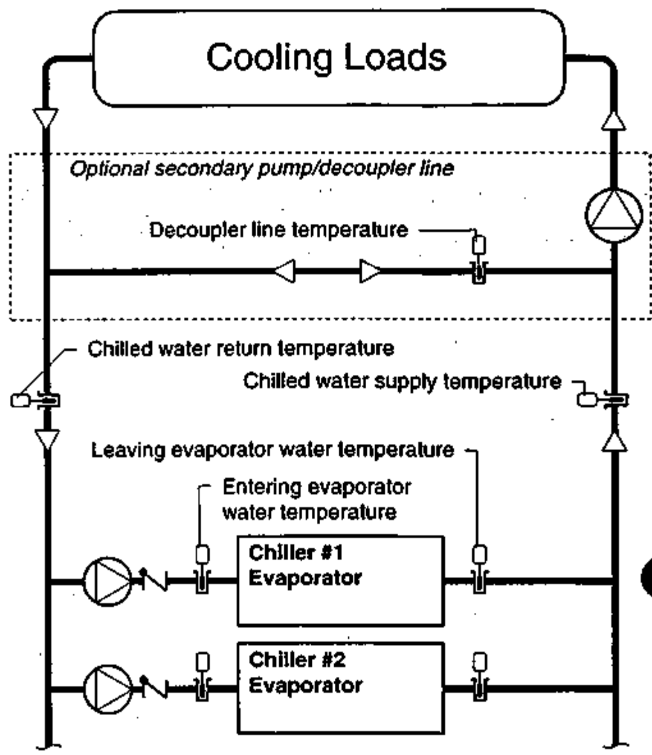
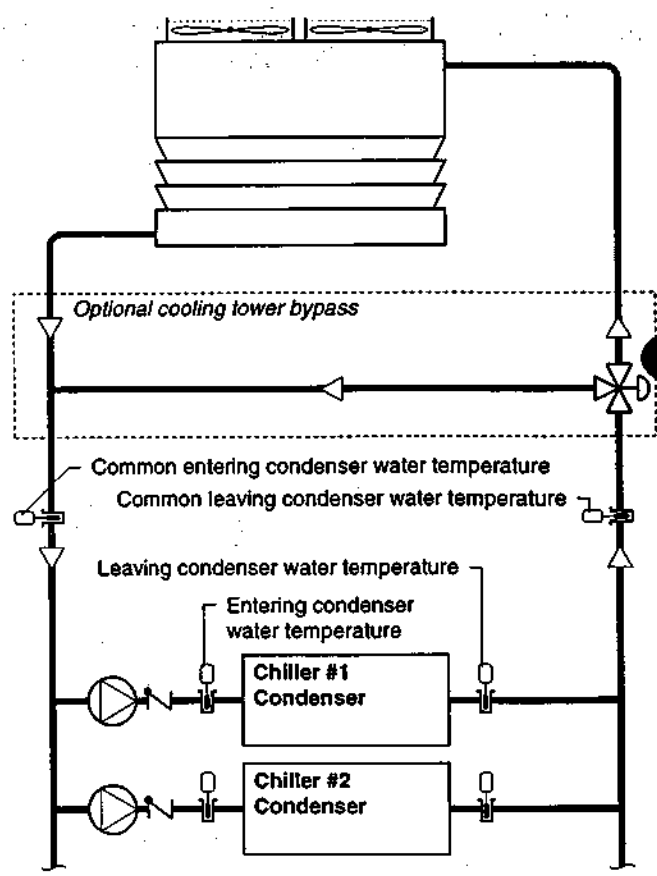


Figure 7. Condenser Water Temperature Sensor Locations



Chiller Run Time

Variable Name	Keypad (Menu-Scr.)
Chiller #* Operating Hours	4-1 to -2

Note: The wildcard character (*) could be 1 through 8.

The CSC keeps track of each chiller's run time, which is measured in hours. For centrifugal chillers, run time is accumulated whenever the compressor is on. For reciprocating and screw chillers, run time is accumulated whenever at least one compressor is on. The CSC uses this run-time data to set the sequence order when the Chiller Sequence Order Option variable (menu 11) is set to "Automatic."

Load Limiting Status

Variable Name	Keypad (Menu-Scr.)
System Load Balancing Load Limit	5-1
System Demand Limiting Load Limit	5-1
Start-Up Unloading Group #1 Load Limit	5-2
Start-Up Unloading Group #2 Load Limit	5-2
Start-Up Unloading Group #3 Load Limit	5-2
Start-Up Unloading Group #4 Load Limit	5-2
Chiller #* Load Limit	5-3 to -4
External Demand Limiting Signal	8-2
Stage-Up Inhibit Level	9-1

Note: The wildcard character (*) could be 1 through 8.

The CSC can perform four types of load limiting:

1. Load balancing
2. Start-up unloading
3. Demand limiting
4. Stage-Up Inhibiting

Following are brief explanations of them. For more information, see the "Load Limiting Control" section in the "Description of Operation" portion of this manual.

Percent-of-Capacity Limiting

The first three types of load limiting prevent the affected chillers from exceeding a certain percentage of their capacity. At the keypad/display, the effects of these load limiting functions are shown on menu 5.

When no percent-of-capacity load limit in effect, the load limit sent to each chiller will be 100%. When any one of them is in effect, the load limit will be less than 100%; for example, 92%. Each chiller receives the minimum of the three percent-of-capacity load limit values that apply to it (see below). The Chiller #* Load Limit variables show the load limit values the CSC sends to the individual chillers.

A centrifugal chiller will use a load limit value it receives from the CSC in the same manner as a load limit value it might generate internally:

1. Loading is inhibited when the load (% RLA) is equal to the load limit or 1% to 4% above the load limit.
2. Unloading occurs when the load is 5% or more above the load limit.

A reciprocating or screw chiller, which can only be affected by the demand limiting function, will convert the load limit value it receives from the CSC into a maximum stage value.

Load Balancing: When load balancing is enabled (menu 14), it will apply to all *centrifugal* chillers associated with the CSC. The System Load Balancing Load Limit variable shows the current value.

Start-Up Unloading: Start-up unloading can be assigned to four separate groups of *centrifugal* chillers. The Start-Up Unloading Group #* Load Limit variables show the load limit values for each group.

Demand Limiting: When the CSC receives a demand limiting signal, it sends it to *all* chillers associated with the CSC. The System Demand Limiting Load Limit variable shows the current value. If an external voltage or current signal is being used, the External Demand Limiting Signal variable shows the *conditioned* value of the input. (The ICM conditions all analog inputs to 0–5 Vdc signals.)

Chiller Stage-Up Inhibiting

The last type of load limiting, stage-up inhibiting, prevents additional chillers from being enabled by preventing a load-based stage-up. (A stage-up can still occur if an operational chiller becomes locally disabled or loses communications.) Stage-up inhibiting is either on or off. If it is off, the CSC stages normally. If it is on, the CSC can stage down, but it cannot stage up. Note that stage-up inhibiting does not affect the loading on each chiller; instead, the overall system load is limited to the available capacity of all *operational* chillers.

The CSC has two types of stage-up inhibiting: (1) Daily and (2) Network. Daily stage-up inhibiting is on when the current time is later than the Inhibit Stage-Up After Time (menu 11). Network stage-up inhibiting is on when the Stage-Up Inhibit Level is greater than or equal to the Stage-Up Inhibit Setpoint (menu 11). This network signal can come to the CSC from a MicroTech Network Master Panel or a building automation system communicating via Open Protocol.

Chilled Water Distribution System Status

Variable Name	Keypad (Menu-Scr.)
Differential Pressure Bypass Valve Position *or* Secondary VFD Pump Speed	7-1
Chilled Water Loop Pressure Difference	7-1
Current Sequenced Pump Stage	7-1
Secondary Pump #1 Operating Hours	7-1
Secondary Pump #2 Operating Hours	7-1
Secondary Pump #* Output State	7-2 to -3
Secondary Pump #* Status	7-2 to -3
Decoupler Flow Rate	8-2

Note: The wildcard character (*) could be 1 through 6.

The CSC can maintain a constant differential pressure across the cooling loads by controlling a bypass valve, variable speed secondary pump(s), or a set of sequenced secondary pumps. For applications that require a "lead/standby" arrangement of two secondary pumps, the CSC can automatically alternate the lead pump to equalize run time. For more information, see the "Chilled Water Flow Control," section in the "Description of Operation" portion of this manual.

Decoupler Line Flow Rate

For primary-secondary systems, the CSC uses the flow rate through the decoupler line to determine whether it should stage down. If the flow rate from supply to return is greater than the flow that would be lost after a stage down (plus an adjustable differential), a stage down becomes possible. For more information, see the "Chiller Sequencing Control" section in the "Description of Operation" portion of this manual.

Cooling Tower Status

Variable Name	Keypad *(Menu-Scr.)*
Current Cooling Tower Stage	6-1
Cooling Tower Bypass Valve Position	6-1
Common Entering Condenser Water Temperature	6-1 and 2-1
Common Leaving Condenser Water Temperature	6-1 and 2-1
Cooling Tower Alarm Input Status	8-1

The CSC can maintain a common entering or leaving condenser water temperature by controlling up to 12 cooling tower stages and a bypass valve. For more information, see the "Cooling Tower Control," section in the "Description of Operation" portion of this manual.

Auto/Manual Operation

⚠ WARNING

Electric shock and moving machinery hazard. Can cause severe personal injury or death.

When the CSC or a chiller controller is in the Off state, power is not removed from the chiller controller or components. Lock power off by means of the unit disconnect switch before servicing line voltage equipment on a chiller.

CSC Control Mode

Variable Name	Keypad *(Menu-Scr.)*
CSC Control Mode	10-1
Digital Output * Service Test State ①	30-1 to -4
Analog Output * Service Test Setpoint ②	30-5

Notes:

1. The wildcard character (*) could be 0 through 23.
2. The wildcard character (*) could be 0 through 3.

You can set up the chiller system for automatic or manual operation with the CSC Control Mode variable. Following are descriptions of the four possible modes.

Manual Off

The Manual Off mode will place the CSC into the Off: Manual state (see warning above). As a result, the CSC will disable all of its associated chillers that are set up for automatic operation, placing them into the Off:CSC chiller status state. Auxiliary equipment such as secondary pumps and cooling tower fans will also be shut down.

Automatic

The Automatic mode allows the chiller system to operate automatically. This means that the CSC will enable and disable chillers according to its scheduling, operator override, network override, optimal start, low ambient lockout, and sequencing control features. Whenever the CSC has enabled at least one chiller, it will also control auxiliary equipment such as secondary pumps and cooling tower fans.

Manual On

When the CSC is in the Manual On mode, it acts as though it were in the Automatic mode with a permanently occupied schedule. This means that the CSC will enable and disable chillers according to its low ambient lockout and sequencing control features. Whenever the CSC has enabled at least one chiller, it will also control auxiliary equipment such as secondary pumps and cooling tower fans.

Service Testing

The Service Testing control mode is a special mode that allows a technician to test the CSC's analog and digital outputs, the field wiring to them, and the auxiliary equipment they control. Service Testing is similar to Manual Off; the only difference is that each output can be manually controlled with the items in menu 30. For example, if the control mode is Service Testing and the Digital Output 3 Service Test State variable is set to "On," LED 3 on the Output Board should light and Pump #1 should start and run. And if the Analog Output 0 Service Test Setpoint is set to "100%," the cooling tower bypass valve should fully open to the tower.

Operator Override

Variable Name	Keypad *(Menu-Scr.)*
CSC Control Mode	10-1
Override Time	24-1

There are two ways an operator can start the chiller system during a scheduled unoccupied period: timed override and nontimed override. Both methods have the same authority as a scheduling function; thus (1) they can only override the Off:Unoccupied state, and (2) the CSC Control Mode must be set to "Automatic" to use them.

Note: These two override methods require that the operator be present to implement the override. If this is not possible, the CSC's one-event time schedule can be used instead. For more information, see the following "Scheduling" section.

Timed Override

With the Override Time variable, you can manually set a timer that will override the CSC's Off:Unoccupied state for the length of time specified. The Override Time variable can be set for any amount of time up to 60 hours in 15-minute increments. After it is set, the Override Time variable will show the time remaining in the override period. You can reset it (up or down) at any time. If nothing else is enabling the CSC (for example, an occupied schedule), the operating state will return to Off:Unoccupied when the timer expires. During a timed override period, the operating state will be On:Schedule.

Nontimed Override

You can use the CSC's external start/stop input to override the CSC's Off:Unoccupied state indefinitely. If the switch or relay contact connected to it is closed, the CSC will be enabled. If nothing else is enabling the CSC (for example, an occupied schedule), the operating state will return to Off:Unoccupied when the switch or relay contact opens. During a nontimed override period, the operating state will be On:Input.

Note: The external start/stop contact can be used for nontimed override, external time clock scheduling, or both (wired in parallel). For more on external time clocks, see the following "Scheduling" section.

Network Override

Variable Name	Keypad *(Menu-Scr.)*
CSC Control Mode	10-1

The CSC's operating state can be overridden by a network command received from any of three sources: a MicroTech Network Master Panel (NMP), a MicroTech Application Specific Controller (ASC), or a building automation system (BAS) communicating with the CSC via Open Protocol. Regardless of the source, the network command has one higher level of authority than a scheduling function; thus it can override the Off:Unoccupied, On:Schedule, and On: Input states. The CSC Control Mode must be set to "Automatic" to use a network command; otherwise, the command is ignored.

The five network override commands and their resultant operating states are as follows:

Network command	CSC Operating State
Stop	Off:Network
Auto	*varies; CSC is in normal operation*
Start	Recirculate On:Network
Recirculate	Recirculate
Free Cooling	Free Cooling

These operating states will occur only when the CSC's control mode is Automatic and the conditions for a higher authority Off state (Off:Alarm, Off:Manual, or Off:Ambient) do not exist.

NMP Source

When the source of the network command is an NMP, the command must be manually issued by an operator at a PC. The NMP variable that holds the network command is called the Global CSC Control Mode because it affects all CSCs in the network.

ASC Source

When the source of the network command is an ASC, the command may be issued in by an operator at a PC or automatically issued by the ASC's custom software application. An ASC might be used, for example, to coordinate a free cooling strategy in which primary chilled water pumps are started, valves are opened, cooling tower setpoints are changed, and the Free Cooling network command is sent to the CSC.

BAS Source

When the source of the network command is a BAS, the command may be manually issued by an operator at a PC or automatically issued by the BAS's scheduling function or a custom free cooling strategy.

To schedule the CSC with a BAS, the BAS would typically send a Start command during occupied periods and a Stop or Auto command during unoccupied periods. If the Stop command is used, the CSC's operator override and internal scheduling features will not work. If the Auto command is used, the CSC's operator override and internal scheduling features will work, but its internal schedules must be set for unoccupied operation and its external start/stop switch must be open before the system will shut down.

A BAS might also be used, for example, to coordinate a free cooling strategy in which primary chilled water pumps are started, valves are opened, cooling tower setpoints are changed, and the Free Cooling network command is sent to the CSC.

Loss of Communications

If the NMP, ASC, or BAS loses communications with the CSC, the CSC will retain and use the last network command it received for 10 minutes. After that it will automatically change the network command to Auto. As a result, the CSC will operate according to its internal scheduling and operator override features.

Note that you can use this fact to fail-safe your system. For example, if you're using a BAS to schedule the CSC, you may want to set the CSC's internal schedules for the same hours as the BAS schedules or even for continuous operation. For more information, see the following "Scheduling" section.

Caution: If an ASC or BAS is coordinating a free cooling strategy in which it changes cooling tower setpoints as it changes the network command, the CSC should be set up to shut down the system upon a loss of communications during any period when free cooling is possible. If this is not done, *chillers could start and operate with extremely low condenser water temperatures.*

Local Override

CSC control can be overridden if you want to enable or disable a chiller locally (at the chiller); however, *this should be done only if it is absolutely necessary.* If you locally enable or disable a chiller that is part of the current chiller stage, the CSC will generate the Chiller Offline alarm and force a stage-up, causing another chiller to start. If you locally enable a chiller that the CSC has disabled, the average load could decrease enough to cause a stage-down to occur.

Following are several ways to locally enable or disable a chiller. When you disable a chiller as described below, it will not run for any reason. When you enable a chiller as described below, it will run—if the CSC is the only thing disabling it. (For example, if there is a Fault alarm in a chiller, the chiller will not start if you try to enable it locally.)

Series-200 Centrifugal Chillers

To locally disable a chiller, do one of the following:

- Set the chiller's control mode to "Manual Off."
- Set the chiller's control mode to "Auto:Local" and set the chiller's schedule for unoccupied operation.
- Set the chiller's front panel switch to "Stop."
- Open the chiller's remote stop switch input.

To locally enable a chiller, do one of the following:

- Set the chiller's control mode to "Manual Enable."
- Set the chiller's control mode to "Auto:Local" and set the chiller's schedule for occupied operation.

Series-100 Centrifugal Chillers

To locally disable a chiller, do one of the following:

- Set the chiller's front panel switch to "Stop."
- Open the chiller's remote stop switch input.

To locally enable a chiller, remove the network communications connector from port B on the display processor and cycle power to the controller.

Reciprocating or Screw Chillers

To locally disable a chiller, do one of the following:

- Set the chiller's control mode to "Manual Unit Off."
- Set the chiller's schedule for unoccupied operation.
- Set the chiller's pumpdown switches to "Pumpdown and Stop."
- Set the chiller's system switch to "Emergency Stop."
- Open the chiller's remote stop switch input.

To locally enable a chiller, do one of the following:

- Set the chiller's control mode to "Manual Staging" and set the desired stage number.
- Remove the network communications connector from port B on the MCB, cycle power to the controller, and set the chiller's schedule for occupied operation.

Low Ambient Lockout

Variable Name	Keypad *(Menu-Scr.)*
Low Ambient Lockout Flag	10-1
Low Ambient Lockout Setpoint	10-1

The CSC's low ambient lockout feature can disable the entire chiller system whenever the outdoor air temperature is less than the Low Ambient Lockout Setpoint. If this occurs, the operating state will change to Off:Ambient. As a result, the CSC will disable all of its associated chillers and shut down all auxiliary system equipment. Note that this will occur regardless of the control mode setting.

When the outdoor air temperature rises to equal the Ambient Lockout Setpoint plus its differential, which is fixed at 2°F (1.1°C), the CSC will enable normal chiller system operation again.

Note: If communications are lost with an NMP or building automation system that is supplying the outdoor air temperature to the CSC, the CSC will retain and use the last temperature it received until communications are restored.

► **To set up low ambient lockout**

1. Set the Low Ambient Lockout Flag to "Yes."
2. Set the Low Ambient Lockout Setpoint as required.

Note: To use the low ambient lockout feature, an outdoor air temperature sensor must be connected to the CSC, a Network Master Panel (NMP), or a building automation system (BAS) communicating with the CSC via Open Protocol. For more information, see the "Field Wiring" section of Bulletin No. IM 618 and the "CSC and Chiller Controller Initial Setup" section of this manual.

Rapid Restart

Variable Name	Keypad *(Menu-Scr.)*
Rapid Restart Time	10-1

The CSC's rapid restart feature allows you to specify how you want the chiller system to react after the CSC has a temporary loss of power. If this happens, the CSC will lose communications and its supervisory control of the chillers. In this instance, series-200 centrifugal chillers will revert to local control after 5 minutes, and all other chillers will stay in whatever state they were in when communications failed (on or off).

If the power-loss period is less than the Rapid Restart Time setting, the CSC will return to normal operation without changing the current chiller stage when its power is restored. Any operational chillers in the current stage will continue to operate.

If the power-loss period is greater than the Rapid Restart Time setting, the CSC will return to normal operation when its power is restored, but it will reset the current chiller stage to stage 0. Any operational chillers will be disabled.

For more on what happens when the CSC loses communications with its chillers, see the "Alarm Control" section in the "Description of Operation" portion of this manual.

Scheduling

The CSC can be scheduled for occupied operation with any of five methods:

1. CSC internal daily scheduling
2. CSC internal holiday scheduling
3. CSC internal one-event scheduling
4. Network Master Panel (NMP) scheduling
5. External time clock

This section describes how to use the CSC's internal scheduling features. Internal CSC variables that must be set to use the NMP scheduling method or an external time clock are also discussed. For information on how to use the NMP scheduling function, refer to the literature provided with the Network Master Panel. For information on how to connect an external time clock, refer to the "Field Wiring" section of Bulletin No. IM 618, *MicroTech Chiller System Controller.*

The CSC's optimal start feature works in conjunction with the internal daily and holiday scheduling methods. When optimal start is enabled, the CSC can start the chiller system early to ensure that the loop temperature is cold when the normal scheduled start time occurs. For more information, see "Optimal Start" below.

Scheduling Method Interaction

When *any* of the above scheduling functions is calling for occupied operation, the CSC (chiller system) will operate—if its control mode is Automatic. Conversely, the CSC will go into its unoccupied state only when *all* of the above scheduling methods are calling for unoccupied operation. Therefore, any unused schedules should be set for continuous unoccupied operation. (An unassigned NMP schedule or a disconnected external time clock are equivalent to an unoccupied setting for those functions.)

Chiller Controller Setup

Every MicroTech-equipped chiller has its own internal scheduling capability. When chillers are networked with a CSC, these chiller schedules are not used because the CSC coordinates chiller operation. Thus the *system* (CSC) is scheduled rather than the individual chillers.

Series-200 Centrifugal: Individual series-200 centrifugal chiller controller schedules cannot affect chiller system operation when the chiller's control mode is set to "Auto: Network." This allows them to be set as appropriate for a situation in which communications are lost with the CSC. In this instance the local chiller schedules are used.

Series-100 Centrifugal: Individual series-100 centrifugal chiller controller schedules cannot affect chiller system operation when the chiller's start mode is set to "Remote." Unlike series-200 centrifugal chillers, the local schedules are not used if communications between the series-100 chiller and the CSC fail. Therefore, no setup is required for local series-100 chiller schedules; they can be set to anything.

Reciprocating and Screw: Individual reciprocating and screw chiller controller schedules can affect chiller system operation. *These chillers must be in a locally scheduled occupied period before the CSC can enable them.* If one of these chillers is in a scheduled unoccupied period, it is locally disabled. Thus each chiller's schedule should normally be set for continuous occupied operation (00:00–23:59) so that the CSC can always have complete authority over scheduling.

Setting Time and Date

Variable Name	Keypad *(Menu-Scr.)*
Current Time	23-1
Current Day	23-1
Current Date	23-1

The CSC uses the time and date to execute its internal scheduling functions. Once set, the battery-backed internal time clock will keep the current time regardless of whether power is being supplied to the panel.

You can set the time of day by entering the hour (0–23), minute (0–59), and second (0–59) into the Current Time variable's three fields; the day of the week by entering the day (Sun–Sat) into the Current Day variable's one field; and the date by entering the month (Jan–Dec), date (1–31), and year (0–99) into the Current Date variable's three fields.

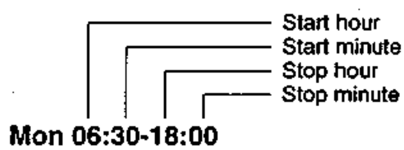
Daily Scheduling

Variable Name	Keypad *(Menu-Scr.)*
Sunday Schedule	24-1
Monday Schedule	24-1
Tuesday Schedule	24-2
Wednesday Schedule	24-2
Thursday Schedule	24-2
Friday Schedule	24-2
Saturday Schedule	24-2
Holiday Schedule	24-2
NMP Schedule Number	24-1

With the CSC's internal daily scheduling function, you can set one start and one stop time for each day of the week and for designated holidays (see below).

As shown in Figure 8, each daily schedule has four adjustable fields: start hour, start minute, stop hour, and stop minute. The schedule shown in Figure 8 would cause the chiller system to start up at 6:30 a.m. and shut down at 6:00 p.m. every Monday.

Figure 8. Daily Schedule Fields



For continuous chiller system operation, set the schedule fields to "00:00–23:59." To keep the chiller system off for the entire day, set the schedule fields to "00:00–00:00" (this is the default setting).

If you want the CSC to have complete authority over chiller system scheduling, set the NMP Schedule Number variable to "NA" (this is the default setting) and do not connect a time clock to the CSC's external start/stop input.

Note: An internal daily schedule's start time must occur before its stop time; otherwise, the chiller system will not start that day. If you want to schedule the chiller system to shut down and then start up again *on the same day*, you must (1) use an NMP schedule, (2) use an external time clock, or (3) use a combination of scheduling methods; for example, a CSC daily schedule and a CSC one-event schedule.

NMP Scheduling

If a Network Master Panel is included in the network with the CSC, an NMP schedule can be used to schedule chiller system operation. To use an NMP schedule, set the CSC's NMP Schedule Number variable as desired. When the CSC Control Mode (menu 10) is set to "Automatic," the NMP schedule you selected will enable and disable the chiller system. If you don't want the CSC to influence scheduling (likely), set the CSC's internal daily schedule variables to "00:00–00:00" (this is the default setting).

Using an External Time Clock

If desired, an external time clock can be used to schedule chiller system operation. The time clock must be connected to the CSC's external start/stop input (DI 0). When the CSC Control Mode (menu 10) is set to "Automatic," the external time clock will enable and disable the chiller system. If you don't want the CSC to influence scheduling (likely), set the

CSC's internal daily schedule variables to "00:00–00:00" (this is the default setting).

An external time clock does not actually schedule the CSC; it works by overriding the CSC's Off:Unoccupied state. Therefore, when the external time clock is in the occupied mode, the CSC's system status will be "On:Input" instead of "On:Schedule." The effect is the same—except that the CSC's optimal start feature will not work in conjunction with an external time clock.

Holiday Scheduling

Variable Name	Keypad *(Menu-Scr.)*
Holiday Schedule	24-2
Holiday Date #*	25-1 to -4
Holiday Date #* Duration	25-1 to -4

Note: The wildcard character (*) could be 1 through 12.

You can schedule special operating hours for up to 12 holiday periods by using the CSC's holiday scheduling feature. Whenever a holiday date occurs, the controller will use the Holiday Schedule's start and stop times for the number of successive days you specify with the associated holiday date duration variable. For example, assume that this year Christmas Eve occurs on a Thursday. Your building will be shut down on both Christmas Eve and Christmas Day, but will operate normally on the weekend. To schedule this holiday, set the Holiday Schedule to "00:00–00:00"; set the Holiday Date #1 variable to "Dec 24"; and set the Holiday Date #1 Duration variable to "2 Days."

If any of the 12 holiday dates are not required, enter "N/A" into the month field of those holiday dates (this is the default setting).

Note: In addition to allowing special operating hours, the CSC's holiday scheduling feature can be used to specify certain days on which the chiller or secondary pump (lead/standby) sequence order will be forced to change. If you specify a holiday date to force a sequence order change and you're using the CSC's internal daily scheduling function, be sure to set the Holiday Schedule's start and stop times as required for chiller system operation on that day. For more information, see the "Chiller Sequencing Control" and "Chilled Water Flow Control" sections.

One-Event Scheduling

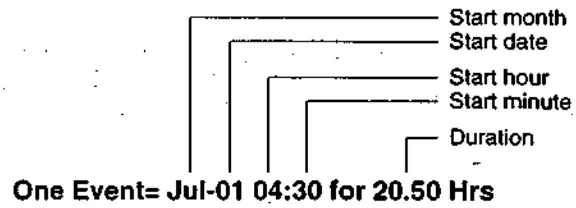
Variable Name	Keypad *(Menu-Scr.)*
One Event Schedule	24-1

With the CSC's internal one-event scheduling function, you can schedule one special period of occupied operation that is outside (or around) the normal daily and holiday schedules. The one-event schedule is similar to the timed operator override feature discussed in the previous "Auto/Manual Operation" section. The difference is that the override period can be set in advance.

As shown in Figure 9, the one-event schedule has five adjustable fields: start month, start date, start hour, start minute, and duration. The schedule shown in Figure 9 would cause the chiller system to start up at 4:30 a.m. on July 1 and shut down 20.5 hours later. Following is an example that uses this schedule.

Assume that your building is a department store and on Saturday July 1 there is a sale that requires the chiller system to start up at 4:30 a.m. and shut down at 1:00 a.m. on Sunday morning. The normal start and stop times are 6:00 a.m. and 11:00 p.m. for both Saturday and Sunday. Although you could change the normal Saturday and Sunday schedules to accommodate the sale (and then change them back before the normal 6:00 a.m. Sunday start), it would be much easier to enter the one-event schedule shown in Figure 9.

Figure 9. One Event Schedule Fields



To disable the one-event schedule, set its start month field to "N/A."

Optimal Start

Variable Name	Keypad *(Menu-Scr.)*
System Setpoint	16-1
Optimal Start Flag	26-1
Auto Update Flag	26-1
Optimal Start Begin Recirculate Time	26-1
Optimal Start Recirculation Period	26-1
Today's Optimal Start Time *(status only)*	26-1
Table of Optimal Start Time Increments	27-1 to -3

The CSC's adaptive optimal start feature works in conjunction with the CSC's internal daily and holiday scheduling functions to start the chiller system early during periods of high cooling load. The goal of optimal start is to pull the chilled water supply temperature down to the System Setpoint just as the normal occupied period begins. Optimal start uses a sophisticated algorithm that adapts to your chiller system's characteristics over time.

The following events occur:

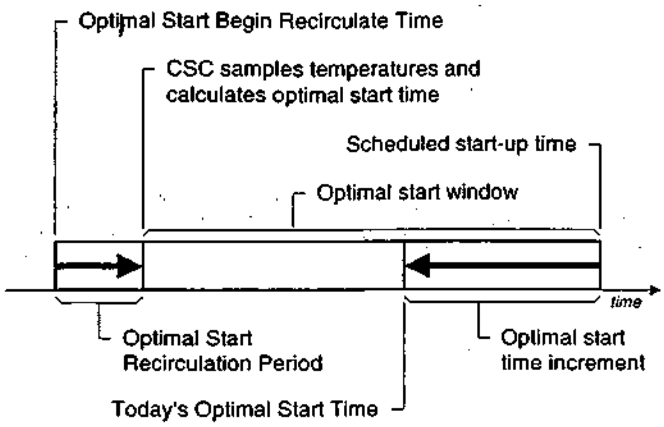
1. The secondary pumps are started and operated just long enough to get a representative return chilled water temperature.
2. The return chilled water and outdoor air temperatures are sampled. Based on these temperatures, an estimate is made of the amount of time required to pull the chilled water supply temperature down to the System Setpoint.
3. An optimal start time is calculated by subtracting this time estimate from the scheduled start time.
4. The system starts and operates. When the chilled water supply temperature reaches the System Setpoint, the actual amount of time that it took to get there is averaged with the estimate—if adaptation is desired.

Note: Optimal start control can be used only with primary-secondary systems in which the CSC is controlling the secondary pump(s).

How Optimal Start Works

Optimal chiller system start-up can occur only during a time window prior to occupancy that is defined by the scheduled start-up time for the day, the Optimal Start Begin Recirculate Time variable, and the Optimal Start Recirculation Period variable. See Figure 10.

Figure 10. Optimal Start Time Line



When the Optimal Start Begin Recirculate Time occurs, the CSC enters the Recirculate operating state and starts the secondary pump(s). The Optimal Start Recirculation Period variable defines the length of time the CSC remains in the Recirculate state. At the end of the recirculation period, the CSC samples the return chilled water and outdoor air temperatures.

The *exact time* at which the CSC enables the chiller system is determined by the Table of Optimal Start Time Increments, which is shown in Table 10 with its default values. For any combination of return water and outdoor air temperatures, a particular time increment value in the table is used. Notice that as the return water or outdoor air temperature increases, the optimal start time increment increases. If the actual temperatures don't exactly match those in the table, the controller selects the closest table value.

For example, if the return water temperature is 83°F (28°C) and the outdoor air temperature is 87°F (31°C), the optimal start time increment would be 40 minutes. If the outdoor air temperature were 106°F (41°C) instead of 87°F (31°C), the optimal start time increment would be 45 minutes. (This example is based on the default time increment values shown in Table 10.)

The CSC subtracts the start time increment from the scheduled start time to get the Today's Optimal Start Time value. If the calculated optimal start time is after the current time (typical), the CSC will return to the Off:Unoccupied state, stop the secondary pump(s), and wait. If the calculated optimal start time is before the current time, the CSC will immediately enter the On:Schedule state and start the system.

Note: If the CSC's return water or outdoor air temperature sensor fails, the optimal start algorithm will assume that the unreliable temperature is higher than those in Table 10. As a result, the time increment used will likely be higher, and thus the CSC will start the chiller system earlier than it would otherwise.

Note: If communications are lost with an NMP or building automation system that is supplying the outdoor air temperature to the CSC, the CSC will retain and use the last temperature it received until communications are restored.

Table 10. Default Optimal Start Time Increments (in Min.)

Outdoor Air Temperature	Return Chilled Water Temperature				
	50°F (10°C)	60°F (15°C)	70°F (21°C)	80°F (26°C)	90°F (32°C)
50°F (10°C)	5	10	15	20	25
60°F (15°C)	10	15	20	25	30
70°F (21°C)	15	20	25	30	35
80°F (26°C)	20	25	30	35	40
90°F (32°C)	25	30	35	40	45
100°F (38°C)	30	35	40	45	50

Adaptation

Each day, the CSC keeps track of how long it takes the chilled water supply temperature to reach the System Setpoint after start-up. When the supply temperature falls to the setpoint, the controller averages this amount of time with the optimal start time increment that it used. The controller then replaces the old table value with the new averaged value. This adaptation process will only occur if the Auto Update Flag is set to "Yes." Adaptation is illustrated below in "Typical Operating Sequence."

Note that if the supply temperature reaches the System Setpoint before the scheduled start-up time, the system will continue to operate; it will *not* shut down and then start up again. Over time, adaptation will reduce the amount of overshoot or undershoot.

You can manually adjust each individual value in the Table of Optimal Start Time Increments. The CSC will continue to use and—if adaptation is enabled—change whatever values are contained in the table.

Typical Operating Sequence

Following is an illustration of how the optimal start feature works. Assume that the following is true:

1. The CSC's Table of Optimal Start Time Increments contains the default values shown in Table 10.
2. The return chilled water temperature is 82.4°F (28.0°C).
3. The outdoor air temperature is 86.7°F (30.4°C).
4. The System Setpoint is 44.0°F (6.6°C).
5. The Optimal Start Begin Recirculate Time is 6:00 a.m.
6. The Optimal Start Recirculation Period is 10 minutes.
7. The scheduled start time is 7:00 a.m.

At 6:00 a.m., the CSC starts the secondary pump as it enters the Recirculate operating state. At 6:10 a.m., the CSC reads the two temperatures above, stops the pump, and returns to the Off:Unoccupied state. The Today's Optimal Start Time variable changes to "6:20" because the optimal start time increment is 40 minutes. As a result, the chiller system is enabled at 6:20 a.m., or 40 minutes early.

The chilled water supply temperature will ideally fall to 44.0°F (6.6°C), the System Setpoint, right at 7:00 a.m. Following are two scenarios that illustrate how the optimal start feature adapts if this doesn't happen.

Scenario 1: The chilled water supply temperature falls to the System Setpoint at 7:12 a.m., or 52 minutes after start-up. When this occurs, the CSC updates the optimal start table by changing the time increment value that it used to 46 minutes, the average of 52 and 40.

Scenario 2: The chilled water supply temperature falls to the System Setpoint at 6:36 a.m., or 16 minutes after start-up. When this occurs, the CSC updates the optimal start table by changing the time increment value that it used to 28 minutes, the average of 16 and 40.

▶ **To set up optimal start control**

1. Set the Optimal Start Flag to "Yes."
2. If you want the CSC to automatically adapt to your chiller system's characteristics, set the Auto Update Flag to "Yes."
3. Set the Optimal Start Begin Recirculate Time to the desired time after which optimal chiller system start-up can be *possible*, allowing time for the recirculation period.

   A typical setting would be about one hour before the normal scheduled start time.

   Note: The scheduled start time and the Optimal Start Begin Recirculate Time must be on the same day.
4. Set the Optimal Start Recirculation Period to the amount time you want the secondary pump(s) to run before the CSC takes a temperature reading at the return chilled water sensor.

   The CSC requires an accurate return water temperature to estimate the load and thus the optimal start-up time.

Note: The CSC's optimal start feature will work only with systems that have at least one secondary pump. To use the optimal start feature, chilled water supply and return temperature sensors must be connected to the CSC. In addition, an outdoor air temperature sensor must be connected to the CSC, an NMP, or a building automation system communicating with the CSC via Open Protocol. For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Alarm Monitoring

About Alarms

The CSC and chiller controllers are programmed to monitor their equipment for specific alarm conditions that may occur. If the CSC or a chiller controller detects an alarm condition, it will indicate the alarm, identify the alarm, and execute appropriate control actions that will fail-safe the equipment.

The CSC will also indicate the existence of chiller alarms, and it will tell you which chiller or chillers have them. It will tell you the type of chiller alarm (Fault, Problem, or Warning), but it will not identify specific chiller alarms. For example, if the Low Evaporator Pressure alarm occurs in Chiller #1 (assume it's reciprocating), the chiller controller's keypad/display will show "Lo Evap Pressure" and the CSC's keypad/display will show "Chil #1= Fault." If you were at the CSC, you would immediately know that a Fault alarm occurred in Chiller #1.

In addition to chiller alarms, the CSC monitors the network for loss-of-communications alarms. This type of alarm is indicated only at the CSC. If a loss-of-communications alarm occurs, the CSC will indicate the existence of the alarm and tell you which chiller or chillers are affected.

For detailed information on CSC alarms, refer to Table 12 and the "Alarm Control" section in the "Description of Operation" portion of this manual. For detailed information on chiller alarms, refer to the appropriate MicroTech unit controller operation manual (see Table 2).

Alarm Indication

The CSC has three components that can indicate the occurrence of alarms: the Alarm LED, the Alarm Horn, and the Alarm Output. The Alarm LED will always flash whenever any alarm occurs. The Alarm Horn and the Alarm Output can be independently set up to indicate certain types of alarms in different ways. The default setup is shown in Table 11. See "Setting Up the Alarm Horn" and "Setting Up the Alarm Output" below for more information.

Silencing the Alarm Horn

To silence the CSC's Alarm Horn, press the ALARM key. Note that silencing the Alarm Horn does not clear the alarm, and it does not return the Alarm Output to its normal state. See "Clearing Alarms" below for more information.

Table 11. Default Alarm Indication Setup

Alarm Type	Indication		
	Alarm LED	**Alarm Horn**	**Alarm Output**
Comm Loss	Flash *(not adj.)*	Off	Fast Pulse
Fault	Flash *(not adj.)*	On	Fast Pulse
Problem	Flash *(not adj.)*	On	Slow Pulse
Warning	Flash *(not adj.)*	Off	Slow Pulse
Normal State	Off *(not adj.)*	Off *(not adj.)*	Open

Priority

The various alarms that can occur in MicroTech unit controllers are prioritized according to their severity. Three categories are possible: Fault, Problem, and Warning. A fourth category is possible in the CSC and other MicroTech controllers that network unit controllers together: Comm Loss. Following are definitions of the four alarm types.

Fault: Faults are the highest priority alarms. If a Fault occurs, the equipment (CSC or chiller) will be shut down until the alarm condition is gone and the Fault is cleared. Reciprocating and screw chillers have an sub-category of Fault alarms: the Circuit-Fault. If a Circuit-Fault occurs, the affected refrigeration circuit will be shut down until the alarm condition is gone and the Fault is cleared. Most Fault alarms must be manually cleared.

Problem: Problems have lower priority than Faults. If a Problem occurs, the equipment will not be shut down, but its operation will be modified in some way to compensate for the alarm condition. Most Problem alarms will automatically clear when the alarm conditions that cause them return to normal.

Warning: Warnings are the lowest priority alarms. No control action is taken when a Warning occurs; it is simply indicated to alert the operator that the alarm condition needs attention. Most Warning alarms will automatically clear when the alarm conditions that cause them return to normal.

Comm Loss: Depending on the application, the priority of a loss-of-communications, or "Comm Loss," alarm varies. In the CSC, the priority of Comm Loss alarms is higher than Problem alarms and lower than Fault alarms. Comm Loss alarms will automatically clear when communications are restored with the affected chillers.

Table 12. CSC Alarms

Alarm Type	Alarm Message	Indication	Reset
Fault	Lvg CndW T Fail	Common leaving condenser water temperature sensor failed while it was the cooling tower Control Temperature source	Manual
	Ent CndW T Fail	Common entering condenser water temperature sensor failed while it was the cooling tower Control Temperature source	Manual
	No Sec ChW Flow	All secondary pumps failed, resulting in a loss of chilled water flow to the loads	Manual
Comm Loss	No Comm Chil #8	Communications lost between CSC and Chiller #8	Auto
	No Comm Chil #7	Communications lost between CSC and Chiller #7	Auto
	No Comm Chil #6	Communications lost between CSC and Chiller #6	Auto
	No Comm Chil #5	Communications lost between CSC and Chiller #5	Auto
	No Comm Chil #4	Communications lost between CSC and Chiller #4	Auto
	No Comm Chil #3	Communications lost between CSC and Chiller #3	Auto
	No Comm Chil #2	Communications lost between CSC and Chiller #2	Auto
	No Comm Chil #1	Communications lost between CSC and Chiller #1	Auto
Problem	Decouple F Fail	Decoupler line flow rate sensor failed	Auto
	Sec Pump #6 Fail	Secondary Pump #6 status not proven after output was energized	Manual
	Sec Pump #5 Fail	Secondary Pump #5 status not proven after output was energized	Manual
	Sec Pump #4 Fail	Secondary Pump #4 status not proven after output was energized	Manual
	Sec Pump #3 Fail	Secondary Pump #3 status not proven after output was energized	Manual
	Sec Pump #2 Fail	Secondary Pump #2 status not proven after output was energized	Manual
	Sec Pump #1 Fail	Secondary Pump #1 status not proven after output was energized	Manual
	Outside T Fail	Outdoor air temperature sensor (connected to CSC) failed	Auto
	Decouple T Fail	Decoupler temperature sensor failed	Auto
	Ret ChW T Fail	Common return chilled water temperature sensor failed	Auto
	Sup ChW T Fail	Common supply chilled water temperature sensor failed	Auto
	ChW Press Fail	Chilled water loop differential pressure sensor failed	Auto
Warning	Clg Tower Fail	Cooling tower partially or totally failed	Auto
	Lvg CndW T Warn	Common leaving condenser water temperature sensor failed while it was not the cooling tower Control Temperature source	Auto
	Ent CndW T Warn	Common entering condenser water temperature sensor failed while it was not the cooling tower Control Temperature source	Auto
	Chiller Offline	At least one chiller that is part of the current stage (1) is not running, (2) is running under local control, or (3) has lost communications with the CSC	Auto

Displaying Alarms

Variable Name	Keypad (Menu-Scr.)
Current CSC Alarm	31-1
Current Chiller #* Alarm Type ①	31-1 to -3
Buffer Alarm #* ②	32-1 to -3

Notes:

1. The wildcard character (*) could be 1 through 8.
2. The wildcard character (*) could be 1 through 9.

Current Alarms

When the CSC indicates that an alarm has occurred, you can find out what it is and when it happened by displaying the current alarms at the keypad or PC. For CSC alarms, the specific alarm is displayed; for chiller alarms, the affected chiller and the alarm type (Fault, Problem, or Warning) is displayed. You can find out what specific chiller alarm occurred by going to the chiller's keypad/display or to the chiller's alarm screen on a PC equipped with Monitor software.

A current CSC alarm will be displayed until either it clears (see below) or another alarm with higher priority occurs. Thus if a situation arises in which two or more CSC alarms exist at the same time, the Current CSC Alarm variable will display the alarm that has the highest priority. The CSC alarms shown in Table 12 are listed in order of priority. For example, the "No Comm Chil #1" alarm has higher priority than the "Chiller Offline" alarm.

CSC Alarm History

When the current CSC alarm is cleared or replaced by another alarm, it is stored in the CSC Alarm Buffer (menu 32), which holds the last nine CSC alarms. Each alarm's time and date of occurrence is also stored. Buffer Alarm #1 is the most recent alarm.

Clearing Alarms

Before any alarm can be cleared, the alarm conditions that caused it must have returned to normal. When the alarm conditions are gone, an alarm may be cleared either automatically or manually. Table 12 shows how CSC alarms are cleared.

An auto-reset alarm will immediately clear whenever the alarm conditions that caused it return to normal.

You can clear a manual-reset alarm at the affected controller's keypad/display (see below) or a PC. Note that you cannot clear a chiller alarm from the CSC's keypad/display.

Note: Some of the chiller safety devices that detect alarm conditions require a manual reset at the device before the controller alarm can clear.

▶ To clear a CSC alarm from the keypad/display

1. Press the ALARM key. The current CSC alarm is displayed.
2. Press the CLEAR key. The alarm condition must be removed before the alarm will clear.

▶ To clear a chiller alarm from the keypad/display

1. Go to the affected chiller.
2. Press the CLEAR key while the current alarm is in the display. (On series-100 centrifugals, it's the CLEAR FAULT key.) The alarm condition must be removed before the alarm will clear.

Setting Up the Alarm Horn

Variable Name	Keypad *(Menu-Scr.)*
Horn On Comm Loss Flag	33-1
Horn On Fault Flag	33-1
Horn On Problem Flag	33-1
Horn On Warning Flag	33-1

The CSC has a piezo alarm annunciator (Alarm Horn) that can be set up to sound whenever an alarm occurs anywhere in the chiller system. You can enable or disable the Alarm Horn so that it sounds only when certain types of alarms occur—or you can disable it completely. For example, if you want the horn to sound when a Fault alarm occurs in the CSC or any chiller, set the Horn On Fault Flag to "Horn." See "About Alarms" above for more on the four possible alarm types: Comm Loss, Fault, Problem, and Warning.

Setting Up the Alarm Output

Variable Name	Keypad *(Menu-Scr.)*
Alarm Output Normal State	34-1
Alarm Output Comm Loss State	34-1
Alarm Output Fault State	34-1
Alarm Output Problem State	34-1
Alarm Output Warning State	34-1

The CSC's Alarm Output can be set up in a variety of ways to accommodate devices such as building automation systems, remote annunciators, or dial-out notification systems. Like the Alarm Horn, the Alarm Output can be set up to change state only when certain types of alarms occur. Four alarm state options are available for each alarm type: open, closed, slow pulse (0.5 second on; 0.5 second off), and fast pulse (0.1 second on; 0.1 second off).

The Alarm Output Normal State variable specifies the state of the alarm output when there are no current CSC or chiller alarms. The other four variables shown above specify the state of the Alarm Output when a current CSC or chiller alarm of that type exists. If multiple alarms exist, the output state will be the one specified for the highest priority alarm. If you don't want any indication for a certain alarm type, set its alarm state variable to the same value as the Alarm Output Normal State variable. See "About Alarms" above for more on the four possible alarm types: Comm Loss, Fault, Problem, and Warning.

As an example, assume that the Alarm Output is connected to a building automation system that requires a constant-state (non-pulsed) input. The Alarm Output must be normally closed, and Warning alarms need not be reported. The following settings would produce the desired result:

Alarm Output	Setting
Normal State	Closed
Comm Loss State	Open
Fault State	Open
Problem State	Open
Warning State	Closed

Description of Operation

The following sections describe how the various CSC control processes work to manage chiller system operation. The adjustable variables that affect these control processes are listed at the beginning of each applicable sub-section. Before changing any control variables, you should read and understand the applicable text.

Chiller Sequencing Control

As the cooling load varies, the CSC enables and disables chillers so that the current cooling capacity is matched to the current cooling load. This action is commonly called chiller *sequencing*. The two fundamental elements of any sequencing control strategy are the *sequence order*, the order in which chillers are enabled and disabled, and the *sequencing logic*, the rules by which chillers are enabled and disabled to match the cooling capacity to the load.

Sequencing and Staging
In the CSC, a *chiller stage* is defined as a set of chillers. As the CSC sequences chillers on and off, it "stages up" and "stages down." If the sequence order is set properly, each successive stage will have more capacity than the preceding stage. Additional capacity could be in the form of one added chiller (typical), two or more added chillers, a chiller swap (in which the replacement chiller has more capacity than the one that is stopped), or any combination of these. Thus the words "sequencing" and "staging" essentially mean the same thing.

Sequence Order

Variable Name	Keypad (Menu-Scr.)
Chiller Sequence Order Option	11-1
First On Chiller	11-2
Last On Chiller	11-2
Chiller Resequence Day/Time	11-3
Number Of Chiller Stages	11-4
Chiller Stage * Bitset	13-1 to -3

Note: The wildcard character (*) could be 1 through 9.

The CSC allows the chiller sequence order to be set automatically or manually. You can select the method with the Chiller Sequence Order Option variable. There are two options:

- Automatic
- Fixed

Regardless of the method used, the sequence order is contained in a *stage table*.

Understanding the Stage Table
An example of a stage table for a typical chiller system is shown below in Table 13. At the keypad/display, the stage table is shown at menu 13. Each Chiller Stage * Bitset variable (1 through 9) is a row of the stage table.

You can find out what the sequence order is by comparing the contents of each stage with the previous stage, starting at stage 1. Any chillers in stage 1 are lead; any new chillers in stage 2 (compared to stage 1) are next in the sequence order; any new chillers in stage 3 (compared to stage 2) are next in the sequence order; and so on.

Table 13. Example of Chiller Stage Table

	Chiller							
Stage No.	**#1**	**#2**	**#3**	**#4**	**#5**	**#6**	**#7**	**#8**
Stage 1	–	–	–	***#4***	–	–	–	–
Stage 2	–	–	–	–	***#5***	–	–	–
Stage 3	–	–	***#3***	–	#5	–	–	–
Stage 4	–	***#2***	#3	–	#5	–	–	–
Stage 5	–	#2	#3	–	#5	***#6***	–	–
Stage 6	***#1***	#2	#3	–	#5	#6	–	–
Stage 7	–	–	–	–	–	–	–	–
Stage 8	–	–	–	–	–	–	–	–
Stage 9	–	–	–	–	–	–	–	–

The advantage of the stage table is that it is flexible enough to allow for unusual sequences; for example, chillers can be turned off when a stage-up occurs, chillers can be turned on when a stage-down occurs, and more than one chiller can be started or stopped for a single stage change.

Consider the stage table shown in Table 13. Notice that this system has six chillers and six stages. Assume that Chiller #4 is a reciprocating chiller, and the other chillers are centrifugals. By comparing rows, you can see that this system's sequence order is as follows ("new" chillers are shown in bold italic):

1. Chiller #4
2. Chiller #5 *(Chiller #4 also goes off)*
3. Chiller #3
4. Chiller #2
5. Chiller #6
6. Chiller #1

Chiller #4, which has much less capacity than any of the centrifugal chillers, is used only when the cooling load is extremely light.

Stage Table Changes: The CSC actually maintains two chiller stage tables in its memory. One is the *active* stage table, and the other is the *ideal* stage table. While the CSC is operational, it uses only the active stage table. Any changes to the sequence order—whether entered manually by an operator or automatically by the CSC—are stored in the ideal stage table. A new sequence order is *implemented* when the ideal stage table is copied over the existing active stage table. Note that until this happens, *any changes to the sequence order will not be used as the CSC sequences its chillers.* There are two methods of implementing a new sequence order: natural and forced. See below for more information.

Note: The stage table of menu 13 is the ideal stage table. The active stage table is not shown on the keypad/display.

Automatic Sequence Order Option
With the Automatic sequence order option, the CSC modifies the stage table as required to equalize each chiller's run time. Chillers that have less run time will be placed

before chillers that have more run time in the sequence order. As changes occur, the CSC stores them in the ideal stage table.

For centrifugal chillers, run time is totalized whenever the compressor is on. For reciprocating and screw chillers, run time is totalized whenever at least one compressor is on. Once every 15 minutes, the CSC reads the run time values from each chiller controller, which totalizes and stores them. At the keypad/display, you can find each chiller's run time under menu 4.

To use the Automatic option, your sequencing strategy must have all of the following characteristics:

- The number of stages must be equal to the number of chillers.
- A stage-up must enable one chiller, and a stage-down must disable one chiller.
- Each chiller must be able to assume any place in the sequence order—with two exceptions: (1) one chiller can be designated as always "first on" (lead), and (2) one chiller can be designated as always "last on" (most lag). See below.
- If both a first-on and a last-on chiller are designated, they must be different chillers.

Designating a First-On Chiller: With the First On Chiller variable, you can designate one chiller that will always be lead regardless of its run time. You can also specify whether this chiller will go off at stage 2 and higher ("Off at Stage Two") or stay on at stage 2 and higher ("Off Last"). The first-on chiller will always be the only chiller in stage 1. For example, the sequence order shown in Table 13 could be set up by designating Chiller #4 as "First On & Off at Stage Two."

Designating a Last-On Chiller: With the Last On Chiller variable, you can designate one chiller that will always be most lag regardless of its run time. The last-on chiller will always be placed only in the highest stage. If a stage-down occurs while the CSC is at the highest stage, the last-on chiller will always be first chiller to be turned off. For example, in the sequence order shown in Table 13, Chiller #1 would never occur in stages 1 through 5 if it were designated as "Last On & First Off."

Note: When the Automatic option is used, the following variables are set by the CSC: Number Of Chiller Stages, Chiller Stage * Bitset (1 through 9). The CSC will not allow you to change them.

▶ To set up the Automatic sequence order option

1. Set the Chiller Sequence Order Option to "Automatic."
2. If one of the chillers will always be lead, set the First On Chiller variable as required.

   Note that in addition to the chiller's number, you must also specify when the first-on chiller will go off ("at Stage Two" or "Last").
3. If one of the chillers will always be most lag, set the Last On Chiller variable as required.

Fixed Sequence Order Option

With the Fixed sequence order option, you can manually enter the sequence order you want into the ideal stage table (menu 13). Once the fixed sequence order is implemented, the CSC will use it until you change it.

The Fixed option is very flexible. It allows you to set up sequencing strategies that (1) have an unequal number of chillers and stages or (2) turn multiple chillers on or off at any stage change.

Note: The following variables are not used with the Fixed option: First On Chiller, Last On Chiller.

▶ To set up the Fixed sequence order option

1. Set the Chiller Sequence Order Option to "Fixed."
2. Set the Number Of Chiller Stages variable to the number of stages the stage table will have.

   In a typical system, this number will equal the number of chillers.
3. Set up the ideal stage table by setting the Chiller Stage * Bitset variables (1 through x, where x is the number of stages specified in step 2).

Natural Sequence Order Implementation

Natural sequence order implementation automatically occurs whenever the CSC is in any Off operating state. Because all chillers are disabled during the Off state, this method allows the active stage table to change *without disabling one chiller in order to enable another chiller.* For a typical chiller system in which all chillers are shut down daily, a new sequence order will be implemented within 24 hours (at most).

Forced Sequence Order Implementation

With the Chiller Resequence Day/Time variable, you can force a new sequence order to go into effect either immediately or at a scheduled time on a scheduled day. You can choose any day of the week, every day, or holidays. The following selections are possible:

- Now
- Daily, *any time*
- Sunday, *any time*
- Monday, *any time*
- Tuesday, *any time*
- Wednesday, *any time*
- Thursday, *any time*
- Friday, *any time*
- Saturday, *any time*
- Holidays, *any time*

If you set the Chiller Resequence Day/Time variable's day setting to "Hol," the forced sequence order implementation will occur whenever a scheduled CSC holiday occurs (see note below). In this way you can customize the sequence order change schedule to make it, for example, biweekly, monthly, or quarterly. You can disable the scheduled sequence order change feature by setting the Chiller Resequence Day/Time variable to "N/A 0:00" (default).

When you enter "Now" or when the current day and time match the Chiller Resequence Day/Time variable's setting, the following will occur regardless of the CSC's operating state:

1. The active stage table will be updated.
2. The Current Chiller Stage (menu 1) will remain the same —except when there is an operational standby chiller.
3. Disabled, available chillers that are part of the current (updated) stage will be enabled. (The chiller status of these available-but-disabled chillers is Off:CSC.)
4. Chillers in the current (updated) stage that were already on will remain on with no interruption.
5. Enabled chillers that are no longer part of the current (updated) stage will be disabled.
6. Locally disabled chillers that are part of the current (updated) stage will remain disabled. (The CSC will not attempt to enable them.)

In a typical situation, the same number of chillers that were enabled before the resequence time will be enabled after the resequence time. However, as described above, *the CSC may simultaneously enable and disable chillers to satisfy a new sequence order when the resequence time occurs.* If enabled and disabled chillers trade positions, a temporary loss of capacity will occur while the new chiller loads up. Because of this, you should only use forced sequence order implementation if your chiller system will seldom or never be shut down.

Restoring Offline Chillers: In addition to forced sequence order implementation, the resequence day/time function can be used to return the CSC and offline chillers to normal operation when the CSC's Chiller Offline alarm exists. In this case, it is likely that more chillers will be enabled after the resequence time than were enabled before it even though the current chiller stage remains the same. See "Special Sequencing Logic" below for more information.

Note: The Chiller Resequence Day/Time variable's setting is always compared with the day and time on the CSC's internal clock. Therefore, if you are using a Network Master Panel (NMP) to schedule chiller system operation and you want to schedule a forced sequence order implementation on a "holiday," you must set that holiday date in the CSC (menu 25).

Normal Sequencing Logic

Variable Name	Keypad *(Menu-Scr.)*
Chiller Sequencing Control Type	11-1
Chiller Stage-Up Differential	11-4
Decoupler Stage-Up Temperature Differential	11-5
Decoupler Stage-Down Flow Rate Factor	11-5
Chiller Stage 1 Stage-Up Setpoint	12-1
Chiller Stage 1 Delay Time	12-1
Chiller Stage * Stage-Up Setpoint ①	12-2 to -9
Chiller Stage * Stage-Down Setpoint ①	12-2 to -9
Chiller Stage * Delay Time ①	12-2 to -9
Chiller #* Flow Rate ②	29-1 to -4

Notes:
1. The wildcard character (*) could be 2 through 9.
2. The wildcard character (*) could be 1 through 8.

The CSC's chiller sequencing logic determines when chillers must be enabled or disabled to increase or decrease capacity. The term "stage up" means to increase capacity by one step (typically by enabling one chiller), and the term "stage down" means to decrease capacity by one step (typically by disabling one chiller). (If there are reciprocating or screw chillers in your chiller system, do not confuse *compressor* staging with *chiller* staging.)

Two types of sequencing logic are available:

- Standard
- Decoupled

You can select the type that is suitable for your system with the Chiller Sequencing Control Type variable.

Start-Up Control

When the chiller system starts, the CSC's operating state changes from Off to Recirculate. If there is a secondary pump, the CSC will prove that chilled water flow in the secondary loop exists before leaving Recirculate and going to the On state.

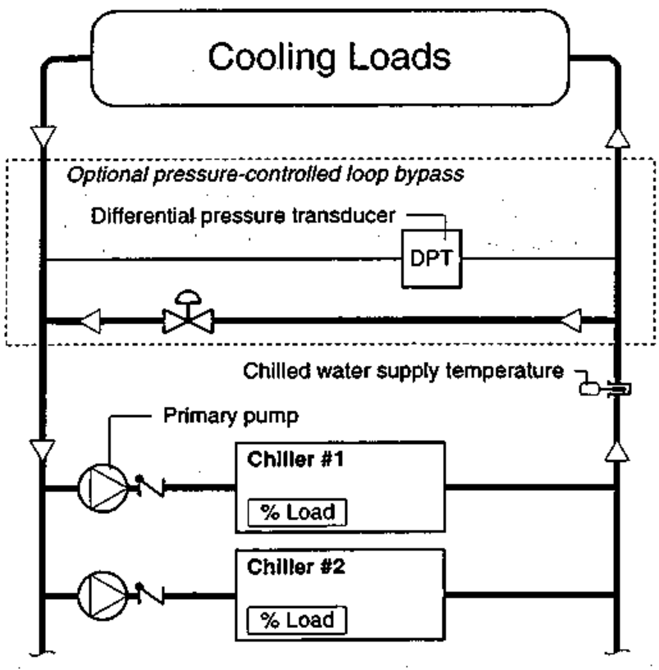
Upon entering the On state, the CSC will enable the stage-1 chiller. (Assume there is only one chiller in stage 1 and that it is available.) Once the stage-1 chiller is enabled, its controller will start the primary chilled water pump, check for evaporator water flow, and check for a cooling load. The chiller will start if there is flow and the leaving evaporator water temperature is greater than the Active Setpoint by more than a differential, which varies and depends on the chiller type.

After the stage-1 chiller starts, its controller will increase cooling capacity as required, but only within the constraints of any active maximum pull down rate control and soft loading control. Note that any active maximum pull down rate or soft loading control in the stage-1 chiller can limit the chiller's capacity and thus may delay chiller sequencing (see below).

Standard Sequencing Logic

Standard sequencing logic is intended for use with primary-only chiller systems. A typical primary-only system is shown in Figure 11. The distinguishing characteristic of this system is that the primary pumps distribute water to the cooling loads. (Note that the primary pump and evaporator piping arrangements are *not* distinguishing characteristics. Dedicated primary pumps and parallel evaporators are shown in Figure 11, but a common primary pump and series evaporators are also possible.)

Figure 11. Typical Primary-Only System



Standard sequencing logic uses each chiller's percent load and the chilled water supply temperature to stage the chillers.

Stage-Up Control: The CSC will stage up when additional cooling capacity is required. This will occur whenever the following three conditions are satisfied:

1. The average percent load of all operational chillers is greater than the Chiller Stage x Stage-Up Setpoint, where x is the current chiller stage (1 through 9).
2. The chilled water supply temperature is greater than the System Setpoint (menu 1 and 16) by more than the Chiller Stage-Up Differential.

3. Conditions 1 and 2 above have been true for a period of time specified by the Chiller Stage *x* Delay Time variable, where *x* is the current chiller stage.

Stage-Down Control: The CSC will stage down when there is an excess of cooling capacity. This will occur whenever the following three conditions are satisfied:

1. At least one chiller in next lower stage is available. (A chiller is available when it is communicating and it is not locally disabled or locally enabled.)
2. The average percent load of all operational chillers is less than the Chiller Stage *x* Stage-Down Setpoint, where *x* is the current chiller stage (2 through 9).
3. Condition 2 above has been true for a period of time specified by the Chiller Stage *x* Delay Time variable, where *x* is the current chiller stage.

▶ To set up Standard sequencing logic

1. Set the Chiller Sequencing Control Type variable to "Standard."
2. Set the Chiller Stage-Up Differential as required.
3. Set the Chiller Stage * Stage-Up Setpoint variables (1 through *x*, where *x* is the number of stages in the stage table) as required.
4. Set the Chiller Stage * Stage-Down Setpoint variables (2 through *x*, where *x* is the number of stages in the stage table) as required.
5. Set the Chiller Stage * Delay Time variables (1 through *x*, where *x* is the number of stages in the stage table) as required.

Note: To use Standard sequencing logic, a chilled water supply temperature sensor must be connected to the CSC. For more information, see the "Field Wiring" section of Bulletin No. IM.618.

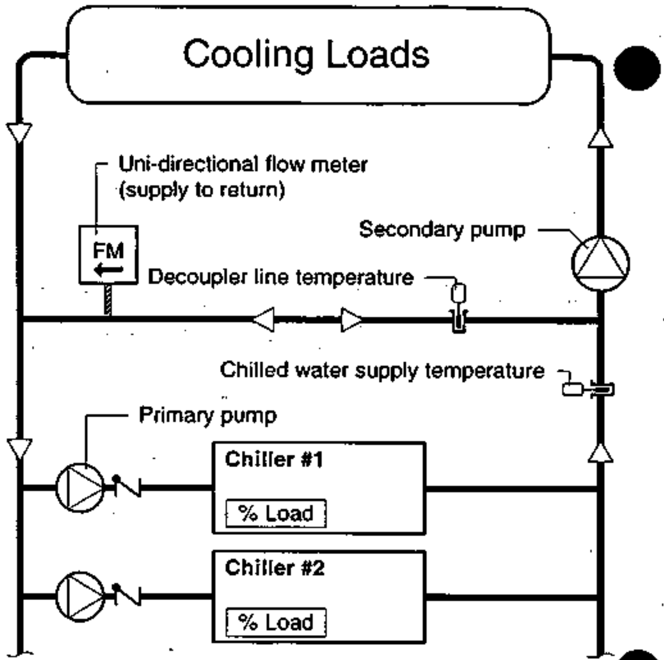
Decoupled Sequencing Logic

Decoupled sequencing logic is intended for use with primary-secondary chiller systems. A typical primary-secondary system is shown in Figure 12. The distinguishing characteristics of this system are as follows: (1) each chiller (or set of series chillers) has its own primary pump, (2) one or more secondary pumps distribute water to the cooling loads, and (3) the secondary circuit is hydraulically isolated from the primary circuit by a decoupler line. (Note that the evaporator piping arrangements are *not* distinguishing characteristics. Parallel evaporators are shown in Figure 12, but series evaporators are also possible.)

The purpose of primary-secondary (decoupled) systems is to maintain relatively constant flow through the chillers while at the same time allowing variable flow to the cooling loads. Because the relationship between a building's total cooling load and its required chilled water flow rate is seldom proportional, situations can occur in which partly loaded chillers cannot provide enough chilled water to the secondary loop. In this instance, water flows from return to supply in the decoupler line. As a result, supply and return water mix, and the chilled water temperature going to the cooling loads rises. The CSC's Decoupled sequencing logic can prevent this from happening.

Decoupled sequencing logic uses each chiller's percent load, the chilled water supply temperature, the decoupler line temperature, and the decoupler line flow rate (supply to return only) to stage the chillers. Note that a stage-up can occur for either of two reasons: (1) to satisfy the need for additional capacity, *or* (2) to satisfy the need for additional flow.

Figure 12. Typical Primary-Secondary System



Stage-Up-for-Capacity Control: The CSC will stage up when additional cooling capacity is required. This will occur whenever the following three conditions are satisfied:

1. The average percent load of all operational chillers is greater than the Chiller Stage *x* Stage-Up Setpoint, where *x* is the current chiller stage (1 through 9).
2. The chilled water supply temperature is greater than the System Setpoint (menu 1 and 16) by more than the Chiller Stage-Up Differential.
3. Conditions 1 and 2 above have been true for a period of time specified by the Chiller Stage *x* Delay Time variable, where *x* is the current chiller stage.

Stage-Up-for-Flow Control: The CSC will stage up when additional primary water flow is required. This will occur whenever the following two conditions are satisfied:

1. The decoupler line temperature is greater than the chilled water supply temperature by more than the Decoupler Stage-Up Temperature Differential. (Water is flowing the wrong way through the decoupler line.)
2. Condition 1 above has been true for a period of time specified by the Chiller Stage *x* Delay Time variable, where *x* is the current chiller stage.

Stage-Down Control: The CSC will stage down when there is an excess of cooling capacity *and* primary chilled water. This will occur whenever the following four conditions are satisfied:

1. At least one chiller in next lower stage is available. (A chiller is available when it is communicating and it is not locally disabled or locally enabled.)
2. The average percent load of all operational chillers is less than the Chiller Stage *x* Stage-Down Setpoint, where *x* is the current chiller stage (2 through 9).
3. The decoupler line flow rate is greater than an adjustable percentage of the defined flow rate of the chiller(s) to be disabled. The chiller flow rates are defined with the Chiller #* Flow Rate variables, and the percentage

is defined with the Decoupler Stage-Down Flow Rate Factor.

4. Conditions 2 and 3 above have been true for a period of time specified by the Chiller Stage x Delay Time variable, where x is the current chiller stage.

Condition 3 assures that the chillers that would still be on after a stage-down will continue to meet the building's flow requirement. As an example, consider a system in which Chiller #3 is the only chiller that is part of stage 2 and not part of stage 1. Assume that Chiller #3's defined flow rate is 1000 gpm (50 L/s) and that the Decoupler Stage-Down Flow Rate Factor is set to 1.10. If the CSC is at stage 2 and the decoupler line flow rate is slightly more than 1100 gpm (55 L/s), condition 3 is satisfied. If the stage down occurs, the flow rate from supply to return in the decoupler line will drop from 1100 gpm (55 L/s) to 100 gpm (5 L/s).

▶ **To set up Decoupled sequencing logic**

1. Set the Chiller Sequencing Control Type variable to "Decoupled."
2. Set the following variables as required:
   - Chiller Stage-Up Differential
   - Decoupler Stage-Up Temperature Differential
   - Decoupler Stage-Down Flow Rate Factor
3. Set the Chiller Stage * Stage-Up Setpoint variables (1 through x, where x is the number of stages in the stage table) as required.
4. Set the Chiller Stage * Stage-Down Setpoint variables (2 through x, where x is the number of stages in the stage table) as required.
5. Set the Chiller Stage * Delay Time variables (1 through x, where x is the number of stages in the stage table) as required.
6. Set the Chiller #* Flow Rate variables (1 through x, where x is the number of chillers) as required.

Note: To use Decoupled sequencing logic, a chilled water supply temperature sensor, a decoupler line temperature sensor, and a uni-directional decoupler line flow meter must be connected to the CSC. For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Special Sequencing Logic

Variable Name	Keypad *(Menu-Scr.)*
Chiller Resequence Day/Time	11-3

The CSC uses special sequencing logic to compensate for a chiller that (1) is part of the current stage and (2) cannot be enabled or disabled by the CSC. Such a chiller is called an *offline chiller.* An offline chiller must be compensated for because it represents a significant loss of capacity for the current stage. For example, if stage 2 consists of two equally sized chillers and one of them is offline, stage 2's capacity is reduced by 50 percent.

Special sequencing logic is similar to normal sequencing logic; the basic differences are that (1) forced stage-ups can occur and (2) normal stage-downs are allowed at lower-than-normal average percent load levels. The overall effect is to make it easier to add capacity and more difficult to shed capacity. Although special sequencing logic will usually keep the chiller system operating with no adverse effects, it is not an ideal situation—especially if multiple chillers are offline at the same time. Therefore, the CSC will generate the Chiller Offline alarm to alert you that the system may need attention. See "Restoring Offline Chillers to Normal Operation" below for more information.

Unavailable and Available Chillers

Before a chiller is marked offline, it must first be *unavailable.* A chiller is unavailable when the CSC cannot influence its start/stop operation. This can occur for any of three reasons:

1. The chiller is locally disabled.

   The chiller status (menu 3) of a locally disabled chiller will always be Off:Local. If a chiller is locally disabled, it is always off. For more information on locally disabled chillers, see "Chiller Status (Generalized Operating State)" in the "Determining Chiller System Status" section and "Local Override" in the "Auto/Manual Operation" section.

2. The chiller is locally enabled.

   If a chiller is locally enabled, it is usually on, but it may also be off if it is locally disabled at the same time. If a locally enabled chiller is part of the current stage, it is not possible to tell whether it is locally enabled from information available at the CSC's keypad/display. However, since a chiller can become locally enabled only as a result of a manual override, the system operator will know which chillers are locally enabled. For more information on locally enabled chillers, see "Local Override" in the "Auto/Manual Operation" section.

3. The chiller has lost communications with the CSC.

   The chiller status (menu 3) of a chiller that has lost communications with the CSC will always be Comm Loss. Such a chiller may be on or off; the CSC has no way of knowing.

Conversely, a chiller is *available* when none of the above conditions apply to it.

New Offline Chillers and Forced Stage-Ups

A normal chiller *becomes* an offline chiller when it is part of the current stage but is unavailable. Whenever the CSC finds an offline chiller, it marks the chiller, disables the chiller, and *usually* forces a stage-up (see below). The chiller is marked so that it does not force another stage-up at a different stage, and it is disabled so that it won't start if the condition that caused it to go offline is removed (this would result in an excess of system capacity).

Once a chiller is marked offline, it remains offline until certain conditions are satisfied. An offline chiller that becomes available again (Off:CSC chiller status) will *not* automatically lose its offline marking and start up. See "Restoring Offline Chillers to Normal Operation" below for more information.

There are three situations in which the CSC can find a new offline chiller:

1. At stage-up
2. At stage-down
3. During steady-state operation

In situations 1 and 3, a forced stage-up will occur.

Offline at Stage-Up: As a stage-up occurs, the CSC checks the availability of each chiller in the new stage. If it finds a new unavailable chiller, it marks the chiller as offline and forces another stage-up. (If it finds a chiller that had been marked offline previously, it does nothing.) For example, if a stage-up from stage 1 to stage 2 occurs and the CSC finds a locally disabled chiller in stage 2 that is not part of stage 1, the CSC will mark the chiller as offline and immediately go to stage 3.

Offline at Stage-Down: As a stage-down occurs, the CSC checks the availability of each chiller in the new stage. If it finds a new unavailable chiller, it marks the chiller as offline. Because it is a stage-down, no forced staging (up or down) will occur. For example, if a stage-down from stage 3 to stage 2 occurs and the CSC finds a locally disabled chiller in stage 2 that is not part of stage 3, the CSC will mark the chiller as offline.

Offline During Steady-State: During the first 60 seconds after any stage change, the CSC ignores each chiller's chiller status. If the CSC finds a new unavailable chiller anytime after this period, it marks it as offline and forces a stage-up. For example, if the CSC has been at stage 2 for more than 60 seconds and a chiller that is part of stage 2 suddenly loses communications, the CSC will mark the chiller as offline and immediately go to stage 3.

Note: In the case of an operational chiller that loses communications, a forced stage-up could result in an excess of capacity until communications are restored because an enabled chiller that loses communications with the CSC will remain enabled. When communications are restored with such a chiller, it will be shut down by the CSC since it is marked as offline.

How Offline Chillers Affect Normal Stage-Down Logic

Any time an offline chiller exists, the CSC ignores the Chiller Stage * Stage-Down Setpoint variables. Instead of the set variables, it uses a value of 0% at stage 2, and it uses the Chiller Stage 2 Stage-Down Setpoint at stage 3 through 9. This is done because these variables are capacity dependent, and when a chiller is offline, there is likely a significant reduction in capacity for any current stage.

As an example, consider a chiller system that has three 400 ton centrifugal chillers. Stage 1 is one chiller; stage 2 is two chillers; and stage 3 is three chillers. The Chiller Stage 2 Stage-Down Setpoint is 50%, and the Chiller Stage 3 Stage-Down Setpoint is 67%.

Normal Logic: During normal operation, a stage-down from stage 3 to stage 2 will occur when the three chillers are operating at an average load of 66% or less. The 67% setting is used for stage 3 because the capacity of three chillers operating at two-thirds load is approximately equal to the capacity of two chillers operating at full load.

Special Logic: If the stage-1 chiller is offline, a stage-down from stage 3 to stage 2 should not occur at the same stage-3 setpoint because the capacity of two chillers operating at two-thirds load is greater than the capacity of one chiller operating at full load. However, if stage 2's lower setting of 50% is used for stage 3, the stage-down can safely occur because the capacity of two chillers operating at one-half load is approximately equal to the capacity of one chiller operating at full load.

Restoring Offline Chillers to Normal Operation

When all offline chillers are unmarked, the Chiller Offline alarm will automatically clear and normal sequencing logic will resume. The CSC will unmark an offline chiller when *any* of the following situations occur:

1. The CSC's operating state changes to Off (chiller system shutdown).

   Like natural sequence order implementation, restoration of offline chillers automatically occurs whenever the CSC is in any Off operating state. For a typical chiller system in which all chillers are shut down daily, any offline, available chillers will be restored to normal operation within 24 hours (at most).

2. The chiller is no longer part of the current stage.

   Regardless of whether a stage-up or stage-down occurs, an offline chiller will be unmarked if it is *not* part of the new stage. Since the chiller's capacity is not required (it is not part of the stage), it will remain disabled after it is unmarked. If there are no offline chillers in the new stage, there is no missing capacity and thus normal sequencing logic can safely resume.

3. The chiller is available, the current stage is the highest stage, and more capacity is required.

   If a normal stage-up condition occurs while the current stage is the highest stage, the CSC will check for any offline chillers that are also available. If it finds one, it will automatically unmark and enable it. If there are two or more offline, available chillers, the CSC will unmark and enable the one that has the lowest chiller number and then reset the stage-up timer. If another stage-up condition occurs, the chiller with the next lowest number will be unmarked and enabled. For example, if Chiller #1 and Chiller #3 are both offline and available, the CSC will unmark and enable Chiller #1 first.

   Note: This logic will *not* occur when a standby chiller is designated. See "Designating a Standby Chiller" below for more information.

4. The chiller is available and a resequence time occurs.

   With the Chiller Resequence Day/Time variable, you can force the CSC to unmark and enable *all* offline chillers that are also available. To do this, set the variable to "Now." (You can also schedule the resequence time.) If there are multiple offline chillers, *be aware that the sudden increase in capacity may be very large.*

   Note: If there is a standby chiller and the current stage is the highest stage, the resequence day/time function will force a stage-down before it executes, disabling the standby chiller. See "Designating a Standby Chiller" below for more information.

   Caution: A forced sequence order implementation will also occur when the resequence day/time function executes. If the ideal stage table changed, some chillers may stop while others start. For more information, see the "Sequence Order" sub-section above.

Notice that offline chillers are unmarked in situations 3 and 4 only if they are available. This is because an offline chiller's capacity is required in these two situations. An offline chiller will become available again when the condition that caused the chiller to be unavailable is removed. For example, if a chiller has a Fault alarm, the alarm must be cleared; if a chiller's remote stop switch input is opened, the input must be closed again; if a chiller is locally enabled, it must be returned to automatic (network) control; if a chiller loses communications, communications must be restored.

An offline chiller that is available will have a chiller status (menu 3) of Off:CSC. This chiller status state indicates that the only thing disabling the chiller is the CSC. Note that if an offline chiller is running when it becomes available again, it will stop. This situation could occur, for example, when communications are restored or when a series-200 chiller's control mode is changed from "Manual Enable" to "Auto:Network."

▶ To manually restore offline chillers to normal operation

1. Verify that the offline chiller(s) you want to run are available.

The chiller status (menu 3) of an offline chiller that is available will be Off:CSC.

2. Set the Chiller Resequence Day/Time variable to "Now."

   After you enter the value, it automatically changes back to "N/A." Note that this will cause a forced sequence order implementation.

The CSC will enable *all* available chillers in the current stage.

Designating a Standby Chiller

Variable Name	Keypad *(Menu-Scr.)*
Standby Chiller	11-2

Regardless of whether you're using Automatic or Fixed sequence ordering, you can designate one chiller as a standby chiller with the Standby Chiller variable. If you designate a standby chiller, the CSC will not allow it to operate unless at least one other chiller is offline. It does this by (1) forcing the standby chiller to exist only in the highest stage and (2) disallowing a stage-up to the highest stage unless a chiller is offline. Notice that when you designate a standby chiller, the highest stage of the stage table effectively becomes a "standby stage."

If you're using Fixed sequence ordering, the CSC will automatically remove the standby chiller from all but the last stage of the ideal stage table. If you're using Automatic sequence ordering, the CSC will automatically set the Last On Chiller variable (menu 11) equal to the Standby Chiller variable, which has the same effect.

Caution: An offline chiller may be operational if it became unavailable as a result of (1) losing communications with the CSC or (2) being locally enabled. In these instances, the standby chiller could start, *making possible a situation in which all chillers are running at the same time.*

Standby Chillers and Special Sequencing Logic
It is assumed that when a standby chiller is designated, a situation in which all chillers are operating at the same time is undesirable—though still possible since offline chillers are not necessarily off (see caution above). Therefore, special sequencing logic is modified in two ways when there is a standby chiller:

1. Offline chillers that are also available are not enabled when the current stage is the standby (highest) stage and more capacity is required.

   Normally, more capacity will not be required when the standby chiller is on unless two or more chillers are offline.

2. The resequence day/time function will force a stage-down if it executes while the current stage is the standby (highest) stage.

   The stage-down will turn off the standby chiller, and any offline chillers in the new stage that are also available will start.

For more information, see "Special Sequencing Logic" above.

► To designate a standby chiller

- Set the Standby Chiller variable as required. If you do not want a standby chiller, set it to "NA."

Load Limiting Control

Load Balancing

Variable Name	Keypad *(Menu-Scr.)*
Load Balancing Flag	14-1
Load Balancing Capacity Difference Limit	14-1

The CSC can provide load balancing control for all *centrifugal* chillers in the system. If you choose to use load balancing control, it will affect the entire system.

When to Use Load Balancing
Load balancing control is *required* if there is at least one dual-compressor centrifugal chiller in the system. It is often used (but not required) when there is at least one set of series-piped centrifugal chillers in the system.

If all the centrifugal chillers have single compressors and are piped in parallel, load balancing control is optional. As long as their leaving evaporator water temperature setpoints are the same, chillers in these systems tend to automatically balance their loads as they control their chilled water temperatures. In fact, load balancing control can actually override chilled water temperature control. So if load balancing control is in use, you can expect some variation in the chillers' leaving evaporator water temperatures. This is more likely to occur in a system that has chillers with a wide range of efficiencies.

How Load Balancing Works
The CSC continually reads the percent load (% RLA) from every centrifugal compressor that is running. It then selects the lowest of these percent load values and adds the Load Balancing Capacity Difference Limit variable (default is 5%) to this minimum. The result is the System Load Balancing Load Limit (menu 5). If the value of this variable is less than the capacity limits produced by the start-up unloading and demand limiting functions, the CSC will send it to every centrifugal chiller controller in the system. Each chiller then inhibits loading or unloads as required to keep the load within 5% of this limit.

The Load Balancing Capacity Difference Limit effectively defines a range of acceptable compressor percent load values. This range will float up and down as the minimum percent load value floats up and down.

As an example, consider a system with two older, inefficient chillers and one new, efficient chiller. The new chiller is Chiller #3, the CSC's Load Balancing Capacity Difference Limit variable is set to 5%, and the chilled water setpoints in each chiller controller are the same. When Chiller #3's load is 55% RLA, the load on Chiller #1 and Chiller #2 will be prevented from exceeding 64% RLA. (Loading is inhibited at 60% through 64%; unloading occurs at 65% and higher.)

► To set up load balancing control

1. Set the Load Balancing Flag to "Yes."

2. Set the Load Balancing Capacity Difference Limit as required.

Start-Up Unloading

Variable Name	Keypad (Menu-Scr.)
Chiller #* Group	15-1 to -2

Note: The wildcard character (*) could be 1 through 8.

The CSC can provide start-up unloading control for defined groups of *centrifugal* chillers. Four groups are possible, and a group can have two to eight chillers. If you choose to use start-up unloading control, it will only affect groups in which a compressor is starting.

When to Use Start-Up Unloading
Start-up unloading control is *required* for dual-compressor centrifugal chillers. Both compressors of a particular chiller must be assigned to the same group so that if either one starts, the other will unload.

For single-compressor centrifugal chillers, start-up unloading control is optional. You may want to use it, for example, if the primary chilled water flow to certain chillers is temporarily but significantly reduced when another chiller starts up.

How Start-Up Unloading Works
When two or more chillers are assigned to a start-up unloading group, *all* chillers in the group will unload whenever *any* chiller in the group starts up. The CSC checks the chiller status of each chiller to find out whether any of them are starting up. If at least one chiller status is Starting, the CSC sets the Start-Up Unloading Group #x Load Limit variable (menu 5) to 30%, where x is the group that the starting chiller is part of. The CSC then sends this 30% load limit to each chiller controller in that group. As a result, all operational compressors in the group will unload.

When all chillers in a group are no longer starting, the CSC sets the Start-Up Unloading Group #x Load Limit variable back to 100%, allowing normal operation to resume.

▶ To set up start-up unloading control

- Assign the same group number to every chiller in the group with the Chiller #* Group variables. Do this for each of the four groups as required.

  For example, if Chiller #1 and Chiller #2 are two compressors of a dual-compressor chiller, set the Chiller #1 Group and Chiller #2 Group variables to "1." This will result in Group 1 consisting of these two chiller controllers.

Demand Limiting

Variable Name	Keypad (Menu-Scr.)
Demand Limiting Type	14-1

The CSC can provide demand limiting control for all chillers in the system. If you choose to use demand limiting control, it will affect the entire system.

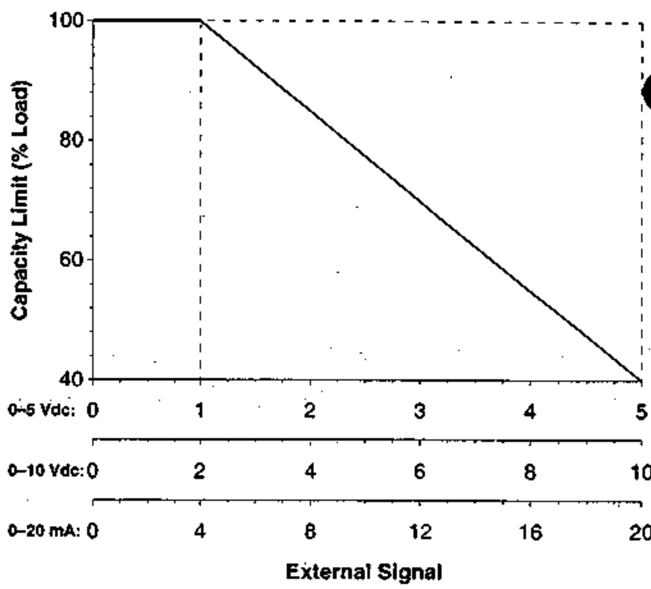
How Demand Limiting Works
Demand limiting control requires a capacity limit value, which must come from an outside source. You can choose one of two possible sources with the Demand Limiting Type variable:

- External *(analog signal)*
- Open Protocol *(network BAS signal)*

After receiving the capacity limit from either source, the CSC generates the System Demand Limiting Load Limit (menu 5). If the value of this variable is less than the capacity limits produced by the load balancing and start-up unloading functions, the CSC will send it to every centrifugal chiller controller in the system. Each centrifugal chiller then inhibits loading or unloads as required to keep the load within 5% of this limit. The CSC will always send the value to every reciprocating or screw chiller controller in the system. After converting the percent-load limit to a maximum-stage limit (see below), each reciprocating or screw chiller then inhibits stage-ups or stages down as required to keep the load at the limit.

Demand Limiting from an External Signal
If the Demand Limiting Type variable is set to "External," the CSC will use an external voltage or current signal as the source of the System Demand Limiting Load Limit. The capacity limit is calculated according to the function shown in Figure 13.

Figure 13. External Signal Demand Limiting Function

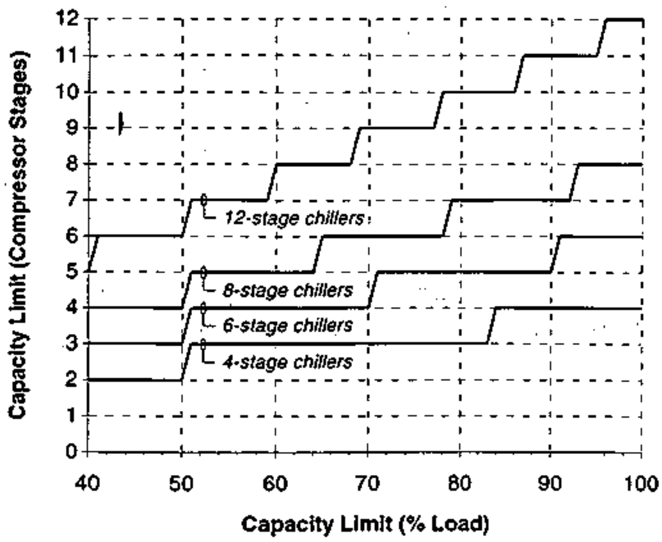


Demand Limiting via Open Protocol
If the Demand Limiting Type variable is set to "Open Protocol," the CSC will accept a capacity limit value sent by a building automation system (BAS) via Open Protocol. The value the BAS sends will become the System Demand Limiting Load Limit; however, the CSC will limit the value to a range of 40% to 100%. For example, if the BAS writes a value of 20%, the System Demand Limiting Load Limit variable will be set to 40%.

Note: If communications are lost with a BAS that is supplying the demand limiting value to the CSC, the CSC will retain and use the last value it received for 10 minutes. After that, it will automatically set the System Demand Limiting Load Limit variable to 100%.

Reciprocating and Screw Chillers
Since reciprocating and screw chillers control their capacity in stages, the System Demand Limiting Load Limit cannot be used directly as it is in centrifugal chillers. Instead, each reciprocating or screw chiller controller converts the percent-load capacity limit into a maximum-stage capacity limit. The step functions these controllers use to do this are shown in Figure 14.

Figure 14. Reciprocating/Screw Chiller Demand Limiting



▶ **To set up demand limiting control**

- Set the Demand Limiting Type variable as required. If you do not want demand limiting control, set it to "None."

Note: To use an externally sourced demand limiting signal, an analog signal (0–5 Vdc, 0–10 Vdc, or 0–20 mA) must be connected to AI 9 on the CSC. For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Stage-Up Inhibiting

Variable Name	Keypad *(Menu-Scr.)*
Inhibit Stage-Up After Time	11-3
Stage-Up Inhibit Setpoint	11-3

As its name implies, stage-up inhibiting limits loading by preventing further stage-ups. If stage-up inhibiting is on, the CSC will be able to stage down, but it will not be able to stage up when a normal stage-up would otherwise occur. If it is off, normal sequencing control occurs. Note that stage-up inhibiting will *not* prevent a forced stage-up from occurring when the CSC finds a new offline chiller. (See "Special Sequencing Logic" in the "Chiller Sequencing Control" section for more on offline chillers.)

Unlike load balancing, start-up unloading, and demand limiting, stage-up inhibiting does not directly influence the loading of individual chillers, and it cannot actively reduce the system-wide load. It can only prevent more capacity—in the form of additional chillers—from being added to the system.

There are two types of stage-up inhibiting:

- Daily
- Network

You can use either type or both types at the same time.

Daily Method
With the Inhibit Stage-Up After Time variable, you can specify a particular time after which no more stage-ups will occur. For example, if your chiller system shuts down at 9:00 p.m., you may want to prevent more capacity from being added to the system after 8:15 p.m. In this instance, you could set the Inhibit Stage-Up After Time to "20:15."

Network Method
If your network includes a MicroTech Network Master Panel (NMP) or if a building automation system (BAS) is connected to the CSC via Open Protocol, you can use the Stage-Up Inhibit Setpoint to turn stage-up inhibiting on and off. Whenever the Stage-Up Inhibit Level (menu 9) is greater than or equal to the setpoint, stage-up inhibiting will be on; otherwise, it will be off. The value of the level and the setpoint can be whole numbers from 1 to 7. If the level or the setpoint is "None" (0), stage-up inhibiting will not occur.

The NMP generates the Stage-Up Inhibit Level according to its load shed function and the input from a demand meter.

A BAS can generate the Stage-Up Inhibit Level in any manner required.

Note: If communications are lost with an NMP or BAS that is supplying the Stage-Up Inhibit Level to the CSC, the CSC will retain and use the last value it received for 10 minutes. After that, it will disable Network stage-up inhibiting.

▶ **To set up stage-up inhibiting control**

1. Set the Inhibit Stage-Up After Time as required.

   Normal stage-ups will not occur after this time.

2. Set the Stage-Up Inhibit Setpoint as required. If there is no NMP or BAS, set it to "None."

   Normal stage-ups will not occur when the Stage-Up Inhibit Level (menu 9) is greater than or equal to this setpoint.

Soft Loading

Soft loading control can be used to prevent the lead chiller's load from rising too fast during chiller system start-up when the return chilled water temperature is high. Unlike the other load limiting functions, soft loading control is performed by the individual chiller controllers, not the CSC. However, the CSC does influence soft loading control by disabling it in all but the lead chiller. This feature allows you to use soft loading control in conjunction with automatic sequence ordering.

How Soft Loading Is Influenced by the CSC
Whenever a chiller starts up, the CSC checks to see whether any other chillers are already running. If no other chillers are running, it does nothing, allowing soft loading to occur. If any other chiller is running, it disables soft loading in all chillers.

The chiller in which the CSC allows soft loading to occur is typically the single chiller in stage 1. If the stage-1 chiller fails or is disabled, the above logic allows the new chiller in stage 2 to start with soft loading.

Note that the above logic may give undesired results with unusual sequence orders. For example, if stage 1 has two chillers in it, soft loading will not occur. And if stage 1 and 2 both have one chiller each (a chiller swap), soft loading will occur in both chillers when they start.

Chiller Controller Setup
If soft loading control is desired, the soft loading variables must be set in all chillers that may at some time be the lead chiller. Typically, these variables will be set identically in each chiller of the same type; however, this is not required.

The soft load variables that must be set in each type of chiller are summarized in Tables 14, 15, and 16. The values shown in italic are typical settings.

Table 14. Soft Loading Variables: Series-200 Centrifugal

Chiller Controller Variable	Keypad/Display ID	
	Menu	Item
Soft Load Flag	13	SoftLoad= *On*
Beginning Soft Load Limit	13	Begin Amp Lim= *40%*
Soft Load Ramp Time	13	Ramp Time= *20 Min*
Maximum Amp Limit	13	Max Amp Spt= *100%*

Table 15. Soft Loading Variables: Series-100 Centrifugal

Chiller Controller Variable	Keypad/Display ID	
	Key	Item
Beginning Soft Load Limit	SOFT LOAD	Beg Amp Limit= *40%*
Soft Load Ramp Time	SOFT LOAD	Ramp Up Time= *20 Min*
Maximum Amp Limit	MAX AMP LIMIT	Max Amp Limit= *100%*

Table 16. Soft Loading Variables: Reciprocating/Screw

Chiller Controller Variable	Keypad/Display ID	
	Menu	Item
Soft Load Time	15 *(2 ckt.)* 18 *(3 ckt.)*	SoftLoad= *20 Min*
Soft Load Maximum Stage	15 *(2 ckt.)* 18 *(3 ckt.)*	SoftLdMaxStg= *4*

▶ **To set up soft loading control**

1. Determine which chillers may at some time be lead.

   A lead chiller can be a stage-2 chiller that starts to replace the designated stage-1 chiller if it fails or is locally disabled.

2. Set the soft loading variables as required in these chiller controllers. Refer to Tables 14, 15, and 16.

The CSC will automatically disable soft loading control in all lag chillers when they start.

Chilled Water Temperature Control

In a system of multiple chillers, each individual chiller should normally maintain its leaving evaporator water temperature at the same setpoint—even if that setpoint is being reset. The CSC can generate this setpoint (with or without reset) and send it to every chiller in the system via network communications.

Figures 15 and 16 show how leaving evaporator water temperature setpoints are generated and how they flow to and through the chiller controllers, which ultimately use them to control capacity and thus water temperature. Notice that the link between the CSC and the chiller controllers—and between the two figures—is the Chiller Setpoint.

The discussion of the following sub-sections starts at the end of the flow chart (setpoint source at chillers in Figure 15) and works back to the beginning (setpoint reset in Figure 16).

Setpoint Source at Chillers

In all cases, each individual chiller controller attempts to maintain its leaving evaporator water temperature at its Active Setpoint, which is the "working" leaving evaporator water temperature setpoint. Any capacity overrides that are in effect, such as load balancing or demand limiting, can affect a chiller's ability to control temperature. See Figure 15.

For almost all applications, the source of the Active Setpoint should be the CSC so that the same setpoint is used throughout the system. Some unusual applications may require local setpoint generation; for example, chillers piped in series that are not being load balanced.

Chiller Controller Setup

In all centrifugal chiller controllers, you can use the Setpoint Source variable to specify whether the Active Setpoint comes from the CSC or the local controller. In reciprocating and screw chiller controllers, the Active Setpoint must come from the CSC.

There are many other chiller controller variables that affect leaving evaporator water temperature and load recycle control; for example, Start-Up Delta-T and Maximum Pull Down Rate. For more information, refer to the appropriate MicroTech unit controller operation manual (see Table 2).

Series-200 Centrifugal: When the Setpoint Source variable is set to "Network," the CSC provides the working setpoint to the chiller. When the Setpoint Source variable is set to "Local," the chiller generates its own working setpoint. The series-200 centrifugal chiller controller has the ability to revert to local control if communications have been lost for five minutes. So if you are using the CSC as the chiller's setpoint source, you may want to specify a local setpoint—and local reset if desired—that would be used in such a case. Table 17 summarizes the local chilled water setpoint variables (excluding local reset variables). The values shown in italic are typical settings.

Table 17. Setpoint Variables: Series-200 Centrifugal

Chiller Controller Variable	Keypad/Display ID	
	Menu	Item
Setpoint Source	12	Spt Source= *Network*
Active Setpoint *(status only)*	12	Active Spt= *45.0°F*
Local Setpoint	12	Local Spt= *44.0°F*

Series-100 Centrifugal: When the Setpoint Source variable is set to "Remote," the CSC provides the working setpoint to the chiller. When the Setpoint Source variable is set to "Local," the chiller generates its own working setpoint. Table 18 summarizes the local chilled water setpoint variables (excluding local reset variables). The values shown in italic are typical settings.

Table 18. Setpoint Variables: Series-100 Centrifugal

Chiller Controller Variable	Keypad/Display ID	
	Key	Item
Setpoint Source	SET-UP OPTIONS	Spt Source= *Remote*
Active Setpoint *(status only)*	WATER TEMP'S	Active Spt= *45.0°F*
Leaving Evaporator Setpoint	WATER TEMP'S	Lvg Evap Spt= *44.0°F*

Reciprocating or Screw: The CSC always provides the working setpoint to the chiller. When the Reset Option variable is set to "None," the Active Setpoint is the same as the Leaving Evaporator Setpoint, which the CSC continuously sets as long as network communications exist. You can reset the Active Setpoint with a local reset method, but it is best to let the CSC perform any reset function. Table 19 summarizes the local chilled water setpoint variables. The values shown in italic are typical settings.

Table 19. Setpoint Variables: Reciprocating/Screw

Chiller Controller Variable	Keypad/Display ID Menu	Keypad/Display ID Item
Active Setpoint *(status only)*	14 *(2 ckt.)* 17 *(3 ckt.)*	Actv Spt= *45.0°F*
Leaving Evaporator Setpoint	14 *(2 ckt.)* 17 *(3 ckt.)*	Lvg Evap= *44.0°F*
Reset Option	14 *(2 ckt.)* 17 *(3 ckt.)*	ResetOpt= *None*

▶ To set up the setpoint source in a chiller

1. Determine whether the chiller needs a local or CSC setpoint.

   In almost all applications, the CSC should provide the setpoint.

2. Set the chilled water setpoint variables as required in the chiller controller. Refer to Tables 17, 18, and 19.

Temperature Control

Variable Name	Keypad *(Menu-Scr.)*
Chilled Water Temperature Control Option	16-1
System Setpoint	16-1
Chiller Setpoint *(status only)*	16-1
Minimum Chiller Setpoint	16-2
Common Supply Deadband	16-2
Common Supply Mod Limit	16-2
Common Supply Sample Time	16-2
Common Supply Max Change	16-2
Common Supply Project Ahead Time	16-2
Minimum System Setpoint	17-1
Maximum System Setpoint	17-1
Glycol Flag	28-1

The CSC's ultimate purpose in temperature control is to distribute the *same* leaving evaporator water temperature setpoint to every chiller in the network. This setpoint is the Chiller Setpoint. The CSC can generate the Chiller Setpoint, which is not manually adjustable, in a variety of ways. See Figure 16.

Figure 15. Chiller Leaving Evaporator Water Temperature Flow Chart

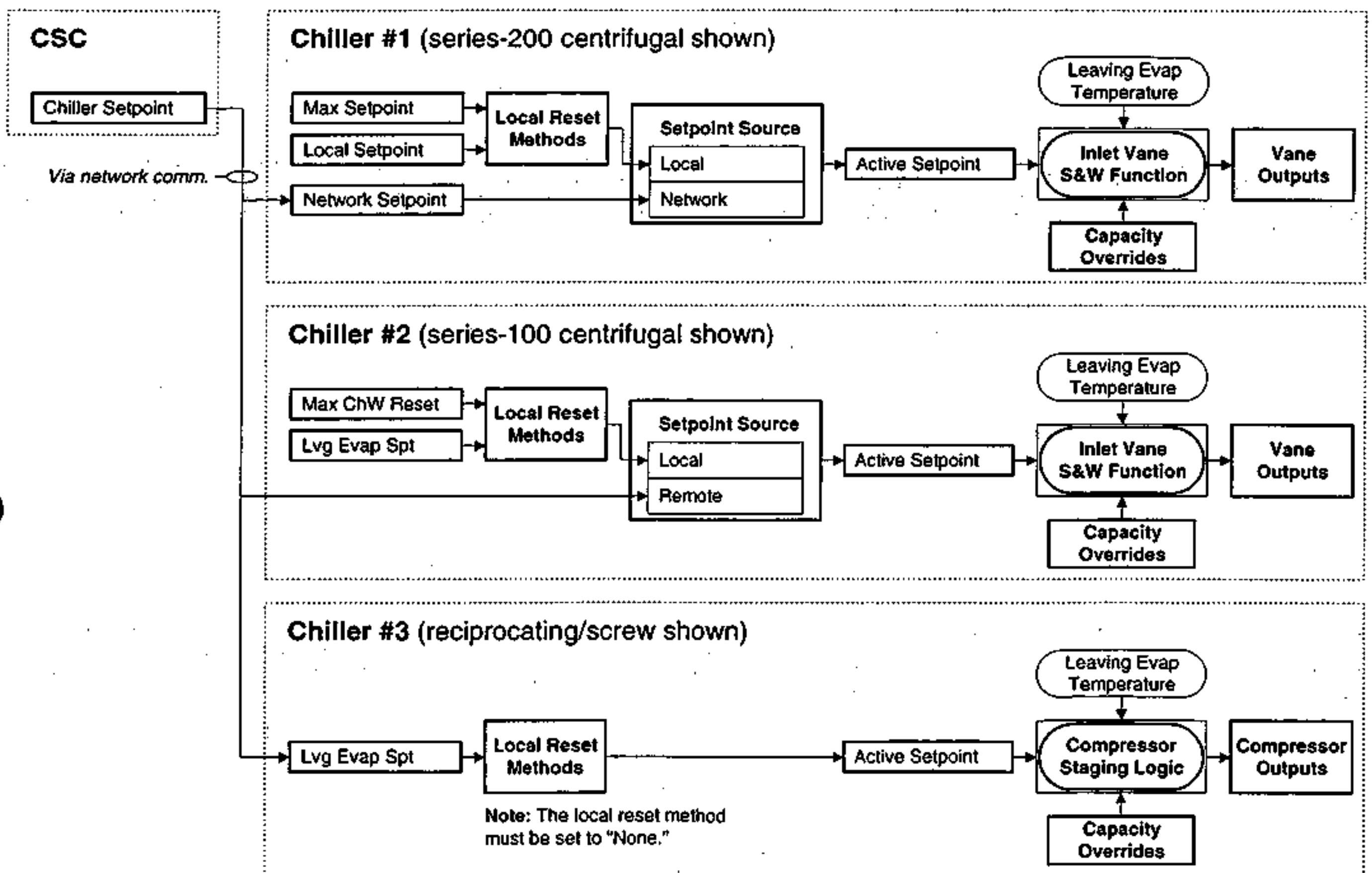
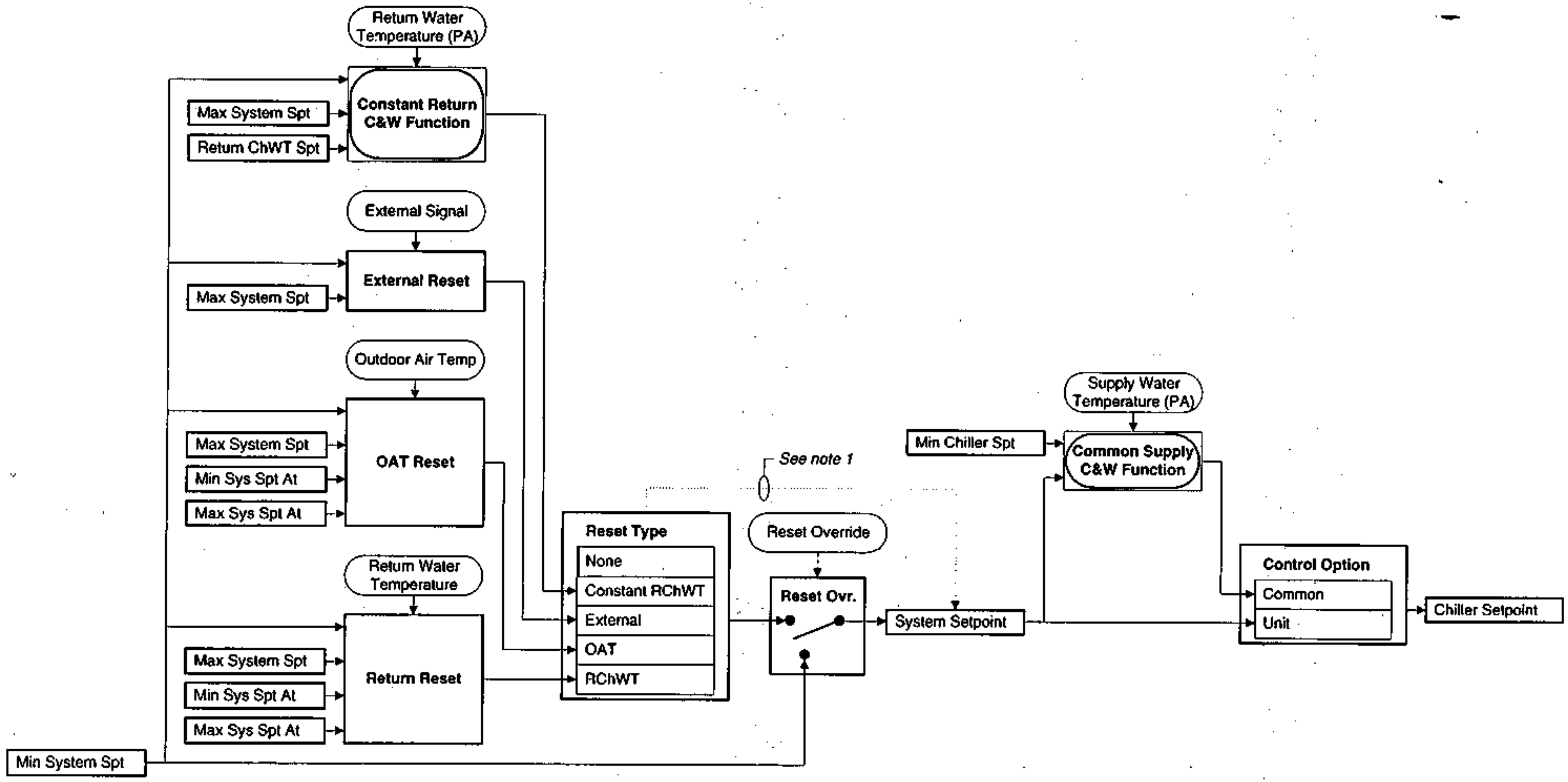


Figure 16. CSC Leaving Evaporator Water Temperature Setpoint Flow Chart



Notes:
1. When the Chilled Water Temperature Reset Type is "None," the System Setpoint can be set manually.

System Setpoint
The Chiller Setpoint is derived from the System Setpoint, which is the CSC's chilled water supply setpoint for the system. You can set the System Setpoint manually or let the CSC reset it automatically. In either case, the System Setpoint will be limited to a range defined by the Minimum System Setpoint and Maximum System Setpoint. For more on reset, see the "Setpoint Reset" sub-section below.

The Chilled Water Temperature Control Option variable defines how the Chiller Setpoint is derived from the System Setpoint. There are two options:

- Unit *(leaving evaporator water temperature control)*
- Common *(chilled water supply temperature control)*

Unit Option
The Unit option simply sets the Chiller Setpoint equal to the System Setpoint. In effect, the common chilled water supply setpoint becomes each chiller's leaving evaporator water setpoint.

The Unit option should be used for systems in which each chiller is isolated when not operating. These systems are by far the most common; they include, for example, chillers with dedicated primary pumps or isolation valves. See Figure 17.

When the Unit option is used in systems with isolated chillers, the supply water temperature will usually be very close to the System Setpoint even though there is no direct control. (This may not be true if your system is using load balancing. See below.) The Common option can also be used in these systems, but the Unit option is simpler and the effect is usually the same.

Common Option
The Common option uses a proportional-integral (PI) control loop to generate a Chiller Setpoint that will keep the chilled water supply temperature at the System Setpoint. See "PI Control Process" below.

The Common option should be used for systems in which each chiller is not isolated when not operating. These systems are uncommon; they include, for example, chillers with a common primary pump and no isolation valves. See Figure 18.

Because water always flows through each chiller's evaporator, the common supply temperature varies with the number of operational chillers in systems with nonisolated chillers. The Common option compensates for this temperature variation by lowering the Chiller Setpoint as necessary to keep the common supply temperature at the System Setpoint. The Unit option can also be used in these systems, but the chilled water supply temperature will be warmer than the System Setpoint whenever one or more chillers are disabled.

The Common option may also be beneficial in any system that is using load balancing. See below.

Load Balancing May Affect Temperature Control
When a centrifugal chiller is being load balanced, its temperature control processes can be overridden. Since load balancing limits a chiller's ability to load, a load-balanced chiller's leaving evaporator water temperature will always be higher than its Active Setpoint—if the temperature control process is being overridden. In most applications, in which all centrifugal chillers have the same capacity and efficiency, load balancing will not override temperature control.

If you find that load balancing is overriding temperature control in your system, you can eliminate the problem by using the Common option. As described above, the Common option will compensate for any temperature control override by lowering each chiller's Active Setpoint. The effect is to lower each chiller's leaving evaporator water temperature, and though these temperatures remain unequal, their average—the supply temperature—eventually falls to the System Setpoint.

For more information on load balancing, see the "Load Limiting Control" section.

Figure 17. Typical System with Isolated Chillers

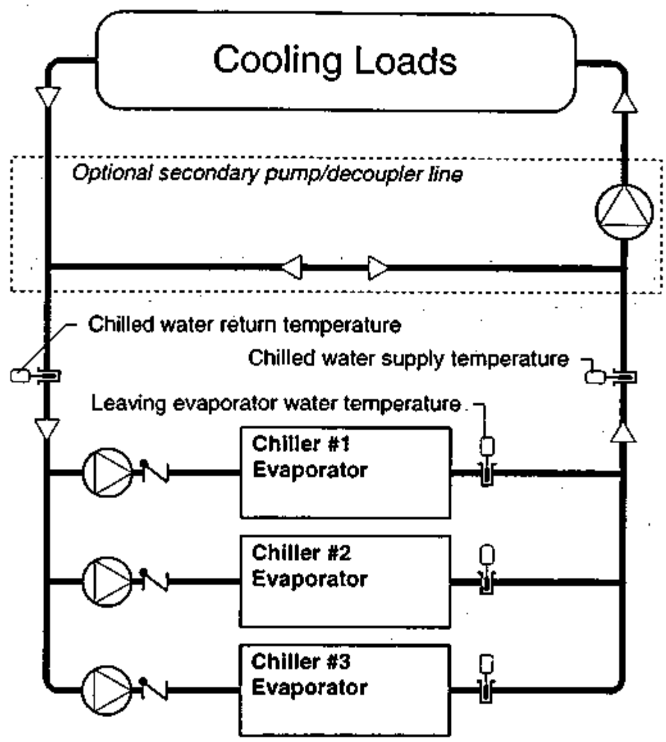
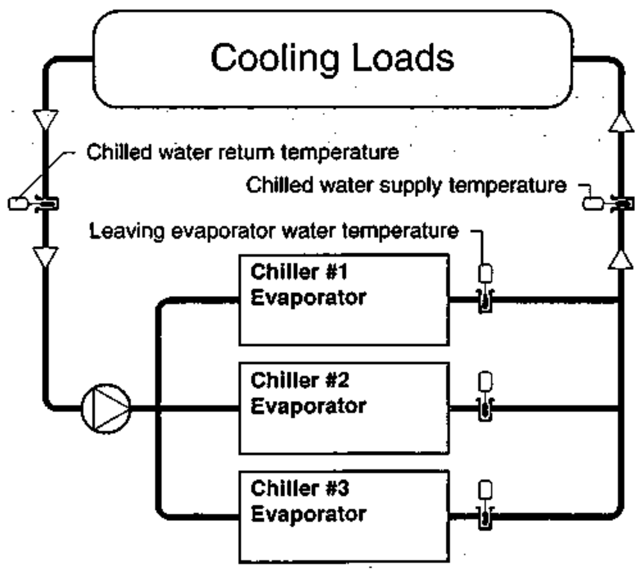


Figure 18. Typical System with Nonisolated Chillers



PI Control Process
When the supply temperature is above the System Setpoint, the control loop lowers the Chiller Setpoint. When the supply temperature is below the System Setpoint, the control loop raises the Chiller Setpoint. The Chiller Setpoint is limited to a range defined by the System Setpoint itself and the Minimum Chiller Setpoint. Since the leaving evaporator water temperatures should never be higher than the desired supply temperature, the System Setpoint is the upper limit. The Minimum Chiller Setpoint is the lower limit. You should set it to the lowest acceptable leaving evaporator water temperature.

The PI control loop consists of two intrinsic MicroTech DDC functions: Change-and-Wait and Project Ahead. To modulate the Chiller Setpoint, these functions use five variables that are dedicated to common chilled water supply temperature control: (1) Common Supply Deadband, (2) Common Supply Mod Limit, (3) Common Supply Sample Time, (4) Common Supply Max Change, and (5) Common Supply Project Ahead Time. For many applications, the default values for these variables will provide good control. For information on how to adjust them, see the "MicroTech PI Control Method" portion of this manual.

Note: The Common option must be used for applications with nonisolated chillers that require optimal start and its automatic adaptation feature. If automatic adaptation is not needed, optimal start will work well with both the Common and Unit options.

Low Temperature Operation
The CSC has a software safety built into it that will not allow the following chilled water setpoints to be adjusted below 40.0°F (4.4°C):

- Minimum System Setpoint
- Maximum System Setpoint
- Minimum Chiller Setpoint

If your system can withstand low temperature operation with no danger of freezing, you can override the safety by setting the Glycol Flag to "Yes." This will allow the above setpoints to be adjusted down to 0.0°F (–17.8°C).

▶ To set up chilled water temperature control

1. Determine whether Common or Unit control is required, and set the Chilled Water Temperature Control Option variable accordingly.

   In almost all applications, the Unit option will provide simple and satisfactory control.

2. Set the remaining chilled water temperature control variables as required.

   If you're using the Unit option, you can ignore the following variables:

   - Minimum Chiller Setpoint
   - Common Supply Deadband
   - Common Supply Mod Limit
   - Common Supply Sample Time
   - Common Supply Max Change
   - Common Supply Project Ahead Time

   If you're using reset, you won't need to set the System Setpoint. See "Setpoint Reset" below.

Setpoint Reset

Variable Name	Keypad *(Menu-Scr.)*
Chilled Water Temperature Reset Type	17-1
System Setpoint	16-1
Minimum System Setpoint	17-1
Maximum System Setpoint	17-1
Minimum System Setpoint At	17-1
Maximum System Setpoint At	17-1
Constant Return Setpoint	17-2
Constant Return Deadband	17-2
Constant Return Mod Limit	17-2
Constant Return Sample Time	17-2
Constant Return Max Change	17-2
Constant Return Project Ahead Time	17-2
External Chilled Water Reset Signal *(status only)*	17-3
Chilled Water Return Temperature *(status only)*	17-3
Outdoor Air Temperature *(status only)*	17-3

By automatically varying the leaving evaporator water temperature to suit the building's cooling load, chilled water temperature reset can make some chiller systems more energy efficient. The CSC provides four types of reset, which are described below:

- Return Water
- Outdoor Air
- External *(analog signal)*
- Constant Return *(PI control)*

When a reset strategy is active, it will automatically change the System Setpoint as required. Regardless of the reset method, the Minimum System Setpoint and the Maximum System Setpoint define the range of possible System Setpoint values. The current value of the System Setpoint is determined by the current value of the input variable; for example, outdoor air temperature. (See the descriptions below for illustrations.)

If you don't want any reset, set the Chilled Water Temperature Reset Type variable to "None" (default).

Reset Override
The CSC provides a digital input (DI 1) that you can use to override reset. You may want to do this, for example, if very cold water is temporarily required for dehumidification.

When the reset override input is closed, the CSC will set the System Setpoint equal to the Minimum System Setpoint. When the input is open, the reset strategy you've selected will operate automatically. Note that reset override can occur even when the Chilled Water Temperature Reset Type variable is set to "None."

Reset from Return Water or Outdoor Air Temperature
When the Return Water or Outdoor Air reset method is used, the System Setpoint is determined by the temperature input and the reset function, which is shown in Figures 19 and 20. The following variables define the function:

- Minimum System Setpoint
- Maximum System Setpoint
- Minimum System Setpoint At
- Maximum System Setpoint At

The figures show typical values of these variables. (The values of the "At" variables shown in the figures would be appropriate for Outdoor Air reset.)

Figure 19. Return Water or Outdoor Air Reset (English)

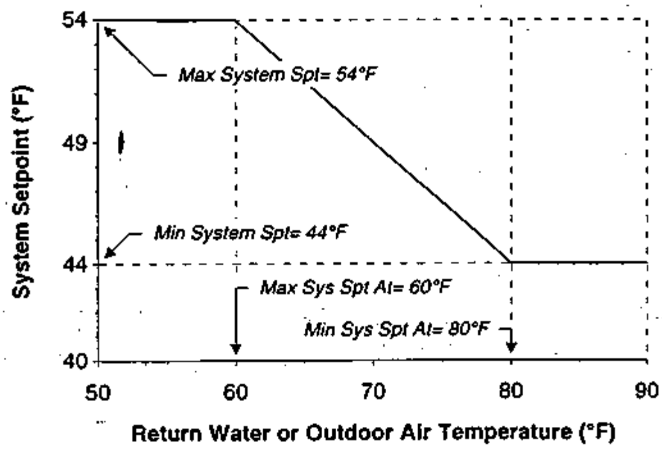
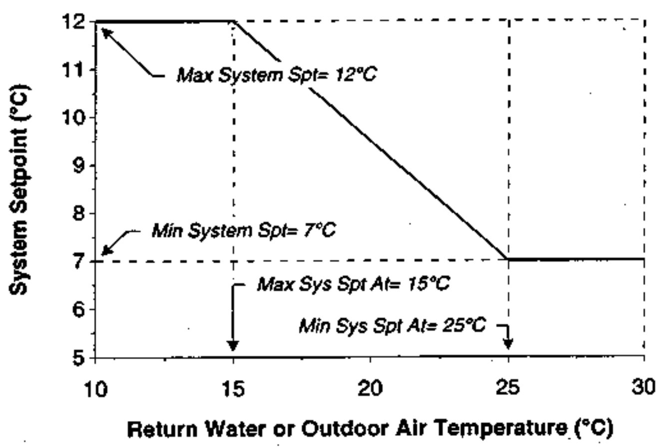


Figure 20. Return Water or Outdoor Air Reset (SI)



For example, if the settings of Figures 19 and 20 are used, the following will occur when Outdoor Air reset is selected:

When the outdoor air temperature is	The System Setpoint will be
55.0°F (12.5°C)	54.0°F (12.0°C)
70.0°F (20.0°C)	49.0°F (9.5°C)
85.0°F (27.5°C)	44.0°F (7.0°C)

At the keypad/display, you can monitor the current return water and outdoor air temperatures on the last screen of menu 17.

Note: If communications are lost with an NMP or building automation system that is supplying the outdoor air temperature to the CSC, the CSC will retain and use the last temperature it received until communications are restored.

▶ To set up Return Water or Outdoor Air reset

1. Set the Chilled Water Temperature Reset Type variable to "RChWT" for Return Water reset or "OAT" for Outdoor Air reset.
2. Set the following variables as required:
   - Minimum System Setpoint
   - Maximum System Setpoint
   - Minimum System Setpoint At
   - Maximum System Setpoint At

   The CSC will automatically reset the System Setpoint. You can ignore the remaining reset variables.

Note: To use the Outdoor Air reset method, an outdoor air temperature sensor must be connected to the CSC, an NMP, or a building automation system communicating with the CSC via Open Protocol. To use the Return Water reset method, a return chilled water temperature sensor must be connected to the CSC. For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Reset from an External Signal

When the External reset method is used, the System Setpoint is determined by an external analog signal and the reset function, which is shown in Figures 21 and 22. The following variables define the function:

- Minimum System Setpoint
- Maximum System Setpoint

The figures show typical values of these variables.

Figure 21. External Reset (English)

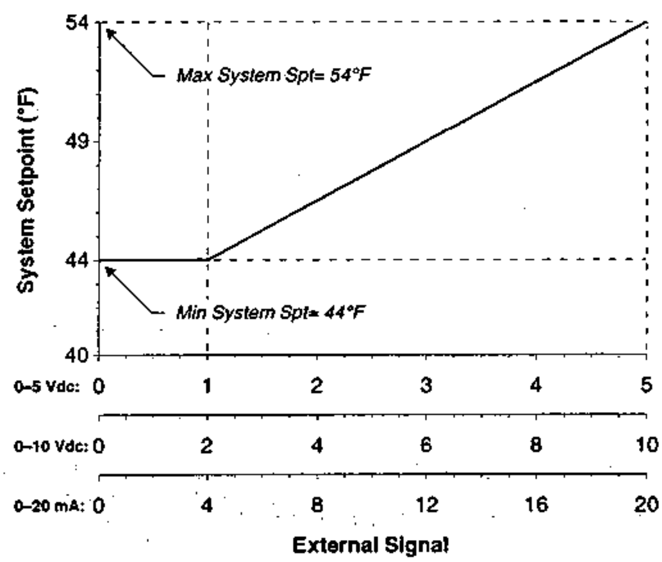
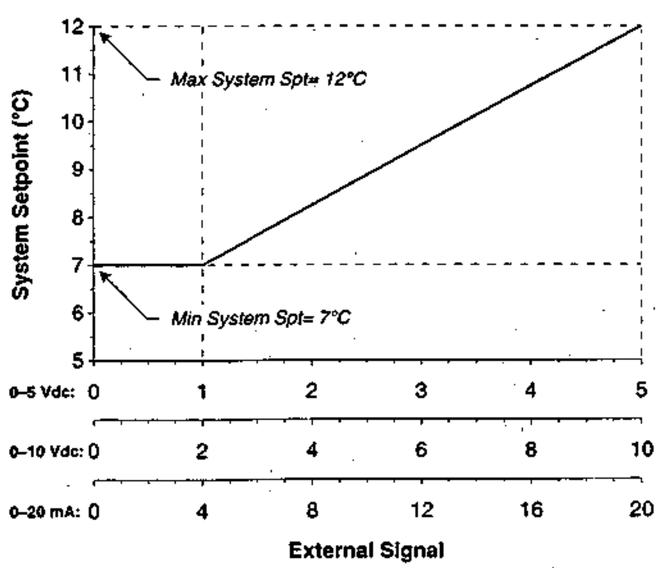


Figure 22. External Reset (SI)



For example, if the settings of Figures 21 and 22 are used, the following will occur when External reset is selected:

When the external analog signal is	The System Setpoint will be
4 mA	44.0°F (7.0°C)
12 mA	49.0°F (9.5°C)
20 mA	54.0°F (12.0°C)

At the keypad/display, you can monitor the current value of the external signal on the last screen of menu 17. Note that in all cases the displayed value is a *conditioned* value of 0–5 Vdc.

► To set up External reset

1. Set the Chilled Water Temperature Reset Type variable to "External."
2. Set the following variables as required:
   - Minimum System Setpoint
   - Maximum System Setpoint

   The CSC will automatically reset the System Setpoint. You can ignore the remaining reset variables.

Note: To use the External reset method, an external analog signal (0–5 Vdc, 0–10 Vdc, or 0–20 mA) must be connected to the CSC. For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Constant Return Chilled Water Temperature Control

The Constant Return reset method uses a proportional-integral (PI) control loop to generate a System Setpoint that will keep the return chilled water temperature at the Constant Return Setpoint. It is different from the other three reset methods in that it does not use a mathematical function to reset the System Setpoint.

Constant return temperature control is usually used only in systems that have constant chilled water flow. This is true because return water temperature is a good indicator of cooling load only when the flow is constant. If your system has three-way valves at the loads or a supply-to-return bypass valve, it probably has constant flow.

When the return temperature is above the Constant Return Setpoint, the control loop lowers the System Setpoint. When the return temperature is below the Constant Return Setpoint, the control loop raises the System Setpoint. The System Setpoint is limited to a range defined by the Minimum System Setpoint and Maximum System Setpoint.

The PI control loop consists of two intrinsic MicroTech DDC functions: Change-and-Wait and Project Ahead. To modulate the System Setpoint, these functions use five variables that are dedicated to return chilled water temperature control: (1) Constant Return Deadband, (2) Constant Return Mod Limit, (3) Constant Return Sample Time, (4) Constant Return Max Change, and (5) Constant Return Project Ahead Time. For many applications, the default values for these variables will provide good control. For information on how to adjust them, see the "MicroTech PI Control Method" portion of this manual.

Note: Although there is nothing to prevent you from using the Constant Return reset method in conjunction with the Common control option, *this is not recommended.* Three cascaded control loops (return to supply to unit) are more likely to become unstable than two cascaded control loops (return to unit). And if a constant return temperature is desired, the common supply temperature does not really need to be controlled—except for applications with nonisolated chillers that require optimal start and its automatic adaptation feature. If constant return temperature control is required for these applications, the Common control option must be used along with the Constant Return reset method.

► To set up Constant Return reset

1. Set the Chilled Water Temperature Reset Type variable to "Constant RChWT."
2. Set the following variables as required:
   - Minimum System Setpoint
   - Maximum System Setpoint
   - Constant Return Setpoint
   - Constant Return Deadband
   - Constant Return Mod Limit
   - Constant Return Sample Time
   - Constant Return Max Change
   - Constant Return Project Ahead Time

   The CSC will automatically reset the System Setpoint. You can ignore the remaining reset variables.

Note: To use the Constant Return reset method, a return chilled water temperature sensor must be connected to the CSC. For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Chilled Water Flow Control

The CSC can control a variety of chilled water distribution system equipment in several combinations. There are seven basic configurations:

1. Fixed-speed secondary pump, with optional pressure-controlled loop bypass valve
2. Fixed-speed lead/standby secondary pump set, with optional pressure-controlled loop bypass valve
3. Fixed-speed sequenced pumps (two to six), with optional pressure-controlled loop bypass valve
4. Variable-speed secondary pump
5. Variable-speed lead/standby secondary pump set
6. Variable-speed sequenced pumps (two to six) or combinations of fixed- and variable-speed sequenced pumps
7. Optional pressure-controlled loop bypass valve (primary-only system)

Typical, schematic representations of these configurations are shown in Figures 23 through 29. Configurations 1 through 6 are primary-secondary (decoupled) systems. Configuration 7 is a primary-only system.

The following sub-sections are organized according to the types of equipment that you may have in your system. You only need to read the ones that apply to your application. For example, if your system is like configuration 4 (Figure 26), you should look at "Secondary Pump Logic: Single Pump" and "Pump Speed Control." Or if your system is like configuration 3 (Figure 25) with the optional bypass valve, you should look at "Secondary Pump Logic: Sequenced Pumps" and "Loop Bypass Valve Control."

Figure 23. Cfg. 1: Fixed-Speed Single Pump

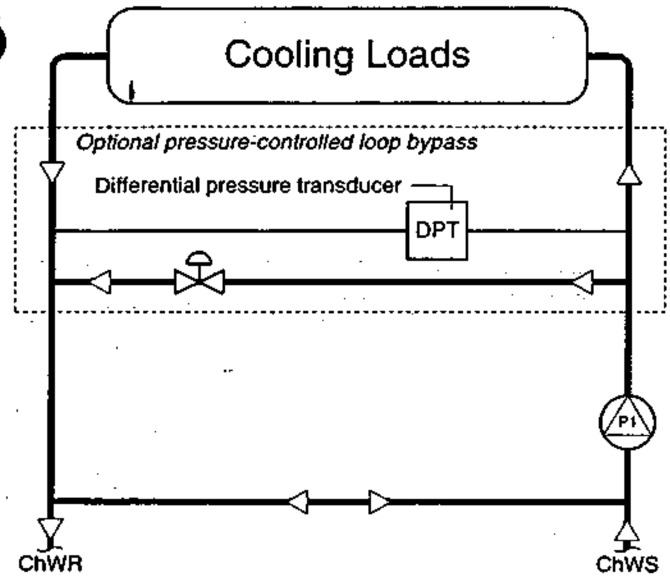


Figure 24. Cfg. 2: Fixed-Speed Lead/Standby Pump Set

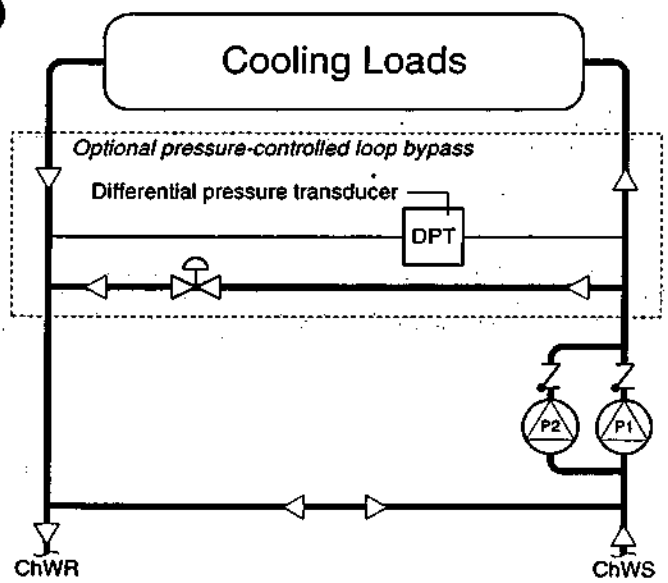


Figure 25. Cfg. 3: Fixed-Speed Sequenced Pumps

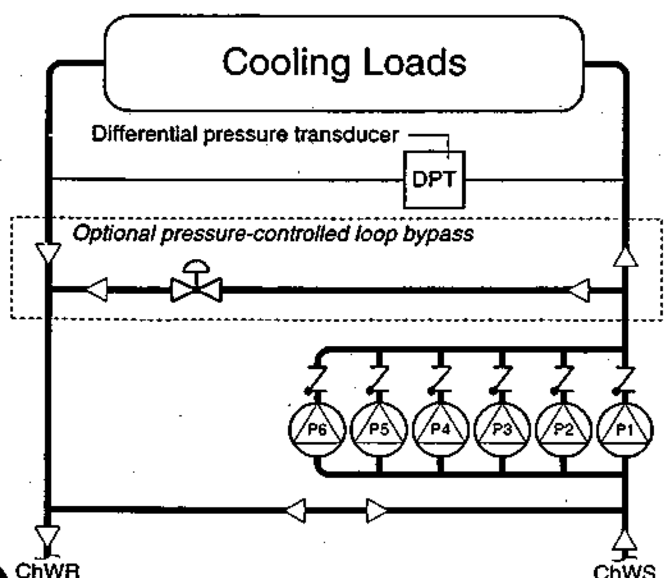


Figure 26. Cfg. 4: Variable-Speed Single Pump

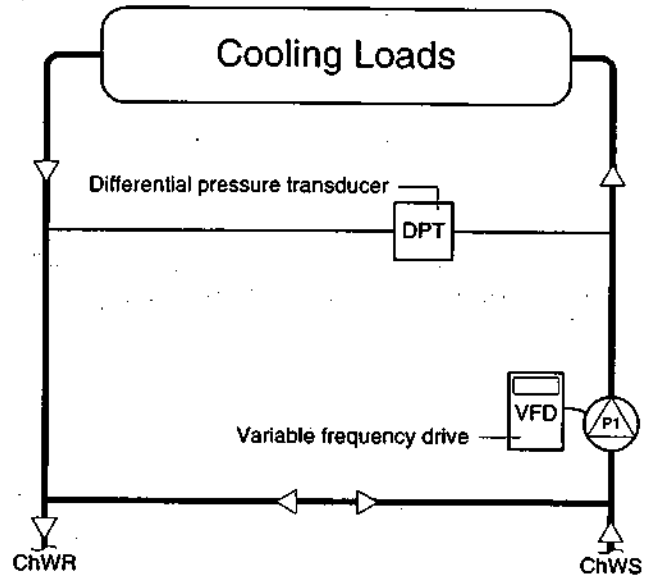


Figure 27. Cfg. 5: Variable-Speed Lead/Standby Pump Set

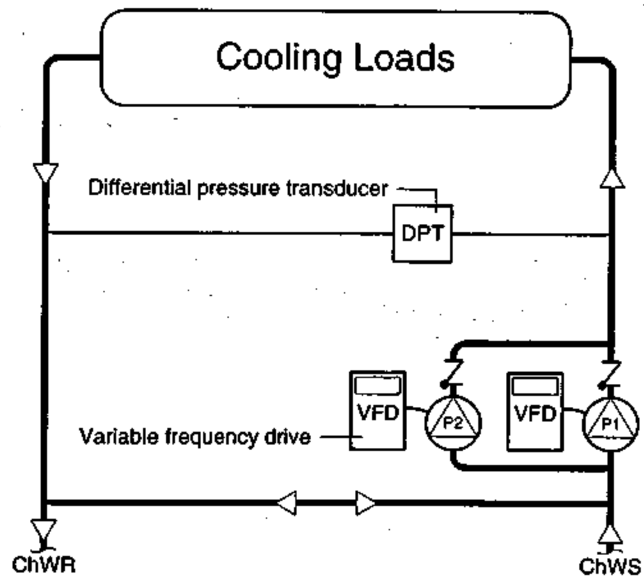


Figure 28. Cfg. 6: Fixed/Variable-Speed Sequenced Pumps

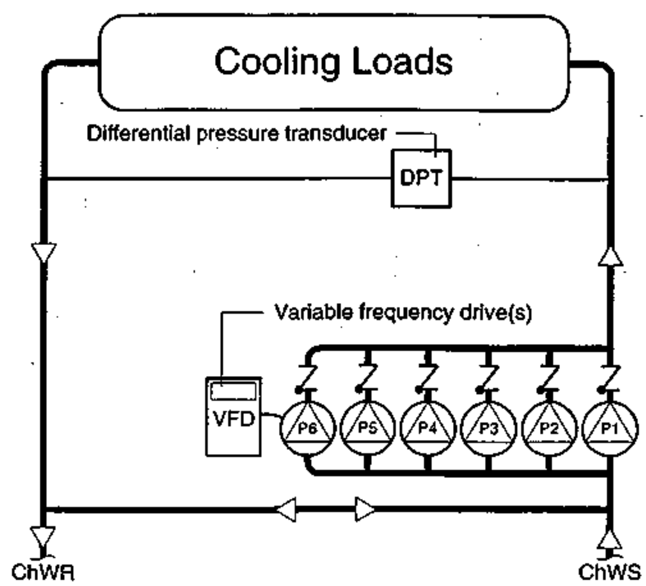
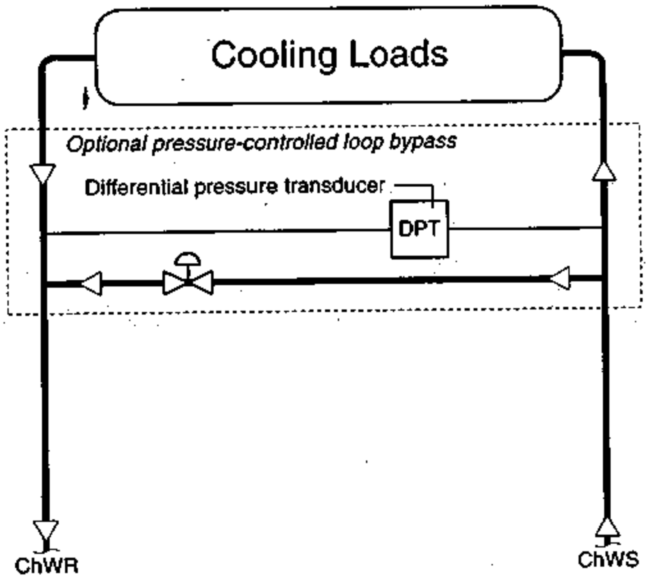


Figure 29. Cfg. 7: Primary-Only System



Secondary Pump Logic: Single Pump

Variable Name	Keypad *(Menu-Scr.)*
Secondary Pump Control Option	21-1
Modulation Control Option	21-1
Pump Status Check Delay Time	21-1

Configurations 1 and 4, which are shown in Figures 23 and 26, use the CSC's single-pump secondary pump logic. Single-pump logic simply starts the secondary pump when the system starts and stops it when the system stops. Note that the pump is identified as Pump #1 on the keypad/display and Monitor software.

Pump Failure
After the CSC starts the pump, it continually checks the pump's status to verify that it is operating. If the CSC finds that the pump is not operating (input DI 3 open), it immediately starts a timer, which is set equal to the Pump Status Check Delay Time (default is 30 seconds). If the status returns before the timer expires, the timer will reset and stop, and the system will continue to operate normally. If the timer expires before the status returns, the No Secondary Chilled Water Flow alarm will occur and the system will shut down.

▶ To set up single-pump secondary pump logic

1. Set the Secondary Pump Control Option variable to "One Pump."
2. Set the Modulation Control Option variable to one of the following:
   - "None," if there is no variable frequency drive or loop bypass valve
   - "Valve," if there is a loop bypass valve (see "Loop Bypass Valve Control" below)
   - "VFD," if there is a variable frequency drive (see "Pump Speed Control" below)
3. Set the Pump Status Check Delay Time variable as required.

Note: To use single-pump secondary pump logic, a pump status device with dry contacts should be connected to the CSC. If pump status is not available, a jumper can be installed, *but this will defeat the CSC's pump-failure alarm control.* As described above, this alarm control can fail-safe the system by shutting it down if the secondary pump fails. *Using a jumper for pump status is not recommended.* For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Secondary Pump Logic: Lead/Standby Pump Set

Variable Name	Keypad *(Menu-Scr.)*
Secondary Pump Control Option	21-1
Modulation Control Option	21-1
Pump Status Check Delay Time	21-1
Pump Resequence Day/Time	21-1

Configurations 2 and 5, which are shown in Figures 24 and 27, use the CSC's lead/standby secondary pump logic. Lead/standby logic can be applied to a set of two pumps, which are identified as Pump #1 and Pump #2 on the keypad/display and Monitor software. It allows only one pump to operate at any one time. If the running pump fails, the other pump starts. See "Pump Failure" below.

The "lead" pump is the pump that the CSC starts when it starts the system. It can be either Pump #1 or Pump #2. You can designate the lead pump manually or let the CSC do it automatically, according to run time. Lead/standby logic provides three control options: Auto Lead, #1 Lead, and #2 Lead.

If the pump that is designated "lead" changes—whether manually or automatically—while the system is operating, the CSC will not stop one pump and start the other. A new lead pump is *implemented* only under certain conditions. See below for more information.

Automatic Lead Designation
When the Auto Lead option is selected, the CSC designates the lead pump as required to equalize each pump's run time. The pump with less run time will be lead, and the pump with more run time will be standby. At the keypad/display, you can find each pump's run time on menu 7.

Manual Lead Designation
When the #1 Lead option is selected, the CSC designates Pump #1 as lead. When the #2 Lead option is selected, the CSC designates Pump #2 as lead. Once you manually designate the lead pump in this way, that pump will remain lead until you change it.

Natural Lead Pump Implementation
Natural lead pump implementation automatically occurs whenever the CSC is in any Off operating state. For a typical chiller system that is shut down daily, a new lead pump will be implemented within 24 hours (at most).

If your chiller system will seldom or never be shut down, you should consider using forced lead pump implementation.

Forced Lead Pump Implementation
With the Pump Resequence Day/Time variable, you can force a new lead pump to start either immediately or at a scheduled time on a scheduled day. You can choose any day of the week, every day, or holidays. The following selections are possible:

- Now
- Daily, *any time*
- Sunday, *any time*
- Monday, *any time*
- Tuesday, *any time*
- Wednesday, *any time*
- Thursday, *any time*
- Friday, *any time*
- Saturday, *any time*
- Holidays, *any time*

If you set the Pump Resequence Day/Time variable's day setting to "Hol," the forced lead pump implementation will occur whenever a scheduled CSC holiday occurs (see note below). In this way you can customize the lead pump changeover schedule to make it, for example, biweekly, monthly, or quarterly. You can disable the scheduled lead pump changeover feature by setting the Pump Resequence Day/Time variable to "N/A 0:00" (default).

When you enter "Now" or when the current day and time match the Pump Resequence Day/Time variable's setting, the following will occur if the CSC is in the Recirculate or On state:

1. The designated lead pump will be started.
2. The standby pump will stop.

Note: The Pump Resequence Day/Time variable's setting is always compared with the day and time on the CSC's internal clock. Therefore, if you are using a Network Master Panel (NMP) to schedule chiller system operation and you want to schedule a forced lead pump implementation on a "holiday," you must set that holiday date in the CSC (menu 25).

Pump Failure

After the CSC starts the lead pump, it continually checks the pump's status to verify that it is operating. If the CSC finds that the pump is not operating (input DI 3 or DI 4 open), it immediately starts a timer, which is set equal to the Pump Status Check Delay Time (default is 30 seconds). If the status returns before the timer expires, the timer will reset and stop, and the system will continue to operate normally. If the timer expires before the status returns, the standby pump will be started and the lead pump's output will be de-energized.

When the CSC starts the standby pump, it checks the pump's status in the same manner described above. If the standby pump starts successfully, it will become the new lead pump and the failed pump will become the new standby pump. If the standby pump does not start, the No Secondary Chilled Water Flow alarm will occur and the system will shut down.

► To set up lead/standby secondary pump logic

1. Set the Secondary Pump Control Option variable to "Auto Lead," "#1 Lead," or "#2 Lead" as required.
2. Set the Modulation Control Option variable to one of the following:
   - "None," if there is no variable frequency drive or loop bypass valve
   - "Valve," if there is a loop bypass valve (see "Loop Bypass Valve Control" below)
   - "VFD," if there is a variable frequency drive (see "Pump Speed Control" below)
3. Set the following variables as required:
   - Pump Status Check Delay Time
   - Pump Resequence Day/Time

Note: To use lead/standby secondary pump logic, a pump status device with dry contacts must be connected to the CSC for each pump. For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Secondary Pump Logic: Sequenced Pumps

Variable Name	Keypad (*Menu-Scr.*)
Secondary Pump Control Option	21-1
Modulation Control Option	21-1
Pump Status Check Delay Time	21-1
Number Of Sequenced Pump Stages	21-3
Loop Differential Pressure Setpoint	21-1
Pump Stage Differential	21-3
Pump Stage-Up Delay Time	21-3
Pump Stage-Down Delay Time	21-3
Minimum Loop Bypass Valve Position	21-3
Maximum Loop Bypass Valve Position	21-3
Pump Stage * Bitset	22-1 to -3

Note: The wildcard character (*) could be 1 through 9.

Configurations 3 and 6, which are shown in Figures 25 and 28, use the CSC's sequencing secondary pump logic. Sequencing logic can be applied to a group of two to six pumps, which are identified as Pump #1 through Pump #6 on the keypad/display and Monitor software. It operates one or more pumps as required to maintain the differential pressure across the loop at the Loop Differential Pressure Setpoint. For applications that require exact differential pressure control, the CSC can modulate a loop bypass valve or vary the speed of one or more pumps as it sequences the pumps.

Sequencing and Staging

Like a chiller stage, a *pump stage* is defined as a set of pumps. As the CSC sequences pumps on and off, it "stages up" and "stages down." Pumps in the current stage are started; any other pumps are stopped.

Table 20. Example of Pump Stage Table

	Pump					
Stage No.	#1	#2	#3	#4	#5	#6
Stage 1	–	***#2***	–	–	–	–
Stage 2	***#1***	#2	–	–	–	–
Stage 3	#1	#2	***#3***	–	–	–
Stage 4	#1	#2	#3	–	***#5***	–
Stage 5	#1	#2	#3	***#4***	#5	–
Stage 6	–	–	–	–	–	–
Stage 7	–	–	–	–	–	–
Stage 8	–	–	–	–	–	–
Stage 9	–	–	–	–	–	–

An example of the pump stage table is shown in Table 20. Notice that this system has five pumps and five stages. By comparing rows, you can see that this system's sequence order is as follows ("new" pumps are shown in bold italic):

1. Pump #2
2. Pump #1
3. Pump #3
4. Pump #5
5. Pump #4

Differences Between Chiller and Pump Sequencing
Pump sequencing is similar to chiller sequencing. The main differences, which make pump sequencing much simpler, are as follows:

- There is no automatic sequence ordering.

  The pump sequence order is always fixed and must be manually entered into the stage table (menu 22).

- There is no ideal stage table.

  The pump stage table is always active. This means that any changes to the table are implemented immediately—regardless of whether the system is on or off. Thus there is no "natural" or "forced" sequence order implementation.

- There are no "unavailable" or "offline" pumps.

  Failed pumps that are part of the current stage are not disabled as offline chillers are. However, as in chiller sequencing, a forced stage-up will occur if a pump fails. See "Pump Failure" below.

Interstage Timers
The CSC uses a stage-up timer and a stage-down timer to coordinate staging. After any pump stage change *or chiller stage change*, both timers reset and start counting down. The stage-up timer is set equal to the Pump Stage-Up Delay Time variable (default is 2 minutes), and the stage-down timer is set equal to the Pump Stage-Down Delay Time variable (default is 5 minutes). A stage change (up or down) cannot occur while the applicable timer is counting down. The timers are reset after a chiller stage change so that the system has a chance to stabilize after a primary pump is started or stopped.

Sequencing Logic, Without Loop Bypass Valve
Pump stage 1 is turned on when the chilled water system is turned on, and it is turned off when the system is turned off. If the Modulation Control Option variable is "None" or "VFD" (no loop bypass valve), the other stages are controlled as described below.

Stage-Up Control: The CSC will stage up when the differential pressure across the cooling loads is too low. This will occur whenever the following two conditions are satisfied:

1. The stage-up timer has expired. (See "Interstage Timers" above.)
2. The differential pressure is less than the Loop Differential Pressure Setpoint.

Stage-Down Control: The CSC will stage down when the differential pressure across the cooling loads is too high. This will occur whenever the following two conditions are satisfied:

1. The stage-down timer has expired. (See "Interstage Timers" above.)
2. The differential pressure is greater than or equal to the sum of the Loop Differential Pressure Setpoint and the Pump Stage Differential.

   Note: If you're using at least one VFD, this condition may not occur unless each drive has a minimum speed setting that is higher than 0%.

Sequencing Logic, With Loop Bypass Valve
Pump stage 1 is turned on when the chilled water system is turned on, and it is turned off when the system is turned off. If the Modulation Control Option variable is "Valve," the other stages are controlled as described below.

Stage-Up Control: The CSC will stage up when the differential pressure across the cooling loads is too low. This will occur whenever the following four conditions are satisfied:

1. The stage-up timer has expired. (See "Interstage Timers" above.)
2. The differential pressure is less than the Loop Differential Pressure Setpoint.
3. The bypass valve position is less than the Minimum Loop Bypass Valve Position setting.
4. Condition 3 above has been true longer than the Pump Stage-Up Delay Time setting. (The stage-up timer continuously resets whenever condition 3 is *not* true.)

Stage-Down Control: The CSC will stage down when the valve is bypassing more water than the stage to be turned off is supplying. This will occur whenever the following three conditions are satisfied:

1. The stage-down timer has expired. (See "Interstage Timers" above.)
2. The valve position is greater than the Maximum Loop Bypass Valve Position setting. (This setting must be determined by trial and error.)
3. Condition 2 above has been true longer than the Pump Stage-Down Delay Time setting. (The stage-down timer continuously resets whenever condition 2 is *not* true.)

Pump Failure
After the CSC starts any pump, it continually checks the pump's status to verify that it is operating. If the CSC finds that a pump is not operating, it immediately starts a timer, which is set equal to the Pump Status Check Delay Time (default is 30 seconds). If the status returns before the timer expires, the timer will reset and stop, and the system will continue to operate normally. If the timer expires before the status returns, a forced stage-up will occur.

If a pump fails, the CSC will not de-energize that pump's output when the timer expires—as long as it is part of the current stage. So if the problem goes away, the pump will restart immediately.

If the current pump stage is the highest stage and all pumps have failed, the No Secondary Chilled Water Flow alarm will occur and the system will shut down. As a result, all pump outputs will be de-energized. The highest stage is specified by the Number Of Sequenced Pump Stages variable.

► To set up sequencing secondary pump logic

1. Set the Secondary Pump Control Option variable to "Sequencing."
2. Set the Number Of Sequenced Pump Stages variable to the number of stages the stage table will have.

   In a typical system, this number will equal the number of pumps.

3. Set up the stage table by setting the Pump Stage * Bitset variables (1 through x, where x is the number of stages specified in step 2).

4. Set the Modulation Control Option variable to one of the following:
   - "None," if there is no variable frequency drive or loop bypass valve
   - "Valve," if there is a loop bypass valve (see "Loop Bypass Valve Control" below)
   - "VFD," if there is a variable frequency drive (see "Pump Speed Control" below)
5. Set the following variables as required:
   - Pump Status Check Delay Time
   - Loop Differential Pressure Setpoint
   - Pump Stage-Up Delay Time
   - Pump Stage-Down Delay Time
6. If you're not using a bypass valve, set the Pump Stage Differential as required.
7. If you are using a bypass valve, set the following variables as required:
   - Minimum Loop Bypass Valve Position
   - Maximum Loop Bypass Valve Position

Note: To use sequencing secondary pump logic, a differential pressure transducer must be installed and connected to the CSC. In addition, a pump status device with dry contacts should be connected to the CSC for each pump. If pump status is not available, jumpers can be installed, *but this will defeat the CSC's pump-failure alarm control.* As described above, this alarm control can fail-safe the system by shutting it down if all secondary pumps fail. *Using jumpers for pump status is not recommended.* For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Pump Speed Control

Variable Name	Keypad *(Menu-Scr.)*
Modulation Control Option	21-1
Loop Differential Pressure Setpoint	21-1
Loop Differential Pressure Deadband	21-2
Loop Differential Pressure Mod Limit	21-2
Loop Differential Pressure Sample Time	21-2
Loop Differential Pressure Max Change	21-2
Loop Differential Pressure Project Ahead Time	21-2

The CSC can control pump speed to maintain the differential pressure at the Loop Differential Pressure Setpoint. Each pump must have a variable frequency drive (VFD) as shown in Figures 26, 27, and 28. The CSC uses a proportional-integral (PI) control loop to generate an analog pump speed signal, which it sends to the VFDs via two analog outputs (AO 1 and AO 2). The Secondary VFD Pump Speed variable (menu 7) shows the current value of this signal. The same signal is always sent to both outputs.

PI Control Process

When the pressure is above the Loop Differential Pressure Setpoint, the control loop reduces the pump speed. When the pressure is below the Loop Differential Pressure Setpoint, the control loop increases the pump speed. The speed can modulate between 0% (low signal) and 100% (high signal).

The PI control loop consists of two intrinsic MicroTech DDC functions: Change-and-Wait and Project Ahead. To modulate the pump speed, these functions use five variables that are dedicated to loop pressure control: (1) Loop Differential Pressure Deadband, (2) Loop Differential Pressure Mod Limit, (3) Loop Differential Pressure Sample Time, (4) Loop Differential Pressure Max Change, and (5) Loop Differential Pressure Project Ahead Time. For many applications, the default values for these variables will provide good control. For information on how to adjust them, see the "MicroTech PI Control Method" portion of this manual.

▶ To set up pump speed control

1. Set the Modulation Control Option variable to "VFD."
2. Set the following variables as required:
   - Loop Differential Pressure Setpoint
   - Loop Differential Pressure Deadband
   - Loop Differential Pressure Mod Limit
   - Loop Differential Sample Time
   - Loop Differential Max Change
   - Loop Differential Project Ahead Time

Loop Bypass Valve Control

Variable Name	Keypad *(Menu-Scr.)*
Modulation Control Option	21-1
Secondary Pump Control Option	21-1
Loop Differential Pressure Setpoint	21-1
Loop Differential Pressure Deadband	21-2
Loop Differential Pressure Mod Limit	21-2
Loop Differential Pressure Sample Time	21-2
Loop Differential Pressure Max Change	21-2
Loop Differential Pressure Project Ahead Time	21-2

The CSC can control the position of a loop bypass valve to maintain the differential pressure at the Loop Differential Pressure Setpoint. This type of control is usually used in primary-only systems, but it can also be effectively used in primary-secondary systems. In either case, the CSC's loop bypass valve control method is the same.

A typical primary-only system is shown in Figure 29. If there is no bypass valve, the Secondary Pump Control Option variable and the Modulation Control Option variable should both be set to "None."

In a primary-secondary system, loop bypass valve control can be used in conjunction with any type of pump logic (single-pump, lead/standby, or sequencing) when exact pressure control is required; however, it cannot be used in the same application with pump speed control. Typical primary-secondary systems that use a bypass valve are shown in Figures 23, 24, and 25.

The CSC uses a proportional-integral (PI) control loop to generate an analog valve position signal, which it sends to the valve via an analog output (AO 1). The Differential Pressure Bypass Valve Position variable (menu 7) shows the current value of this signal.

PI Control Process

When the pressure is above the Loop Differential Pressure Setpoint, the control loop increases the valve position, which opens the valve and increases the bypass flow. When the pressure is below the Loop Differential Pressure Setpoint, the control loop decreases the valve position, which closes the valve and reduces the bypass flow. The position can modulate between 0% (low signal) and 100% (high signal).

The PI control loop consists of two intrinsic MicroTech DDC functions: Change-and-Wait and Project Ahead. To modulate the valve position, these functions use five variables that are dedicated to loop pressure control: (1) Loop Differential Pressure Deadband, (2) Loop Differential Pressure Mod Limit, (3) Loop Differential Pressure Sample Time, (4) Loop Differential Pressure Max Change, and (5) Loop Differential Pressure Project Ahead Time. For many applications, the default values for these variables will provide good control. For information on how to adjust them, see the "MicroTech PI Control Method" portion of this manual.

▶ **To set up loop bypass valve control**

1. Set the Modulation Control Option variable to "Valve."
2. For primary-only applications, set the Secondary Pump Control Option variable to "None."
3. Set the following variables as required:
   - Loop Differential Pressure Setpoint
   - Loop Differential Pressure Deadband
   - Loop Differential Pressure Mod Limit
   - Loop Differential Sample Time
   - Loop Differential Max Change
   - Loop Differential Project Ahead Time

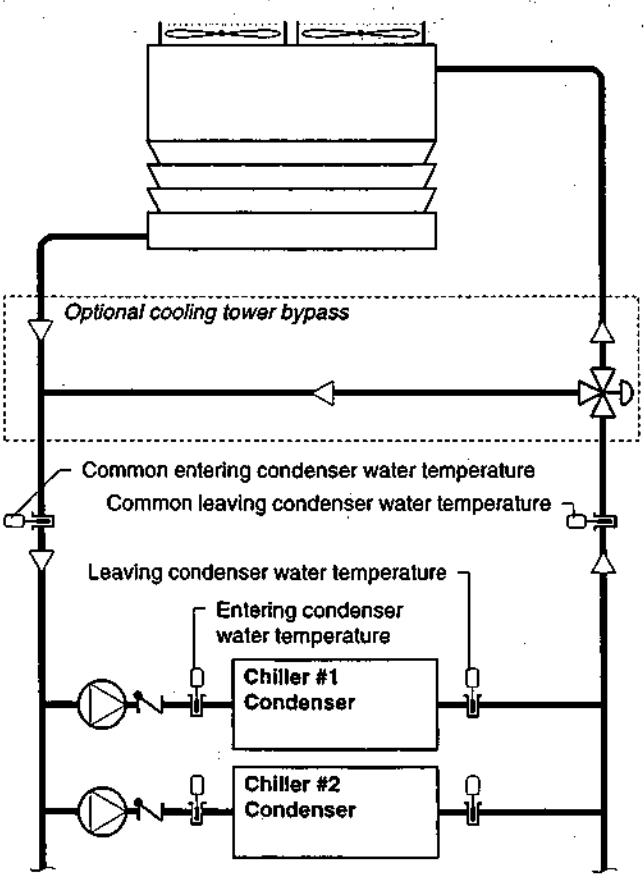
Cooling Tower Control

The CSC can control a cooling tower system that has up to 12 stages of heat rejection. It can also control a tower bypass valve, but this is not required.

A typical condenser water loop is shown in Figure 30. Notice that the condenser pumps at the chillers pump water through the system. The CSC does not directly control the operation of these pumps; the chiller controllers do.

When to Use the CSC's Cooling Tower Control
MicroTech centrifugal chiller controllers and the CSC both have cooling tower control capability. If the cooling tower system is piped so that it is common to all chillers (typical), you should use the CSC for cooling tower control. This type of configuration is shown in Figure 30. If each chiller has a dedicated cooling tower (unusual), you should use the chiller controllers for cooling tower control.

Figure 30. Typical Condenser Water Loop



Tower Staging Logic

Variable Name	Keypad (*Menu-Scr.*)
Tower Control Flag	18-1
Tower Valve Control Option	20-1
Control Temperature Source	18-1
Number Of Tower Stages	18-1
Tower Stage Differential	18-1
Tower Stage-Up Delay Time	18-1
Tower Stage-Down Delay Time	18-1
Tower Stage * Setpoint ①	18-2 to -3
Tower Stage * Bitset ①	19-1 to -4
Tower Valve Setpoint	20-1
Tower Valve Deadband	20-1
Minimum Tower Valve Position	20-1
Maximum Tower Valve Position	20-1
Chiller Stage * Max Tower Stage ②	12-1 to -9

Notes:
1. The wildcard character (*) could be 1 through 12.
2. The wildcard character (*) could be 1 through 9.

Cooling tower staging logic depends on whether or not there is a bypass valve in the system, and if there is, it further depends on how the valve is controlled. There are three possible applications, which are described below:

1. Tower staging only
2. Tower staging with low-limit controlled bypass valve
3. Tower staging with intrastage controlled bypass valve

In all of these applications, the CSC controls up to 12 digital outputs, which can be arranged in up to 12 stages. The number of outputs does not need to match the number of stages. A separate temperature setpoint is provided for each cooling tower stage.

Tower Stage Table
Similar to a chiller stage, a *tower stage* is defined as a set of tower outputs. An output might be used to start a fan, or it might be used to set the speed of a two-speed fan. In any case, as the stage number increases, the proper outputs should be specified so that the heat rejection capacity increases. Outputs in the current stage are closed; any other tower outputs are opened.

An example of the tower stage table is shown in Table 21. Assume that this system has three two-speed fans that are controlled in six stages. Each fan is assigned two out-

Table 21. Example of Tower Stage Table

Stage No.	Tower Output											
	1	2	3	4	5	6	7	8	9	10	11	12
Stage 1	–	2	–	–	–	–	–	–	–	–	–	–
Stage 2	1	–	–	–	–	–	–	–	–	–	–	–
Stage 3	1	–	–	4	–	–	–	–	–	–	–	–
Stage 4	1	–	3	–	–	–	–	–	–	–	–	–
Stage 5	1	–	3	–	–	6	–	–	–	–	–	–
Stage 6	1	–	3	–	5	–	–	–	–	–	–	–
Stage 7	–	–	–	–	–	–	–	–	–	–	–	–
Stage 8	–	–	–	–	–	–	–	–	–	–	–	–
Stage 9	–	–	–	–	–	–	–	–	–	–	–	–
Stage 10	–	–	–	–	–	–	–	–	–	–	–	–
Stage 11	–	–	–	–	–	–	–	–	–	–	–	–
Stage 12	–	–	–	–	–	–	–	–	–	–	–	–

puts: an odd output for high speed, and an even output for low speed. Fan #1 has outputs 1 and 2; Fan #2 has outputs 3 and 4; and Fan #3 has outputs 5 and 6. Actual staging operation is as follows:

Tower Stage	Result
Stage 1	Fan #1 low speed
Stage 2	Fan #1 high speed
Stage 3	Fan #1 high speed Fan #2 low speed
Stage 4	Fan #1 high speed Fan #2 high speed
Stage 5	Fan #1 high speed Fan #2 high speed Fan #3 low speed
Stage 6	Fan #1 high speed Fan #2 high speed Fan #3 high speed

Control Temperature

The CSC controls the tower bypass valve (if any) and the tower stages to maintain a desired condenser water temperature. This temperature is called the *Control Temperature*, and it can be either the common entering condenser water temperature or the common leaving condenser water temperature. You can specify which one it is with the Control Temperature Source variable.

Interstage Timers

The CSC uses a stage-up timer and a stage-down timer to coordinate staging. After any tower stage change, both timers reset and start counting down. The stage-up timer is set equal to the Tower Stage-Up Delay Time variable (default is 2 minutes), and the stage-down timer is set equal to the Tower Stage-Down Delay Time variable (default is 5 minutes).

A stage-up cannot occur while the stage-up timer is counting down. A stage-down cannot occur while the stage-down timer is counting down—unless a chiller stage-down forces the tower to stage-down. See "Linking Tower Capacity to Chiller Capacity" below.

When the system starts up, the stage-up timer will likely be expired, and thus stage 1 will start immediately if the other stage-up conditions described below are satisfied.

Linking Tower Capacity to Chiller Capacity

You can link the available heat rejection capacity of the cooling tower to the amount of online cooling capacity with the Chiller Stage * Max Tower Stage variables. These variables allow you to define a separate maximum tower stage for each chiller stage. The CSC will prevent a tower stage-up when the current tower stage is equal to the max tower stage variable for the current chiller stage. And if a chiller stage-down results in a max tower stage variable that is lower than the current tower stage, a forced tower stage-down will occur immediately—regardless of the Control Temperature or whether the stage-down timer has expired. If a forced stage-down occurs, the interstage timers will reset as they would with any other stage change.

As an example, consider a system that has six cooling tower stages. The Chiller Stage 1 Max Tower Stage variable is set to 2, and the Chiller Stage 2 Max Tower Stage variable is set to 3. If the current tower stage is stage 3 and the current chiller stage is stage 2, the CSC will not allow the tower to stage up any further. If a chiller stage-down suddenly occurs, the CSC will force the tower to stage down to stage 2.

Tower Staging Only

If the Tower Valve Control Option variable is "None" (no tower bypass valve), the tower stages are controlled as described below. See Figure 31.

Stage-Up Control: The CSC will stage up when the Control Temperature is too high. This will occur whenever the following three conditions are satisfied:

1. The stage-up timer has expired. (See "Interstage Timers" above.)
2. The Control Temperature is greater than the Tower Stage x Setpoint, where x is the next higher tower stage (1 through 12).
3. The current tower stage is less than the Chiller Stage x Max Tower Stage setting, where x is the current chiller stage (1 through 9).

Stage-Down Control: The CSC will stage down when the Control Temperature is too low. This will occur whenever the following two conditions are satisfied:

1. The stage-down timer has expired. (See "Interstage Timers" above.)
2. The Control Temperature is less than or equal to the sum of the Tower Stage x Setpoint and the Tower Stage Differential, where x is the current tower stage (1 through 12).

Tower Staging With Low-Limit Controlled Bypass Valve

If the Tower Valve Control Option variable is "Valve Spt," the tower stages are controlled as described below. See Figure 32.

Stage-Up Control: The CSC will stage up when the Control Temperature is too high. This will occur whenever the following four conditions are satisfied:

1. The stage-up timer has expired. (See "Interstage Timers" above.)
2. The Control Temperature is greater than the Tower Stage x Setpoint, where x is the next higher tower stage (1 through 12).
3. The current tower stage is less than the Chiller Stage x Max Tower Stage setting, where x is the current chiller stage (1 through 9).
4. The bypass valve position is greater than the Maximum Tower Valve Position setting. (This ensures that the valve is sufficiently open to the tower.)

Stage-Down Control: The CSC will stage down when the Control Temperature is too low. This will occur whenever the following two conditions are satisfied:

1. The stage-down timer has expired. (See "Interstage Timers" above.)
2. The Control Temperature is less than or equal to the sum of the Tower Stage x Setpoint and the Tower Stage Differential, where x is the current tower stage (1 through 12).

Tower Staging With Intrastage Controlled Bypass Valve

If the Tower Valve Control Option variable is "Stage Spt," the tower stages are controlled as described below. See Figure 33.

Stage-Up Control: The CSC will stage up when the Control Temperature is too high. This will occur whenever the following four conditions are satisfied:

1. The stage-up timer has expired. (See "Interstage Timers" above.)
2. The Control Temperature is greater than the Tower Stage x Setpoint, where x is the next higher tower stage (1 through 12).
3. The current tower stage is less than the Chiller Stage x Max Tower Stage setting, where x is the current chiller stage (1 through 9).
4. The bypass valve position is greater than the Maximum Tower Valve Position setting. (This ensures that the valve is sufficiently open to the tower.)

Stage-Down Control: The CSC will stage down when the valve is bypassing more heat than the stage to be turned off can reject. This will occur whenever the following two conditions are satisfied:

1. The stage-down timer has expired. (See "Interstage Timers" above.)
2. The bypass valve position is less than the Minimum Tower Valve Position setting. (This setting must be determined by trial and error.)

Examples of Applications

Examples of the three tower staging control applications are shown in Figures 31, 32, and 33. All three applications have six stages, and all stage setpoints are the same.

The tower-only application is straightforward. The first four stages have successively higher setpoints, which effectively resets the Control Temperature as the load increases. The last two stages have the same setpoint as stage 4. Because of this, the interstage time variables must be set long enough to prevent cycling.

The tower with low-limit controlled bypass valve is similar to the tower-only application. The valve modulates open when the Control Temperature is greater than the Tower Valve Setpoint by more than the Tower Valve Deadband, and it modulates closed when the Control Temperature is less than the Tower Valve Setpoint by more than the Tower Valve Deadband. When the Control Temperature is within the range defined by the deadband, the valve holds its position. The first stage cannot start until the valve is sufficiently open.

The tower with intrastage controlled bypass valve is a combination of the other two applications. The valve modulates open when the Control Temperature is greater than the *current stage's* setpoint by more than the Tower Valve Deadband, and it modulates closed when the Control Temperature is less than the current stage's setpoint by more than the Tower Valve Deadband. When the Control Temperature is within the range defined by the deadband, the valve holds its position. The "off" point for each stage is not shown in Figure 33 because it does not depend on the Control Temperature; instead, it depends on the bypass valve position. Note that the valve cannot reach the stage-down position unless it is closing, and it cannot close unless the Control Temperature is below the deadband range.

The settings of the variable used in the examples are as follows:

Variable	Setting
Tower Stage 1 Setpoint	74.0°F (23.0°C)
Tower Stage 2 Setpoint	75.0°F (23.5°C)
Tower Stage 3 Setpoint	76.0°F (24.0°C)
Tower Stage 4 Setpoint	77.0°F (24.5°C)
Tower Stage 5 Setpoint	77.0°F (24.5°C)
Tower Stage 6 Setpoint	77.0°F (24.5°C)
Tower Stage Differential	–3.0°F (–1.5°C)
Tower Valve Setpoint	72.0°F (22.0°C)
Tower Valve Deadband	±1.0°F (±0.5°C)

Figure 31. Tower Staging Only

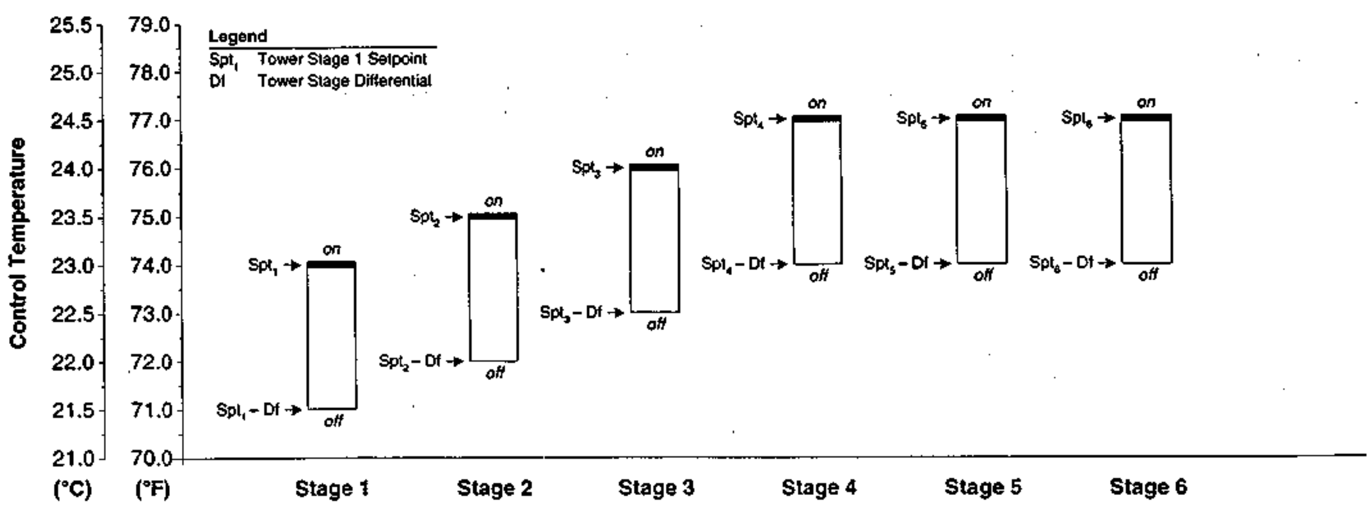


Figure 32. Tower Staging With Low-Limit Controlled Bypass Valve

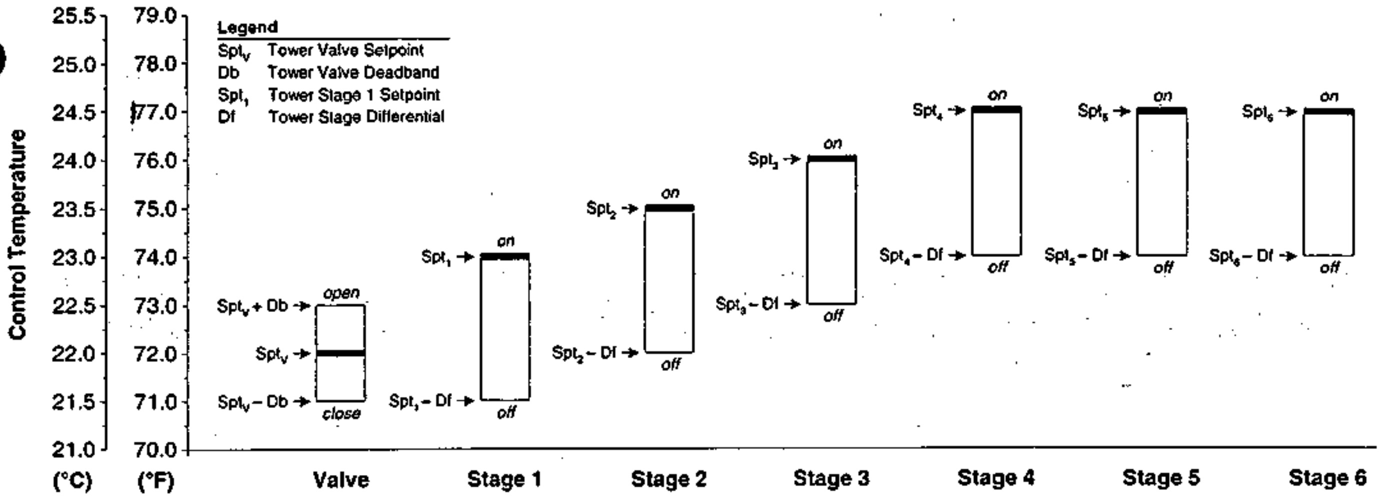
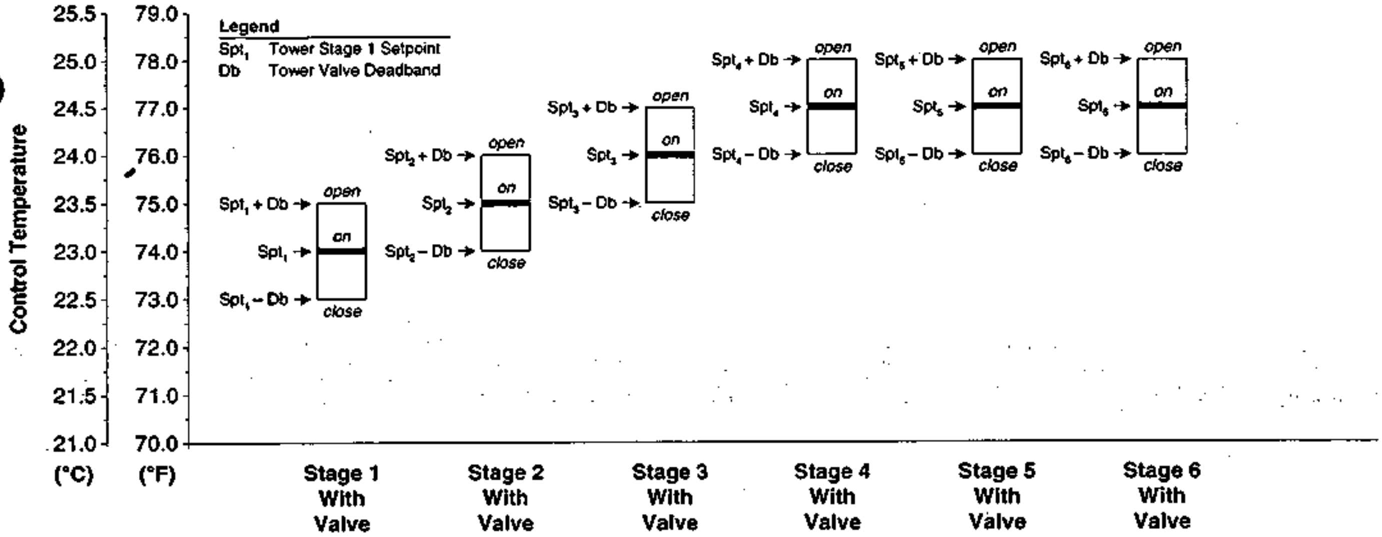


Figure 33. Tower Staging With Intrastage Controlled Bypass Valve



► **To set up cooling tower staging logic**

1. Set the Tower Control Flag to "Yes."
2. Set the Control Temperature Source variable to one of the following:
   - "Ent" *(entering condenser water temperature control)*
   - "Lvg" *(leaving condenser water temperature control)*
3. Set the Number Of Tower Stages variable to the number of stages the stage table will have.
4. Set up the stage table by setting the Tower Stage * Bitset variables (1 through x, where x is the number of stages specified in step 3).
5. Set the Tower Valve Control Option variable to one of the following:
   - "None," if there is no tower bypass valve
   - "Valve Spt," if there is a tower bypass valve and it is used to provide low-limit temperature control
   - "Stage Spt," if there is a tower bypass valve and it is used to provide intrastage temperature control

   If you are using a tower bypass valve, see "Tower Bypass Valve Control" below for additional setup information.
6. Set the Tower Stage * Setpoint variables as required (1 through x, where x is the number of stages specified in step 3).
7. Set the following staging variables as required:
   - Tower Stage Differential *(not needed for intrastage)*
   - Tower Stage-Up Delay Time
   - Tower Stage-Down Delay Time
8. If you are using a bypass valve in a low-limit control application, set the following valve variables as required:
   - Tower Valve Setpoint
   - Tower Valve Deadband
   - Maximum Tower Valve Position
9. If you are using a bypass valve in a intrastage control application, set the following valve variables as required:
   - Tower Valve Deadband
   - Minimum Tower Valve Position
   - Maximum Tower Valve Position

Note: To use cooling tower staging logic, a common entering or leaving condenser water temperature sensor must be installed and connected to the CSC. For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Tower Bypass Valve Control

Variable Name	Keypad *(Menu-Scr.)*
Tower Valve Setpoint	20-1
Tower Valve Deadband	20-1
Tower Valve Mod Limit	20-2
Tower Valve Sample Time	20-2
Tower Valve Max Change	20-2
Tower Valve Project Ahead Time	20-2
Minimum Tower Valve Start-Up Position	20-3
Maximum Tower Valve Start-Up Position	20-3
Minimum Tower Valve Start-Up Position At	20-3
Maximum Tower Valve Start-Up Position At	20-3

The CSC can control the position of a cooling tower bypass valve to maintain the Control Temperature at the Tower Valve Setpoint (low-limit control) or the individual stage setpoints (intrastage control). Except for the setpoint used, the CSC's tower bypass valve control method is the same in either case. (See "Tower Staging Logic" above for information about the Control Temperature and the valve control methods.)

The CSC uses a proportional-integral (PI) control loop to generate an analog valve position signal, which it sends to the valve via an analog output (AO 0). The Cooling Tower Bypass Valve Position variable (menu 6) shows the current value of this signal.

PI Control Process

When the Control Temperature is above the setpoint, the control loop increases the valve position, which opens the valve to the tower. When the Control Temperature is below the setpoint, the control loop decreases the valve position, which closes the valve to the tower and increases the bypass flow. The position can modulate between 0% (NC low signal; NO high signal) and 100% (NC high signal; NO low signal).

The PI control loop consists of two intrinsic MicroTech DDC functions: Change-and-Wait and Project Ahead. To modulate the valve position, these functions use five variables that are dedicated to tower bypass valve control: (1) Tower Valve Deadband, (2) Tower Valve Mod Limit, (3) Tower Valve Sample Time, (4) Tower Valve Max Change, and (5) Tower Valve Project Ahead Time. For many applications, the default values for these variables will provide good control. For information on how to adjust them, see the "MicroTech PI Control Method" portion of this manual.

Start-Up Valve Position Control

When the chiller system is starting up, the CSC will position the bypass valve to anticipate the heat rejection needed. This action will occur whenever (1) at least one chiller is in the Starting chiller status state and (2) no chillers are in the Running chiller status state. The initial valve position is based on the outdoor air temperature and a reset function, which is shown in Figures 34 and 35. The following variables define the function:

- Minimum Tower Valve Start-Up Position
- Maximum Tower Valve Start-Up Position
- Minimum Tower Valve Start-Up Position At *(OAT)*
- Maximum Tower Valve Start-Up Position At *(OAT)*

For example, if the settings of Figures 34 and 35 are used, the following will occur:

When the outdoor air temperature is	The initial valve position will be
55.0°F (12.5°C)	20% open to tower
75.0°F (22.5°C)	60% open to tower
90.0°F (30.0°C)	100% open to tower

When at least one chiller enters the Running chiller status state, the CSC begins modulating the bypass valve to maintain the Control Temperature, starting from the initial position. The valve is fully closed to the tower (0%) when all of the chillers are in the Off chiller status state.

Note that the initial valve position does not need to be based on the outdoor air temperature. If the minimum and maximum position variables are set to the same value, the initial valve position will always be set to that value regardless of the outdoor air temperature. By doing this, you can use the initial valve position function even if you do not have an outdoor air temperature source (local or remote).

Note: If communications are lost with an NMP or building automation system that is supplying the outdoor air temperature to the CSC, the CSC will retain and use the last temperature it received until communications are restored.

Figure 34. Initial Tower Bypass Valve Position (English)

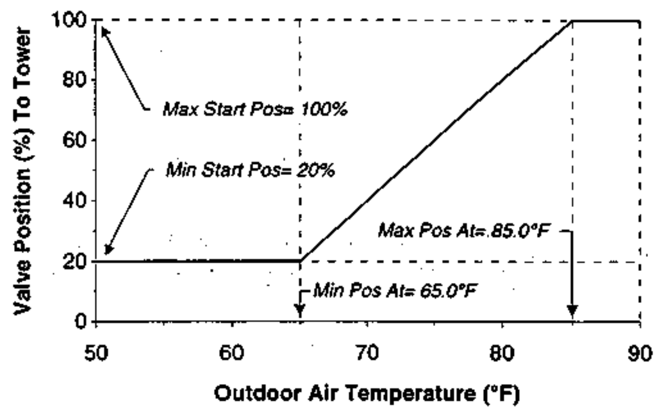
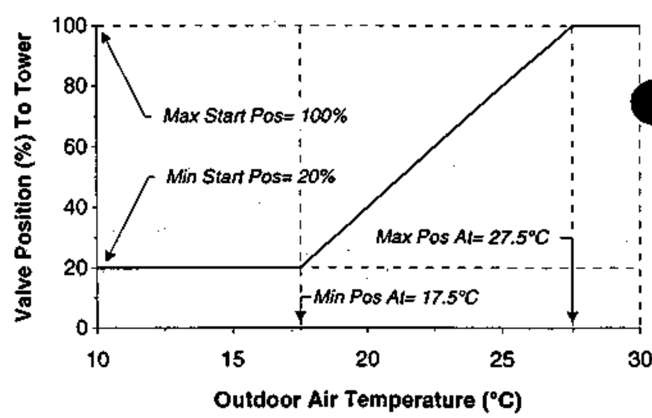


Figure 35. Initial Tower Bypass Valve Position (SI)



▶ **To set up cooling tower bypass valve control**

1. Set up the cooling tower staging logic as described above in the "Tower Staging Logic" sub-section.

2. Set the following variables as required:

- Tower Valve Deadband
- Tower Valve Mod Limit
- Tower Valve Sample Time
- Tower Valve Max Change
- Tower Valve Project Ahead Time
- Minimum Tower Valve Start-Up Position
- Maximum Tower Valve Start-Up Position
- Minimum Tower Valve Start-Up Position At
- Maximum Tower Valve Start-Up Position At

Note: To use the CSC's initial valve position function, an outdoor air temperature sensor should be connected to the CSC, an NMP, or a building automation system communicating with the CSC via Open Protocol; however, this is not required. For more information, see the "Field Wiring" section of Bulletin No. IM 618.

Alarm Control

Comm Loss Alarms

Comm Loss alarm	Keypad/display abbreviation
Comm Loss With Chiller #*	No Comm Chil #*

Note: The wildcard character (*) could be 1 through 8.

If the CSC loses communications with a chiller, it will wait for one minute (fixed) to confirm that the loss is not temporary. If communications are not restored after the one minute period, the Comm Loss With Chiller #*x* alarm will occur, where *x* is the number of the affected chiller.

If the affected chiller is part of the current chiller stage, the Chiller Offline alarm will also occur (see "Warning Alarms" below), and a forced stage-up will occur. See "Special Sequencing Logic" in the "Chiller Sequencing Control" section for more information.

The CSC provides each chiller with four main pieces of information:

- Enable/disable command
- Leaving evaporator water temperature setpoint
- Capacity limit
- Soft load override

The way a chiller reacts when it loses this information depends on the type of chiller.

Enable/disable command
The CSC's enable/disable command tells a chiller when to start and stop. This command is issued by the CSC as it performs its chiller sequencing control processes.

A series-200 centrifugal chiller will continue to operate with the last command it got from the CSC for 5 minutes after the loss of communications occurs. After that, the chiller will act as though its Control Mode variable were "Auto:Local." Thus the chiller will start and stop according to its local schedules. You can use this fact to fail-safe a chiller against communications loss. For example, if you want a chiller to always stop when the CSC is no longer supervising it, set its local schedules for continuous unoccupied operation (00:00–00:00). If you do not want to wait to restore local control, you can manually change the chiller's control mode to "Auto:Local" before the 5 minute period expires.

A series-100 centrifugal, reciprocating, or screw chiller will continue to operate with the last command it got from the CSC indefinitely—or until communications are restored. You can clear the last enable/disable command by cycling power to the chiller controller. This will allow you to enable or disable the chiller locally.

Note that when communications are restored to any type of chiller, *the CSC will usually send a disable command to it.* This is true because chillers that are part of the current stage when they lose communications are marked "offline." See "Special Sequencing Logic" in the "Chiller Sequencing Control" section for more information.

If you want to start or stop any chiller that has lost communications, you can enable or disable it locally. See "Local Override" in the "Auto/Manual Operation" section for information.

The following table summarizes the ways local chiller control is established when communications between the CSC and a chiller do not exist:

When the CSC loses communications with a	The last enable/disable command from the CSC is replaced by a local value
Series-200 centrifugal	Automatically after 5 minutes *or* When Control Mode variable is set to "Auto:Local"
Series-100 centrifugal	When controller power is cycled
Reciprocating/screw	When controller power is cycled

Leaving Evaporator Water Temperature Setpoint
In a typical application, each chiller controller is set up to receive its leaving evaporator water temperature setpoint—the Active Setpoint—from the CSC. See the "Chilled Water Temperature Control" section for more information.

A series-200 centrifugal chiller will continue to operate with the last Chiller Setpoint it got from the CSC for a period of 5 minutes after the loss of communications occurs. After that, the chiller will act as though its Setpoint Source variable were "Local." Thus the chiller's Active Setpoint will be set according to its Local Setpoint and any local reset functions. You can use this fact to fail-safe the chiller against communications loss. For example, if you want a chiller's Active Setpoint to always be 44.0°F (6.6°C) when the CSC is no longer supervising it, set its Local Setpoint to 44.0°F (6.6°C) and set its Chilled Water Temperature Reset Type variable to "No Reset."

A series-100 centrifugal chiller will continue to operate with the last Chiller Setpoint it got from the CSC indefinitely—or until communications are restored. You can clear this last Chiller Setpoint by cycling power to the chiller controller. This will set the Active Setpoint equal to the Leaving Evaporator Setpoint. You can also restore the local setpoint by changing the Setpoint Source variable to "Local." In this instance, any local reset functions will influence the Active Setpoint.

A reciprocating or screw chiller will continue to operate with the last Chiller Setpoint it got from the CSC indefinitely—or until communications are restored. If you want a different setpoint, you can simply edit the chiller's Leaving Evaporator Setpoint.

The following table summarizes the ways local chiller control is established when communications between the CSC and a chiller do not exist:

When the CSC loses communications with a	The last Chiller Setpoint from the CSC is replaced by a local value
Series-200 centrifugal	Automatically after 5 minutes *or* When Setpoint Source variable is set to "Local"
Series-100 centrifugal	When controller power is cycled *or* When Setpoint Source variable is set to "Local"
Reciprocating/screw	When Leaving Evaporator Setpoint is edited

Capacity limit
The CSC automatically sends a capacity limit to each chiller. For centrifugal chillers, it is the minimum of the load balancing, start-up unloading, and demand limiting values. For reciprocating and screw chillers, it is whatever the demand limiting value is. The CSC's Chiller #* Load Limit variables (menu 5) hold these values. See the "Load Limiting Control" section for more information.

A series-200 centrifugal chiller will continue to operate with the last capacity limit it got from the CSC for a period of 5 minutes after the loss of communications occurs. After that, the chiller's Active Amp Limit Setpoint will be set according to its local capacity override functions.

A series-100 centrifugal, reciprocating, or screw chiller will continue to operate with the last capacity limit it got from the CSC indefinitely—or until communications are restored. You can clear this last capacity limit by cycling power to the chiller controller.

The following table summarizes the ways local chiller control is established when communications between the CSC and a chiller do not exist:

When the CSC loses communications with a	The last capacity limit from the CSC is replaced by a local value
Series-200 centrifugal	Automatically after 5 minutes
Series-100 centrifugal	When controller power is cycled
Reciprocating/screw	When controller power is cycled

Soft Load Override
Regardless of the chiller type, soft loading control is executed in the chiller controller. The CSC automatically overrides soft loading control in any lag chiller as it starts. For all chiller types, the CSC does this by setting the soft load timer to zero.

So if communications with the CSC are lost and then a chiller starts up, soft loading—if it is set up—will always occur. If communications with the CSC are lost after the soft load override occurs but before the set soft load period ends, soft loading will not occur. If the same chiller stops and then starts again before communications are restored, soft loading will occur. This is true for all chiller types. See the "Load Limiting Control" section for more information.

Fault Alarms

Fault alarm	Keypad/display abbreviation
Leaving Condenser Water Temperature Sensor Fail	Lvg CndW T Fail
Entering Condenser Water Temperature Sensor Fail	Ent CndW T Fail
No Secondary Chilled Water Flow	No Sec ChW Flow

Leaving Condenser Water Temperature Sensor Fail
If the common leaving condenser water temperature sensor fails while it is the selected Control Temperature source for the cooling tower, the Leaving Condenser Water Temperature Sensor Fail alarm will occur as a Fault. As a result, the system will be immediately shut down. It will remain shut down until the alarm is manually cleared.

If you don't have a common leaving condenser water temperature sensor, you should disable this alarm by setting the Leaving Condenser Water Sensor Present Flag (menu 28) to "No."

Entering Condenser Water Temperature Sensor Fail
If the common entering condenser water temperature sensor fails while it is the selected Control Temperature source for the cooling tower, the Entering Condenser Water Temperature Sensor Fail alarm will occur as a Fault. As a result, the system will be immediately shut down. It will remain shut down until the alarm is manually cleared.

If you don't have a common entering condenser water temperature sensor, you should disable this alarm by setting the Entering Condenser Water Sensor Present Flag (menu 28) to "No."

No Secondary Chilled Water Flow
The No Secondary Chilled Water Flow alarm is applicable only to systems that have at least one secondary pump. The alarm will occur whenever all secondary pumps have failed. A pump is considered "failed" if its digital input is open while its digital output is closed for any continuous period of time equal to the Pump Status Check Delay Time variable (menu 21).

If the No Secondary Chilled Water Flow alarm occurs, the system will be immediately shut down. It will remain shut down until the alarm is manually cleared. See the "Chilled Water Flow Control" section for more information.

Problem Alarms

Problem alarm	Keypad/display abbreviation
Decoupler Flow Meter Fail	Decouple F Fail
Secondary Pump #* Fail	Sec Pump #* Fail
Outdoor Air Temperature Sensor Fail	Outside T Fail
Decoupler Temperature Sensor Fail	Decouple T Fail
Return Chilled Water Temperature Sensor Fail	Ret ChW T Fail
Supply Chilled Water Temperature Sensor Fail	Sup ChW T Fail
Loop Differential Pressure Sensor Fail	ChW Press Fail

Note: The wildcard character (*) could be 1 through 6.

Decoupler Flow Meter Fail

If the conditioned analog signal from the decoupler line flow meter falls below 0.5 Vdc, the Decoupler Flow Meter Fail alarm will occur. As a result, the system will continue to operate, but the Decoupled chiller sequencing logic will be modified to eliminate excess primary water flow as a stage-down precondition. Thus stage-down control will be based on average load and time only. (The decoupler line flow meter is used to check for excess primary water flow.)

When the alarm condition is gone, the alarm will automatically clear.

If a decoupler line flow meter is not connected to the CSC, you can disable this alarm by setting up AI 6 for a thermistor input. To do this, set input conditioning switch 1 to "On" and set the other three switches to "Off." These switches are located on Input Conditioning Module 1 (ICM 1).

Secondary Pump #* Fail

If there are two or more secondary pumps and pump *x* fails, the Secondary Pump #*x* Fail alarm will occur, where *x* is the pump number. As a result, the CSC will attempt to start another pump, and the system will continue to operate. A pump is considered "failed" if its digital input is open while its digital output is closed for any continuous period of time equal to the Pump Status Check Delay Time variable (menu 21).

The alarm must be manually cleared. See the "Chilled Water Flow Control" section for more information.

Outdoor Air Temperature Sensor Fail

If an outdoor air temperature sensor is connected to the CSC and it fails, the Outdoor Air Temperature Sensor Fail alarm will occur. As a result, the system will continue to operate, but the following features will be affected:

- Low ambient lockout

  The low ambient lockout feature will act as though the outdoor air temperature is extremely high. Therefore, low ambient lockout will never occur.

- Optimal start

  The optimal start feature will act as though the outdoor air temperature is extremely high. Therefore, it will use an optimal start time increment from the 100°F (38°C) row in the table, which will likely result in an earlier start-up time.

- Chilled water reset based on outdoor air temperature

  The Outdoor Air reset function will act as though the outdoor air temperature is extremely high. Therefore, it will set the System Setpoint equal to the Minimum System Setpoint.

- Cooling tower bypass valve initial position

  The initial bypass valve position function will act as though the outdoor air temperature is extremely high. Therefore, it will set the initial valve position equal to the Maximum Tower Valve Start-Up Position variable.

When the alarm condition is gone, the alarm will automatically clear.

If an outdoor air temperature sensor is not connected to the CSC, you should disable this alarm by setting the Outdoor Air Temperature Source variable (menu 28) to "None" or "Remote." (The "Remote" selection is used when the outdoor air temperature comes to the CSC via network communications.)

Decoupler Temperature Sensor Fail

If the decoupler line temperature sensor fails, the Decoupler Temperature Sensor Fail alarm will occur. As a result, the system will continue to operate, but the Decoupled chiller sequencing logic will be modified to allow stage-ups only when additional capacity is required, not when additional primary water flow is required. (The decoupler line temperature is used to check the need for additional primary water flow.)

When the alarm condition is gone, the alarm will automatically clear.

If a decoupler line temperature sensor is not connected to the CSC, you should disable this alarm by setting the Decoupler Sensor Present Flag (menu 28) to "No."

Return Chilled Water Temperature Sensor Fail

If the return chilled water temperature sensor fails, the Return Chilled Water Temperature Sensor Fail alarm will occur. As a result, the system will continue to operate, but the following features will be affected:

- Optimal start

  The optimal start feature will act as though the return water temperature is extremely high. Therefore, it will use an optimal start time increment from the 90°F (32°C) column in the table, which will likely result in an earlier start-up time.

- Chilled water reset based on return water temperature

  The Return Water reset function will act as though the return water temperature is extremely high. Therefore, it will set the System Setpoint equal to the Minimum System Setpoint.

- Chilled water reset for constant return water temperature

  The Constant Return reset function will act as though the return water temperature is extremely high. Therefore, it will quickly reduce the System Setpoint to the Minimum System Setpoint.

When the alarm condition is gone, the alarm will automatically clear.

If a return chilled water temperature sensor is not connected to the CSC, you should disable this alarm by setting the Return Chilled Water Sensor Present Flag (menu 28) to "No."

Supply Chilled Water Temperature Sensor Fail
If the supply chilled water temperature sensor fails, the Supply Chilled Water Temperature Sensor Fail alarm will occur. As a result, the system will continue to operate, but the following features will be affected:

- Optimal start

  The optimal start feature will disable its adaptation process. Thus, an optimal start can still occur, but the time increment used will not be updated.

- Standard chiller sequencing

  Standard sequencing logic will act as though the supply water temperature is extremely high. Therefore, stage-up control will be based on average load and time only.

- Decoupled chiller sequencing

  Decoupled sequencing logic will act as though the supply water temperature is extremely high. Therefore, stage-up control will be based on average load and time only. A stage-up will not occur if additional primary water flow is required.

- Common chilled water temperature control option

  The Common chilled water control option will act as though the supply water temperature is extremely high. Therefore, it will quickly reduce the Chiller Setpoint to the Minimum Chiller Setpoint.

When the alarm condition is gone, the alarm will automatically clear.

Loop Differential Pressure Sensor Fail
If the conditioned analog signal from the loop differential pressure sensor falls below 0.5 Vdc, the Loop Differential Pressure Sensor Fail alarm will occur. As a result, the system will continue to operate, but the following features will be affected:

- Sequencing pump logic

  Sequencing pump logic will act as though the loop differential pressure is extremely high. Therefore, stage-down control will be based on time only, and thus the pump set will quickly stage down to stage 1.

- Variable speed secondary pump control

  The variable speed pump control process will act as though the loop differential pressure is extremely high. Therefore, it will quickly reduce the pump speed to 0%.

- Chilled water loop bypass valve control

  The loop bypass valve control process will act as though the loop differential pressure is extremely high. Therefore, it will quickly increase the valve position to 100% (full bypass).

When the alarm condition is gone, the alarm will automatically clear.

If a differential pressure sensor is not connected to the CSC, you can disable this alarm by setting up AI 7 for a thermistor input. To do this, set input conditioning switch 1 to "On" and set the other three switches to "Off." These switches are located on Input Conditioning Module 1 (ICM 1).

Warning Alarms

Warning alarm	Keypad/display abbreviation
Cooling Tower Fail	Clg Tower Fail
Leaving Condenser Water Temperature Sensor Fail	Lvg CndW T Warn
Entering Condenser Water Temperature Sensor Fail	Ent CndW T Warn
Chiller Offline	Chiller Offline

Cooling Tower Fail
If the cooling tower alarm input (DI 2) is open, the Cooling Tower Fail alarm will occur. System operation will not be affected by this alarm. When the input is closed again, the alarm will automatically clear. The input and alarm are provided so that an external alarm-logic circuit for cooling tower equipment can be field wired. See the "Field Wiring" section of Bulletin No. IM 618 for more information.

If you don't have an external alarm-logic circuit for the cooling tower, you should disable this alarm by installing a jumper wire across terminals 120 and 121 on the ICM Terminal Board.

Leaving Condenser Water Temperature Sensor Fail
If the common leaving condenser water temperature sensor fails while it is not the selected Control Temperature source for the cooling tower, the Leaving Condenser Water Temperature Sensor Fail alarm will occur as a Warning. System operation will not be affected by this alarm. When the alarm condition is gone, the alarm will automatically clear.

If you don't have a common leaving condenser water temperature sensor, you should disable this alarm by setting the Leaving Condenser Water Sensor Present Flag (menu 28) to "No."

Entering Condenser Water Temperature Sensor Fail
If the common entering condenser water temperature sensor fails while it is not the selected Control Temperature source for the cooling tower, the Entering Condenser Water Temperature Sensor Fail alarm will occur as a Warning. System operation will not be affected by this alarm. When the alarm condition is gone, the alarm will automatically clear.

If you don't have a common entering condenser water temperature sensor, you should disable this alarm by setting the Entering Condenser Water Sensor Present Flag (menu 28) to "No."

Chiller Offline
The Chiller Offline alarm will occur whenever at least one chiller is marked "offline." This alarm will not affect system operation; it simply indicates that special sequencing logic is in effect. When no offline chillers exist, the alarm will automatically clear.

Special sequencing logic will keep the system running, but it is not an ideal situation. See "Special Sequencing Logic" in the "Chiller Sequencing Control" section for more information on offline chillers and how to restore them to normal operation.

MicroTech PI Control Method

The following sections provide detailed information on two intrinsic MicroTech direct digital control (DDC) functions that constitute the CSC's proportional-integral (PI) control method: Change-and-Wait and Project Ahead.

There are many ways of implementing PI control. Most other methods are based on proportional control and add in integral control. The MicroTech PI control method is just the opposite; it is based on integral control and adds in proportional control. Change-and-Wait is the integral part, and Project Ahead is the proportional part. The main advantage of basing the PI control method on integral control is that load dependent offset (also known as "proportional droop") is inherently eliminated. Thus controlled variables, such as temperature or pressure, will always be held very close to setpoint regardless of the load.

Note: No PI control method will perform properly if (1) the control variables are out of adjustment or (2) the equipment being controlled is not suitable for the application. The following sections will help you adjust the control variables for your application; however, it is assumed that the field-supplied equipment has been properly selected. If, for example, a chilled water valve is grossly oversized, no amount of variable adjustment will eliminate a hunting problem.

Change-and-Wait Algorithm

About Change-and-Wait

MicroTech controllers use the Change-and-Wait algorithm to produce a setpoint—the *output setpoint*—that varies in response to a controlled variable's deviation from a different operator-adjusted or controller-adjusted setpoint—the *control setpoint*. Depending on the control strategy, the Change-and-Wait algorithm is either *direct acting* or *reverse acting*. A direct acting loop will increase the output setpoint when the controlled variable is above the control setpoint. Conversely, a reverse acting loop will decrease the output setpoint when the controlled variable is above the control setpoint. Tables 22 and 23 list the controlled variables and setpoints used in the CSC's direct and reverse acting control strategies.

The output setpoint can be used in two ways: (1) it can become the control setpoint for another control loop or (2) it can become the actual value of an analog output. The CSC's output setpoints are used in both ways. For example, the Chiller Setpoint is used as a control setpoint in each chiller controller's capacity control process, and the Secondary VFD Pump Speed is converted to a voltage or current signal for use by a variable frequency drive connected to AO 1 or AO 2.

Controlled Variables and Project Ahead

Throughout this section the term "controlled variable" refers to the *anticipated* value of the controlled variable. This anticipated value V is produced by the Project Ahead algorithm and is used in the Change-and-Wait algorithm. The actual value V_a is shown on the keypad/display and Monitor program. V will usually be very close to V_a, and if Project Ahead is not being used, it will be equal to V_a. For more information, see the following "Project Ahead Algorithm" section.

Description of Operation

⚠ CAUTION

Grossly misadjusting Change-and-Wait parameters can cause erratic unit operation and equipment damage.

Change-and-Wait parameters should be adjusted only by personnel that have a thorough understanding of how they affect overall system operation.

In addition to the control setpoint, there are four Change-and-Wait parameters that regulate the control loop action: (1) sample time T, (2) max change M, (3) mod limit L, and (4) deadband D. Following are descriptions of each parameter.

Sample Time

The sample time sets the control loop sampling rate. During each sample time cycle, the controlled variable is read and the output setpoint is adjusted accordingly. The sample time parameter's units are always in time (seconds or minutes).

Max Change

The max change defines the maximum amount the output setpoint can be raised or lowered at the beginning of each sample time cycle. If set properly, it effectively clamps the loop's output when the controlled variable is far from the control setpoint, preventing integral wind-up. Depending on the mod limit setting and the deviation of the controlled variable from the control setpoint, the *actual* amount of output setpoint change is some percentage of the max change. The greater the deviation is, the greater the output setpoint change will be (see "Mod Limit" below). The max change parameter's units are the same as the output setpoint's.

Mod Limit

The mod limit sets the gain, which is the responsiveness of the control loop to the controlled variable's deviation from setpoint. The actual amount the output setpoint is either raised or lowered for each sample time period is set in proportion to this deviation. The lower the mod limit is, the more responsive the control loop will be. The mod limit parameter's units are the same as the control setpoint's.

The following equations can be used to determine the output setpoint change if the controlled variable's deviation from setpoint is less than or equal to the mod limit and greater than the deadband:

$$\Delta S_{out} = \frac{M}{L}\left(V - S_c\right) \qquad \textit{Direct acting}$$

$$\Delta S_{out} = -\frac{M}{L}\left(V - S_c\right) \qquad \textit{Reverse acting}$$

where ΔS_{out} is the change in the output setpoint, V is the controlled variable, S_c is the control setpoint, M is the max change, and L is the mod limit. See "Output Function" below for graphical representations of these equations.

As an example, consider a cooling tower system that is using a bypass valve for low-limit control. The Control Temperature is the common entering condenser water temperature. Assume that the Tower Valve Mod Limit is 10.0°F (5.0°C) and the Tower Valve Max Change is 5%. If the Control Temperature is 85.0°F (30.0°C) and the Tower Valve Setpoint is 80.0°F (27.5°C), the Cooling Tower Bypass Valve Position will be raised 2.5%.

$$\Delta S_{out} = \frac{5\%}{10.0°F}(85.0°F - 80.0°F)$$

$$\Delta S_{out} = \frac{5\%}{5.0°C}(30.0°C - 27.5°C)$$

$$\Delta S_{out} = 2.5\%$$

If the controlled variable is above or below the control setpoint by more than the mod limit, the output setpoint will be raised or lowered by the full max change amount. Thus, if the Control Temperature in the above example is more than 10°F (5.0°C) from the Tower Valve Setpoint, the Cooling Tower Bypass Valve Position will change 5% each sample time cycle. This feature allows the controlled variable to approach its setpoint as quickly as possible during transient periods—for example, after system start-up—while reducing the likelihood of overshoot.

Deadband

The deadband sets a range around the control setpoint in which no action is taken. If the controlled variable is within the deadband range, the output setpoint will not change. Note that the deadband's value is added to and subtracted from the control setpoint to determine the deadband range. For example, if the Tower Valve Deadband is 2.0°F (1.0°C) and the Tower Valve Setpoint is 80.0°F (27.5°C), the Cooling Tower Bypass Valve Position will not change when the Control Temperature is 78.0°F (26.5°C), 82.0°F (28.5°C), or any value in between. The deadband's units are the same as the control setpoint's.

Output Function

Figures 36 and 37 show direct and reverse acting Change-and-Wait output functions. In the figures,

S_c is the setpoint
D is the deadband
L is the mod limit
M is the max change
ΔV is the controlled variable's deviation from setpoint S_c
ΔS_{out} is the change in the output setpoint

The applicable function is used to calculate the change in the output setpoint at the beginning of each sample time cycle.

Figure 36. Change-and Wait Function: Direct Acting

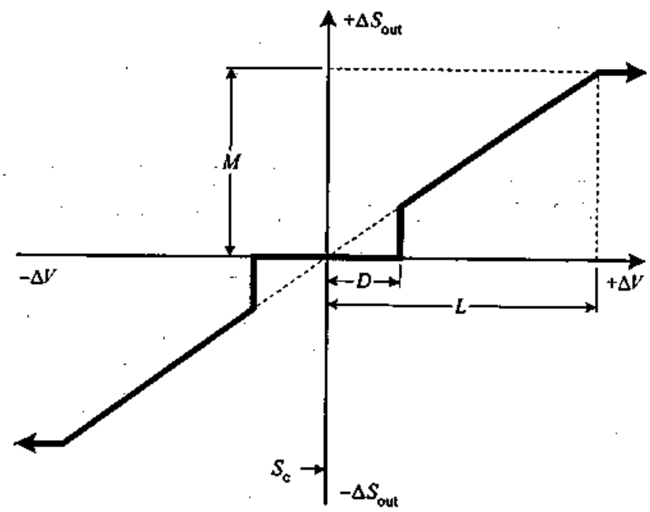


Figure 37. Change-and Wait Function: Reverse Acting

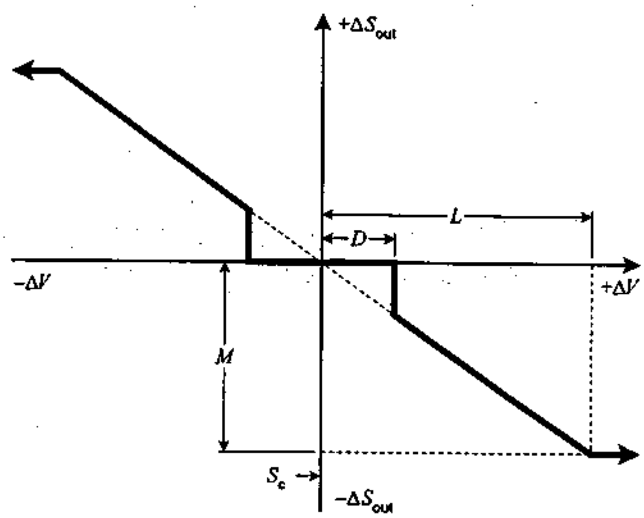


Table 22. Change-and-Wait Controlled Variables and Setpoints for Direct Acting CSC Control Strategies

Control Strategy	Controlled Variable	Control Setpoint	Output Setpoint
Condenser water temperature control: Low-limit bypass valve	Control Temperature for tower *(common entering or leaving condenser water temperature)*	Tower Valve Setpoint	Cooling Tower Bypass Valve Position
Condenser water temperature control: Intrastage bypass valve	Control Temperature for tower *(common entering or leaving condenser water temperature)*	Tower Stage • Setpoint	Cooling Tower Bypass Valve Position
Loop differential pressure control: Bypass valve	Chilled Water Loop Pressure Difference	Loop Differential Pressure Setpoint	Differential Pressure Bypass Valve Position

Table 23. Change-and-Wait Controlled Variables and Setpoints for Reverse Acting CSC Control Strategies

Control Strategy	Controlled Variable	Control Setpoint	Output Setpoint
Supply chilled water temperature control	Chilled Water Supply Temperature	System Setpoint	Chiller Setpoint
Return chilled water temperature control *(Constant Return reset)*	Chilled Water Return Temperature	Constant Return Setpoint	System Setpoint
Loop differential pressure control: VFD pump	Chilled Water Loop Pressure Difference	Loop Differential Pressure Setpoint	Secondary VFD Pump Speed

Adjusting Change-and-Wait Parameters

Default values for Change-and-Wait parameters are loaded into each controller at the factory. These values will provide proper control for many applications; however, since the physical configuration of the chiller system can affect control, field tuning may be required. If the default values do not provide acceptable system operation, follow these guidelines as you adjust the parameters:

- Use trial and error, making *small* adjustments to the parameters and allowing enough time between trials to let the system settle out.
- Set the sample time according to the control loop's "speed." Quick loops should have smaller sample times, and slow loops should have larger sample times. One rule of thumb is to select a sample time that is one-half to one-tenth of the time required for a change in output to affect the controlled variable. Note that temperature changes are transmitted only as fast as water can flow, while pressure changes are transmitted throughout a system almost immediately. So, for example, if you're using a temperature control process in a system that has very long piping runs, you may want to increase the sample time for that process.
  Note: Project Ahead can help systems with slow control loops. See the following section for information on Project Ahead.
- In cascaded control loops, set the sample times to different values. An example of a cascaded control loop is a combination of the return temperature control and supply temperature control strategies. This combination is cascaded because the return loop generates the control setpoint for the supply loop (see Table 23).
- If the controlled variable hunts above and below its setpoint or if it overshoots the setpoint too much during start-up or other abrupt changes in system operation, "slow down" Change-and-Wait control by decreasing the max change value, increasing the mod limit value, or both. Change-and-Wait control can also be slowed down by increasing the sample time. Increasing the deadband can eliminate hunting problems, but this can also result in looser control.
- If the controlled variable does not approach its setpoint fast enough during start-up or other abrupt changes in system operation, "speed up" Change-and-Wait control by increasing the max change value, decreasing the mod limit value, or both. Change-and-Wait control can also be speeded up by decreasing the sample time.
- Set the deadband to adjust the tightness of control. The smaller it is, the closer the controlled variable will be to its setpoint. Note that if the deadband is set too low, it can cause hunting in some situations.

Project Ahead Algorithm

About Project Ahead

The Project Ahead algorithm is a supplement to the Change-and-Wait algorithm. It can be used to compensate for the "lag effect" that is inherent in systems with slow response times. This lag effect can cause the controlled variable to hunt.

For example, consider a large space in which the temperature is falling while an air handling unit is supplying more cooling than necessary to meet the load. The space would likely overcool without Project Ahead because the unit's cooling output would be reduced too late. Now consider the same space in which the temperature is rising while the unit is supplying insufficient cooling to meet the load. The space would likely overheat without Project Ahead because the unit's cooling output would be increased too late.

Project Ahead is comparable to a shock absorber on a car. When the car hits a bump, it starts bouncing on its springs. The shock absorbers damp the bounce. When the car is not bouncing, the shock absorbers do nothing. Similarly, Project Ahead damps a controlled variable that is rapidly moving toward or away from setpoint. It effectively "amplifies" the effect of the control processes *only during periods in which the controlled variable is changing.* As a result, the output is increased or decreased early enough to avoid overshoot.

Description of Operation

Project Ahead calculates the rate at which the controlled variable is changing and increases or decreases the control loop's output as required to prevent setpoint overshoot. To do this, it uses an *anticipated* value of the controlled variable V instead of the actual controlled variable V_a as the input to the control processes. (The anticipated value is not available for display.)

There is one Project Ahead parameter that affects the control loop action: the project ahead time P. A different project ahead time is used for each control loop.

Project Ahead Time

The project ahead time defines how far into the future the controlled variable should be anticipated. For example, if the project ahead time is set to 8 minutes, the algorithm will calculate what the controlled variable would be in 8 minutes—if the current rate of change remained the same. If the actual controlled variable had been increasing, the anticipated controlled variable (8 minutes from now) would be higher. A direct acting control loop using this anticipated value would thus increase its output far more than it would if the actual value were used. The project ahead time parameter's units must be the same as the sample time parameter's (seconds or minutes). The controller will automatically ensure that they match.

To calculate the anticipated controlled variable, the Project Ahead algorithm uses the actual controlled variable's rate of change over the last sample time interval. The following equation can be used to determine the anticipated controlled variable:

$$V = V_a + \frac{P}{T}\left(V_a - V_{a\text{-}1}\right)$$

where V is the anticipated controlled variable, V_a is the actual controlled variable during the current sample cycle, $V_{a\text{-}1}$ is the actual controlled variable during the previous sample cycle, P is the project ahead time, and T is the sample time. Notice that when P is zero, V is set equal to V_a.

As an example, consider the same cooling tower system discussed in the "Change-and-Wait Algorithm" section above. In that example, Project Ahead was not used (P = 0 sec, and thus $V = V_a$). Now assume that the Tower Valve

Project Ahead Time is 30 seconds and the Tower Valve Sample Time is 15 seconds. If the current Control Temperature is 85.0°F (30.0°C) and the previous Control Temperature (15 seconds ago) was 87.0°F (31.0°C), the anticipated Control Temperature (30 seconds from now) will be 81.0°F (28.0°C). See Figure 38.

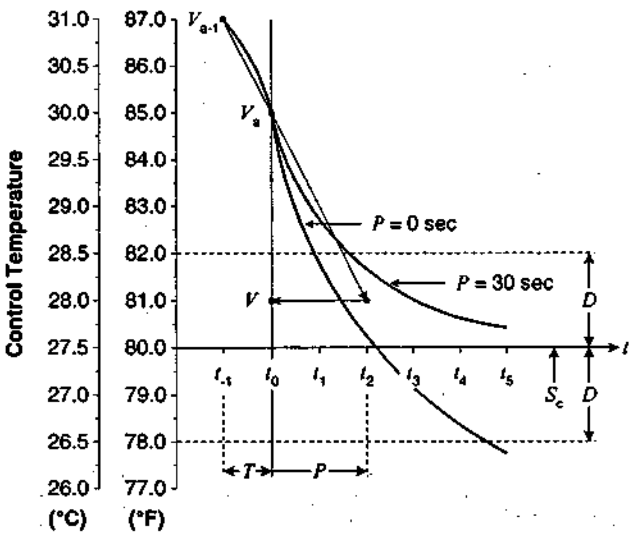
$$V = 85.0°F + \frac{30 \text{ sec}}{15 \text{ sec}}(85.0°F - 87.0°F)$$

$$V = 81.0°F$$

$$V = 30.0°C + \frac{30 \text{ sec}}{15 \text{ sec}}(30.0°C - 31.0°C)$$

$$V = 28.0°C$$

Figure 38. Project Ahead Example



In this example, the Control Temperature (entering condenser water temperature) is decreasing at a rapid rate of 8.0°F (4.0°C) per minute. This may be, for instance, because a chiller just stopped. The bypass valve needs to react quickly to prevent the Control Temperature from overshooting the Tower Valve Setpoint, which is 80°F (27.5°C). Notice that the temperature at time t_0 is still above setpoint even though it is falling. Since it is above setpoint, the valve should open more to the tower, but this will make the temperature fall even faster. If the Tower Valve Deadband is 2.0°F (1.0°C), the anticipated temperature of 81.0°F (28.0°C) will cause the valve to stop opening (0% change) because it is within the deadband range. As a result, the temperature will level out faster than it would if the actual temperature of 85.0°F (30.0°C) were used. Figure 38 shows two possible paths the temperature could follow after time t_0: one with Project Ahead ($P = 30$ sec) and the other without Project Ahead ($P = 0$ sec).

Adjusting Project Ahead Parameters

Default values for Project Ahead parameters are loaded into each controller at the factory. These values will provide proper control for many applications; however, since the physical configuration of the chiller system can affect control, field tuning may be required. If the default values do not provide acceptable system operation, follow these guidelines as you adjust the parameters:

- Use trial and error, making *small* adjustments to the project ahead time parameter. Since Project Ahead only works when the controlled variable is changing, perform the trial when there is an abrupt change to the system; for example, after system start-up or a large setpoint change.
- Begin by setting the project ahead time equal to about twice the sample time. For example, if your sample time is 15 seconds, start with a project ahead time of 30 seconds. This is a rule of thumb; your system may need a quite different project ahead time setting.
- If the controlled variable overshoots its setpoint but then stabilizes fairly quickly after an abrupt change to the system, try increasing the project ahead time value.
- If the controlled variable approaches its setpoint too slowly after an abrupt change to the system, try decreasing the project ahead time value.

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6

Castel

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20132 Milano Italy
tel. 215.38.28 - fax 264.132.95
Tribunale di Milano
Registro Imprese 113702
Cod. Fisc. 00779080159
Cap. Soc. L. 500.000.000

Stabilimento e Magazzino ... Provinciale N. 2-4
20060 Pessano con Bornago (MI)
Tel. 95702.1
Telefax 957.413.17
C.C.I.A.A. Milano 590888
Mecc. MI 019956

PER QUANTO CONCERNE LE VERIFICHE ISTITUZIONALI (ISPESL e/o USSL), IL CERTIFICATO DI TARATURA AL BANCO EFFETTUATA ALLA PRESENZA DELL'ISPESL, HA VALIDITÀ DI 1 ANNO

VALVOLA DI SICUREZZA - CERTIFICATO DI FABBRICAZIONE

(Decreto ministeriale 21 maggio 1974)
(Norma ANCC, raccolta E, fascicolo E1D, edizione gennaio 1979 punto 10.1)

In base alle norme di cui sopra, si certifica quanto segue:

a) Ditta fabbricante: CASTEL s.r.l.

b) Numero di Modello (catalogo) della valvola	:	3030/88
c) Numero di matricola della valvola (n. di fabbrica) e numero del certificato di fabbricazione	:	22807
d) Pressione nominale per le connessioni di ingresso e di uscita della valvola	: PN	40/40
Diametri nominali per le connessioni di ingresso e uscita della valvola	: DN	1" / 1"
e) Diametro dell'orifizio	: D_o, mm.	19,50
Area "A" della sezione trasversale minima netta dell'orifizio	: cm.^{2}	2,98
f) Alzata "h"	: mm.	6,80
Coefficiente "K"	:	0,83
g) Campo di variabilità pressione di taratura a contropressione atmosferica	: bar	22,70/29,40
Campo di temperatura	: °C	(−50) ÷ (+150)
h) Sovrappressione espressa in % della pressione di taratura	: %	5%

(Prot. 21916 del 28/06/1982) Sez. Lombardia Centr.
Certificato Omologazione n. 21757 A
Riconferma Omologazione VS/88/92 — Del 10/06/82 (per 3030/44 - 3030/44 A)
Certificato Omologazione n. 21757 B
Riconferma Omologazione VS/89/92 — Del 10/06/82 (per 3030/88 - 3030/88 A)

i) materiali impiegati:
- corpo valvola e otturatore: OT 58 UNI 5705
- molla: Acciaio Classe C UNI 3823
- guarnizione otturatore: Teflon (Politetrafluoroetilene)

l) esito dei collaudi:

– controllo dimensionale	positivo
– collaudo finale	positivo
– prova idraulica lato ingresso e lato uscita a 60 bar	positivo

m) Scarto di richiusura espresso in % della pressione di taratura : % — 15%
- Fluidi: Aria - Freon - Cloruro di metile
- Stato fisico: vapore o gas

Pessano, li 25/11/97

Castel

I.S.P.E.S.L.

Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro

Sede di Milano, Via Mangiagalli 3

Certificato N. 22807

Certificato di taratura al banco di valvola di sicurezza presso il fabbricante

Località, Pessano con Bornago

li 03/12/97

La valvola di sicurezza di cui al presente certificato, fabbricante CASTEL s.r.l. - n.f. vedi a fianco corrisponde al modello 3030/88 di cui al certificato di fabbricazione n. vedi a fianco del vedi a fianco ed al certificato cumulativo di taratura n. 986 del 03/12/97 (solo per le valvole costruite in serie), con diametro dell'orifizio D_o = 19,50 mm.

La taratura della valvola è stata eseguita con aria compressa a temperatura ambiente e contro-pressione atmosferica alla pressione di 24,50 bar

Dispositivo di blocco della taratura:
- caratteristiche: vite di bloccaggio
- posizione: inserimento sulla parte superiore del corpo valvola
- inamovibilità: assicurata dal piombo

Sulla vite di regolazione di taratura o sul corpo, risultano punzonati i seguenti dati:
- numero di modello (catalogo) della valvola: 3030/88
- pressione di taratura 24,50 bar
- numero di fabbrica: vedi a fianco
- sul corpo risultano ricavati per stampaggio il marchio del costruttore e il senso di percorrenza del fluido
- punzone ISPESL N. 178 sul piombo

I.S.P.E.S.L. — MINISTERO DELLA SANITÀ — DIPARTIMENTO DI MILANO

IL TECNICO
Dott. Ing. Alfonso DE LUCIA

ALL. 6

Dichiarazione di cui al punto 2 della disposizione E.1 D. ed. gennaio 1979

2.1. – Valvola a molla diretta.

2.2. – La costruzione ed i materiali impiegati sono idonei per le condizioni di funzionamento, temperatura, corrosività ed altre proprietà dei seguenti fluidi: - Cloro fluoroderivati "Freon" per usi frigoriferi, Cloruro di Metile, aria compressa.

2.3. – Sedi piane.

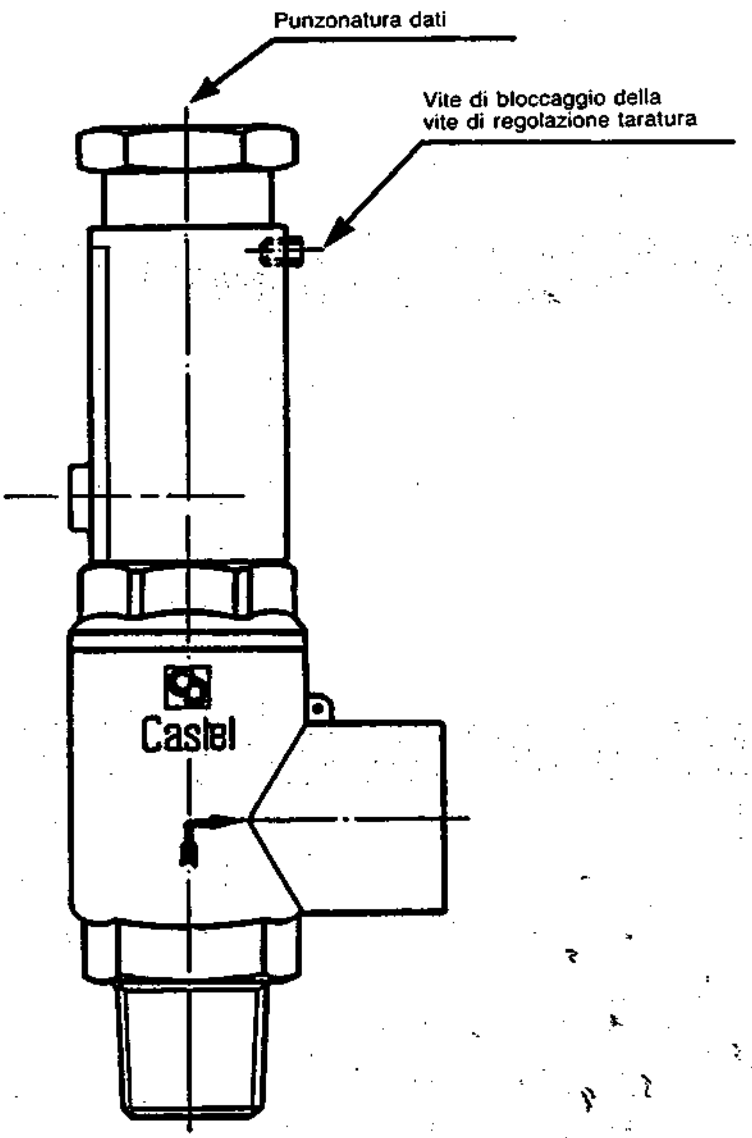
2.4. – La guarnizione di tenuta in teflon è tale che, anche in prolungato esercizio, conserva buone caratteristiche di resistenza e non provoca fenomeni di incollamento nell'otturatore sulla sede.

2.5. – L'otturatore è guidato nel suo movimento.

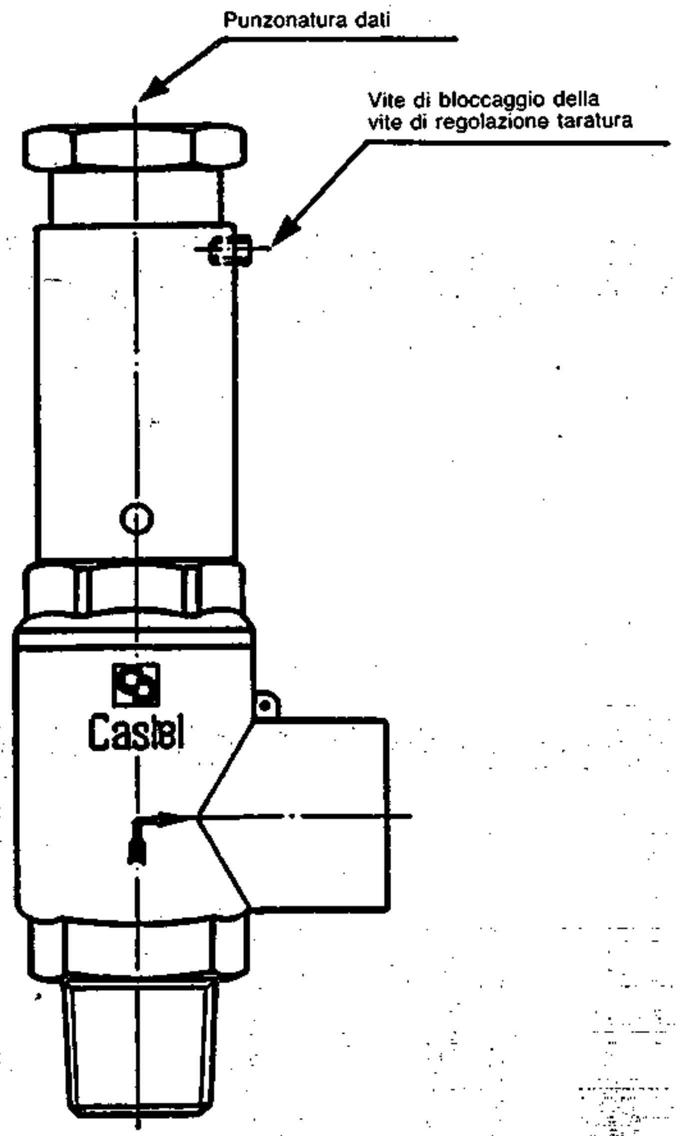
2.6. – L'otturatore è privo di premistoppa.

2.7. – Le spire della molla, escluse quelle terminali, sono distanziate tra di loro del minore tra mezzo diametro del filo e 2 mm. quando l'otturatore raggiunge l'alzata. La freccia della molla, quando l'otturatore è in posizione di blocco meccanico, non è superiore all'85% della freccia totale.

2.8. – Il sistema di taratura è meccanicamente bloccato tramite la vite.



3030/44



3030/88

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

UNI EN ISO 9002 (ISO 9002)
DNV
Certified Quality System

CERTIFICATO DI COLLAUDO
TEST CERTIFICATE

- Heat Exchanger / Scambiatore : CO 2731 030
- Serial Number / Numero di fabbrica : 12438/B
- Drawing N. / Disegno n. : 2014/I
- Year / Anno : 1998
- Manifacturer / Costruttore : **PROVIDES Metalmeccanica Srl . Latina**

		Inside of the shell Interno mantello	Inside of the tube Interno tubi
Maximum operating pressure Pressione massima di esercizio	Bar	24.5	16
Operating temperature Temperatura di esercizio	°C	-10 +62	-10 +80
Hydraulic testing pressure Pressione di prova idraulica	Bar	30.7	21
Refrigerant content Capacità	Litres Litri	118	37
Refrigerant Natura del fluido		Freon R407C	Acqua

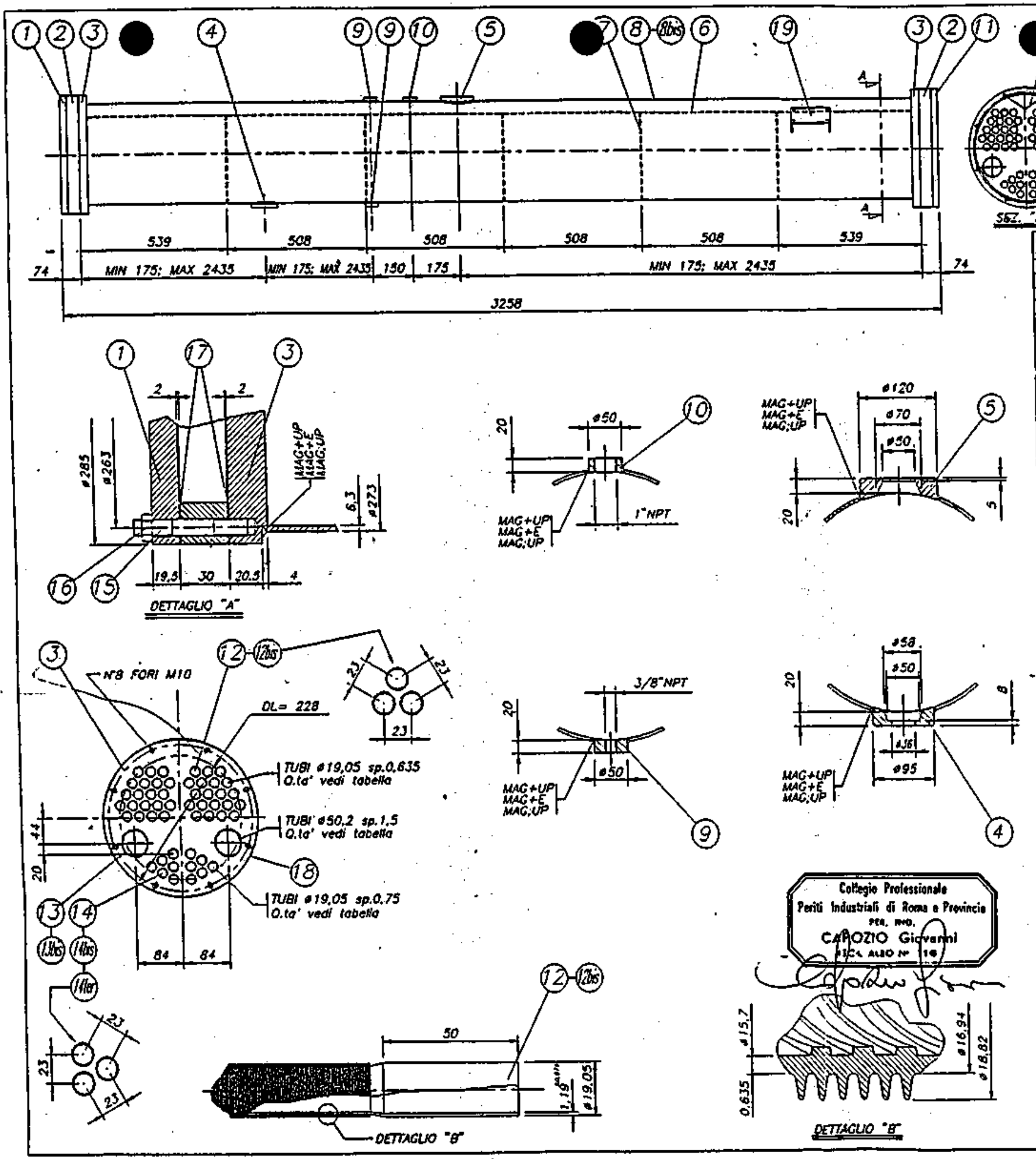
The costruction and materials correspond to the heat exchanger rules. On the heat exchanger there is a plate indicating the serial number, the date of the hydraulic test and a marking (see below) attesting that a test was conducted with a positive outcome.

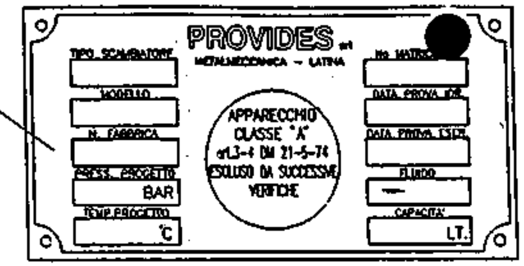
La costruzione ed i materiali impiegati risultano conformi alle normative degli apparecchi a pressione.
Sull'apparecchio è posta la targa con il numero di fabbrica, la data della prova idraulica e la punzonatura (vedi sotto) di avvenuto collaudo con esito positivo della prova.

Latina, 28/10/98

PROVIDES metalmec. s.r.l.
Via Piave n. 82 - LATINA

Allegati n. 1-2-3-4-5-6





N.B.: VALORI TRA PARENTESI () DI ALTERNATIVA

MATERIALE DI APPORTO OMOLOGATO: FILO: PIVS + FILOGAS (MAG) ; ELETTRODO BOHLER FOX EV 47-(E)
AUTOMATIC: AS35/AS331 ø2,38

GRUPPO DI APPARTENENZA MATERIALE: SA1	PREPARAZIONE LEMBI SECONDO UNI 11301	CATEGORIA II (SECONDA)
MODULO DI EFFICIENZA: Z=0,85 / Rx= 10%	QUALIFICA SALDATORI DEL LATO: MAG-3-OR+28/Fe UNI 5869	
CLASSE ACCETTABILITA' DIFETTI: III (TERZA)		
QUALIFICA DI PROCEDIMENTO SALDATURA:		

SALDATURE

SI DICHIARA CHE IL PROGETTO NEL SUO INSIEME E NEI SUOI PARTICOLARI E' CONFORME ALLE DISPOSIZIONI DELLA RACCOLTA "S". INOLTRE IL MEATO ESISTENTE AL VERTICE DELLA SALDATURA NON ATTIVA FENOMENI PERICOLOSI DI CORROSIONE.

POS	DESCRIZIONE	MATERIALE
20	TARGA DI RICONOSCIMENTO	ALLUMINIO
19	PORTA TARGA	HII DIN 17155/ Fe410 1KW/ 2KW UNI 5869-75
18	PLACCATURA IN CU-NI (SE INSTALLATA)	CuNi 10 Fe 1 Mn UNI 7280
17	GUARNIZIONE CALOTTA	ELASTOMERO NEOPRENE
16	DADO ALTO M10	CLASSE 5.6
15	PRIGIONIERO M10	CLASSE 8.8
14ter	TUBO CU-NI ø19,05 sp.0,75 mm	P-CuNi 10 Fe 1 Mn UNI 6785
14bis	TUBO RAME ø19,05 sp.0,75 mm	Cu 99,9% SF Cu F22 DIN 1787
14	TUBO ACCIAIO ø19,05 sp.0,75 mm	St 35.8 DIN 17175 / ASTM A106-75 GrB
13ter	TUBO RAME ø50 sp.1,5 mm	Cu 99,9% SF Cu F22 DIN 1787
13bis	TUBO CU-NI ø50 sp.1,5 mm	P-CuNi 10 Fe 1 Mn UNI 6785
13	TUBO ACCIAIO ø50 sp.1,5 mm	St 35.8 DIN 17175 / ASTM A106-75 GrB
12bis	TUBO CU-NI ø19,05 sp. 0,635mm	P-CuNi 10 Fe 1 Mn UNI 6785
12	TUBO RAME ø19,05 sp. 0,635mm	Cu 99,9% SF Cu F22 DIN 1787
11	FONDO DI CHIUSURA POSTERIORE sp.24,5 mm	HII DIN 17155 / Fe 360C UNI 7070
10	MANICOTTO 1"NPT	Fe 410 1KW/2KW UNI 5869-75
9	MANICOTTO 3/8"NPT	HII DIN 17155
8	INVOLUCRO (RICAVATO DA TUBO)	St 35.8 DIN 17175 / ASTM A106-75 GrB
7	DIAFRAMMA So. 2 mm	Fe 360C UNI 7070
6	DISTRIBUTORE GAS	
5	MANICOTTO INGRESSO GAS	HII DIN 17155
4	MANICOTTO USCITA LIQUIDO	Fe 410 1KW UNI 5869-75
3	PIASTRA TUBIERA	Fe 410 2KW UNI 5869-75
2	DISTRIBUTORE CALOTTA POST./ANTER.	GHISA G25
1	FONDO PIANO CALOTTA ANTERIORE	HII DIN 17155 / Fe 360C UNI 7070

DISTINTA MATERIALI

TUTTI I MATERIALI COSTITUENTI LE MEMBRATURE IN PRESSIONE SARANNO FORNITI CON CERTIFICATI DI COLLAUDO O DI PROVENIENZA SECONDO LA VIGENTE NORMATIVA I.S.P.E.S.L.

CAMERA		LATO ACQUA	LATO REFRIGERANTE			
CAPACITA'	l	VEDI TABELLA FOGLIO ALLEGATO 2/2				
PRESSIONE DI PROVA IDRAULICA	bar (kg/cmq)	21 (21,5)	30,7 (31,3)			
PRESSIONE DI PROGETTO	bar (kg/cmq)	18 (18,4)	24,5 (25,0)			
TEMPERATURA DI PROGETTO	°C	MIN.+10 MAX+80	MIN.+10 MAX+47		MIN.+10 MAX+80	MIN.+10 MAX+47
FLUIDO		ACQUA	R22	R407C	R134a	R410A
OVALIZZAZIONE MASSIMA	%	1	1			
SOVRASPESSORE DI CORROSIONE	mm	1	0			
COLLAUDO I.S.P.E.S.L.		NO	SI			
CLASSE DI APPART. SECONDO RACCOLTA "E"		"e"				

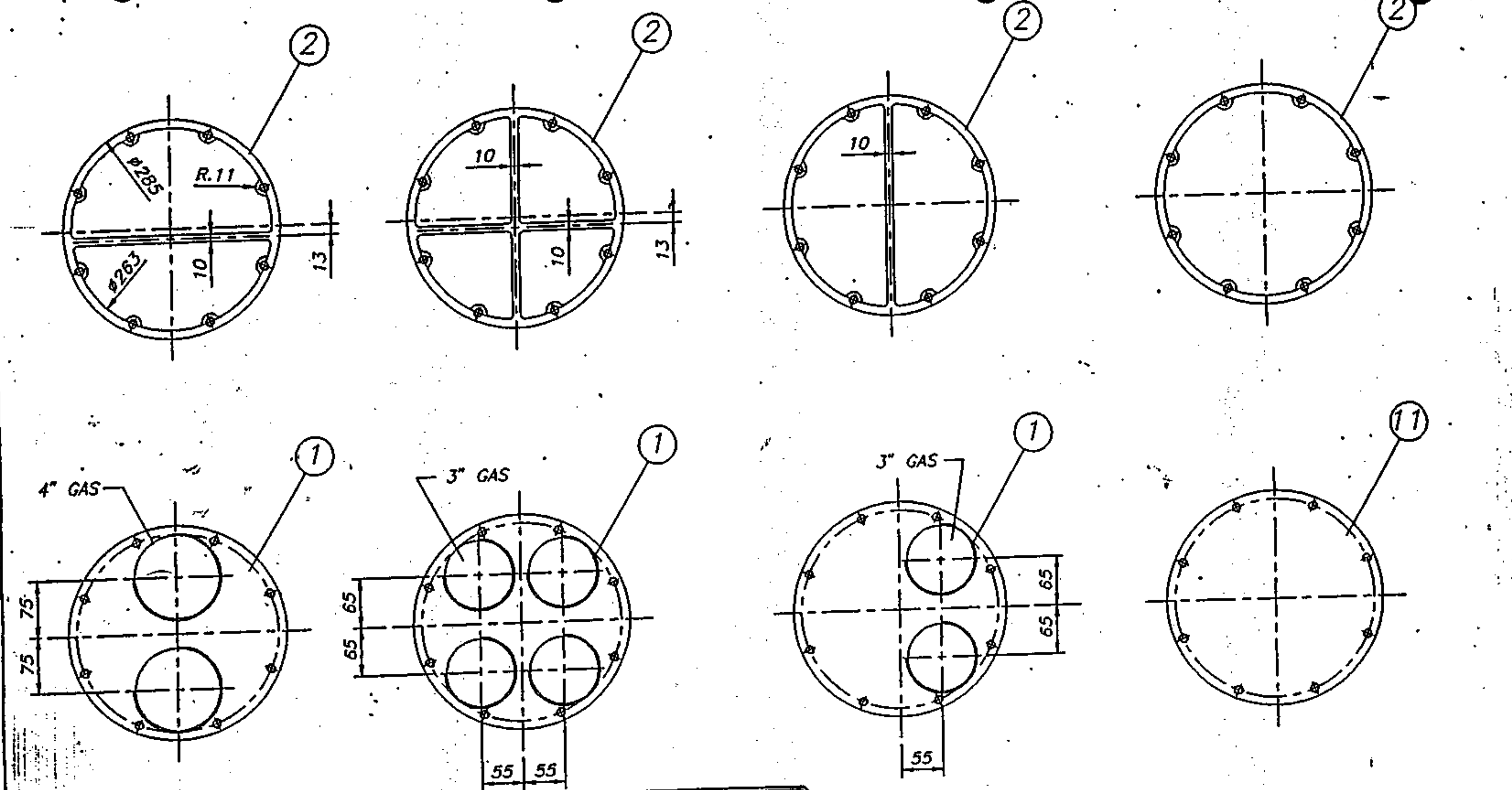
DATI DI PROGETTO

LE MEMBRATURE A PRESSIONE SONO VERIFICATE PER LE CONDIZIONI PREVISTE DALL'ART. 1 D.M. 21-11-1972
NEI CALCOLI LE PRESSIONI SONO ESPRESSE IN kg/cmq CON LE SEGUENTI EQUIVALENZE:
1 kg/cmq = 0,98665 bar ; 1 bar = 1,019716 kg/cmq

COSTRUZIONE APPROVATA CON LETTERA I.S.P.E.S.L. No DI PROTOCOLLO .... DEL ....
NUMERO DI FABBRICA ....
PROGETTISTA: P.I. GIOVANNI CAPOZIO

Descrizione: CONDENSATORE RECUPERATORE	Data : 21-02-1997	Tolleranze generale — Grezzo: ± / Finito: ±		Peso grezzo (kg): ....
	Scala :			Peso finito (kg): ....
	Dim. grezzo :	Disegnato:		Ver/Appr. : ....
PROVIDES METALMECCANICA Srl	MODELLO: C2731			Classifica: 2014/i foglio 1/2

All. 1



ALL 1 BIS

Collegio Professionale Periti Industriali di Roma e Provincia
PER. IND.
CAPOZIO Giovanni
ISCR. ALBO N° 710

ALTERNATIVE PER FONDI PIANI E DISTRIBUTORI

MODELLO CONDENSATORE	N°TUBI Pos.12	N°TUBI Pos.13	N°TUBI Pos.14	LATO GAS CAPACITA'(lt)	LATO ACQUA
2731040	40	2	12	101	46
2731036	36	2	10	111	42
2731030	30	2	8	118	37
2731026	26	2	8	121	35
2731020	20	2	6	128	30

Descrizione:
CONDENSATORE RECUPERATORE

Data : 21-02-1997
Scala : ....
Dim. grezzo : ....
Tolleranza generale
Grezzo: ± ... Finito: ± ...
Disegnato: ....
Peso grezzo (kg): ....
Peso finito (kg): ....
Ver/Appr. : ....

PROVIDES
METALMECCANICA Srl

MODELLO:
C2731

Classifica:
2014/i
Foglio 2/2

Costruttore Provides Metalmeccanica S.r.l.

N. di fabbrica 12638/B Matricola e sigla 98 LT

Allegato N° 2

DICHIARAZIONI DEL COSTRUTTORE

a) MATERIALI (1) - MEMBRATURE (2)

- Tubo di rame ø 19,05 x 0,75 certificato Wieland secondo EN 10204 tipo 3.1B n. 68/0547 del 20/05/97
- Tubo di rame Ø 19,05 x 0,63 certificato Wieland secondo EN 10204 tipo 3.1B n. 68/0516 del 18/02/97
- Tubo di rame Ø 50 x 1,5 certificato Outokumpu secondo EN 10204 del 14/10/97

b) TRATTAMENTI TERMICI (3) - EVENTUALI ALTRE DICHIARAZIONI (4)

c) SALDATURE (estremi dei certificati di qualifica e di omologazione)

— Procedimenti di saldatura (5)

- Elettrico procedimento MAG (staffe e selle)
- Automatico in arco sommerso (fasciame - fondi p. tubiera)

Qualifiche IIS n. 4200 - 4343 - 4359
27315 data 21/05/84

— Elettrodi impiegati (6)

Filo pieno tipo RMS Ø 1 mm.
Filo pieno RM2 - AS - 35
Flusso AS 231 (SIO)

— Saldatori (7)

D'Annibale Romeo-Qualif. I.I.S. n.4343 Rinn. ISPESL del 23/06/98
Comuzzi Sergio - Qualif.ISPESL n. 12534-12535 Rinn.ISPESL del 23/06/98
Magagna Stefano- Qualif.ISPESL n. 12536-12537 Rinn. ISPESL del 23/06/98

d) TALLONI DI SALDATURA (8)

e) ESAMI NON DISTRUTTIVI (9)

Data 28/10/98

Timbro e firma del Costruttore
PROVIDES metalmecc. s.r.l.
Via Piave n. 82 - LATINA

(Vedere Note a tergo)

Poligrafico - Roma (L.178 Id. - 10641) 12.1972

PROVIDES

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Allegato n. 3
Encl. n. 3

Costruttore : PROVIDES
Manufacturer : METALMECCANICA Srl

N. di fabbrica : 12438/B
Serial number :

Materiali - Materials					Certif. - Certif.		
Posiz. Item	Spessore Thickness mm	Fabbricante Manufacturer	Qualità sigla tab.unificata Quality and specifications	Colata pezzo o lotto n. Heat n.	Numero Number	Data Date	Note Notes
1	25	Thyssen Krupp Stahl	P 265 GH	637551	99845	03/06/98	P. tubiera
2	35	Falck	HII DIN 17155	22213	9939	28/07/95	Zuccherotti
3	5	Dalmine	ASTM A 106 gr. B	32475	2592	10/02/96	Virola

All dimensions have been verified and correspond to standard quoted in UNI EN 22768-1

La verifica dimensionale è stata effettuata conformemente alle Norme Tolleranze Generali UNI EN 22768-1

Dimensioni in mm
Dimensions in mm

Classe di Tolleranza Tolerance Classification		Scostamenti per campi di dimensioni fondamentali Tolerances for various ranges quoted below							
Designazione Designation	Denominazione Tolerance Specification	da 0.5 fino a 3 from 0.5 to 3	oltre 3 fino a 6 more than 3 up to 6	oltre 6 fino a 30 more than 6 up to 30	oltre 30 fino a 120 more than 30 up to 120	oltre 120 fino a 400 more than 120 up to 400	oltre 400 fino a 1000 more than 400 up to 1000	oltre 1000 fino a 2000 more than 1000 up to 2000	oltre 2000 fino a 4000 more than 2000 up to 4000
c	grossolana rough	± 0.2	± 0.5	± 1	± 0.8	± 1.2	± 2	± 3	± 4

Firma del costruttore
Manufacturer's signature
PROVIDES metalmecc. s.r.l.
Via Piave n. 82 - LATINA

Data: 28/10/98

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

All. n. 4

APPARECCHIO TIPO: CO 2731 030

NUMERO DI FABBRICA: 12438/B

NUMERO DI MATRICOLA I.S.P.E.S.L.:---

L'apparecchio ha in dotazione i seguenti accessori di sicurezza e di controllo:

Manometro tipo Wika matr.: 1610460

Valvola di sicurezza costruzione CASTEL n.f.: 22807

16-EE498362-IT
ALL. 5

ISTITUTO SUPERIORE PER LA PREVENZIONE
E LA SICUREZZA DEL LAVORO

MINISTERO DELLA SANITÀ

Dipartimento di ROMA

via Angelo BARGONI n° 8 - 00153 Roma

Nella risposta
citare il seguente riferimento

Latina, **13/10/98**

Verifiche eseguite presso la soc. PROVIDES METALMECCANICA S.r.l. Via Piave n. 82 - LATINA

TARATURA AL BANCO DI MANOMETRI

Su richiesta della ditta in oggetto, in data odierna si è eseguita la verifica della taratura al banco di n. 150 manometri per impianti frigo tipo Wika, aventi fondo scala 40 bar e segno rosso di max a 24,5 bar contraddistinti dai seguenti numeri:

1575406-1575407-1575408-1575409-1575410-1575411-1575412-1575413-1575414-
1575415-1575416-1575417-1575418-1575419-1575420-1575421-1575422-1575423-
1575424-2575425-1575426-1575427-1575428-1575429-1575430-1575431-1575432-
1575433-1575434-1575435-1575436-1575437-1575438-1575439-1575440-1575441-
1575442-1575443-1575444-1575445-1575446-1575447-1575448-1575449-1575450-
1575451-1575452-1575453-1575454-1575455-1575456-1575457-1575458-1575459-
1575460-1575461-1575462-1575463-1575464-1575465-1575466-1575467-1575468-
1575469-1575470-1575471-1575472-1575473-1575474-1575475-1575476-1574577-
1575478-1575479-1575480-1575481-1575482-1575483-1575484-1575485-1575486-
1575487-1575488-1575489-1575490-1575491-1575492-1575493-1575494-1575495-
1610401-1610403-1610404-1610405-1610406-1610410-1610412-1610414-1610417-
1610419-1610421-1610423-1610424-1610429-1610430-1610431-1610432-1610433-
1610434-1610435-1610436-1610439-1610440-1610441-1610442-1610443-1610444-
1610445-1610447-1610448-1610452-1610459-1610460-1610461-1610462-1610463-
1610465-1610466-1610467-1610468-1610470-1610471-1610472-1610473-1610478-
1610479-1610481-1610482-1610483-1610484-1610485-1610486-1610489-1610491-
1610493-1610494-1610495-1610497-1610498-1610499.

Non si sono rilevati scarti con manometro campione superiore a ±3% del valore del fondo scala.
(Raccolta E-E1 D6 punto 24)

I.S.P.E.S.L. Dipartimento di Roma

Il Tecnico dell'I.S.P.E.S.L.
Dott. Ing. E. Scerch

CE DECLARATION MANUFACTURER

McQuay International

Reference to the specification under which conformity is declared in accordance with
89 / 392 / CEE , 91 / 368 CEE , e 93 / 68 / CEE
73 / 23 EEC, EMC 89 / 336

Manufacturer : McQUAY ITALIA S.p.A.

Sede Amm. va S.S. Nettunense Km. 12 + 300

00040 Cecchina (Roma) , Italy

Tel. ++39 + 6 937311 **Fax. ++39 + 6 9374014**

declare that the product

Denomination	: WHS 220.3
No. Order McQUAY	: 981365/2
Year of Construction	: 1998

Standard specifications :

CEI EN 60204 - 1	Safety of machinery - Electrical equipment of machines Part 1 - general requirements
UNI EN 292 Part 1° - 2°	Safety of machinery - Basic concepts , general principles for design - technical principles and specifications
UNI EN 294	Safety of machinery - Safety distances to prevent danger zones being reached by the upper limbs
EMC 89 / 336	EMC Electromagnetic compatibility - Standard specifications : EN 50081 - 1 - EN 50082 - 1 - EN 50081 - 2 - EN 50082 EN 55011 - EN 55022 - IEC 801 - 2 - IEC 801 - 3 - IEC 801 - 4 - ENV 50140 - ENV 50141 - EN 61000 - 4 - 8
EEC 73 / 23	Low Voltage Directive

EMC [X] LVD [X] [ ] (..................)

Place , Date : Ariccia, 20 NOV. 1998

Signature :

Name & Surname : Claudio Capozio - Managing Director -

CE DECLARATION MANUFACTURER

McQuay International

Reference to the specification under which conformity is declared in accordance with
89 / 392 / CEE , 91 / 368 CEE , e 93 / 68 / CEE
73 / 23 EEC, EMC 89 / 336

Manufacturer : McQUAY ITALIA S.p.A.

Sede Amm. va S.S. Nettunense Km. 12 + 300

00040 Cecchina (Roma) , Italy

Tel. ++39 + 6 937311 Fax. ++39 + 6 9374014

declare that the product

Denomination WHS 220.3
No. Order McQUAY 981365/1
Year of Construction 1998

Standard specifications :

CEI EN 60204 - 1	Safety of machinery - Electrical equipment of machines Part 1 - general requirements
UNI EN 292 Part 1° - 2°	Safety of machinery - Basic concepts , general principles for design - technical principles and specifications
UNI EN 294	Safety of machinery - Safety distances to prevent danger zones being reached by the upper limbs
EMC 89 / 336	EMC Electromagnetic compatibility - Standard specifications : EN 50081 - 1 - EN 50082 - 1 - EN 50081 - 2 - EN 50082 EN 55011 - EN 55022 - IEC 801 - 2 - IEC 801 - 3 - IEC 801 - 4 - ENV 50140 - ENV 50141 - EN 61000 - 4 - 8
EEC 73 / 23	Low Voltage Directive

EMC [X] LVD [X] [ ] (..................)

Place , Date : Ariccia, 20 NOV. 1998

Signature :

Name & Surname : Claudio Capozio - Managing Director -

PROVIDES

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

UNI EN ISO 9002 (ISO 9002)

DNV

Certified Quality System

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

CERTIFICATO DI COLLAUDO
TEST CERTIFICATE

- Heat Exchanger / Scambiatore : CO 2731 030
- Serial Number / Numero di fabbrica : 12438/B
- Drawing N. / Disegno n. : 2014/I
- Year / Anno : 1998
- Manufacturer / Costruttore : **PROVIDES Metalmeccanica Srl . Latina**

		Inside of the shell Interno mantello	Inside of the tube Interno tubi
Maximum operating pressure Pressione massima di esercizio	Bar	24.5	16
Operating temperature Temperatura di esercizio	°C	-10 +62	-10 +80
Hydraulic testing pressure Pressione di prova idraulica	Bar	30.7	21
Refrigerant content Capacità	Litres Litri	118	37
Refrigerant Natura del fluido		Freon R407C	Acqua

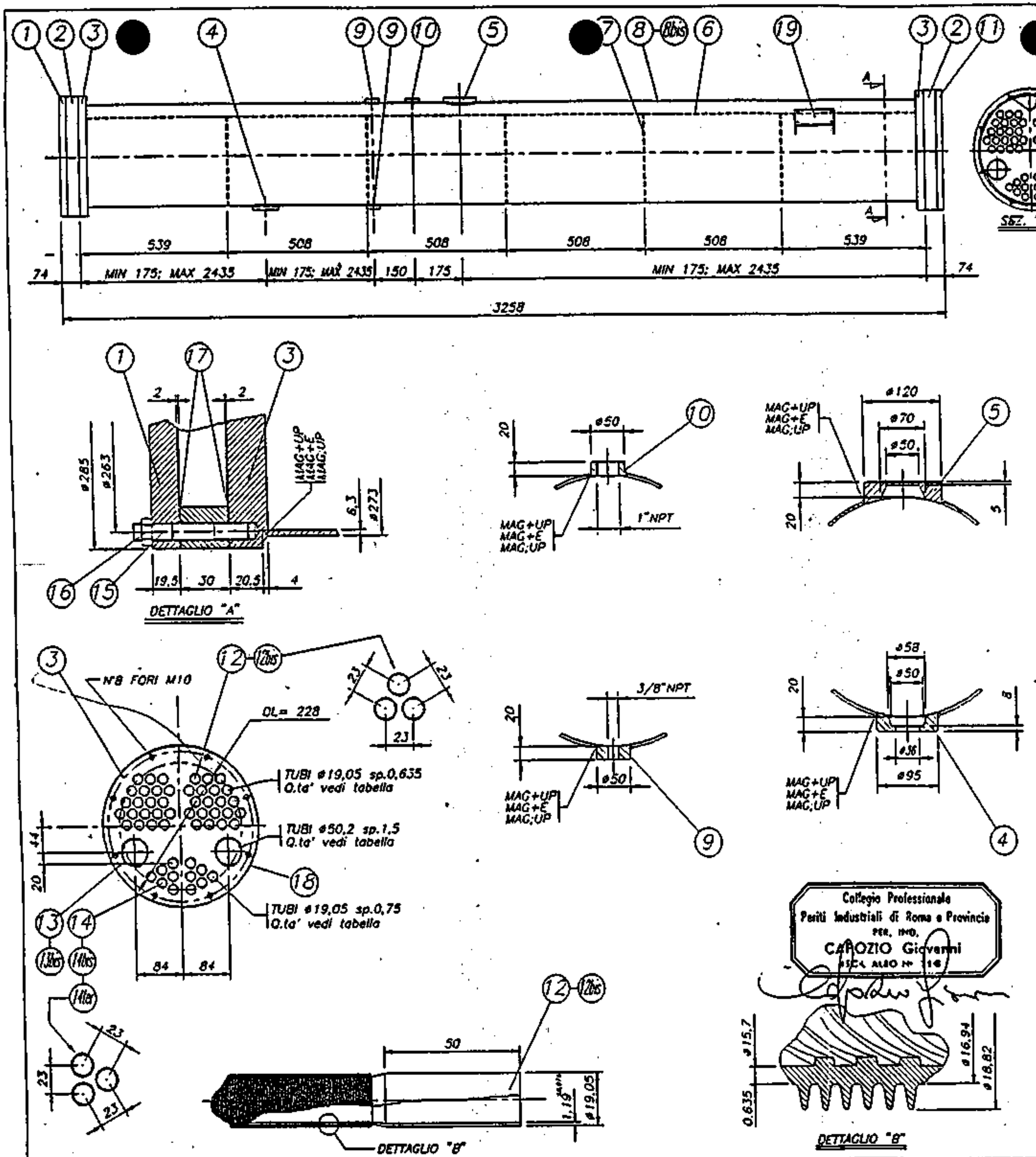
The costruction and materials correspond to the heat exchanger rules. On the heat exchanger there is a plate indicating the serial number, the date of the hydraulic test and a marking (see below) attesting that a test was conducted with a positive outcome.

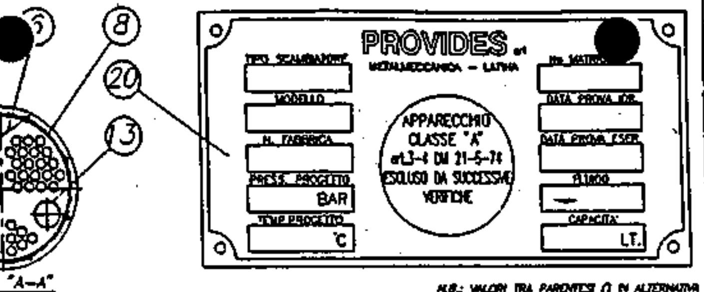
La costruzione ed i materiali impiegati risultano conformi alle normative degli apparecchi a pressione. Sull'apparecchio è posta la targa con il numero di fabbrica, la data della prova idraulica e la punzonatura (vedi sotto) di avvenuto collaudo con esito positivo della prova.

Latina, 28/10/98

PROVIDES metalmec. s.r.l.
Via Piave n. 82 - LATINA

Allegati n. 1-2-3-4-5-6





N.B.: VALORI TRA PARENTESI () IN ALTERNATIVA

MATERIALE DI APPORTO OMOLOGATO: FILO: RMS + FILOCAS (MAG) ; ELETTRODO BOHLER FOX EV 47-(S) AUTOMATIC: AS35/AS231 ø2,36		
GRUPPO DI APPARTENENZA MATERIALE: SA1	PREPARAZIONE LEMBI SECONDO UNI 11001	CATEGORIA II (SECONDA)
MODULO DI EFFICIENZA: Z=0,85 Rx= 10%	QUALIFICA SALDATORI DEL LAZIO: MAG-3-DR+28/Fe UNI 5869	
CLASSE ACCETTABILITA' DIFETTI: III (TERZA)		
QUALIFICA DI PROCEDIMENTO SALDATURA:		

SALDATURE

SI DICHIARA CHE IL PROGETTO NEL SUO INSIEME E NEI SUOI PARTICOLARI E' CONFORME ALLE DISPOSIZIONI DELLA RACCOLTA "S". INOLTRE IL MEATO ESISTENTE AL VERTICE DELLA SALDATURA NON ATTIVA FENOMENI PERICOLOSI DI CORROSIONE

POS	DESCRIZIONE	MATERIALE
20	TARGA DI RICONOSCIMENTO	ALLUMINIO
19	PORTA TARGA	HII DIN 17155/ Fe410 1KW/ 2KW UNI 5869-75
18	PLACCATURA IN CU-NI (SE INSTALLATA)	CuNi 10 Fe 1 Mn UNI 7280
17	GUARNIZIONE CALOTTA	ELASTOMERO NEOPRENE
16	DADO ALTO M10	CLASSE 5.6
15	PRIGIONIERO M10	CLASSE 8.8
14ter	TUBO CU-NI ø19,05 sp.0,75 mm	P-CuNi 10 Fe 1 Mn UNI 6785
14bis	TUBO RAME ø19,05 sp.0,75 mm	Cu 99.9% SF Cu F22 DIN 1787
14	TUBO ACCIAIO ø19,05 sp.0,75 mm	St 35.8 DIN 17175 / ASTM A106-75 GrB
13ter	TUBO RAME ø50 sp.1,5 mm	Cu 99.9% SF Cu F22 DIN 1787
13bis	TUBO CU-NI ø50 sp.1,5 mm	P-CuNi 10 Fe 1 Mn UNI 6785
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12bis	TUBO CU-NI ø19,05 sp. 0,635mm	P-CuNi 10 Fe 1 Mn UNI 6785
12	TUBO RAME ø19,05 sp. 0,635mm	Cu 99.9% SF Cu F22 DIN 1787
11	FONDO DI CHIUSURA POSTERIORE sp.24,5 mm	HII DIN 17155 / Fe 360C UNI 7070
10	MANICOTTO 1"NPT	Fe 410 1KW/2KW UNI 5869-75
9	MANICOTTO 3/8"NPT	HII DIN 17155
8	INVOLUCRO (RICAVATO DA TUBO)	St 35.8 DIN 17175 / ASTM A106-75 GrB
7	DIAFRAMMA Sp. 2 mm	Fe 360C UNI 7070
6	DISTRIBUTORE GAS	
5	MANICOTTO INGRESSO GAS	HII DIN 17155
4	MANICOTTO USCITA LIQUIDO	Fe 410 1KW UNI 5869-75
3	PIASTRA TUBIERA	Fe 410 2KW UNI 5869-75
2	DISTRIBUTORE CALOTTA POST./ANTER.	GHISA G25
1	FONDO PIANO CALOTTA ANTERIORE	HII DIN 17155 / Fe 360C UNI 7070

DISTINTA MATERIALI

TUTTI I MATERIALI COSTITUENTI LE MEMBRATURE IN PRESSIONE SARANNO FORNITI CON CERTIFICATI DI COLLAUDO O DI PROVENIENZA SECONDO LA VIGENTE NORMATIVA I.S.P.E.S.L.

CAPACITA'	ℓ	VEDI TABELLA FOGLIO ALLEGATO 2/2				
PRESSIONE DI PROVA IDRAULICA	bar (kg/cmq)	21 (21,5)	30.7 (31,3)			
PRESSIONE DI PROGETTO	bar (kg/cmq)	16 (16,4)	24,9 (25.0)			
TEMPERATURA DI PROGETTO	°C	MIN.+10 MAX+40	MIN.+10 MAX+67		MIN.+10 MAX+80	MIN.+10 MAX+67
FLUIDO		ACQUA	R22	R407C	R134a	R410A
OVALIZZAZIONE MASSIMA	%	1	1			
SOVRASPESSORE DI CORROSIONE	mm	1	0			
COLLAUDO I.S.P.E.S.L.		NO	SI			
CLASSE DI APPART. SECONDO RACCOLTA "E"		"a"				
CAMERA		LATO ACQUA	LATO REFRIGERANTE			

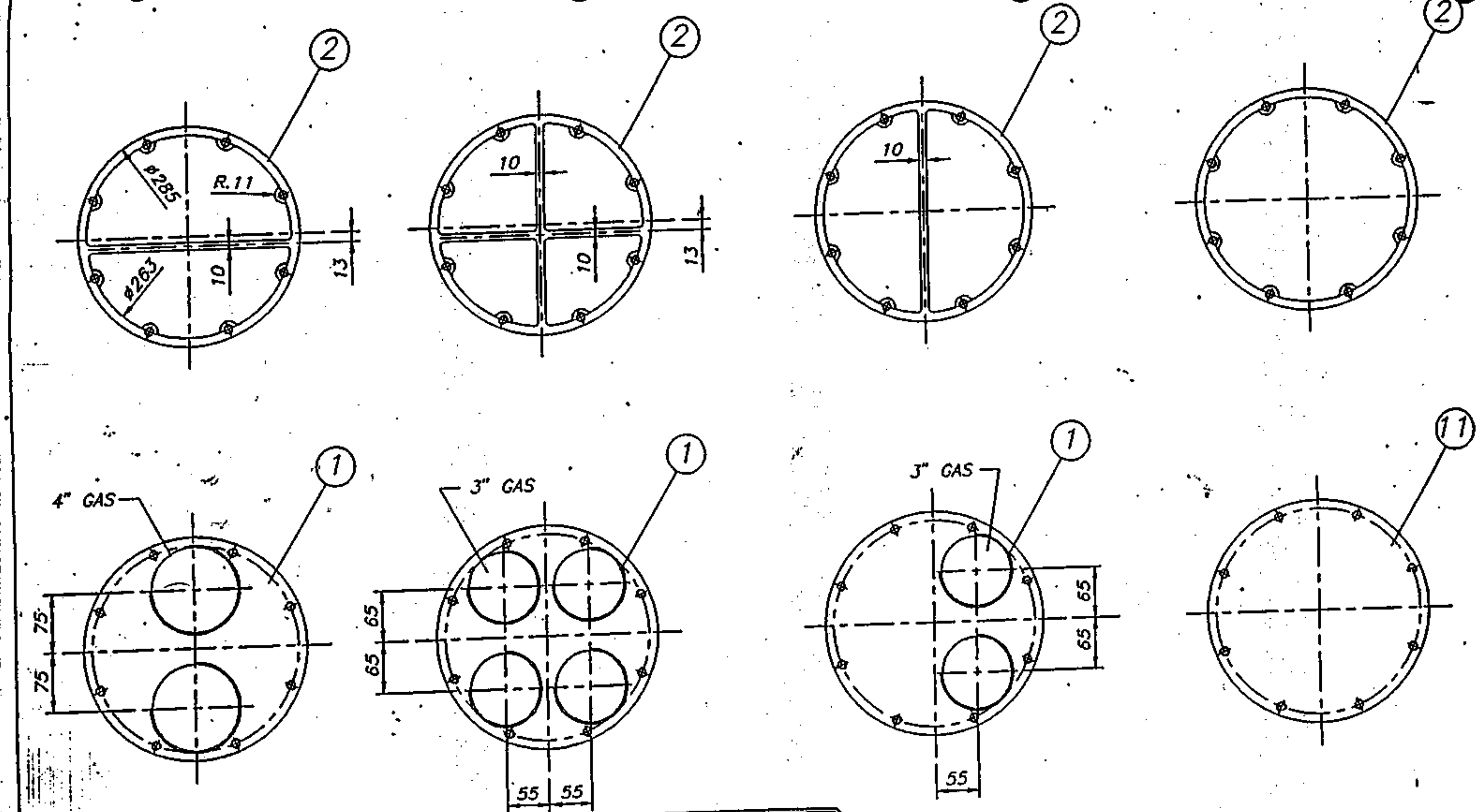
DATI DI PROGETTO

LE MEMBRATURE A PRESSIONE SONO VERIFICATE PER LE CONDIZIONI PREVISTE DALL'ART. 1 D.M. 21-11-1972
NEI CALCOLI LE PRESSIONI SONO ESPRESSE IN kg/cmq CON LE SEGUENTI EQUIVALENZE:
1 kg/cmq = 0,98665 bar ; 1 bar = 1,019716 kg/cmq

COSTRUZIONE APPROVATA CON LETTERA I.S.P.E.S.L. No DI PROTOCOLLO .... DEL ....
NUMERO DI FABBRICA ....
PROGETTISTA: P.I. GIOVANNI CAPOZIO

Descrizione: CONDENSATORE RECUPERATORE	Data :21-02-1997	Tolleranza generale Grezza: ± / Finito: ±		Peso grezzo (kg): ....
	Scala : 1:			Peso finito (kg): ....
	Dim. grezze : ...	Disegnato:		Ver/Appr. : ....
PROVIDES	MODELLO: C2731			Classifica: 2014/i foglio 1/2

All. 1



ALL 1 BIS

Collegio Professionale
Periti Industriali di Roma e Provincia
PER. IND.
CAPOZIO Giovanni
ISCR. ALBO N° 716

ALTERNATIVE PER FONDI PIANI E DISTRIBUTORI

2731040	40	2	12	101	46
2731036	36	2	10	111	42
2731030	30	2	8	118	37
2731026	26	2	8	121	35
2731020	20	2	6	128	30
MODELLO CONDENSATORE	N°TUBI Pos.12	N°TUBI Pos.13	N°TUBI Pos.14	LATO GAS	LATO ACQUA
				CAPACITA' (lt)	

Descrizione:
CONDENSATORE RECUPERATORE

Data : 21-02-1997
Scala :
Dim. grezzo :

Tolleranze generale
Grezzo: ±
Finito: ±
Disegnato:

Peso grezzo (kg) :
Peso finito (kg) :
Ver/Appr. :

PROVIDES
METALMECCANICA Srl

MODELLO:
C2731

Classifica:
2014/i
Foglio 2/2

Allegato N° 2

Costruttore Provides Metalmeccanica S.r.l.

N. di fabbrica 12638/B Matricola e sigla 98 LT

DICHIARAZIONI DEL COSTRUTTORE

a) MATERIALI (1) - MEMBRATURE (2)

- Tubo di rame ø 19,05 x 0,75 certificato Wieland secondo EN 10204 tipo 3.1B n. 68/0547 del 20/05/97
- Tubo di rame Ø 19,05 x 0,63 certificato Wieland secondo EN 10204 tipo 3.1B n. 68/0516 del 18/02/97
- Tubo di rame Ø 50 x 1,5 certificato Outokumpu secondo EN 10204 del 14/10/97

b) TRATTAMENTI TERMICI (3) - EVENTUALI ALTRE DICHIARAZIONI (4)

c) SALDATURE (estremi dei certificati di qualifica e di omologazione)

— Procedimenti di saldatura (5)

- Elettrico procedimento MAG (staffe e selle)
- Automatico in arco sommerso (fasciame - fondi - p. tubiera)

Qualifiche IIS n. 4200 - 4343 - 4359 27315 data 21/05/84

— Elettrodi impiegati (6)

Filo pieno tipo RMS Ø 1 mm.
Filo pieno RM2 - AS - 35
Flusso AS 231 (SIO)

— Saldatori (7)

D'Annibale Romeo-Qualif. I.I.S. n.4343 Rinn. ISPESL del 23/06/98
Comuzzi Sergio - Qualif.ISPESL n. 12534-12535 Rinn.ISPESL del 23/06/98
Magagna Stefano- Qualif.ISPESL n. 12536-12537 Rinn. ISPESL del 23/06/98

d) TALLONI DI SALDATURA (8)

e) ESAMI NON DISTRUTTIVI (9)

Data 28/10/98

Timbro e firma del Costruttore
PROVIDES Metalmecc. S.r.l.
Via Piave n. 82 - LATINA

(Vedere Note a tergo)

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

UNI EN ISO 9002 (ISO 9002) DNV Certified Quality System

Allegato n. 3
Encl. n. 3

Costruttore : PROVIDES
Manufacturer : METALMECCANICA Srl

N. di fabbrica : 12438/B
Serial number :

Materiali - Materials					Certif. - Certif.		Note Notes
Posiz. Item	Spessore Thickness mm	Fabbricante Manufacturer	Qualità sigla tab.unificata Quality and specifications	Colata pezzo o lotto n. Heat n.	Numero Number	Data Date	
1	25	Thyssen Krupp Stahl	P 265 GH	637551	99845	03/06/98	P. tubiera
2	35	Falck	HII DIN 17155	22213	9939	28/07/95	Zuccherotti
3	5	Dalmine	ASTM A 106 gr. B	32475	2592	10/02/96	Virola

All dimensions have been verified and correspond to standard quoted in UNI EN 22768-1

La verifica dimensionale è stata effettuata conformemente alle Norme Tolleranze Generali UNI EN 22768-1

Dimensioni in mm
Dimensions in mm

Classe di Tolleranza Tolerance Classification		Scostamenti per campi di dimensioni fondamentali Tolerances for various ranges quoted below							
Designazione Designation	Denominazione Tolerance Specification	da 0.5 fino a 3 from 0.5 to 3	oltre 3 fino a 6 more than 3 up to 6	oltre 6 fino a 30 more than 6 up to 30	oltre 30 fino a 120 more than 30 up to 120	oltre 120 fino a 400 more than 120 up to 400	oltre 400 fino a 1000 more than 400 up to 1000	oltre 1000 fino a 2000 more than 1000 up to 2000	oltre 2000 fino a 4000 more than 2000 up to 4000
c	grossolana rough	± 0.2	± 0.5	± 1	± 0.8	± 1.2	± 2	± 3	± 4

Firma del costruttore
Manufacturer's signature

PROVIDES metalmecc. s.r.l.
Via Piave n. 82 - LATINA

Data: 28/10/98

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

All. n. 4

APPARECCHIO TIPO: CO 2731 030

NUMERO DI FABBRICA: 12438/B

NUMERO DI MATRICOLA I.S.P.E.S.L.:---

L'apparecchio ha in dotazione i seguenti accessori di sicurezza e di controllo:

Manometro tipo Wika matr.: 1610460

Valvola di sicurezza costruzione CASTEL n.f.: 22807

C.C.I.A.A. Latina 42232 - Reg. Impr. Trib. Latina 2285 - C.C.P. 12385043 Ufficio I.V.A. Latina Partita n° 00080600596

16-EE498362-IT
ALL. 5

MINISTERO DELLA SANITÀ

ISTITUTO SUPERIORE PER LA PREVENZIONE
E LA SICUREZZA DEL LAVORO

Dipartimento di ROMA

via Angelo BARGONI n° 8 - 00153 Roma

Nella risposta
citare il seguente riferimento

Latina, **13/10/98**

Verifiche eseguite presso la soc. PROVIDES METALMECCANICA S.r.l. Via Piave n. 82 - LATINA

TARATURA AL BANCO DI MANOMETRI

Su richiesta della ditta in oggetto, in data odierna si è eseguita la verifica della taratura al banco di n. 150 manometri per impianti frigo tipo Wika, aventi fondo scala 40 bar e segno rosso di max a 24,5 bar contraddistinti dai seguenti numeri:

1575406-1575407-1575408-1575409-1575410-1575411-1575412-1575413-1575414-
1575415-1575416-1575417-1575418-1575419-1575420-1575421-1575422-1575423-
1575424-2575425-1575426-1575427-1575428-1575429-1575430-1575431-1575432-
1575433-1575434-1575435-1575436-1575437-1575438-1575439-1575440-1575441-
1575442-1575443-1575444-1575445-1575446-1575447-1575448-1575449-1575450-
1575451-1575452-1575453-1575454-1575455-1575456-1575457-1575458-1575459-
1575460-1575461-1575462-1575463-1575464-1575465-1575466-1575467-1575468-
1575469-1575470-1575471-1575472-1575473-1575474-1575475-1575476-1574577-
1575478-1575479-1575480-1575481-1575482-1575483-1575484-1575485-1575486-
1575487-1575488-1575489-1575490-1575491-1575492-1575493-1575494-1575495-
1610401-1610403-1610404-1610405-1610406-1610410-1610412-1610414-1610417-
1610419-1610421-1610423-1610424-1610429-1610430-1610431-1610432-1610433-
1610434-1610435-1610436-1610439-1610440-1610441-1610442-1610443-1610444-
1610445-1610447-1610448-1610452-1610459-1610460-1610461-1610462-1610463-
1610465-1610466-1610467-1610468-1610470-1610471-1610472-1610473-1610478-
1610479-1610481-1610482-1610483-1610484-1610485-1610486-1610489-1610491-
1610493-1610494-1610495-1610497-1610498-1610499.

Non si sono rilevati scarti con manometro campione superiore a +3% del valore del fondo scala.
(Raccolta E-E1 D6 punto 24)

I.S.P.E.S.L. Dipartimento di Roma

Il Tecnico dell'I.S.P.E.S.L.
Dott. Ing. E. Scerch

Castel

s.r.l. Sede soc. e amm.: Via Pordenone, 38
20132 Milano Italy
tel. 215.38.28 - fax 264.132.95
Tribunale di Milano
Registro Imprese 113702
Cod. Fisc. 00779080159
Cap. Soc. L. 500.000.000

Stabilimento e Magazzini: Via Provinciale N. 2-4
20060 Pessano con Bornago (MI)
Tel. 95702.1
Telefax 957.413.17
C.C.I.A.A. Milano 590866
Mecc. MI 019956

PER QUANTO CONCERNE LE VERIFICHE ISTITUZIONALI (ISPESL e/o USSL), IL CERTIFICATO DI TARATURA AL BANCO EFFETTUATA ALLA PRESENZA DELL'ISPESL, HA VALIDITÀ DI 1 ANNO

VALVOLA DI SICUREZZA - CERTIFICATO DI FABBRICAZIONE

(Decreto ministeriale 21 maggio 1974)
(Norma ANCC, raccolta E, fascicolo E1D, edizione gennaio 1979 punto 10.1)

In base alle norme di cui sopra, si certifica quanto segue:

a) Ditta fabbricante: CASTEL s.r.l.		
b) Numero di Modello (catalogo) della valvola	:	3030/88
c) Numero di matricola della valvola (n. di fabbrica) e numero del certificato di fabbricazione	:	22807
d) Pressione nominale per le connessioni di ingresso e di uscita della valvola	: PN	40/40
Diametri nominali per le connessioni di ingresso e uscita della valvola	: DN	1" / 1"
e) Diametro dell'orifizio	: D_o, mm.	19,50
Area "A" della sezione trasversale minima netta dell'orifizio	: cm.^{2}	2,98
f) Alzata "h"	: mm.	6,80
Coefficiente "K"	:	0,83
g) Campo di variabilità pressione di taratura a contropressione atmosferica	: bar	22,70/29,40
Campo di temperatura	: °C	(–50) + (+150)
h) Sovrappressione espressa in % della pressione di taratura	: %	5%

(Prot. 21916 del 28/06/1982) Sez. Lombardia Centr.
Certificato Omologazione n. 21757 A Riconferma Omologazione VS/88/92 Del 10/06/82 (per 3030/44 - 3030/44 A)
Certificato Omologazione n. 21757 B Riconferma Omologazione VS/89/92 Del 10/06/82 (per 3030/88 - 3030/88 A)

i) materiali impiegati:
- corpo valvola e otturatore: OT 58 UNI 5705
- molla: Acciaio Classe C UNI 3823
- guarnizione otturatore: Teflon (Politetrafluoroetilene)

l) esito dei collaudi:	
– controllo dimensionale	positivo
– collaudo finale	positivo
– prova idraulica lato ingresso e lato uscita a 60 bar	positivo
m) Scarto di richiusura espresso in % della pressione di taratura : %	15%

- Fluidi: Aria - Freon - Cloruro di metile
- Stato fisico: vapore o gas

Pessano, li 25/11/97

Castel

I.S.P.E.S.L.
Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro
Sede di Milano, Via Mangiagalli 3

Certificato N. 22807

Certificato di taratura al banco di valvola di sicurezza presso il fabbricante

Località, Pessano con Bornago

li 03/12/97

La valvola di sicurezza di cui al presente certificato, fabbricante CASTEL s.r.l. - **n.f. vedi a fianco** corrisponde al modello 3030/88 di cui al certificato di fabbricazione n. **vedi a fianco** del **vedi a fianco** ed al certificato cumulativo di taratura n. 986 del 03/12/97 (solo per le valvole costruite in serie), con diametro dell'orifizio D_o = 19,50 mm.
La taratura della valvola è stata eseguita con aria compressa a temperatura ambiente e contropressione atmosferica alla pressione di 24,50 bar
Dispositivo di blocco della taratura:
- caratteristiche: vite di bloccaggio
- posizione: inserimento sulla parte superiore del corpo valvola
- inamovibilità: assicurata dal piombo

Sulla vite di regolazione di taratura o sul corpo, risultano punzonati i seguenti dati:
- numero di modello (catalogo) della valvola: 3030/88
- pressione di taratura 24,50 bar
- numero di fabbrica: **vedi a fianco**
- sul corpo risultano ricavati per stampaggio il marchio del costruttore e il senso di percorrenza del fluido
- punzone ISPESL N. 178 sul piombo

I.S.P.E.S.L. MINISTERO DELLA SANITÀ DIPARTIMENTO DI MILANO

IL TECNICO
Dott. Ing. Alfonso DE LUCIA

Dichiarazione di cui al punto 2 della disposizione E.1 D. ed. gennaio 1979

2.1. – Valvola a molla diretta.

2.2. – La costruzione ed i materiali impiegati sono idonei per le condizioni di funzionamento, temperatura, corrosività ed altre proprietà dei seguenti fluidi: - Cloro fluoroderivati "Freon" per usi frigoriferi, Cloruro di Metile, aria compressa.

2.3. – Sedi piane.

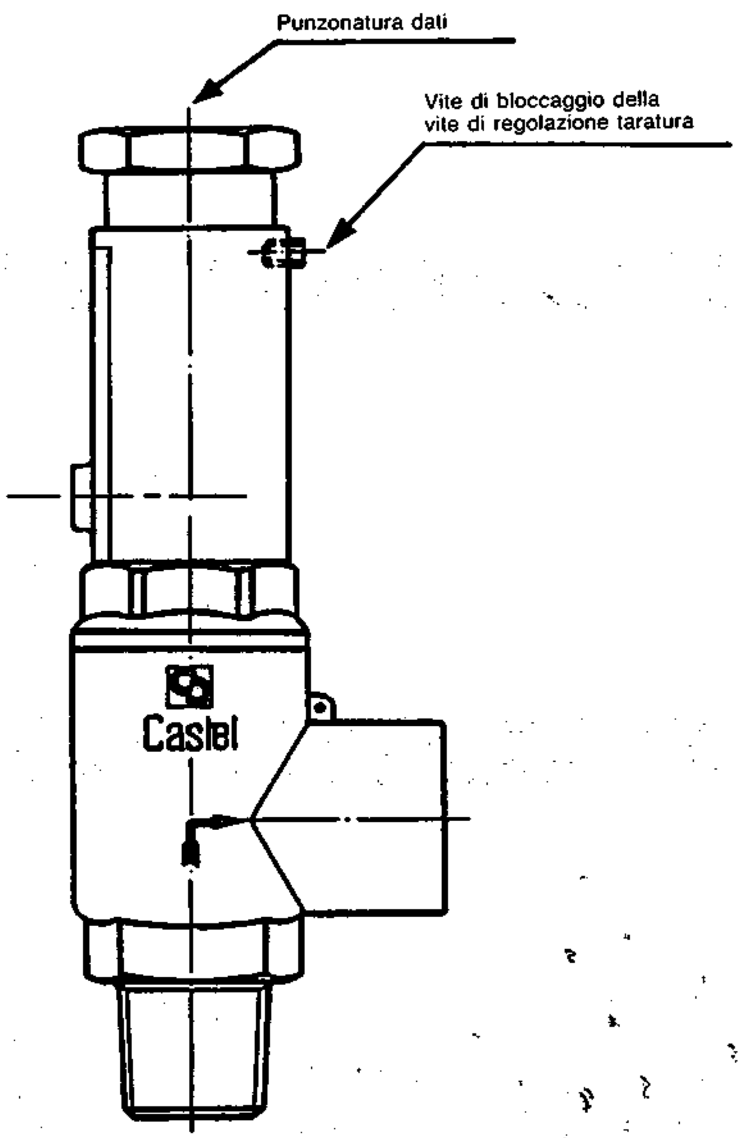
2.4. – La guarnizione di tenuta in teflon è tale che, anche in prolungato esercizio, conserva buone caratteristiche di resistenza e non provoca fenomeni di incollamento nell'otturatore sulla sede.

2.5. – L'otturatore è guidato nel suo movimento.

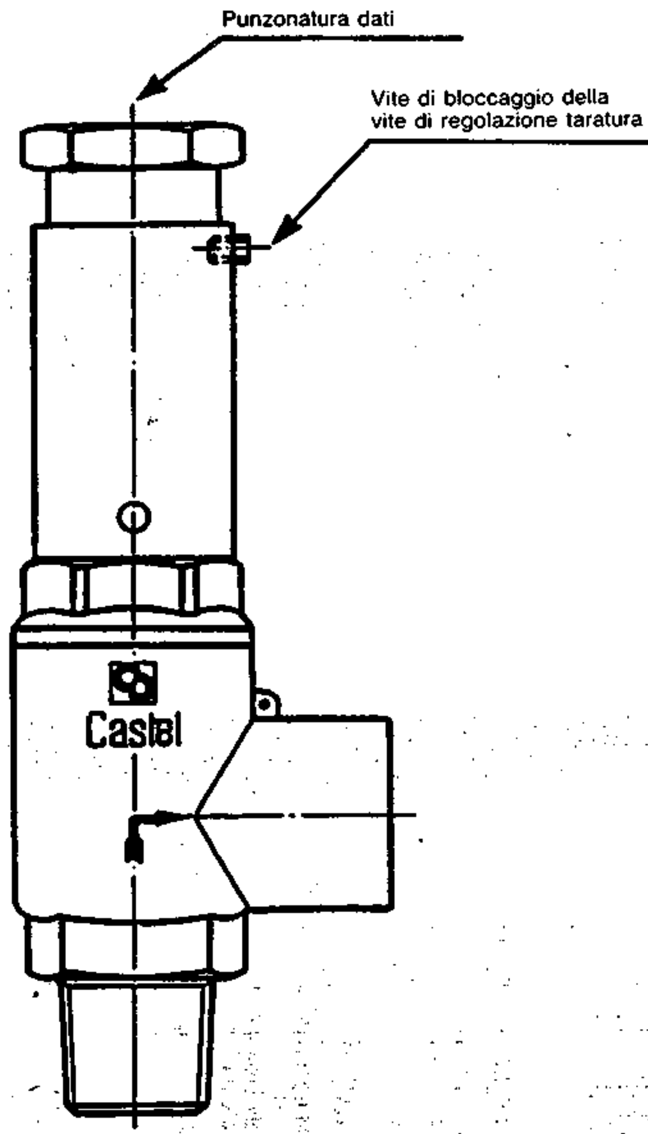
2.6. – L'otturatore è privo di premistoppa.

2.7. – Le spire della molla, escluse quelle terminali, sono distanziate tra di loro del minore tra mezzo diametro del filo e 2 mm. quando l'otturatore raggiunge l'alzata. La freccia della molla, quando l'otturatore è in posizione di blocco meccanico, non è superiore all'85% della freccia totale.

2.8. – Il sistema di taratura è meccanicamente bloccato tramite la vite.



3030/44



3030/88

CE DECLARATION MANUFACTURER

McQuay International

Reference to the specification under which conformity is declared in accordance with
89 / 392 / CEE , 91 / 368 CEE , e 93 / 68 / CEE
73 / 23 EEC, EMC 89 / 336

Manufacturer : **McQUAY ITALIA S.p.A.**

Sede Amm. va S.S. Nettunense Km. 12 + 300

00040 Cecchina (Roma) , Italy

Tel. ++39 + 6 937311 **Fax. ++39 + 6 9374014**

declare that the product

Denomination WHS 220.3
No. Order McQUAY 981365/1
Year of Construction 1998

Standard specifications :

CEI EN 60204 - 1	Safety of machinery - Electrical equipment of machines Part 1 - general requirements
UNI EN 292 Part 1° - 2°	Safety of machinery - Basic concepts , general principles for design - technical principles and specifications
UNI EN 294	Safety of machinery - Safety distances to prevent danger zones being reached by the upper limbs
EMC 89 / 336	EMC Electromagnetic compatibility - Standard specifications : EN 50081 - 1 - EN 50082 - 1 - EN 50081 - 2 - EN 50082 EN 55011 - EN 55022 - IEC 801 - 2 - IEC 801 - 3 - IEC 801 - 4 - ENV 50140 - ENV 50141 - EN 61000 - 4 - 8
EEC 73 / 23	Low Voltage Directive

EMC ☒ LVD ☒ ☐ (..................)

Place , Date : Ariccia, 20 NOV. 1998

Signature :

Name & Surname : Claudio Capozio - Managing Director -

CE DECLARATION MANUFACTURER

McQuay International

Reference to the specification under which conformity is declared in accordance with
89 / 392 / CEE , 91 / 368 CEE , e 93 / 68 / CEE
73 / 23 EEC, EMC 89 / 336

Manufacturer : McQUAY ITALIA S.p.A.

Sede Amm. va S.S. Nettunense Km. 12 + 300

00040 Cecchina (Roma) , Italy

Tel. ++39 + 6 937311 Fax. ++39 + 6 9374014

declare that the product

Denomination :WHS 220.3
No. Order McQUAY :981365/2
Year of Construction :1998

Standard specifications :

CEI EN 60204 - 1	Safety of machinery - Electrical equipment of machines Part 1 - general requirements
UNI EN 292 Part 1° - 2°	Safety of machinery - Basic concepts , general principles for design - technical principles and specifications
UNI EN 294	Safety of machinery - Safety distances to prevent danger zones being reached by the upper limbs
EMC 89 / 336	EMC Electromagnetic compatibility - Standard specifications : EN 50081 - 1 - EN 50082 - 1 - EN 50081 - 2 - EN 50082 EN 55011 - EN 55022 - IEC 801 - 2 - IEC 801 - 3 - IEC 801 - 4 - ENV 50140 - ENV 50141 - EN 61000 - 4 - 8
EEC 73 / 23	Low Voltage Directive

EMC [X] LVD [X] [ ] (..................)

Place , Date : Ariccia, 20 NOV. 1998

Signature :

Name & Surname : Claudio Capozio - Managing Director -

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT
UNI EN ISO 9002 (ISO 9002)
DNV
Certified Quality System

CERTIFICATO DI COLLAUDO
TEST CERTIFICATE

- Heat Exchanger / Scambiatore: **CO 3515 060**
- Serial Number / Numero di fabbrica: 12437/B
- Drawing N. / Disegno n.: 2012/I
- Year / Anno: 1998
- Manifacturer / Costruttore: **PROVIDES Metalmeccanica Srl . Latina**

		Inside of the shell Interno mantello	Inside of the tube Interno tubi
Maximum operating pressure Pressione massima di esercizio	Bar	24.5	16
Operating temperature Temperatura di esercizio	°C	-10 +62	-10 +80
Hydraulic testing pressure Pressione di prova idraulica	Bar	30.7	21
Refrigerant content Capacità	Litres Litri	96	44
Refrigerant Natura del fluido		Freon R22/407C	Acqua

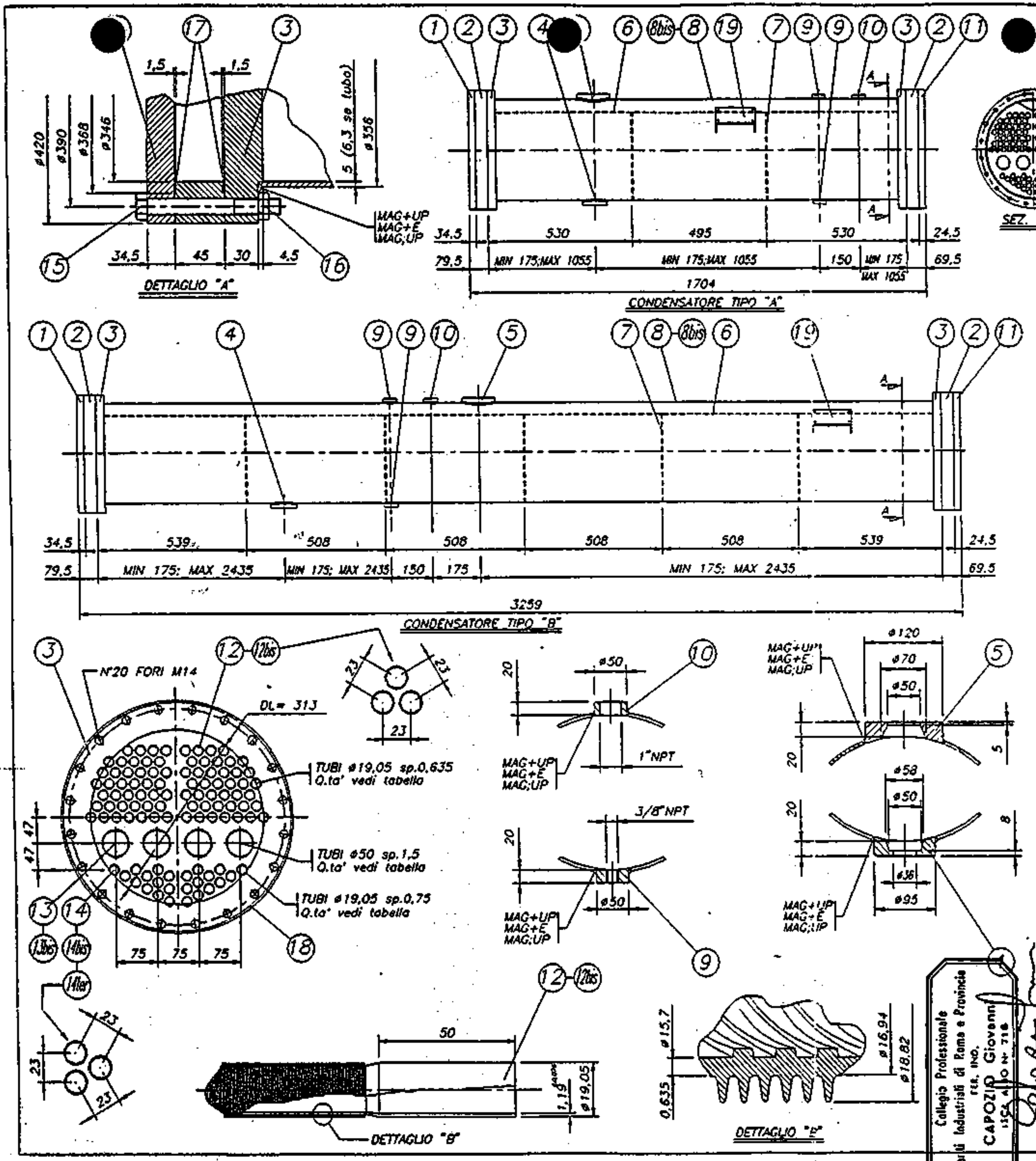
The costruction and materials correspond to the heat exchanger rules. On the heat exchanger there is a plate indicating the serial number, the date of the hydraulic test and a marking (see below) attesting that a test was conducted with a positive outcome.

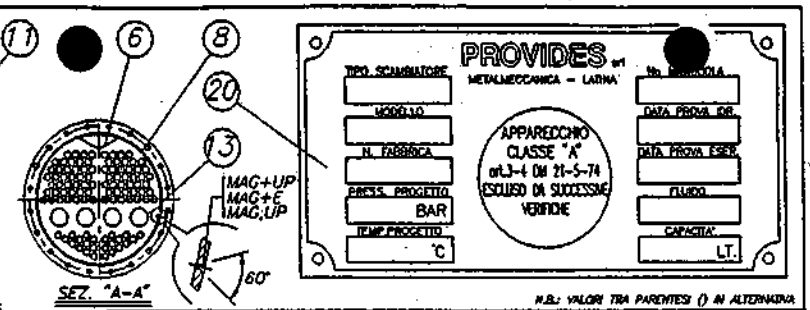
La costruzione ed i materiali impiegati risultano conformi alle normative degli apparecchi a pressione.
Sull'apparecchio è posta la targa con il numero di fabbrica, la data della prova idraulica e la punzonatura (vedi sotto) di avvenuto collaudo con esito positivo della prova.

Latina, 28/10/98

PROVIDES metalmecc. s.r.l.
Via Piave n. 82 LATINA

Allegati n. 1-2-3-4-5-6





N.B.: VALORI TRA PARENTESI () IN ALTERNATIVA

MATERIALE DI APPORTO OMOLOGATO: FILO: RMS + FILOGAS (MAG) ; ELETTRODO BOHLER FOX EV 47-(E) AUTOMATIC: AS35/AS231 ø2,39		
GRUPPO DI APPARTENENZA MATERIALI: SA1	PREPARAZIONE LEMBI SECONDO UNI 11001	CATEGORIA II (SECONDA)
MODULO DI EFFICIENZA: Z=0,85 Rx= 10%	QUALIFICA SALDATORI DEL LAZIO: MAG-3-OR+20/Fe UNI 5669	
CLASSE ACCETTABILITA' DIFETTI: III (TERZA)		
QUALIFICA DI PROCEDIMENTO SALDATURA:		

SALDATURE

SI DICHIARA CHE IL PROGETTO NEL SUO INSIEME E NEI SUOI PARTICOLARI E' CONFORME ALLE DISPOSIZIONI DELLA RACCOLTA "S". INOLTRE IL MEATO ESISTENTE AL VERTICE DELLA SALDATURA NON ATTIVA FENOMENI PERICOLOSI DI CORROSIONE.

POS	DESCRIZIONE	MATERIALE
20	TARGA DI RICONOSCIMENTO	ALLUMINIO
19	PORTA TARGA	HII DIN 17155/ Fe410 1KW/ 2KW UNI 5869-75
18	PLACCATURA IN CU-NI (SE INSTALLATA)	CuNi 10 Fe 1 Mn UNI 7280
17	GUARNIZIONE CALOTTA	ELASTOMERO NEOPRENE
16	DADO ALTO	CLASSE 5.6
15	VITE M14	CLASSE 8.8
14ter	TUBO CU-NI ø19,05 sp.0,75 mm	P-CuNi 10 Fe 1 Mn UNI 6785
14bis	TUBO RAME ø19,05 sp.0,75 mm	Cu 99,9% SF Cu F22 DIN 1787
14	TUBO ACCIAIO ø19,05 sp.0,75 mm	St 35.8 DIN 17175 / ASTM A106-75 GrB
13ter	TUBO RAME ø50 sp.1,5 mm	Cu 99.9% SF Cu F22 DIN 1787
13bis	TUBO CU-NI ø50 sp.1,5 mm	P-CuNi 10 Fe 1 Mn UNI 6785
13	TUBO ACCIAIO ø50 sp.1,5 mm	St 35.8 DIN 17175 / ASTM A106-75 GrB
12bis	TUBO CU-NI ø19,05 sp. 0,635mm	P-CuNi 10 Fe 1 Mn UNI 6785
12	TUBO RAME ø19,05 sp. 0,635mm	Cu 99,9% SF Cu F22 DIN 1787
11	FONDO DI CHIUSURA POSTERIORE sp.24,5 mm	HII DIN 17155 / Fe 360C UNI 7070
10	MANICOTTO 1"NPT	Fe 410 1KW/2KW UNI 5869-75
9	MANICOTTO 3/8"NPT	HII DIN 17155
8bis	INVOLUCRO (RICAVATO DA TUBO)	St 35.8 DIN 17175 / ASTM A106-75 GrB
8	INVOLUCRO (RICAVATO DA LAMIERA)	HII DIN 17155/ Fe410 1KW/ 2KW UNI 5869-75
7	DIAFRAMMA Sp. 2 mm	Fe 360C UNI 7070
6	DISTRIBUTORE GAS	
5	MANICOTTO INGRESSO GAS	HII DIN 17155
4	MANICOTTO USCITA LIQUIDO	Fe 410 1KW UNI 5869-75
3	PIASTRA TUBIERA	Fe 410 2KW UNI 5869-75
2	DISTRIBUTORE CALOTTA POST./ANTER.	GHISA G25
1	FONDO PIANO CALOTTA ANTERIORE	HII DIN 17155 / Fe 360C UNI 7070

DISTINTA MATERIALI

TUTTI I MATERIALI COSTITUENTI LE MEMBRATURE IN PRESSIONE SARANNO FORNITI CON CERTIFICATI DI COLLAUDO O DI PROVENIENZA SECONDO LA VIGENTE NORMATIVA I.S.P.E.S.L.

CAPACITA' lt	VEDI TABELLA FOGLIO ALLEGATO 2/2				
PRESSIONE DI PROVA IDRAULICA bar (kg/cmq)	21 (21,5)	30,7 (31,3)			
PRESSIONE DI PROGETTO bar (kg/cmq)	16 (16,4)	24,5 (25,0)			
TEMPERATURA DI PROGETTO °C	MIN.+10 MAX+80	MIN.+10 MAX+62		MIN.+10 MAX+80	MIN.+10 MAX+4?
FLUIDO	ACQUA	R22	R407C	R134a	R410A
OVALIZZAZIONE MASSIMA %	1	1			
SOVRASPESSORE DI CORROSIONE mm	1	0			
COLLAUDO I.S.P.E.S.L.	NO	SI			
CLASSE DI APPART. SECONDO RACCOLTA "E"	"d"				
CAMERA	LATO ACQUA	LATO REFRIGERANTE			

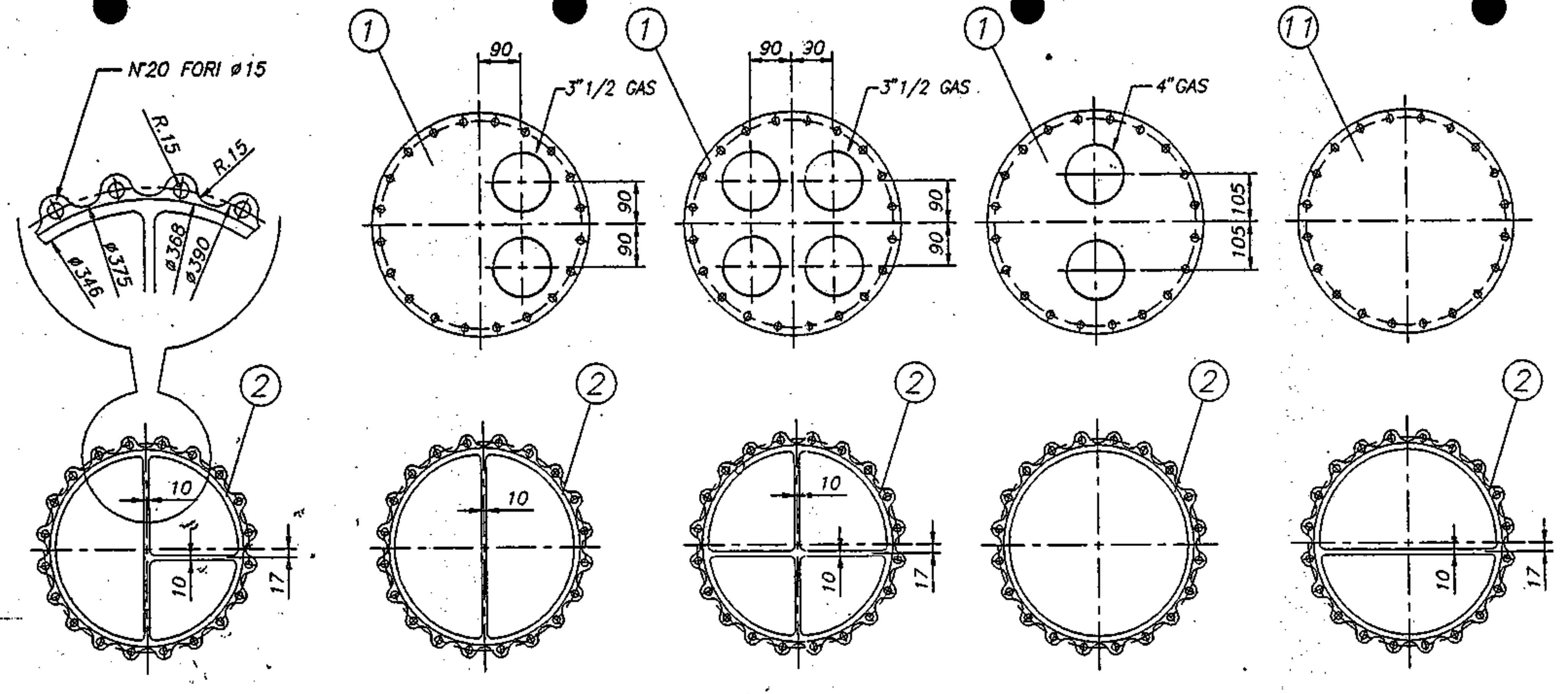
DATI DI PROGETTO

LE MEMBRATURE A PRESSIONE SONO VERIFICATE PER LE CONDIZIONI PREVISTE DALL'ART. 1 D.M. 21-11-1972
NEI CALCOLI LE PRESSIONI SONO ESPRESSE IN kg/cmq CON LE SEGUENTI EQUIVALENZE:
1 kg/cmq = 0,98665 bar ; 1 bar = 1,019716 kg/cmq

COSTRUZIONE APPROVATA CON LETTERA I.S.P.E.S.L. No DI PROTOCOLLO .... DEL ....
NUMERO DI FABBRICA ....
PROGETTISTA: P.I. GIOVANNI CAPOZIO

Descrizione: CONDENSATORE RECUPERATORE	Data :06-03-1997	Tolleranze generali: Grezze: ... Finite: ...		Peso grezzo (kg): ....
	Scala :			Peso finito (kg) : ....
	Dim. grezze :	Disegnato:		Ver/Appr. : ....
PROVIDES	MODELLO: C3515 TIPO "A" C3531 TIPO "B"			Classifica: 2012/i foglio 1/2

ALL. 7



ALTERNATIVE PER FONDI PIANI E DISTRIBUTORI

ALL. 1 BIS

MODELLO CONDENSATORE	N°TUBI Pos.12	N°TUBI Pos.13	N°TUBI Pos.14	CONDENS. TIPO	CAPACITA'(lt) LATO GAS	CAPACITA'(lt) LATO ACQUA
3531080	80	4	24	B	173	96
3531072	72	4	22	B	182	90
3531060	60	4	18	B	196	80
3531052	52	4	16	B	204	73
3531040	40	2	12	B	229	52
3531036	36	2	10	B	234	49
3531030	30	2	8	B	241	44
3531026	26	2	8	B	245	41
3515080	80	4	24	A	85	52
3515072	72	4	22	A	89	49
3515060	60	4	18	A	96	44
3515052	52	4	16	A	100	41

Descrizione: CONDENSATORE RECUPERATORE	Data :06-02-1997	Tolleranza generale Grezzo: ± Finito: ±	Peso grezzo (kg):
	Scala :		Peso finito (kg):
	Dim. grezzo :	Disegnato:	Ver/Appr. :
PROVIDES METALMECCANICA Srl	MODELLO: C3515 C3531		Classifica: 2012/i Foglio 2/2

Allegato N° 2

Costruttore Provides Metalmeccanica S.r.l.

N. di fabbrica 12437/B Matricola e sigla 98 , LT

DICHIARAZIONI DEL COSTRUTTORE

a) MATERIALI (1) - MEMBRATURE (2)

- Tubo di rame ø 19,05 x 0,75 certificato Wieland secondo EN 10204 tipo 3.1B n. 68/0547 del 20/05/97
- Tubo di rame Ø 19,05 x 0,63 certificato Wieland secondo EN 10204 tipo 3.1B n. 68/0516 del 18/02/97
- Tubo di rame Ø 50 x 1,5 certificato Outokumpu secondo EN 10204 del 14/10/97

b) TRATTAMENTI TERMICI (3) - EVENTUALI ALTRE DICHIARAZIONI (4)

c) SALDATURE (estremi dei certificati di qualifica e di omologazione)

— Procedimenti di saldatura (5)

- Elettrico procedimento MAG (staffe e selle)
- Automatico in arco sommerso (fasciame, fondi p. tubiera)

Qualifiche IIS n. 4200 - 4343 - 4359
27315 data 21/05/84

— Elettrodi impiegati (6)

Filo pieno tipo RMS Ø 1 mm.
Filo pieno RM2 - AS - 35
Flusso AS 231 (SIO)

— Saldatori (7)

D'Annibale Romeo - Qualif. I.I.S. n.4343 Rinn. ISPESL del 23/06/98
Comuzzi Sergio - Qualif. ISPESL n.12534-12535 Rinn. ISPESL 23/06/98
Magagna Stefano- Qualif. ISPESL n.12536-12537 Rinn. ISPESL 23/06/98

d) TALLONI DI SALDATURA (8)

e) ESAMI NON DISTRUTTIVI (9)

Data 28/10/98

Timbro e firma del Costruttore
PROVIDES metalmecc. s.r.l.
Via Piave n. 82 - LATINA

(Vedere Note a tergo)

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

UNI EN ISO 9002 (ISO 9002)

DNV

Certified Quality System

Allegato n. 3
Encl. n. 3

Costruttore : PROVIDES
Manufacturer : METALMECCANICA Srl

N. di fabbrica : 12437/B
Serial number :

Materiali - Materials					Certif. - Certif.		
Posiz. Item	Spessore Thickness mm	Fabbricante Manufacturer	Qualità sigla tab.unificata Quality and specifications	Colata pezzo o lotto n. Heat n.	Numero Number	Data Date	Note Notes
1	35	Vitkovice	HII DIN 17155	382220	13303	09/07/98	P. tubiera
2	35	Falck	HII DIN 17155	22213	9939	28/07/95	Zuccherotti
3	5	Preussag Stahl	HII DIN 17155	66462	87295	11/03/96	Virola

All dimensions have been verified and correspond to standard quoted in UNI EN 22768-1

La verifica dimensionale è stata effettuata conformemente alle Norme Tolleranze Generali UNI EN 22768-1

Dimensioni in mm
Dimensions in mm

Classe di Tolleranza Tolerance Classification		Scostamenti per campi di dimensioni fondamentali Tolerances for various ranges quoted below							
Designazione Designation	Denominazione Tolerance Specification	da 0.5 fino a 3 from 0.5 to 3	oltre 3 fino a 6 more than 3 up to 6	oltre 6 fino a 30 more than 6 up to 30	oltre 30 fino a 120 more than 30 up to 120	oltre 120 fino a 400 more than 120 up to 400	oltre 400 fino a 1000 more than 400 up to 1000	oltre 1000 fino a 2000 more than 1000 up to 2000	oltre 2000 fino a 4000 more than 2000 up to 4000
c	grossolana rough	± 0.2	± 0.5	± 1	± 0.8	± 1.2	± 2	± 3	± 4

Data: 28/10/98

Firma del costruttore
Manifacturer's signature
PROVIDES metalmecc. s.r.l.
Via Piave n. 82 - LATINA
....

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

All. n. 4

APPARECCHIO TIPO: **CO 3515 060**

NUMERO DI FABBRICA: 12437/B

NUMERO DI MATRICOLA I.S.P.E.S.L.:---

L'apparecchio ha in dotazione i seguenti accessori di sicurezza e di controllo:

Manometro tipo Wika matr.: 1610459

Valvola di sicurezza costruzione CASTEL n.f.: 22785

16-EE498362-it
ALL. 5

ISTITUTO SUPERIORE PER LA PREVENZIONE
E LA SICUREZZA DEL LAVORO

MINISTERO DELLA SANITÀ

Dipartimento di ROMA

via Angelo BARGONI n° 8 - 00153 Roma

Nella risposta
citare il seguente riferimento

Latina, **13/10/98**

Verifiche eseguite presso la soc. PROVIDES METALMECCANICA S.r.l. Via Piave n. 82 - LATINA

TARATURA AL BANCO DI MANOMETRI

Su richiesta della ditta in oggetto, in data odierna si è eseguita la verifica della taratura al banco di n. 150 manometri per impianti frigo tipo Wika, aventi fondo scala 40 bar e segno rosso di max a 24,5 bar contraddistinti dai seguenti numeri:

1575406-1575407-1575408-1575409-1575410-1575411-1575412-1575413-1575414-1575415-1575416-1575417-1575418-1575419-1575420-1575421-1575422-1575423-1575424-2575425-1575426-1575427-1575428-1575429-1575430-1575431-1575432-1575433-1575434-1575435-1575436-1575437-1575438-1575439-1575440-1575441-1575442-1575443-1575444-1575445-1575446-1575447-1575448-1575449-1575450-1575451-1575452-1575453-1575454-1575455-1575456-1575457-1575458-1575459-1575460-1575461-1575462-1575463-1575464-1575465-1575466-1575467-1575468-1575469-1575470-1575471-1575472-1575473-1575474-1575475-1575476-1574577-1575478-1575479-1575480-1575481-1575482-1575483-1575484-1575485-1575486-1575487-1575488-1575489-1575490-1575491-1575492-1575493-1575494-1575495-1610401-1610403-1610404-1610405-1610406-1610410-1610412-1610414-1610417-1610419-1610421-1610423-1610424-1610429-1610430-1610431-1610432-1610433-1610434-1610435-1610436-1610439-1610440-1610441-1610442-1610443-1610444-1610445-1610447-1610448-1610452-1610459-1610460-1610461-1610462-1610463-1610465-1610466-1610467-1610468-1610470-1610471-1610472-1610473-1610478-1610479-1610481-1610482-1610483-1610484-1610485-1610486-1610489-1610491-1610493-1610494-1610495-1610497-1610498-1610499.

Non si sono rilevati scarti con manometro campione superiore a +3% del valore del fondo scala.
(Raccolta E-E1 D6 punto 24)

I.S.P.E.S.L. Dipartimento di Roma

Il Tecnico dell'I.S.P.E.S.L.
Dott. Ing. E. Scerch

Castel

s.r.l. Sede soc. e amm.: Via Pordenone, 38 - 20132 Milano Italy - tel. 215.38.28 - fax 264.132.95 - Tribunale di Milano - Registro Imprese 113702 - Cod. Fisc. 00779080159 - Cap. Soc. L. 500.000.000

Stabilimento e Magazzino: Via Provinciale N. 2-4 - 20060 Pessano con Bornago (MI) - Tel. 95702.1 - Telefax 957.413.17 - C.C.I.A.A. Milano 590886 - Mecc. MI 019956

PER QUANTO CONCERNE LE VERIFICHE ISTITUZIONALI (ISPESL e/o USSL), IL CERTIFICATO DI TARATURA AL BANCO EFFETTUATA ALLA PRESENZA DELL'ISPESL, HA VALIDITÀ DI 1 ANNO

VALVOLA DI SICUREZZA - CERTIFICATO DI FABBRICAZIONE

(Decreto ministeriale 21 maggio 1974)
(Norma ANCC, raccolta E, fascicolo E1D, edizione gennaio 1979 punto 10.1)

In base alle norme di cui sopra, si certifica quanto segue:

a) Ditta fabbricante: CASTEL s.r.l.			
b) Numero di Modello (catalogo) della valvola	:		3030/88
c) Numero di matricola della valvola (n. di fabbrica) e numero del certificato di fabbricazione	:		22785
d) Pressione nominale per le connessioni di ingresso e di uscita della valvola	:	PN	40/40
Diametri nominali per le connessioni di ingresso e uscita della valvola	:	DN	1" / 1"
e) Diametro dell'orifizio	:	D_o, mm.	19,50
Area "A" della sezione trasversale minima netta dell'orifizio	:	cm.²	2,98
f) Alzata "h"	:	mm.	6,80
Coefficiente "K"	:		0,83

(Prot. 21916 del 28/06/1982) Sez. Lombardia Centr.
Certificato Omologazione n. 21757 A Riconferma Omologazione VS/88/92 Del 10/06/82 (per 3030/44 - 3030/44 A)
Certificato Omologazione n. 21757 B Riconferma Omologazione VS/89/92 Del 10/06/82 (per 3030/88 - 3030/88 A)

g) Campo di variabilità pressione di taratura a contropressione atmosferica	:	bar	22,70/29,40
Campo di temperatura	:	°C	(−50) ÷ (+150)
h) Sovrappressione espressa in % della pressione di taratura	:	%	5%

i) materiali impiegati:
- corpo valvola e otturatore: OT 58 UNI 5705
- molla: Acciaio Classe C UNI 3823
- guarnizione otturatore: Teflon (Politetrafluoroetilene)

l) esito dei collaudi:	
– controllo dimensionale	positivo
– collaudo finale	positivo
– prova idraulica lato ingresso e lato uscita a 60 bar	positivo

m) Scarto di richiusura espresso in % della pressione di taratura : % 15%
- Fluidi: Aria - Freon - Cloruro di metile
- Stato fisico: vapore o gas

Pessano, li 25/11/97

Castel

I.S.P.E.S.L.
Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro
Sede di Milano, Via Mangiagalli 3

Certificato N. 22785

Certificato di taratura al banco di valvola di sicurezza

presso il fabbricante

Località, Pessano con Bornago

li 03/12/97

La valvola di sicurezza di cui al presente certificato, fabbricante CASTEL s.r.l. - n.f. vedi a fianco corrisponde al modello 3030/88 di cui al certificato di fabbricazione n. vedi a fianco del vedi a fianco ed al certificato cumulativo di taratura n. 986 del 03/12/97 (solo per le valvole costruite in serie), con diametro dell'orifizio D_o = 19,50 mm.

La taratura della valvola è stata eseguita con aria compressa a temperatura ambiente e contropressione atmosferica alla pressione di 24,50 bar

Dispositivo di blocco della taratura:
- caratteristiche: vite di bloccaggio
- posizione: inserimento sulla parte superiore del corpo valvola
- inamovibilità: assicurata dal piombo

Sulla vite di regolazione di taratura o sul corpo, risultano punzonati i seguenti dati:
- numero di modello (catalogo) della valvola: 3030/88
- pressione di taratura 24,50 bar
- numero di fabbrica: vedi a fianco
- sul corpo risultano ricavati per stampaggio il marchio del costruttore e il senso di percorrenza del fluido
- punzone ISPESL N. 178 sul piombo

ALL. 6

I.S.P.E.S.L. MILANO DIPARTIMENTO MINISTERO DELLA SANITÀ

IL TECNICO
Dott. Ing. Alfonso DE LUCIA

Dichiarazione di cui al punto 2 della disposizione E.1 D. ed. gennaio 1979

2.1. – Valvola a molla diretta.

2.2. – La costruzione ed i materiali impiegati sono idonei per le condizioni di funzionamento, temperatura, corrosività ed altre proprietà dei seguenti fluidi: - Cloro fluoroderivati "Freon" per usi frigoriferi, Cloruro di Metile, aria compressa.

2.3. – Sedi piane.

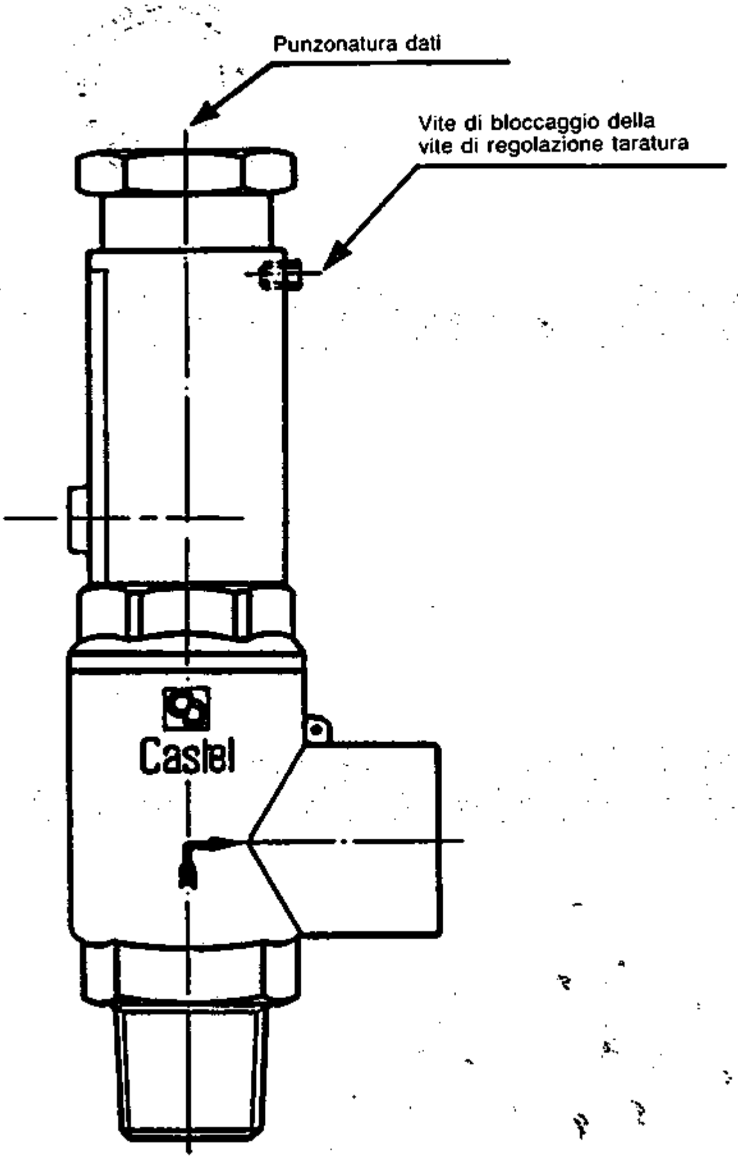
2.4. – La guarnizione di tenuta in teflon è tale che, anche in prolungato esercizio, conserva buone caratteristiche di resistenza e non provoca fenomeni di incollamento nell'otturatore sulla sede.

2.5. – L'otturatore è guidato nel suo movimento.

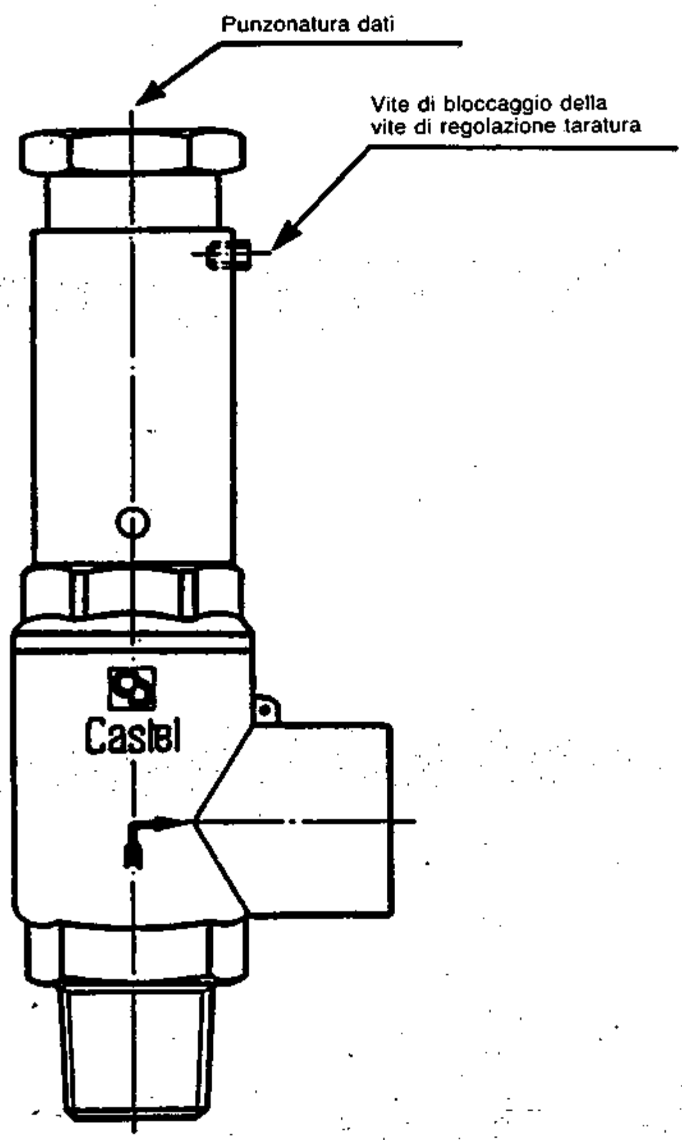
2.6. – L'otturatore è privo di premistoppa.

2.7. – Le spire della molla, escluse quelle terminali, sono distanziate tra di loro del minore tra mezzo diametro del filo e 2 mm. quando l'otturatore raggiunge l'alzata. La freccia della molla, quando l'otturatore è in posizione di blocco meccanico, non è superiore all'85% della freccia totale.

2.8. – Il sistema di taratura è meccanicamente bloccato tramite la vite.



3030/44



3030/88

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

UNI EN ISO 9002 (ISO 9002)

DNV

Certified Quality System

CERTIFICATO DI COLLAUDO
TEST CERTIFICATE

- Heat Exchanger / Scambiatore : **CO 3515 060**
- Serial Number / Numero di fabbrica : 12437/B
- Drawing N. / Disegno n. : 2012/I
- Year / Anno : 1998
- Manifacturer / Costruttore : **PROVIDES Metalmeccanica Srl . Latina**

		Inside of the shell Interno mantello	Inside of the tube Interno tubi
Maximum operating pressure Pressione massima di esercizio	Bar	24.5	16
Operating temperature Temperatura di esercizio	°C	-10 +62	-10 +80
Hydraulic testing pressure Pressione di prova idraulica	Bar	30.7	21
Refrigerant content Capacità	Litres Litri	96	44
Refrigerant Natura del fluido		Freon R22/407C	Acqua

The costruction and materials correspond to the heat exchanger rules. On the heat exchanger there is a plate indicating the serial number, the date of the hydraulic test and a marking (see below) attesting that a test was conducted with a positive outcome.

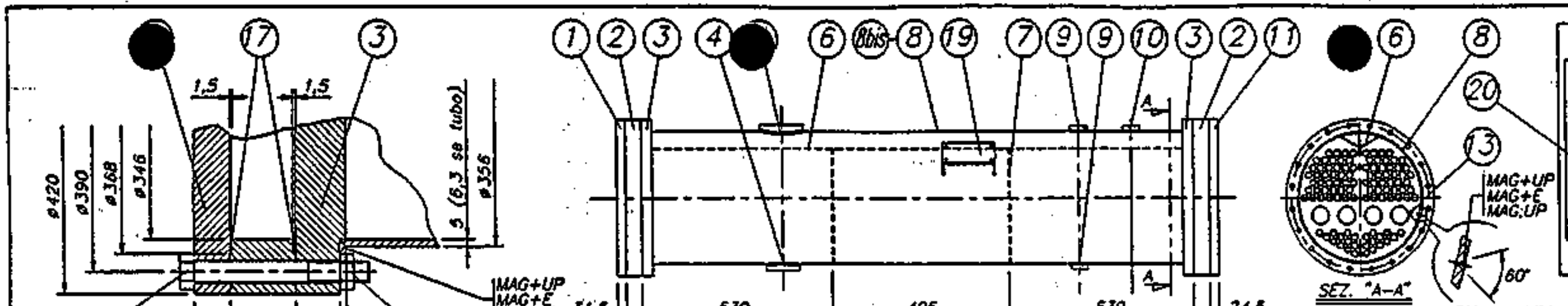
La costruzione ed i materiali impiegati risultano conformi alle normative degli apparecchi a pressione.
Sull'apparecchio è posta la targa con il numero di fabbrica, la data della prova idraulica e la punzonatura (vedi sotto) di avvenuto collaudo con esito positivo della prova.

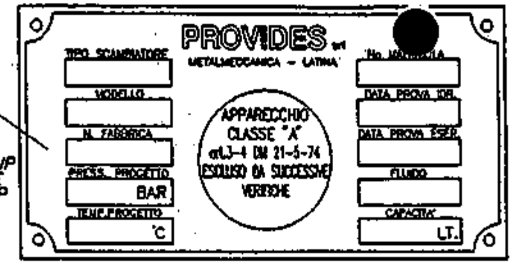
Latina, 28/10/98

PROVIDES metalmecc. s.r.l.
Via Piave n. 82 - LATINA

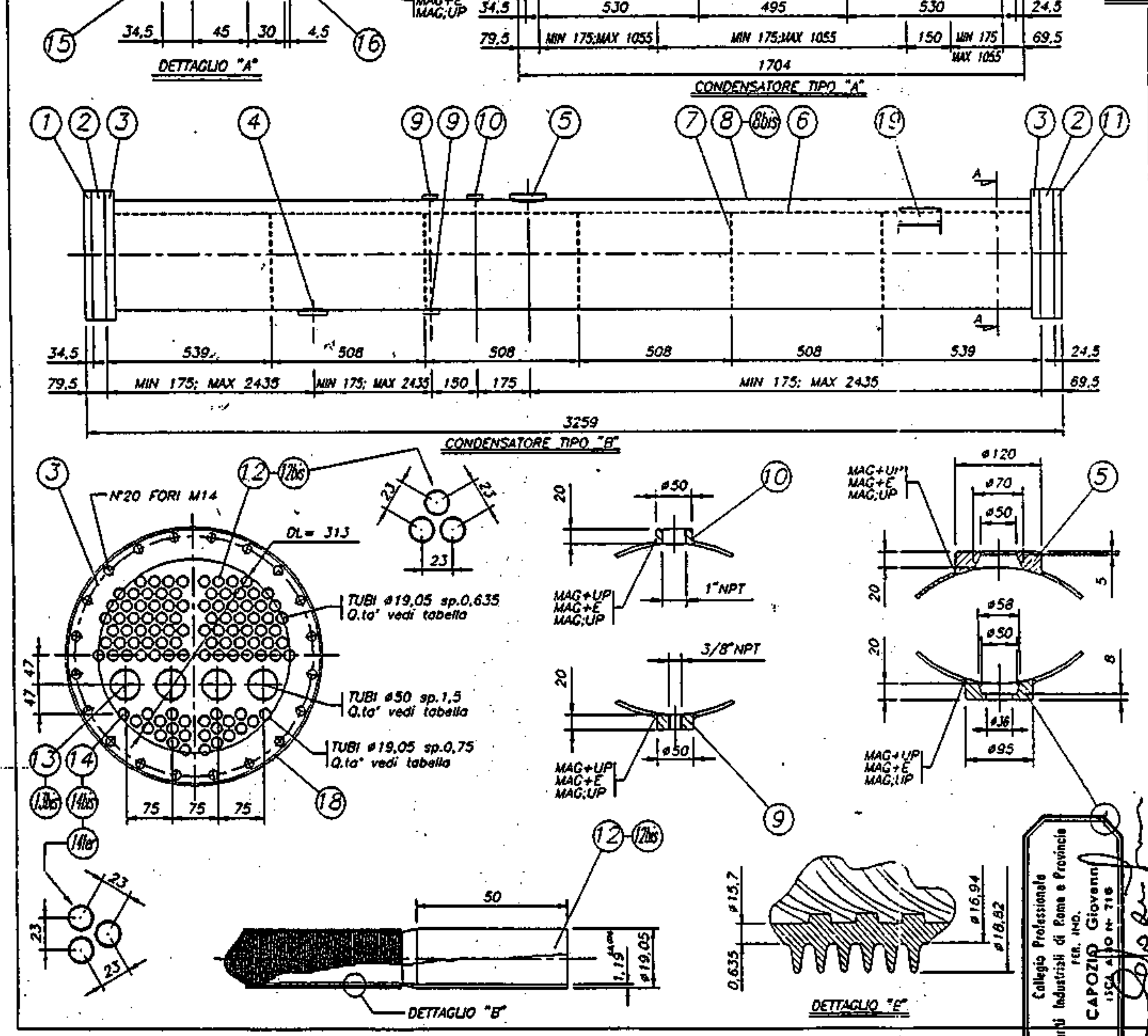
Allegati n. 1-2-3-4-5-6

C.C.I.A.A. Latina 42232 - Reg. Impr. Trib. Latina 2285 - C.C.P. 12385043 Ufficio I.V.A. Latina Partita n° 00080600596





N.B.: VALORI TRA PARENTESI () IN ALTERNATIVA



Collegio Professionale Periti Industriali di Roma e Provincia
PER. IND. CAPOZIO Giovanni
ISCR. ALBO N° 716

MATERIALE DI APPORTO OMOLOGATO: FILO: RMS + FILOGAS (MAG) ; ELETTRODO BOHLER FOX EV 47–(E) AUTOMATIC: AS35/AS231 ø2,38		
GRUPPO DI APPARTENENZA MATERIALE: SA1	PREPARAZIONE LEMBI SECONDO UNI 11001	CATEGORIA II (SECONDA)
MODULO DI EFFICIENZA: Z=0,85 Rx= 10%	QUALIFICA SALDATORI DEL LAZIO: MAG-3-09+28/Fe UNI 5869	
CLASSE ACCETTABILITA' DIFETTI: III (TERZA)		
QUALIFICA DI PROCEDIMENTO SALDATURA:		

SALDATURE

SI DICHIARA CHE IL PROGETTO NEL SUO INSIEME E NEI SUOI PARTICOLARI E' CONFORME ALLE DISPOSIZIONI DELLA RACCOLTA "S". INOLTRE IL MEATO ESISTENTE AL VERTICE DELLA SALDATURA NON ATTIVA FENOMENI PERICOLOSI DI CORROSIONE.

POS	DESCRIZIONE	MATERIALE
20	TARGA DI RICONOSCIMENTO	ALLUMINIO
19	PORTA TARGA	HII DIN 17155/ Fe410 1KW/ 2KW UNI 5869-75
18	PLACCATURA IN CU-NI (SE INSTALLATA)	CuNi 10 Fe 1 Mn UNI 7280
17	GUARNIZIONE CALOTTA	ELASTOMERO NEOPRENE
16	DADO ALTO	CLASSE 5.6
15	VITE M14	CLASSE 8.8
14ter	TUBO CU-NI ø19,05 sp.0,75 mm	P-CuNi 10 Fe 1 Mn UNI 6785
14bis	TUBO RAME ø19,05 sp.0,75 mm	Cu 99,9% SF Cu F22 DIN 1787
14	TUBO ACCIAIO ø19,05 sp.0,75 mm	St 35.8 DIN 17175 / ASTM A106-75 GrB
13ter	TUBO RAME ø50 sp.1,5 mm	Cu 99,9% SF Cu F22 DIN 1787
13bis	TUBO CU-NI ø50 sp.1,5 mm	P-CuNi 10 Fe 1 Mn UNI 6785
13	TUBO ACCIAIO ø50 sp.1,5 mm	St 35.8 DIN 17175 / ASTM A106-75 GrB
12bis	TUBO CU-NI ø19,05 sp. 0,635mm	P-CuNi 10 Fe 1 Mn UNI 6785
12	TUBO RAME ø19,05 sp. 0,635mm	Cu 99,9% SF Cu F22 DIN 1787
11	FONDO DI CHIUSURA POSTERIORE sp.24,5 mm	HII DIN 17155 / Fe 360C UNI 7070
10	MANICOTTO 1"NPT	Fe 410 1KW/2KW UNI 5869-75
9	MANICOTTO 3/8"NPT	HII DIN 17155
8bis	INVOLUCRO (RICAVATO DA TUBO)	St 35.8 DIN 17175 / ASTM A106-75 GrB
8	INVOLUCRO (RICAVATO DA LAMIERA)	HII DIN 17155/ Fe410 1KW/ 2KW UNI 5869-75
7	DIAFRAMMA Sp. 2 mm	Fe 360C UNI 7070
6	DISTRIBUTORE GAS	
5	MANICOTTO INGRESSO GAS	HII DIN 17155
4	MANICOTTO USCITA LIQUIDO	Fe 410 1KW UNI 5869-75
3	PIASTRA TUBIERA	Fe 410 2KW UNI 5869-75
2	DISTRIBUTORE CALOTTA POST./ANTER.	GHISA G25
1	FONDO PIANO CALOTTA ANTERIORE	HII DIN 17155 / Fe 360C UNI 7070

DISTINTA MATERIALI

TUTTI I MATERIALI COSTITUENTI LE MEMBRATURE IN PRESSIONE SARANNO FORNITI CON CERTIFICATI DI COLLAUDO O DI PROVENIENZA SECONDO LA VIGENTE NORMATIVA I.S.P.E.S.L.

CAMERA		LATO ACQUA	LATO REFRIGERANTE			
CAPACITA'	lt	VEDI TABELLA FOGLIO ALLEGATO 2/2				
PRESSIONE DI PROVA IDRAULICA	bar (kg/cmq)	21 (21,5)	30,7 (31,3)			
PRESSIONE DI PROGETTO	bar (kg/cmq)	16 (16,4)	24,5 (25,0)			
TEMPERATURA DI PROGETTO	°C	MIN.+10 MAX+80	MIN.+10 MAX+62		MIN.+10 MAX+80	MIN.+10 MAX+42
FLUIDO		ACQUA	R22	R407C	R134a	R410A
OVALIZZAZIONE MASSIMA	%	1	1			
SOVRASPESSORE DI CORROSIONE	mm	1	0			
COLLAUDO I.S.P.E.S.L.		NO	SI			
CLASSE DI APPART. SECONDO RACCOLTA "E"		"c"				

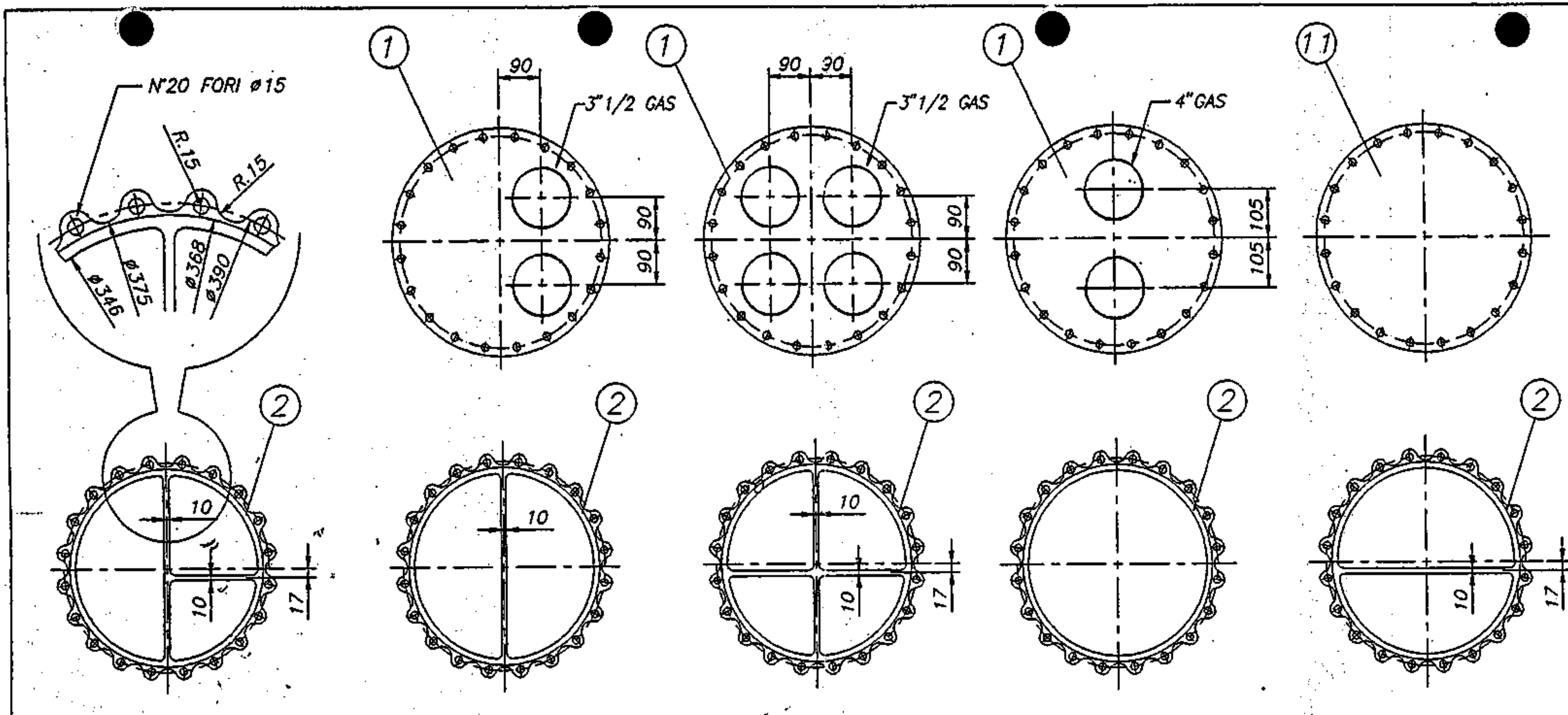
DATI DI PROGETTO

LE MEMBRATURE A PRESSIONE SONO VERIFICATE PER LE CONDIZIONI PREVISTE DALL'ART. 1 D.M. 21-11-1972
NEI CALCOLI LE PRESSIONI SONO ESPRESSE IN kg/cmq CON LE SEGUENTI EQUIVALENZE:
1 kg/cmq = 0,98665 bar ; 1 bar = 1,019716 kg/cmq

COSTRUZIONE APPROVATA CON LETTERA I.S.P.E.S.L. No DI PROTOCOLLO .... DEL ....
NUMERO DI FABBRICA ....
PROGETTISTA: P.I. GIOVANNI CAPOZIO

Descrizione: CONDENSATORE RECUPERATORE	Data :05-02-1997	Tolleranze generali: Grezzo: ± ... Finito: ± ...		Peso grezzo (kg): ....
	Scala :........			Peso finito (kg): ....
	Dim. grezze :........	Disegnatore:		Ver/Appr. :........
PROVIDES METALMECCANICA SRL	MODELLO: C3515 TIPO "A" C3531 TIPO "B"			Classifica: 2012/i foglio 1/2

ALL.1



ALL. 1 BIS

ALTERNATIVE PER FONDI PIANI E DISTRIBUTORI

MODELLO CONDENSATORE	N°TUBI Pos.12	N°TUBI Pos.13	N°TUBI Pos.14	CONDENS. TIPO	CAPACITA'(lt) LATO GAS	CAPACITA'(lt) LATO ACQUA
3531080	80	4	24	B	173	96
3531072	72	4	22	B	182	90
3531060	60	4	18	B	196	80
3531052	52	4	16	B	204	73
3531040	40	2	12	B	229	52
3531036	36	2	10	B	234	49
3531030	30	2	8	B	241	44
3531026	26	2	8	B	245	41
3515080	80	4	24	A	85	52
3515072	72	4	22	A	89	49
3515060	60	4	18	A	96	44
3515052	52	4	16	A	100	41

Descrizione: CONDENSATORE RECUPERATORE	Data: 06-02-1997	Tolleranza generale — Grezzo: ± Finito: ±	Peso grezzo (kg):
	Scala:		Peso finito (kg):
	Dim. grezzo:	Disegnato:	Ver/Appr.:
PROVIDES METALMECCANICA Srl	MODELLO: C3515 C3531		Classifica: 2012/i Foglio 2/2

Allegato N° 2

LT

Costruttore Provides Metalmeccanica S.r.l.

N. di fabbrica 12437/B Matricola e sigla 98

DICHIARAZIONI DEL COSTRUTTORE

a) MATERIALI (1) - MEMBRATURE (2)

- Tubo di rame ø 19,05 x 0,75 certificato Wieland secondo EN 10204 tipo 3.1B n. 68/0547 del 20/05/97
- Tubo di rame Ø 19,05 x 0,63 certificato Wieland secondo EN 10204 tipo 3.1B n. 68/0516 del 18/02/97
- Tubo di rame Ø 50 x 1,5 certificato Outokumpu secondo EN 10204 del 14/10/97

b) TRATTAMENTI TERMICI (3) - EVENTUALI ALTRE DICHIARAZIONI (4)

c) SALDATURE (estremi dei certificati di qualifica e di omologazione)

— Procedimenti di saldatura (5)

- Elettrico procedimento MAG (staffe e selle)
- Automatico in arco sommerso (fasciame, fondi p. tubiera)

Qualifiche IIS n. 4200 - 4343 - 4359 27315 data 21/05/84

— Elettrodi impiegati (6)

Filo pieno tipo RMS Ø 1 mm.

Filo pieno RM2 - AS - 35

Flusso AS 231 (SIO)

— Saldatori (7)

D'Annibale Romeo - Qualif. I.I.S. n.4343 Rinn. ISPESL del 23/06/98

Comuzzi Sergio - Qualif. ISPESL n.12534-12535 Rinn.ISPESL 23/06/98

Magagna Stefano- Qualif. ISPESL n.12536-12537 Rinn.ISPESL 23/06/98

d) TALLONI DI SALDATURA (8)

e) ESAMI NON DISTRUTTIVI (9)

Data 28/10/98

Timbro e firma del Costruttore

PROVIDES metalmecc. s.r.l.
Via Piave n.82 - LATINA

(Vedere Note a tergo)

PROVIDES

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Allegato n. 3
Encl. n. 3

Costruttore : **PROVIDES**
Manufacturer : **METALMECCANICA Srl**

N. di fabbrica : 12437/B
Serial number :

Materiali - Materials					Certif. - Certif.		
Posiz. Item	Spessore Thickness mm	Fabbricante Manufacturer	Qualità sigla tab.unificata Quality and specifications	Colata pezzo o lotto n. Heat n.	Numero Number	Data Date	Note Notes
1	35	Vitkovice	HII DIN 17155	382220	13303	09/07/98	P. tubiera
2	35	Falck	HII DIN 17155	22213	9939	28/07/95	Zuccherotti
3	5	Preussag Stahl	HII DIN 17155	66462	87295	11/03/96	Virola

All dimensions have been verified and correspond to standard quoted in UNI EN 22768-1

La verifica dimensionale è stata effettuata conformemente alle Norme Tolleranze Generali UNI EN 22768-1

Dimensioni in mm
Dimensions in mm

Classe di Tolleranza / Tolerance Classification		Scostamenti per campi di dimensioni fondamentali / Tolerances for various ranges quoted below							
Designazione / Designation	Denominazione / Tolerance Specification	da 0.5 fino a 3 from 0.5 to 3	oltre 3 fino a 6 more than 3 up to 6	oltre 6 fino a 30 more than 6 up to 30	oltre 30 fino a 120 more than 30 up to 120	oltre 120 fino a 400 more than 120 up to 400	oltre 400 fino a 1000 more than 400 up to 1000	oltre 1000 fino a 2000 more than 1000 up to 2000	oltre 2000 fino a 4000 more than 2000 up to 4000
c	grossolana rough	± 0.2	± 0.5	± 1	± 0.8	± 1.2	± 2	± 3	± 4

Firma del costruttore
Manufacturer's signature
PROVIDES metalmecc. s.r.l.
Via Piave n. 82 - LATINA
....

Data: 28/10/98

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

All. n. 4

APPARECCHIO TIPO: **CO 3515 060**

NUMERO DI FABBRICA: 12437/B

NUMERO DI MATRICOLA I.S.P.E.S.L.:---

L'apparecchio ha in dotazione i seguenti accessori di sicurezza e di controllo:

Manometro tipo Wika matr.: 1610459

Valvola di sicurezza costruzione CASTEL n.f.: 22785

16-EE498362-II
ALL. 5

ISTITUTO SUPERIORE PER LA PREVENZIONE
E LA SICUREZZA DEL LAVORO

MINISTERO DELLA SANITÀ

Dipartimento di ROMA

via Angelo BARGONI n° 8 - 00153 Roma

Nella risposta
citare il seguente riferimento

Latina, **13/10/98**

Verifiche eseguite presso la soc. PROVIDES METALMECCANICA S.r.l. Via Piave n. 82 - LATINA

TARATURA AL BANCO DI MANOMETRI

Su richiesta della ditta in oggetto, in data odierna si è eseguita la verifica della taratura al banco di n. 150 manometri per impianti frigo tipo Wika, aventi fondo scala 40 bar e segno rosso di max a 24,5 bar contraddistinti dai seguenti numeri:

1575406-1575407-1575408-1575409-1575410-1575411-1575412-1575413-1575414-
1575415-1575416-1575417-1575418-1575419-1575420-1575421-1575422-1575423-
1575424-2575425-1575426-1575427-1575428-1575429-1575430-1575431-1575432-
1575433-1575434-1575435-1575436-1575437-1575438-1575439-1575440-1575441-
1575442-1575443-1575444-1575445-1575446-1575447-1575448-1575449-1575450-
1575451-1575452-1575453-1575454-1575455-1575456-1575457-1575458-1575459-
1575460-1575461-1575462-1575463-1575464-1575465-1575466-1575467-1575468-
1575469-1575470-1575471-1575472-1575473-1575474-1575475-1575476-1574577-
1575478-1575479-1575480-1575481-1575482-1575483-1575484-1575485-1575486-
1575487-1575488-1575489-1575490-1575491-1575492-1575493-1575494-1575495-
1610401-1610403-1610404-1610405-1610406-1610410-1610412-1610414-1610417-
1610419-1610421-1610423-1610424-1610429-1610430-1610431-1610432-1610433-
1610434-1610435-1610436-1610439-1610440-1610441-1610442-1610443-1610444-
1610445-1610447-1610448-1610452-1610459-1610460-1610461-1610462-1610463-
1610465-1610466-1610467-1610468-1610470-1610471-1610472-1610473-1610478-
1610479-1610481-1610482-1610483-1610484-1610485-1610486-1610489-1610491-
1610493-1610494-1610495-1610497-1610498-1610499.

Non si sono rilevati scarti con manometro campione superiore a +3% del valore del fondo scala.
(Raccolta E-E1 D6 punto 24)

Il Tecnico dell'I.S.P.E.S.L.
Dott. Ing. E. Scerch

I.S.P.E.S.L. - Dipartimento di Roma

Castel

s.r.l. Sede soc. e amm.: Via Pordenone, 38
20132 Milano Italy
tel. 215.38.28 - fax 264.132.95
Tribunale di Milano
Registro Imprese 113702
Cod. Fisc. 00779080159
Cap. Soc. L. 500.000.000

Stabilimento e Magazzini: Via Provinciale N. 2-4
20060 Pessano con Bornago (MI)
Tel. 95702.1
Telefax 957.413.17
C.C.I.A.A. Milano 590688
Mecc. MI 019958

PER QUANTO CONCERNE LE VERIFICHE ISTITUZIONALI (ISPESL e/o USSL), IL CERTIFICATO DI TARATURA AL BANCO EFFETTUATA ALLA PRESENZA DELL'ISPESL, HA VALIDITÀ DI 1 ANNO

VALVOLA DI SICUREZZA - CERTIFICATO DI FABBRICAZIONE

(Decreto ministeriale 21 maggio 1974)
(Norma ANCC, raccolta E, fascicolo E1D, edizione gennaio 1979 punto 10.1)

In base alle norme di cui sopra, si certifica quanto segue:

a) Ditta fabbricante: CASTEL s.r.l.			
b) Numero di Modello (catalogo) della valvola	:		3030/88
c) Numero di matricola della valvola (n. di fabbrica) e numero del certificato di fabbricazione	:		22785
d) Pressione nominale per le connessioni di ingresso e di uscita della valvola	:	PN	40/40
Diametri nominali per le connessioni di ingresso e uscita della valvola	:	DN	1" / 1"
e) Diametro dell'orifizio	:	D_o, mm.	19,50
Area "A" della sezione trasversale minima netta dell'orifizio	:	cm.^{2}	2,98
f) Alzata "h"	:	mm.	6,80
Coefficiente "K" (Prot. 21916 del 28/06/1982) Sez. Lombardia Centr. Certificato Omologazione n. 21757 A Riconferma Omologazione VS/88/92 Del 10/06/82 (per 3030/44 - 3030/44 A) Certificato Omologazione n. 21757 B Riconferma Omologazione VS/89/92 Del 10/06/82 (per 3030/88 - 3030/88 A)	:		0,83
g) Campo di variabilità pressione di taratura a contropressione atmosferica	:	bar	22,70/29,40
Campo di temperatura	:	°C	(-50) ÷ (+150)
h) Sovrappressione espressa in % della pressione di taratura	:	%	5%

i) materiali impiegati:
- corpo valvola e otturatore: OT 58 UNI 5705
- molla: Acciaio Classe C UNI 3823
- guarnizione otturatore: Teflon (Politetrafluoroetilene)

l) esito dei collaudi:	
– controllo dimensionale	positivo
– collaudo finale	positivo
– prova idraulica lato ingresso e lato uscita a 60 bar	positivo

m) Scarto di richiusura espresso in % della pressione di taratura : % 15%
- Fluidi: Aria - Freon - Cloruro di metile
- Stato fisico: vapore o gas

Pessano, li 25/11/97

Castel

I.S.P.E.S.L.
Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro
Sede di Milano, Via Mangiagalli 3

Certificato N. 22785

Certificato di taratura al banco di valvola di sicurezza presso il fabbricante

Località, Pessano con Bornago

li 03/12/97

La valvola di sicurezza di cui al presente certificato, fabbricante CASTEL s.r.l. - n.f. vedi a fianco corrisponde al modello 3030/88 di cui al certificato di fabbricazione n. vedi a fianco del vedi a fianco ed al certificato cumulativo di taratura n. 986 del 03/12/97 (solo per le valvole costruite in serie), con diametro dell'orifizio D_o = 19,50 mm.

La taratura della valvola è stata eseguita con aria compressa a temperatura ambiente e contropressione atmosferica alla pressione di 24,50 bar

Dispositivo di blocco della taratura:
- caratteristiche: vite di bloccaggio
- posizione: inserimento sulla parte superiore del corpo valvola
- inamovibilità: assicurata dal piombo

Sulla vite di regolazione di taratura o sul corpo, risultano punzonati i seguenti dati:
- numero di modello (catalogo) della valvola: 3030/88
- pressione di taratura 24,50 bar
- numero di fabbrica: vedi a fianco
- sul corpo risultano ricavati per stampaggio il marchio del costruttore e il senso di percorrenza del fluido
- punzone ISPESL N. 178 sul piombo

I.S.P.E.S.L. MILANO DIPARTIMENTO MINISTERO DELLA SANITÀ

IL TECNICO
Dott. Ing. Alfonso DE LUCIA

ALL 6

Dichiarazione di cui al punto 2 della disposizione E.1 D. ed. gennaio 1979

2.1. – Valvola a molla diretta.

2.2. – La costruzione ed i materiali impiegati sono idonei per le condizioni di funzionamento, temperatura, corrosività ed altre proprietà dei seguenti fluidi: - Cloro fluoroderivati "Freon" per usi frigoriferi, Cloruro di Metile, aria compressa.

2.3. – Sedi piane.

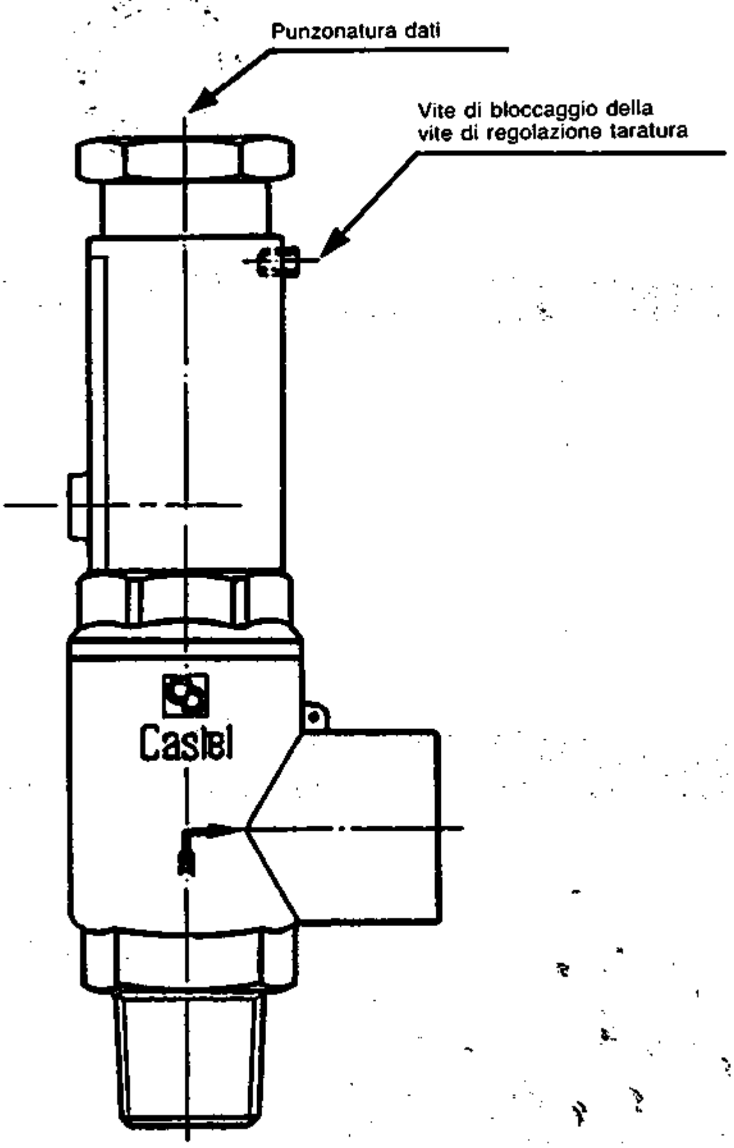
2.4. – La guarnizione di tenuta in teflon è tale che, anche in prolungato esercizio, conserva buone caratteristiche di resistenza e non provoca fenomeni di incollamento nell'otturatore sulla sede.

2.5. – L'otturatore è guidato nel suo movimento.

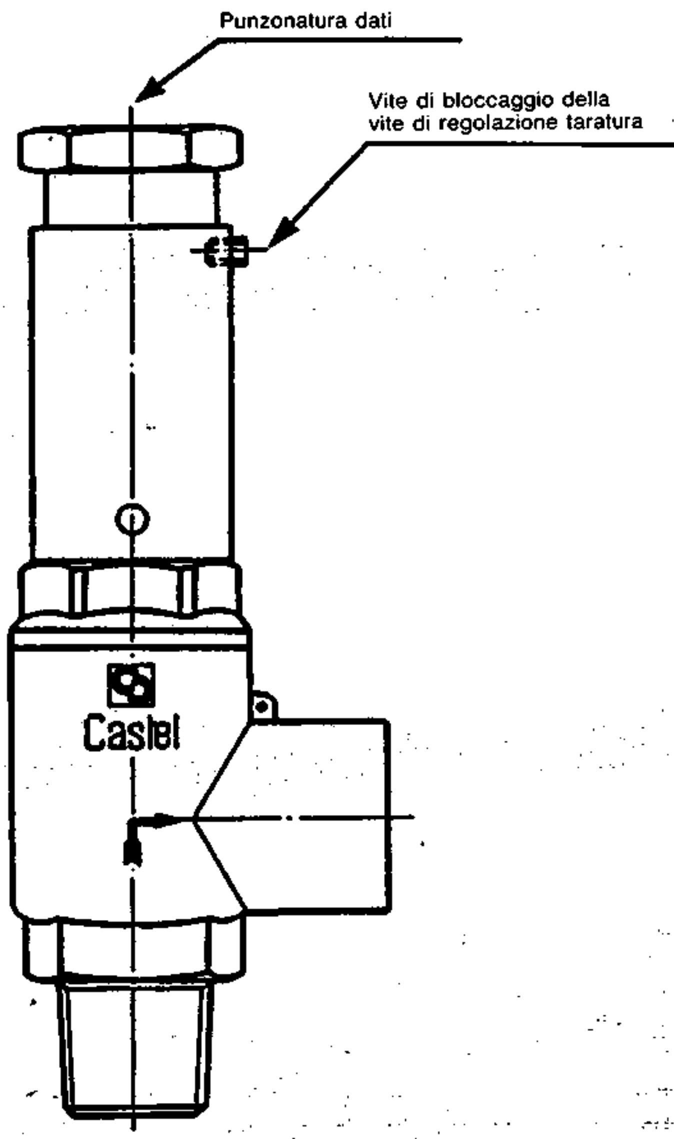
2.6. – L'otturatore è privo di premistoppa.

2.7. – Le spire della molla, escluse quelle terminali, sono distanziate tra di loro del minore tra mezzo diametro del filo e 2 mm. quando l'otturatore raggiunge l'alzata. La freccia della molla, quando l'otturatore è in posizione di blocco meccanico, non è superiore all'85% della freccia totale.

2.8. – Il sistema di taratura è meccanicamente bloccato tramite la vite.



3030/44



3030/88

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

CERTIFICATO DI COLLAUDO
TEST CERTIFICATE

- Heat Exchanger / Scambiatore : **EV 40260666 L**
- Serial Number / Numero di fabbrica : 12431/B
- Drawing N. / Disegno n. : 2003/I
- Year / Anno : 1998
- Manifacturer / Costruttore : **PROVIDES Metalmeccanica Srl . Latina**

		Inside of the tube Interno tubi	Inside of the shell Interno mantello
Maximum operating pressure Pressione massima di esercizio	Bar	16	16
Operating temperature Temperatura di esercizio	°C	-10 +44	-10 +61
Hydraulic testing pressure Pressione di prova idraulica	Bar	21	21
Refrigerant content Capacità	Litres Litri	84	371
Refrigerant Natura del fluido		Freon R22/407C	Acqua

The costruction and materials correspond to the heat exchanger rules. On the heat exchanger there is a plate indicating the serial number, the date of the hydraulic test and a marking (see below) attesting that a test was conducted with a positive outcome.

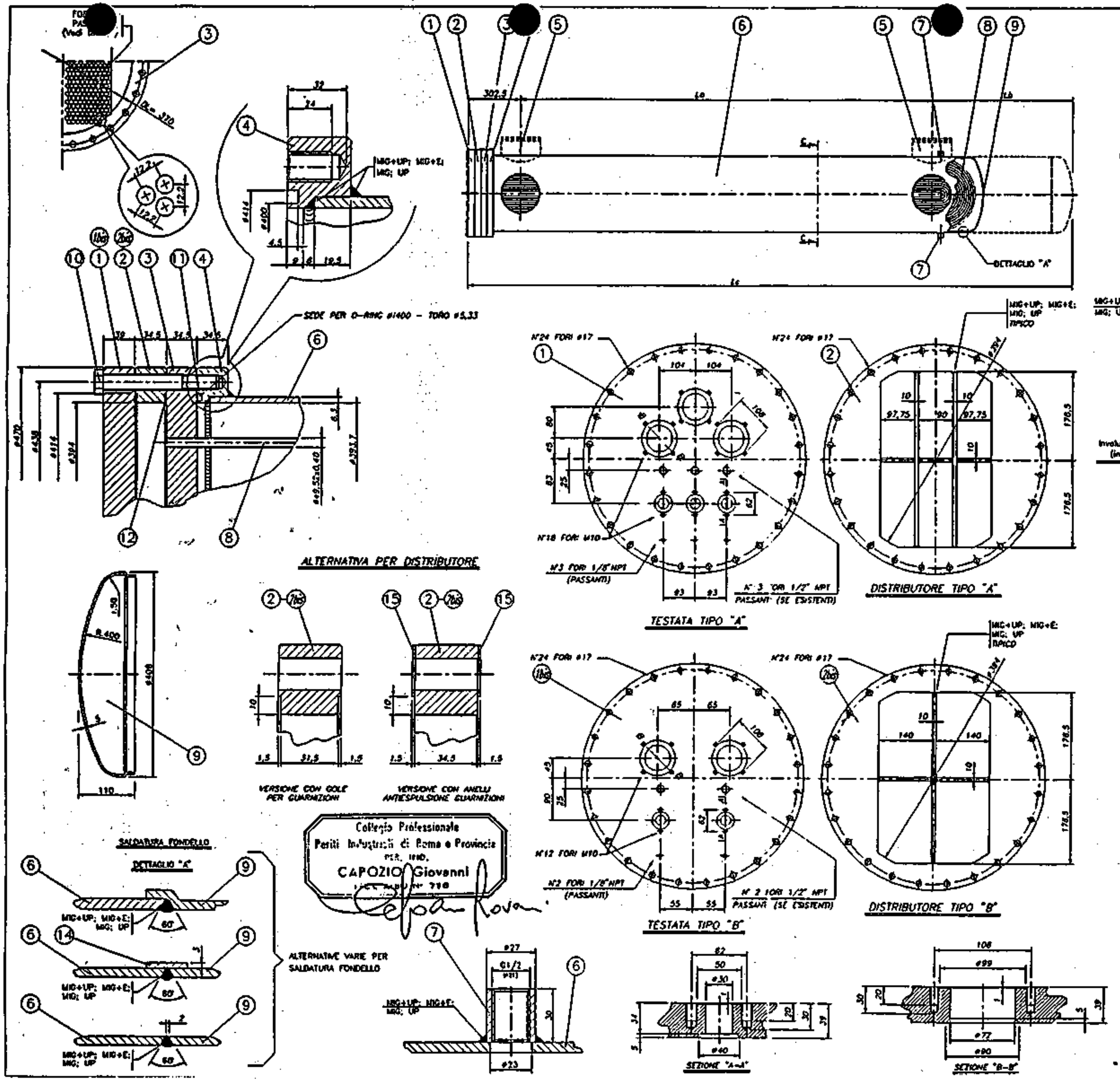
La costruzione ed i materiali impiegati risultano conformi alle normative degli apparecchi a pressione.
Sull'apparecchio è posta la targa con il numero di fabbrica, la data della prova idraulica e la punzonatura (vedi sotto) di avvenuto collaudo con esito positivo della prova.

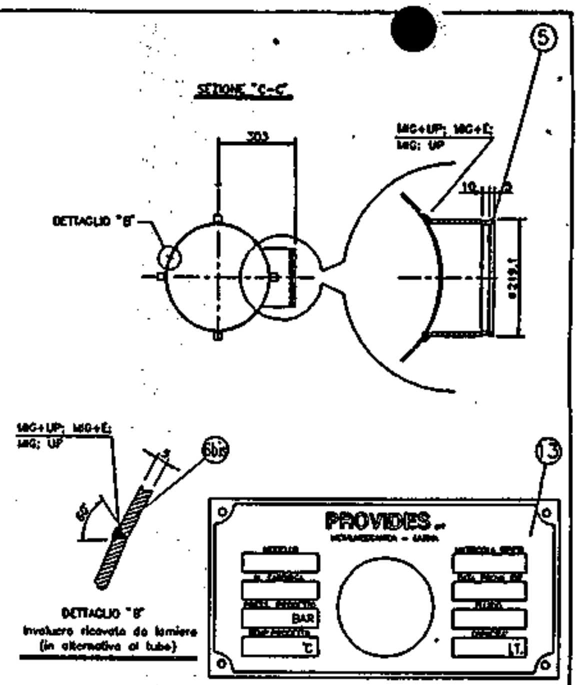
Latina, 28/10/98

PROVIDES metalmecc. s.r.l.
Via Piave n. 82 LATINA

Allegati n. 1-2-3-4-5-6-7-8

C.C.I.A.A. Latina 42232 - Reg. Impr. Trib. Latina 2285 - C.C.P. 12385043 Ufficio I.V.A. Latina Partita n° 00080600596





SALDATURE

DISTINTA MATERIALI

POS	DESCRIZIONE	MATERIALE
15	ANELLO ANTIESPULSIONE GUARNIZIONE (SE ESISTENTE)	[illegible]
14	SUPPORTO SALDATURA FONDELLO (SE ESISTENTE)	[illegible]
13	TARGA DI RICONOSCIMENTO	ALLUMINIO
12	GUARNIZIONE TESTATA	ELASTOMERO NEOPRENE
11	O-RING	ELASTOMERO NEOPRENE
10	VITE A TESTA ESAGONALE M16X1,5	B7 ASTM-A193-75
9	FONDELLO PARABOLICO A DUE RAGGI	[illegible]
8	TUBO DI RAME ø9,52 Sp. 0,40 mm	[illegible]
7	MANICOTTO RESISTENZA E SCARICO	[illegible]
6bis	INVOLUCRO IN LAMIERA Sp.5 (ALTERNATIVA)	[illegible]
6	INVOLUCRO	[illegible]
5	TUBO ENTRATA/USCITA ACQUA	[illegible]
4	FLANGIA	
3	PIASTRA TUBIERA	
2bis	DISTRIBUTORE TIPO "B"	H1 DIN 17155
2	DISTRIBUTORE TIPO "A"	Fe 410 1KW UNI 5869-75
1bis	TESTATA TIPO "B"	Fe 410 2 KW UNI 5869-75
1	TESTATA TIPO "A"	

DATI DI PROGETTO

CAMERA	LATO ACQUA	LATO REFRIGERANTE
CAPACITA'		
PRESSIONE DI PROVA IDRAULICA		
PRESSIONE DI PROGETTO		
TEMPERATURA DI PROGETTO		
FLUIDO		
OVALIZZAZIONE MASSIMA		
SOVRASPESSORE DI CORROSIONE		
COLLAUDO I.S.P.E.S.L.		
CLASSE DI APPART. SECONDO RACCOLTA "E"		"E"

COSTRUZIONE APPROVATA CON LETTERA I.S.P.E.S.L. N° DI PROTOCOLLO ______ DEL ______

NUMERO DI FABBRICA ______

PROGETTISTA: P.I. GIOVANNI CAPOZIO

EVAPORATORE

PROVIDES

2003

ALL. 7

ALC. 1 BIS

40260777L	A	A	277	554	2600	820	3723	97	359
40260767L	A	A	264	528	2600	820	3723	92	363
40260676L	A	A	253	506	2600	820	3723	89	367
40260666L	A	A	240	480	2600	820	3723	84	371
40260656L	A	A	225	450	2600	820	3723	79	376
40260565L	A	A	212	424	2600	820	3723	78	377
40260555L	A	A	197	394	2600	820	3723	71	384
40260777S	A	A	277	554	2600	260	3163	97	291
40260767S	A	A	264	528	2600	260	3163	92	295
40260676S	A	A	253	506	2600	260	3163	89	299
40260666S	A	A	240	480	2600	260	3163	84	303
40260656S	A	A	225	450	2600	260	3163	79	308
40260565S	A	A	212	424	2600	260	3163	78	309
40260555S	A	A	197	394	2600	260	3163	71	316
40230777S	A	A	277	554	2300	260	2863	88	363
40230767S	A	A	264	528	2300	260	2863	84	267
40230676S	A	A	253	506	2300	260	2863	80	270
40230666S	A	A	240	480	2300	260	2863	76	274
40230656S	A	A	225	450	2300	260	2863	72	279
40230565S	A	A	212	424	2300	260	2863	69	281
40230555S	A	A	197	394	2300	260	2863	65	286
40231010S	B	B	266	532	2300	260	2863	84	266
40230910S	B	B	254	508	2300	260	2863	81	270
40230099S	B	B	242	484	2300	260	2863	77	274
40230089S	B	B	229	458	2300	260	2863	73	277
40230088S	B	B	216	432	2300	260	2863	69	281
40230079S	B	B	216	432	2300	260	2863	69	281
40230078S	B	B	203	406	2300	260	2863	65	285
40230077S	B	B	190	380	2300	260	2863	61	289
MODELLO EVAP.	TESTATA TIPO	DISTRIB. TIPO	N°TUBI	N°FORI ø10	La	Lb	Lc	LATO GAS	LATO ACQUA
								CAPACITA' (lt)	

Collegio Professionale Periti Industriali di Roma e Provincia
CAPOZIO Giovanni

Descrizione: EVAPORATORE	Data: 27-08-1996	Tolleranza generale — Grezzo: ± / Finito: ±	Peso grezzo (kg):
	Scala:		Peso finito (kg):
	Dim. grezzo:	Disegnato:	Ver/Appr.:
PROVIDES METALMECCANICA Srl	Modello: Vedi tabella		Classifica: 2003 Foglio 2/2

Allegato N° 9

Costruttore Fabbricato da Provides Srl

N. di fabbrica 12431/B Matricola e sigla

DICHIARAZIONI DEL COSTRUTTORE

a) MATERIALI (1) - MEMBRATURE (2)

- Tubo di rame Ø 9,52 x 0,40 Certificato di origine Wieland norme EN10204 Cert. n.68/0525 del 14/03/97
- Guarnizione elastomero neoprene

b) TRATTAMENTI TERMICI (3) - EVENTUALI ALTRE DICHIARAZIONI (4)

c) SALDATURE (estremi dei certificati di qualifica e di omologazione)

— Procedimenti di saldatura (5)

- Elettrico procedimento MAG (staffe e selle)
- Automatico in arco sommerso (fasciame, fondi P. tubiera)

Qualifiche IIS n. 4200 - 4343 - 4359
27315 data 21/05/84

— Elettrodi impiegati (6)

Filo pieno tipo RMS Ø 1 mm.
Filo pieno RM2 - AS - 35
Flusso AS 231 (SIO)

— Saldatori (7)

D'Annibale Romeo - Qualif. I.I.S. n.4343 Rinn. ISPESL del : 23/06/98
Comuzzi Sergio - Qualif. ISPESL n.12534-12535 Rinn. ISPESL del 23/06/98
Magagna Stefano- Qualif. ISPESL n.12536-12537 Rinn. ISPESL del 23/06/98

d) TALLONI DI SALDATURA (8)

e) ESAMI NON DISTRUTTIVI (9)

Data 28/10/98

Timbro e firma del Costruttore

PROVIDES metalmecc. s.r.l.
Via Piave n. 82 ... ANNA

(Vedere Note a tergo)

PROVIDES

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

UNI EN ISO 9002 (ISO 9002) DNV Certified Quality System

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Allegato n. 3
Encl. n. 3

Costruttore : PROVIDES
Manufacturer : METALMECCANICA Srl

N. di fabbrica : 12431/B
Serial number :

Materiali - Materials					Certif. - Certif.		
Posiz. Item	Spessore Thickness mm	Fabbricante Manufacturer	Qualità sigla tab.unificata Quality and specifications	Colata pezzo o lotto n. Heat n.	Numero Number	Data Date	Note Notes
1	35	Vitkovice	HII DIN 17155	382126	13303	09/07/98	
2	35	Ilva	HII DIN 17155	503337001	27119	28/10/96	
3	35	Vitkovice	HII DIN 17155	382126	13303	09/07/98	
4	40	Dillinger Hütte	P 265 GH	49106-01	1010644	15/06/98	

All dimensions have been verified and correspond to standard quoted in UNI EN 22768-1

La verifica dimensionale è stata effettuata conformemente alle Norme Tolleranze Generali UNI EN 22768-1

Dimensioni in mm
Dimensions in mm

Classe di Tolleranza Tolerance Classification		Scostamenti per campi di dimensioni fondamentali Tolerances for various ranges quoted below							
Designazione Designation	Denominazione Tolerance Specification	da 0.5 fino a 3 from 0.5 to 3	oltre 3 fino a 6 more than 3 up to 6	oltre 6 fino a 30 more than 6 up to 30	oltre 30 fino a 120 more than 30 up to 120	oltre 120 fino a 400 more than 120 up to 400	oltre 400 fino a 1000 more than 400 up to 1000	oltre 1000 fino a 2000 more than 1000 up to 2000	oltre 2000 fino a 4000 more than 2000 up to 4000
c	grossolana rough	± 0.2	± 0.5	± 1	± 0.8	± 1.2	± 2	± 3	± 4

Firma del costruttore
Manufacturer's signature

Data: 28/10/98

PROVIDES metalmecc. s.r.l.
Via Piave n. 82 LATINA

PROVIDES
INDUSTRIA METALMECCANICA S.R.L.
Stabilimento e Amministrazione:
VIA PIAVE. 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

All. n. 4

APPARECCHIO TIPO: **EV 40260666 L**

NUMERO DI FABBRICA: 12431/B

NUMERO DI MATRICOLA I.S.P.E.S.L.:---

L'apparecchio ha in dotazione i seguenti accessori di sicurezza e di controllo:

Manometro tipo Wika matr.: 1555123, 1555124, 1555122

Valvola di sicurezza costruzione CASTEL n.f.: 17429, 17651, 22286

ALL. 5

ISTITUTO SUPERIORE PER LA PREVENZIONE
E LA SICUREZZA DEL LAVORO

MINISTERO DELLA SANITÀ

Dipartimento di ROMA

MC QUAY ITALIA S.p.A.

Via Piani di S. Maria 72

00040 ARICCIA (Roma)

Data - 8 GIU. 1998

16-EE483669 M

Su richiesta della ditta in oggetto, in data odierna si é eseguita la verifica della taratura al banco, di N° 210 manometri per impianti frigo tipo marca WIKA aventi fondo scala 20 Bar e segno rosso di max a 15,5 Bar , contraddistinti:

dal N° 1555065

al N° 1555275

Sottoposti a pressione di gas inerte fino a 20 Bar gli stessi non hanno dato segni di irregolarità. Non si sono rilevati scarti con manometro campione superiori a + 3% del valore del fondo scala (Raccolta E-El D6 punto 24).

I.S.P.E.S.L. - Dipartimento di Roma

IL FUNZIONARIO

Dott. Ing. ENRICO SCERCH

Castel

s.r.l. Sede soc. e amm.: Via Pordenone, 38
20132 Milano Italy
tel. 215.38.28 - fax 264.132.95
Tribunale di Milano
Registro Imprese 113702
Cod. Fisc. 00779060159
Cap. Soc. L. 500.000.000

Stabilimento e Magazzino ... Provinciale N. 2-4
20060 Pessano con Bornago (MI)
Tel. 95702.1
Telefax 957.413.17
C.C.I.A.A. Milano 590866
Mecc. MI 019956

PER QUANTO CONCERNE LE VERIFICHE ISTITUZIONALI (ISPESL e/o USSL), IL CERTIFICATO DI TARATURA AL BANCO EFFETTUATA ALLA PRESENZA DELL'ISPESL, HA VALIDITÀ DI 1 ANNO

VALVOLA DI SICUREZZA - CERTIFICATO DI FABBRICAZIONE

(Decreto ministeriale 21 maggio 1974)
(Norma ANCC, raccolta E, fascicolo E1D, edizione gennaio 1979 punto 10.1)

In base alle norme di cui sopra, si certifica quanto segue:

a) Ditta fabbricante: CASTEL s.r.l.

b) Numero di Modello (catalogo) della valvola	:		3030/44
c) Numero di matricola della valvola (n. di fabbrica) e numero del certificato di fabbricazione	:		22286
d) Pressione nominale per le connessioni di ingresso e di uscita della valvola	:	PN	40/40
Diametri nominali per le connessioni di ingresso e uscita della valvola	:	DN	1/2" / 1/2"
e) Diametro dell'orifizio	:	D_o, mm.	12,00
Area "A" della sezione trasversale minima netta dell'orifizio	:	$cm.^2$	1,13
f) Alzata "h"	:	mm.	4,10
Coefficiente "K"	:		0,90
g) Campo di variabilità pressione di taratura a contropressione atmosferica	:	bar	13,40/17,40
Campo di temperatura	:	°C	(−50) ÷ (+150)
h) Sovrappressione espressa in % della pressione di taratura	:	%	5%

(Prot. 21916 del 28/06/1982) Sez. Lombardia Centr.
Certificato Omologazione n. 21757 A Riconferma Omologazione VS/88/92 Del 10/06/82 (per 3030/44 - 3030/44 A)
Certificato Omologazione n. 21757 B Riconferma Omologazione VS/89/92 Del 10/06/82 (per 3030/88 - 3030/88 A)

i) materiali impiegati:
- corpo valvola e otturatore: OT 58 UNI 5705
- molla: Acciaio Classe C UNI 3823
- guarnizione otturatore: Teflon (Politetrafluoroetilene)

l) esito dei collaudi:

– controllo dimensionale	positivo
– collaudo finale	positivo
– prova idraulica lato ingresso e lato uscita a 60 bar	positivo

m) Scarto di richiusura espresso in % della pressione di taratura : % 15%
- Fluidi: Aria - Freon - Cloruro di metile
- Stato fisico: vapore o gas

Pessano, li 25/11/97

Castel

I.S.P.E.S.L.
Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro
Sede di Milano, Via Mangiagalli 3

Certificato N. 22286

Certificato di taratura al banco di valvola di sicurezza presso il fabbricante

Località, Pessano con Bornago

li 03/12/97

La valvola di sicurezza di cui al presente certificato, fabbricante CASTEL s.r.l. - n.f. vedi a fianco corrisponde al modello 3030/44 di cui al certificato di fabbricazione n. vedi a fianco del vedi a fianco ed al certificato cumulativo di taratura n. 958 del 03/12/97 (solo per le valvole costruite in serie), con diametro dell'orifizio D_o = 12,00 mm.

La taratura della valvola è stata eseguita con aria compressa a temperatura ambiente e contropressione atmosferica alla pressione di 15,50 bar

Dispositivo di blocco della taratura:
- caratteristiche: vite di bloccaggio
- posizione: inserimento sulla parte superiore del corpo valvola
- inamovibilità: assicurata dal piombo

Sulla vite di regolazione di taratura o sul corpo, risultano punzonati i seguenti dati:
- numero di modello (catalogo) della valvola: 3030/44
- pressione di taratura 15,50 bar
- numero di fabbrica: vedi a fianco
- sul corpo risultano ricavati per stampaggio il marchio del costruttore e il senso di percorrenza del fluido
- punzone ISPESL N. 178 sul piombo

I.S.P.E.S.L. – MINISTERO DELLA SANITÀ – DIPARTIMENTO DI MILANO

IL TECNICO
Dott. Ing. Alfonso DE LUCIA

ALL. 8

Dichiarazione di cui al punto 2 della disposizione E.1 D. ed. gennaio 1979

2.1. – Valvola a molla diretta.

2.2. – La costruzione ed i materiali impiegati sono idonei per le condizioni di funzionamento, temperatura, corrosività ed altre proprietà dei seguenti fluidi: - Cloro fluoroderivati "Freon" per usi frigoriferi, Cloruro di Metile, aria compressa.

2.3. – Sedi piane.

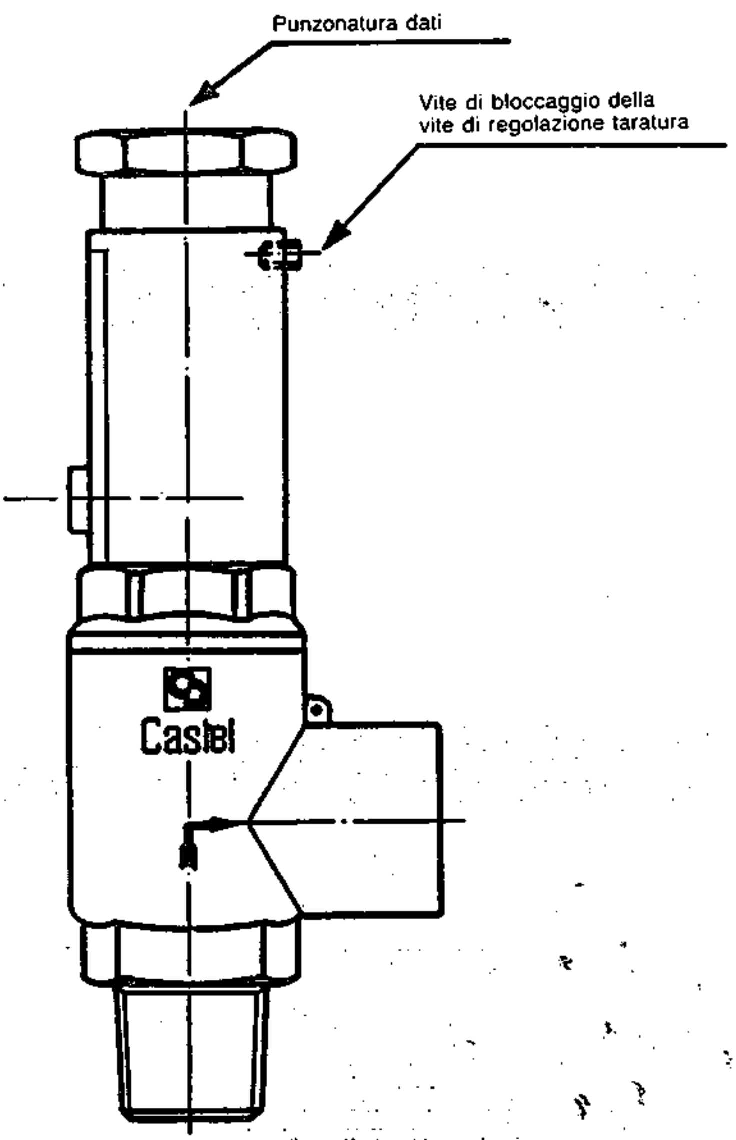
2.4. – La guarnizione di tenuta in teflon è tale che, anche in prolungato esercizio, conserva buone caratteristiche di resistenza e non provoca fenomeni di incollamento nell'otturatore sulla sede.

2.5. – L'otturatore è guidato nel suo movimento.

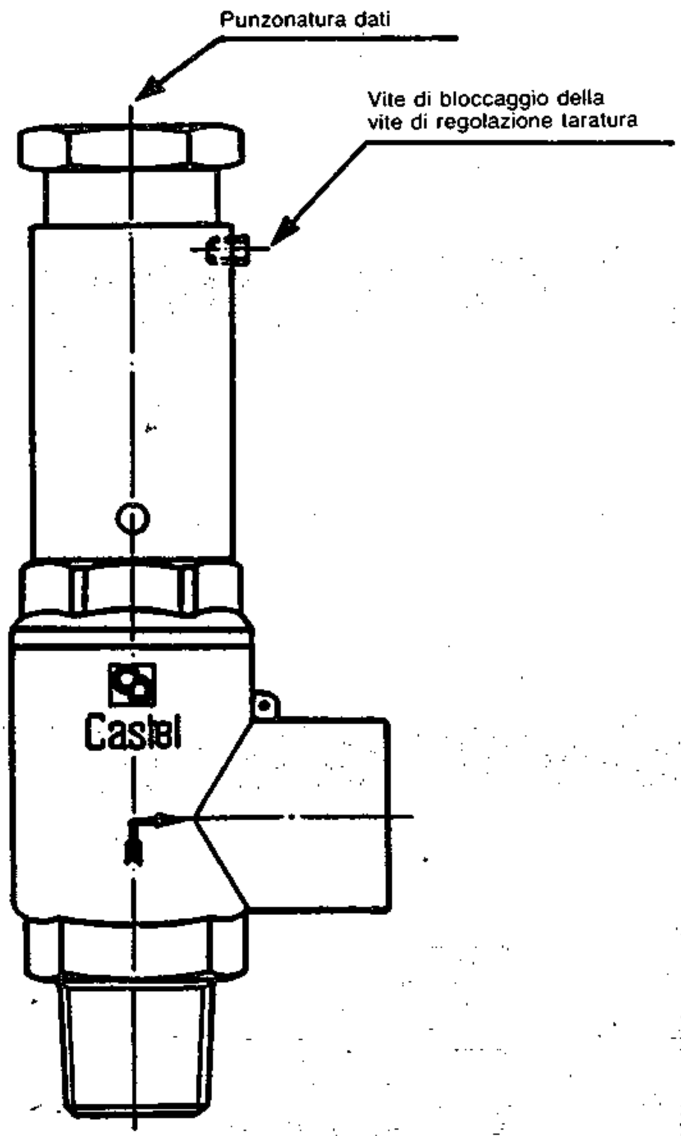
2.6. – L'otturatore è privo di premistoppa.

2.7. – Le spire della molla, escluse quelle terminali, sono distanziate tra di loro del minore tra mezzo diametro del filo e 2 mm. quando l'otturatore raggiunge l'alzata. La freccia della molla, quando l'otturatore è in posizione di blocco meccanico, non è superiore all'85% della freccia totale.

2.8. – Il sistema di taratura è meccanicamente bloccato tramite la vite.



3030/44



3030/88

Castel

s.r.l. Sede soc. e amm.: Via Pordenone, 38
20132 Milano Italy
tel. 215.38.28 - fax 264.132.95
Tribunale di Milano
Registro Imprese 113702
Cod. Fisc. 00779080159
Cap. Soc. L. 500.000.000

Stabilimento e Magazzini: Via Provinciale N. 2-4
20060 Pessano con Bornago (MI)
Tel. 95702.1
Telefax 957.413.17
C.C.I.A.A. Milano 690866
Mecc. MI 019958

PER QUANTO CONCERNE LE VERIFICHE ISTITUZIONALI (ISPESL e/o USSL), IL CERTIFICATO DI TARATURA AL BANCO EFFETTUATA ALLA PRESENZA DELL'ISPESL, HA VALIDITÀ DI 1 ANNO

VALVOLA DI SICUREZZA - CERTIFICATO DI FABBRICAZIONE

(Decreto ministeriale 21 maggio 1974)
(Norma ANCC, raccolta E, fascicolo E1D, edizione gennaio 1979 punto 10.1)

In base alle norme di cui sopra, si certifica quanto segue:

a) Ditta fabbricante: CASTEL s.r.l.

b) Numero di Modello (catalogo) della valvola	:		3030/44
c) Numero di matricola della valvola (n. di fabbrica) e numero del certificato di fabbricazione	:		17651
d) Pressione nominale per le connessioni di ingresso e di uscita della valvola	:	PN	40/40
Diametri nominali per le connessioni di ingresso e uscita della valvola	:	DN	1/2" / 1/2"
e) Diametro dell'orifizio	:	D_0, mm.	12,00
Area "A" della sezione trasversale minima netta dell'orifizio	:	$cm.^2$	1,13
f) Alzata "h"	:	mm.	4,10
Coefficiente "K" (Prot. 21916 del 26/06/1982) Sez. Lombardia Centr. Certificato Omologazione n. 21757 A Riconferma Omologazione VS/88/92 Del 10/06/82 (per 3030/44 - 3030/44 A) Certificato Omologazione n. 21757 B Riconferma Omologazione VS/89/92 Del 10/06/82 (per 3030/88 - 3030/88 A)	:		0,90
g) Campo di variabilità pressione di taratura a contropressione atmosferica	:	bar	13,40/17,40
Campo di temperatura	:	°C	(−50) ÷ (+150)
h) Sovrappressione espressa in % della pressione di taratura	:	%	5%

i) materiali impiegati:
- corpo valvola e otturatore: OT 58 UNI 5705
- molla: Acciaio Classe C UNI 3823
- guarnizione otturatore: Teflon (Politetrafluoroetilene)

l) esito dei collaudi:

– controllo dimensionale	positivo
– collaudo finale	positivo
– prova idraulica lato ingresso e lato uscita a 60 bar	positivo

m) Scarto di richiusura espresso in % della pressione di taratura %: 15%
- Fluidi: Aria - Freon - Cloruro di metile
- Stato fisico: vapore o gas

Castel
Castellin A

Pessano, li 01/09/97

I.S.P.E.S.L.
Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro
Sede di Milano, Via Mangiagalli 3

Certificato N. 17651

Certificato di taratura al banco di valvola di sicurezza

presso il fabbricante

Località, Pessano con Bornago

li 04/09/97

La valvola di sicurezza di cui al presente certificato, fabbricante CASTEL s.r.l. - **n.f. vedi a fianco** corrisponde al modello 3030/44 di cui al certificato di fabbricazione n. **vedi a fianco** del **vedi a fianco** ed al certificato cumulativo di taratura n. 776 del 04/09/97 (solo per le valvole costruite in serie), con diametro dell'orifizio D_o = 12,00 mm.
La taratura della valvola è stata eseguita con aria compressa a temperatura ambiente e contropressione atmosferica alla pressione di 15,50 bar
Dispositivo di blocco della taratura:
- caratteristiche: vite di bloccaggio
- posizione: inserimento sulla parte superiore del corpo valvola
- inamovibilità: assicurata dal piombo

Sulla vite di regolazione di taratura o sul corpo, risultano punzonati i seguenti dati:
- numero di modello (catalogo) della valvola: 3030/44
- pressione di taratura 15,50 bar
- numero di fabbrica: **vedi a fianco**
- sul corpo risultano ricavati per stampaggio il marchio del costruttore e il senso di percorrenza del fluido
- punzone ISPESL N. 178 sul piombo

I.S.P.E.S.L. MINISTERO DELLA SANITÀ DIPARTIMENTO DI MILANO

IL TECNICO
Dott. Ing. Alfonso DE LUCIA

A.C.7

Dichiarazione di cui al punto 2 della disposizione E.1 D. ed. gennaio 1979

2.1. – Valvola a molla diretta.

2.2. – La costruzione ed i materiali impiegati sono idonei per le condizioni di funzionamento, temperatura, corrosività ed altre proprietà dei seguenti fluidi: - Cloro fluoroderivati "Freon" per usi frigoriferi, Cloruro di Metile, aria compressa.

2.3. – Sedi piane.

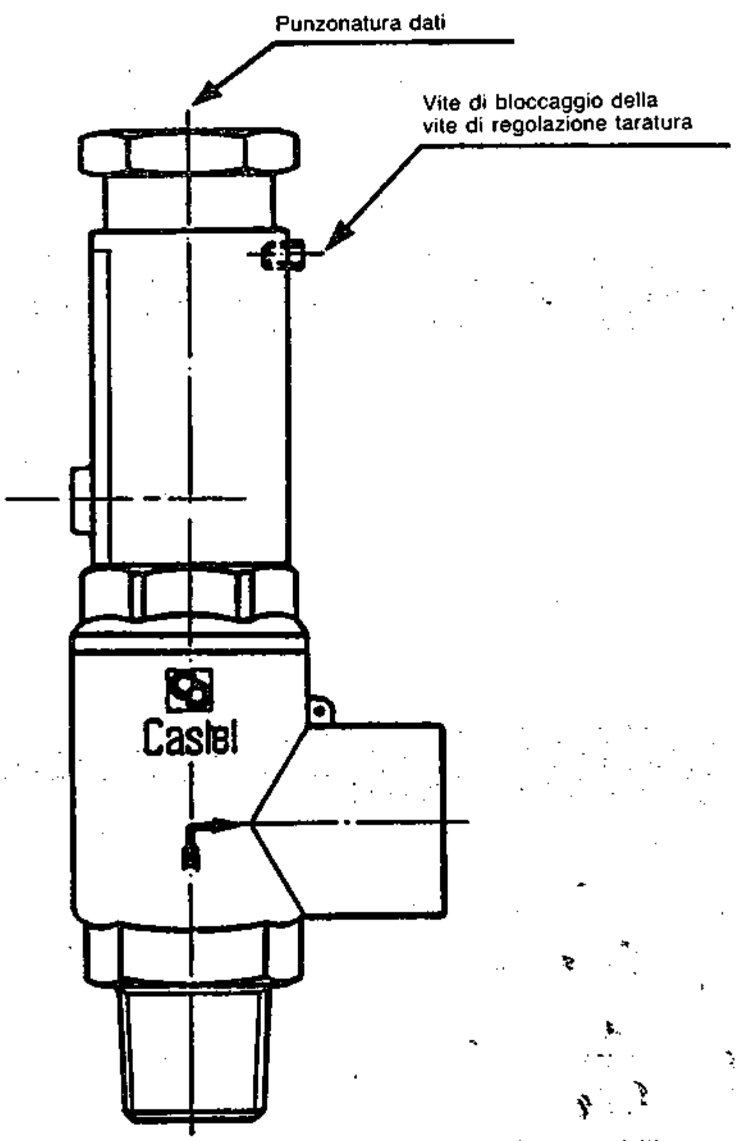
2.4. – La guarnizione di tenuta in teflon è tale che, anche in prolungato esercizio, conserva buone caratteristiche di resistenza e non provoca fenomeni di incollamento nell'otturatore sulla sede.

2.5. – L'otturatore è guidato nel suo movimento.

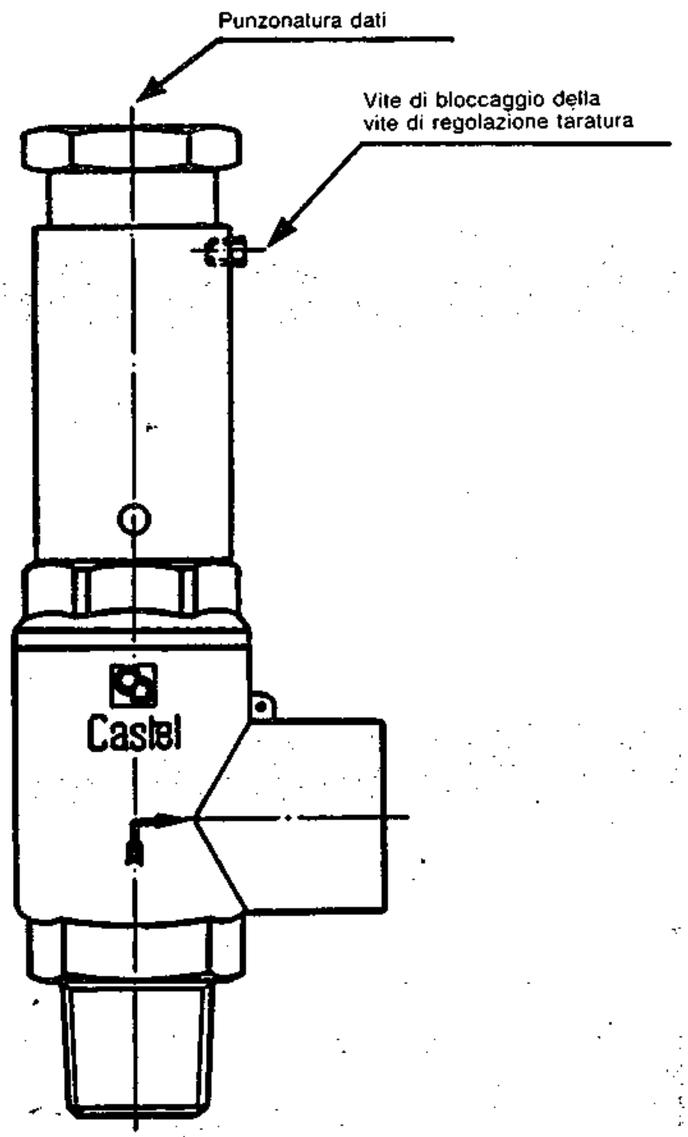
2.6. – L'otturatore è privo di premistoppa.

2.7. – Le spire della molla, escluse quelle terminali, sono distanziate tra di loro del minore tra mezzo diametro del filo e 2 mm. quando l'otturatore raggiunge l'alzata. La freccia della molla, quando l'otturatore è in posizione di blocco meccanico, non è superiore all'85% della freccia totale.

2.8. – Il sistema di taratura è meccanicamente bloccato tramite la vite.



3030/44



3030/88

Castel

s.r.l. Sede soc. e amm.: Via Pordenone, 38
20132 Milano Italy
tel. 215.38.28 - fax 264.132.95
Tribunale di Milano
Registro Imprese 113702
Cod. Fisc. 00779080159
Cap. Soc. L. 500.000.000

Stabilimento e Magazzino: via Provinciale N. 2-4
20060 Pessano con Bornago (MI)
Tel. 95702.1
Telefax 957.413.17
C.C.I.A.A. Milano 590868
Mecc. MI 019956

PER QUANTO CONCERNE LE VERIFICHE ISTITUZIONALI (ISPESL e/o USSL), IL CERTIFICATO DI TARATURA AL BANCO EFFETTUATA ALLA PRESENZA DELL'ISPESL, HA VALIDITÀ DI 1 ANNO

VALVOLA DI SICUREZZA - CERTIFICATO DI FABBRICAZIONE

(Decreto ministeriale 21 maggio 1974)
(Norma ANCC, raccolta E, fascicolo E1D, edizione gennaio 1979 punto 10.1)

In base alle norme di cui sopra, si certifica quanto segue:

a) Ditta fabbricante: CASTEL s.r.l.

b) Numero di Modello (catalogo) della valvola	:	3030/44
c) Numero di matricola della valvola (n. di fabbrica) e numero del certificato di fabbricazione	:	17429
d) Pressione nominale per le connessioni di ingresso e di uscita della valvola	: PN	40/40
Diametri nominali per le connessioni di ingresso e uscita della valvola	: DN	1/2" / 1/2"
e) Diametro dell'orifizio	: D_o, mm.	12,00
Area "A" della sezione trasversale minima netta dell'orifizio	: cm.^{2}	1,13
f) Alzata "h"	: mm.	4,10
Coefficiente "K" (Prot. 21916 del 28/06/1982) Sez. Lombardia Centr. Certificato Omologazione n. 21757 A Riconferma Omologazione VS/88/92 Del 10/06/82 (per 3030/44 - 3030/44 A) Certificato Omologazione n. 21757 B Riconferma Omologazione VS/09/92 Del 10/06/82 (per 3030/88 - 3030/88 A)	:	0,90
g) Campo di variabilità pressione di taratura a contropressione atmosferica	: bar	13,40/17,40
Campo di temperatura	: °C	(−50) + (+150)
h) Sovrappressione espressa in % della pressione di taratura	: %	5%

i) materiali impiegati:
- corpo valvola e otturatore: OT 58 UNI 5705
- molla: Acciaio Classe C UNI 3823
- guarnizione otturatore: Teflon (Politetrafluoroetilene)

l) esito dei collaudi:

– controllo dimensionale	positivo
– collaudo finale	positivo
– prova idraulica lato ingresso e lato uscita a 60 bar	positivo

m) Scarto di richiusura espresso in % della pressione di taratura : % 15%
- Fluidi: Aria - Freon - Cloruro di metile
- Stato fisico: vapore o gas

Pessano, li 01/09/97

Castel s.r.l. Castelli A

I.S.P.E.S.L.
Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro
Sede di Milano, Via Mangiagalli 3

Certificato N. 17429

Certificato di taratura al banco di valvola di sicurezza presso il fabbricante

Località, Pessano con Bornago

li 04/09/97

La valvola di sicurezza di cui al presente certificato, fabbricante CASTEL s.r.l. - n.f. vedi a fianco corrisponde al modello 3030/44 di cui al certificato di fabbricazione n. vedi a fianco del vedi a fianco ed al certificato cumulativo di taratura n. 776 del 04/09/97 (solo per le valvole costruite in serie), con diametro dell'orifizio D_o = 12,00 mm.

La taratura della valvola è stata eseguita con aria compressa a temperatura ambiente e contropressione atmosferica alla pressione di 15,50 bar

Dispositivo di blocco della taratura:
- caratteristiche: vite di bloccaggio
- posizione: inserimento sulla parte superiore del corpo valvola
- inamovibilità: assicurata dal piombo

Sulla vite di regolazione di taratura o sul corpo, risultano punzonati i seguenti dati:
- numero di modello (catalogo) della valvola: 3030/44
- pressione di taratura 15,50 bar
- numero di fabbrica: vedi a fianco
- sul corpo risultano ricavati per stampaggio il marchio del costruttore e il senso di percorrenza del fluido
- punzone ISPESL N. 178 sul piombo

DIPARTIMENTO DI MILANO

IL TECNICO
Dott. Ing. Alfonso DE LUCIA

ALL. 6

Dichiarazione di cui al punto 2 della disposizione E.1 D. ed. gennaio 1979

2.1. – Valvola a molla diretta.

2.2. – La costruzione ed i materiali impiegati sono idonei per le condizioni di funzionamento, temperatura, corrosività ed altre proprietà dei seguenti fluidi: - Cloro fluoroderivati "Freon" per usi frigoriferi, Cloruro di Metile, aria compressa.

2.3. – Sedi piane.

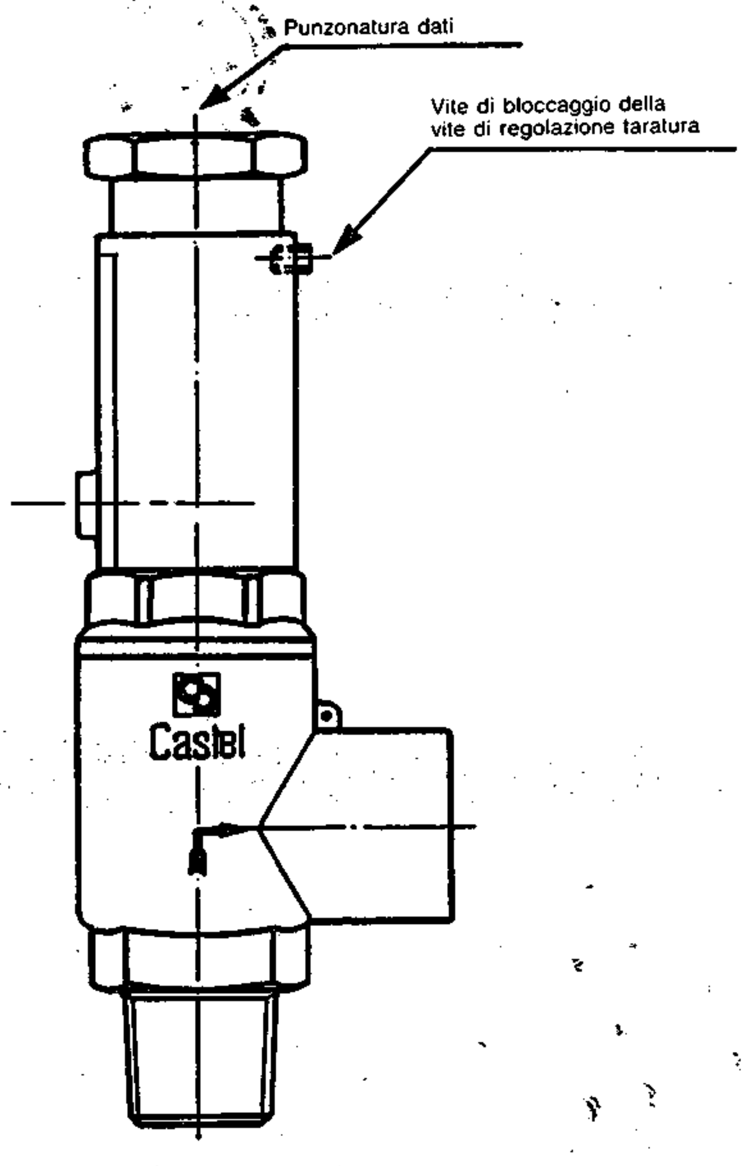
2.4. – La guarnizione di tenuta in teflon è tale che, anche in prolungato esercizio, conserva buone caratteristiche di resistenza e non provoca fenomeni di incollamento nell'otturatore sulla sede.

2.5. – L'otturatore è guidato nel suo movimento.

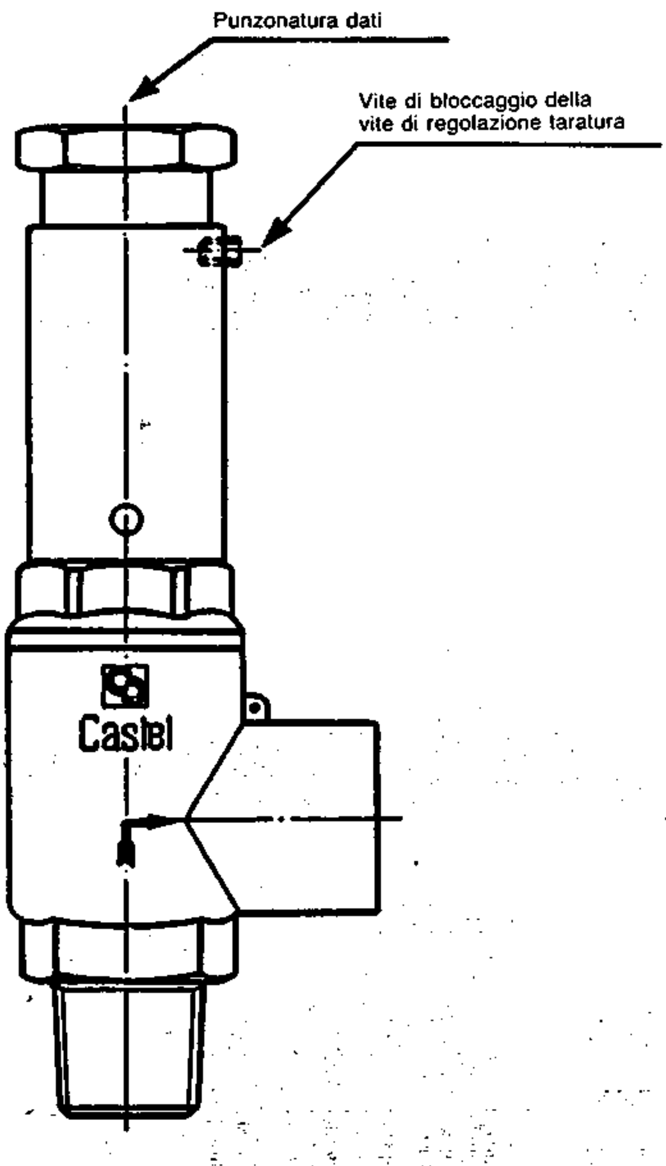
2.6. – L'otturatore è privo di premistoppa.

2.7. – Le spire della molla, escluse quelle terminali, sono distanziate tra di loro del minore tra mezzo diametro del filo e 2 mm. quando l'otturatore raggiunge l'alzata. La freccia della molla, quando l'otturatore è in posizione di blocco meccanico, non è superiore all'85% della freccia totale.

2.8. – Il sistema di taratura è meccanicamente bloccato tramite la vite.



3030/44



3030/88

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

CERTIFICATO DI COLLAUDO
TEST CERTIFICATE

- Heat Exchanger / Scambiatore : **EV 40260666 L**
- Serial Number / Numero di fabbrica : 12431/B
- Drawing N. / Disegno n. : 2003/1
- Year / Anno : 1998
- Manufacturer / Costruttore : **PROVIDES Metalmeccanica Srl . Latina**

		Inside of the tube Interno tubi	Inside of the shell Interno mantello
Maximum operating pressure Pressione massima di esercizio	Bar	16	16
Operating temperature Temperatura di esercizio	°C	-10 +44	-10 +61
Hydraulic testing pressure Pressione di prova idraulica	Bar	21	21
Refrigerant content Capacità	Litres Litri	84	371
Refrigerant Natura del fluido		Freon R22/407C	Acqua

The costruction and materials correspond to the heat exchanger rules. On the heat exchanger there is a plate indicating the serial number, the date of the hydraulic test and a marking (see below) attesting that a test was conducted with a positive outcome.

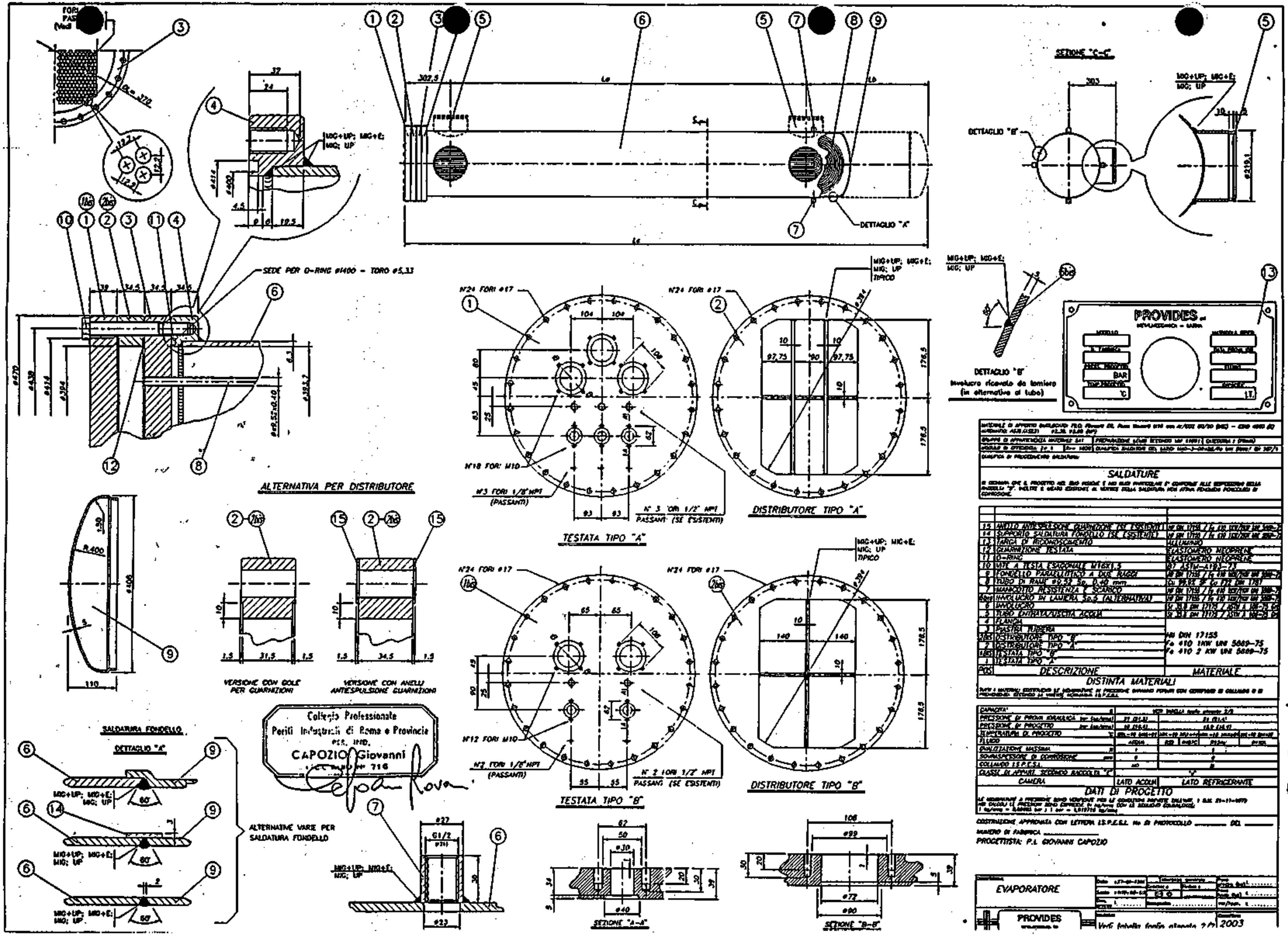
La costruzione ed i materiali impiegati risultano conformi alle normative degli apparecchi a pressione.
Sull'apparecchio è posta la targa con il numero di fabbrica, la data della prova idraulica e la punzonatura (vedi sotto) di avvenuto collaudo con esito positivo della prova.

Latina, 28/10/98

PROVIDES metalmecc. s.r.l.
Via Piave n. 82 LATINA

Allegati n. 1-2-3-4-5-6-7-8

C.C.I.A.A. Latina 42232 - Reg. Impr. Trib. Latina 2285 - C.C.P. 12385043 Ufficio I.V.A. Latina Partita n° 00080600596



SEZIONE "C-C"
DETTAGLIO "B"
DETTAGLIO "A"
SEDE PER O-RING ø400 - TORO ø5,33
MIG+UP; MIG+E; MIG; UP
DETTAGLIO "B"
Involucro ricavato da lamiera (in alternativa al tubo)
PROVIDES
ALTERNATIVA PER DISTRIBUTORE
VERSIONE CON GOLE PER GUARNIZIONI
VERSIONE CON ANELLI ANTIESPULSIONE GUARNIZIONI
N°24 FORI ø17
N°18 FORI M10
N°3 FORI 1/8" NPT (PASSANTI)
N° 3 FORI 1/2" NPT PASSANTI (SE ESISTENTI)
TESTATA TIPO "A"
DISTRIBUTORE TIPO "A"
N°12 FORI M10
N°2 FORI 1/8" NPT (PASSANTI)
N° 2 FORI 1/2" NPT PASSANTI (SE ESISTENTI)
TESTATA TIPO "B"
DISTRIBUTORE TIPO "B"
SALDATURA FONDELLO
DETTAGLIO "A"
ALTERNATIVE VARIE PER SALDATURA FONDELLO
SEZIONE "A-A"
SEZIONE "B-B"
Collegio Professionale Periti Industriali di Roma e Provincia
PER. IND. CAPOZIO Giovanni
SALDATURE
15 ANELLO ANTIESPULSIONE GUARNIZIONE (SE ESISTENTI)
14 SUPPORTO SALDATURA FONDELLO (SE ESISTENTE)
13 TARGA DI RICONOSCIMENTO — ALLUMINIO
12 GUARNIZIONE TESTATA — ELASTOMERO NEOPRENE
11 O-RING — ELASTOMERO NEOPRENE
10 VITE A TESTA ESAGONALE M10X1,5
9 FONDELLO PARALLELITICO A DUE RAGGI
8 TUBO DI RAME ø9,52 Sp. 0,40 mm
7 MANICOTTO RESISTENZA E SCARICO
6bis INVOLUCRO IN LAMIERA Sp.5 (ALTERNATIVA)
6 INVOLUCRO
5 TUBO ENTRATA/USCITA ACQUA
4 FLANGIA
3 PIASTRA TUBIERA
2bis DISTRIBUTORE TIPO "B"
2 DISTRIBUTORE TIPO "A"
1bis TESTATA TIPO "B"
1 TESTATA TIPO "A"
DIN 17155
Fe 410 1KW UNI 5869-75
Fe 410 2 KW UNI 5869-75
POS DESCRIZIONE MATERIALE
DISTINTA MATERIALI
CAPACITA'
PRESSIONE DI PROVA IDRAULICA
PRESSIONE DI PROGETTO
TEMPERATURA DI PROGETTO
FLUIDO
SOVRASPESSORE DI CORROSIONE
COLLAUDO I.S.P.E.S.L.
CAMERA
LATO ACQUA
LATO REFRIGERANTE
DATI DI PROGETTO
PROGETTISTA: P.I. GIOVANNI CAPOZIO
EVAPORATORE
PROVIDES
2003
ALL. 4

ALL. 1 BIS

MODELLO EVAP.	TESTATA TIPO	DISTRIB. TIPO	N°TUBI	N°FORI Ø10	La	Lb	Lc	LATO GAS	LATO ACQUA
								CAPACITA' (lt)	
40260777L	A	A	277	554	2600	820	3723	97	359
40260767L	A	A	264	528	2600	820	3723	92	363
40260676L	A	A	253	506	2600	820	3723	89	367
40260666L	A	A	240	480	2600	820	3723	84	371
40260656L	A	A	225	450	2600	820	3723	79	376
40260565L	A	A	212	424	2600	820	3723	78	377
40260555L	A	A	197	394	2600	820	3723	71	384
40260777S	A	A	277	554	2600	260	3163	97	291
40260767S	A	A	264	528	2600	260	3163	92	295
40260676S	A	A	253	506	2600	260	3163	89	299
40260666S	A	A	240	480	2600	260	3163	84	303
40260656S	A	A	225	450	2600	260	3163	79	308
40260565S	A	A	212	424	2600	260	3163	78	309
40260555S	A	A	197	394	2600	260	3163	71	316
40230777S	A	A	277	554	2300	260	2863	88	363
40230767S	A	A	264	528	2300	260	2863	84	267
40230676S	A	A	253	506	2300	260	2863	80	270
40230666S	A	A	240	480	2300	260	2863	76	274
40230656S	A	A	225	450	2300	260	2863	72	279
40230565S	A	A	212	424	2300	260	2863	69	281
40230555S	A	A	197	394	2300	260	2863	65	286
40231010S	B	B	266	532	2300	260	2863	84	266
40230910S	B	B	254	508	2300	260	2863	81	270
40230099S	B	B	242	484	2300	260	2863	77	274
40230089S	B	B	229	458	2300	260	2863	73	277
40230088S	B	B	216	432	2300	260	2863	69	281
40230079S	B	B	216	432	2300	260	2863	69	281
40230078S	B	B	203	406	2300	260	2863	65	285
40230077S	B	B	190	380	2300	260	2863	61	289

Capozio Giovanni

Collegio Professionale
Periti Industriali di Roma e Provincia
PER. IND.
CAPOZIO Giovanni
ISCR. ALBO N° 716

Descrizione:	Data : 27-08-1996	Tolleranza generale		Peso grezzo (kg) :
EVAPORATORE	Scala :	Grezzo: ±	Finito: ±	Peso finito (kg) :
	Dim. grezzo :	Disegnato:		Ver/Appr. :
PROVIDES METALMECCANICA Srl Via Piave, 82 – 04100 LATINA	Modello: Vedi tabella			Classifica: 2003 Foglio 2/2

Allegato N° 9

Costruttore Fabbricato da Provides Srl

N. di fabbrica 12431/B Matricola e sigla

DICHIARAZIONI DEL COSTRUTTORE

a) MATERIALI (1) - MEMBRATURE (2)

- Tubo di rame Ø 9,52 x 0,40 Certificato di origine Wieland norme EN10204 Cert. n.68/0525 del 14/03/97
- Guarnizione elastomero neoprene

b) TRATTAMENTI TERMICI (3) - EVENTUALI ALTRE DICHIARAZIONI (4)

(Vedere Note a tergo)

c) SALDATURE (estremi dei certificati di qualifica e di omologazione)

— Procedimenti di saldatura (5)

- Elettrico procedimento MAG (staffe e selle)
- Automatico in arco sommerso (fasciame, fondi P. tubiera)

Qualifiche IIS n. 4200 - 4343 - 4359
27315 data 21/05/84

— Elettrodi impiegati (6)

Filo pieno tipo RMS Ø 1 mm.
Filo pieno RM2 - AS - 35
Flusso AS 231 (SIO)

— Saldatori (7)

D'Annibale Romeo - Qualif. I.I.S. n.4343 Rinn. ISPESL del 23/06/98
Comuzzi Sergio - Qualif. ISPESL n.12534-12535 Rinn. ISPESL del 23/06/98
Magagna Stefano- Qualif. ISPESL n.12536-12537 Rinn. ISPESL del 23/06/98

d) TALLONI DI SALDATURA (8)

e) ESAMI NON DISTRUTTIVI (9)

Data 28/10/98

Timbro e firma del Costruttore
PROVIDES metalmecc. s.r.l.
Via Pieve n. 82 LANNA

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

UNI EN ISO 9002 (ISO 9002) DNV Certified Quality System

Allegato n. 3
Encl. n. 3

Costruttore : PROVIDES
Manufacturer : METALMECCANICA Srl

N. di fabbrica : 12431/B
Serial number :

Materiali - Materials					Certif. - Certif.		
Posiz. Item	Spessore Thickness mm	Fabbricante Manufacturer	Qualità sigla tab.unificata Quality and specifications	Colata pezzo o lotto n. Heat n.	Numero Number	Data Date	Note Notes
1	35	Vitkovice	HII DIN 17155	382126	13303	09/07/98	
2	35	Ilva	HII DIN 17155	503337001	27119	28/10/96	
3	35	Vitkovice	HII DIN 17155	382126	13303	09/07/98	
4	40	Dillinger Hütte	P 265 GH	49106-01	1010644	15/06/98	

All dimensions have been verified and correspond to standard quoted in UNI EN 22768-1

La verifica dimensionale è stata effettuata conformemente alle Norme Tolleranze Generali UNI EN 22768-1

Dimensioni in mm
Dimensions in mm

Classe di Tolleranza Tolerance Classification		Scostamenti per campi di dimensioni fondamentali Tolerances for various ranges quoted below							
Designazione Designation	Denominazione Tolerance Specification	da 0.5 fino a 3 from 0.5 to 3	oltre 3 fino a 6 more than 3 up to 6	oltre 6 fino a 30 more than 6 up to 30	oltre 30 fino a 120 more than 30 up to 120	oltre 120 fino a 400 more than 120 up to 400	oltre 400 fino a 1000 more than 400 up to 1000	oltre 1000 fino a 2000 more than 1000 up to 2000	oltre 2000 fino a 4000 more than 2000 up to 4000
c	grossolana rough	± 0.2	± 0.5	± 1	± 0.8	± 1.2	± 2	± 3	± 4

Firma del costruttore
Manufacturer's signature

PROVIDES metalmecc. s.r.l.
Via Piave n. 82 - LATINA

Data: 28/10/98

PROVIDES

INDUSTRIA METALMECCANICA S.R.L.

Stabilimento e Amministrazione:
VIA PIAVE, 82 - 04100 LATINA - TEL. 0773/479597-8 - FAX 0773/696874

Scambiatori di calore a fascio tubiero
Serbatoi G.P.L. Autotrazione
Cabine Telefoniche

SINCERT

All. n. 4

APPARECCHIO TIPO: EV **40260666 L**

NUMERO DI FABBRICA: 12431/B

NUMERO DI MATRICOLA I.S.P.E.S.L.:---

L'apparecchio ha in dotazione i seguenti accessori di sicurezza e di controllo:

Manometro tipo Wika matr.: 1555123, 1555124, 1555122

Valvola di sicurezza costruzione CASTEL n.f.: 17429, 17651, 22286

ALL. 5

MINISTERO DELLA SANITÀ

ISTITUTO SUPERIORE PER LA PREVENZIONE
E LA SICUREZZA DEL LAVORO

Dipartimento di ROMA

MC QUAY ITALIA S.p.A.

Via Piani di S. Maria 72

00040 ARICCIA (Roma)

Data 8 GIU. 1998

16-EE483669 M

Su richiesta della ditta in oggetto, in data odierna si é eseguita la verifica della taratura al banco, di N° 210 manometri per impianti frigo tipo marca WIKA aventi fondo scala 20 Bar e segno rosso di max a 15,5 Bar , contraddistinti:

dal N° 1555065

al N° 1555275

Sottoposti a pressione di gas inerte fino a 20 Bar gli stessi non hanno dato segni di irregolarità. Non si sono rilevati scarti con manometro campione superiori a + 3% del valore del fondo scala (Raccolta E-E1 D6 punto 24).

I.S.P.E.S.L. - Dipartimento di Roma

IL FUNZIONARIO

Dott. Ing. ENRICO SCERCH

Castel

s.r.l. Sede soc. e amm.: Via Pordenone, 38
20132 Milano Italy
tel. 215.38.28 - fax 264.132.95
Tribunale di Milano
Registro Imprese 113702
Cod. Fisc. 00779080159
Cap. Soc. L. 500.000.000

Stabilimento e Magazzino Via Provinciale N. 2-4
20060 Pessano con Bornago (MI)
Tel. 95702.1
Telefax 957.413.17
C.C.I.A.A. Milano 590666
Mecc. MI 019956

PER QUANTO CONCERNE LE VERIFICHE ISTITUZIONALI (ISPESL e/o USSL), IL CERTIFICATO DI TARATURA AL BANCO EFFETTUATA ALLA PRESENZA DELL'ISPESL, HA VALIDITÀ DI 1 ANNO

VALVOLA DI SICUREZZA - CERTIFICATO DI FABBRICAZIONE

(Decreto ministeriale 21 maggio 1974)
(Norma ANCC, raccolta E, fascicolo E1D, edizione gennaio 1979 punto 10.1)

In base alle norme di cui sopra, si certifica quanto segue:

a) Ditta fabbricante: CASTEL s.r.l.

b) Numero di Modello (catalogo) della valvola	:		3030/44
c) Numero di matricola della valvola (n. di fabbrica) e numero del certificato di fabbricazione	:		22286
d) Pressione nominale per le connessioni di ingresso e di uscita della valvola	:	PN	40/40
Diametri nominali per le connessioni di ingresso e uscita della valvola	:	DN	1/2" / 1/2"
e) Diametro dell'orifizio	:	D_o, mm.	12,00
Area "A" della sezione trasversale minima netta dell'orifizio	:	cm.^{2}	1,13
f) Alzata "h"	:	mm.	4,10
Coefficiente "K"	:		0,90

(Prot. 21916 del 28/06/1982) Sez. Lombardia Centr..
Certificato Omologazione n. 21757 A
Riconferma Omologazione VS/88/92 Del 10/06/82 (per 3030/44 - 3030/44 A)
Certificato Omologazione n. 21757 B
Riconferma Omologazione VS/88/92 Del 10/06/82 (per 3030/88 - 3030/88 A)

g) Campo di variabilità pressione di taratura a contropressione atmosferica	:	bar	13,40/17,40
Campo di temperatura	:	°C	(−50) ÷ (+150)
h) Sovrappressione espressa in % della pressione di taratura	:	%	5%

i) materiali impiegati:
- corpo valvola e otturatore: OT 58 UNI 5705
- molla: Acciaio Classe C UNI 3823
- guarnizione otturatore: Teflon (Politetrafluoroetilene)

l) esito dei collaudi:

– controllo dimensionale	positivo
– collaudo finale	positivo
– prova idraulica lato ingresso e lato uscita a 60 bar	positivo

m) Scarto di richiusura espresso in % della pressione di taratura : % 15%
- Fluidi: Aria - Freon - Cloruro di metile
- Stato fisico: vapore o gas

Pessano, li 25/11/97

Castel

I.S.P.E.S.L.
Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro
Sede di Milano, Via Mangiagalli 3

Certificato N. 22286

Certificato di taratura al banco di valvola di sicurezza presso il fabbricante

Località, Pessano con Bornago

li 03/12/97

La valvola di sicurezza di cui al presente certificato, fabbricante CASTEL s.r.l. - n.f. vedi a fianco corrisponde al modello 3030/44 di cui al certificato di fabbricazione n. vedi a fianco del vedi a fianco ed al certificato cumulativo di taratura n. 958 del 03/12/97 (solo per le valvole costruite in serie), con diametro dell'orifizio D_o = 12,00 mm.

La taratura della valvola è stata eseguita con aria compressa a temperatura ambiente e contropressione atmosferica alla pressione di 15,50 bar

Dispositivo di blocco della taratura:
- caratteristiche: vite di bloccaggio
- posizione: inserimento sulla parte superiore del corpo valvola
- inamovibilità: assicurata dal piombo

Sulla vite di regolazione di taratura o sul corpo, risultano punzonati i seguenti dati:
- numero di modello (catalogo) della valvola: 3030/44
- pressione di taratura 15,50 bar
- numero di fabbrica: vedi a fianco
- sul corpo risultano ricavati per stampaggio il marchio del costruttore e il senso di percorrenza del fluido
- punzone ISPESL N. 178 sul piombo

I.S.P.E.S.L. DIPARTIMENTO DI MILANO
MINISTERO DELLA SANITÀ

IL TECNICO
Dott. Ing. Alfonso DE LUCIA

All. 8

Dichiarazione di cui al punto 2 della disposizione E.1 D. ed. gennaio 1979

2.1. – Valvola a molla diretta.

2.2. – La costruzione ed i materiali impiegati sono idonei per le condizioni di funzionamento, temperatura, corrosività ed altre proprietà dei seguenti fluidi: - Cloro fluoroderivati "Freon" per usi frigoriferi, Cloruro di Metile, aria compressa.

2.3. – Sedi piane.

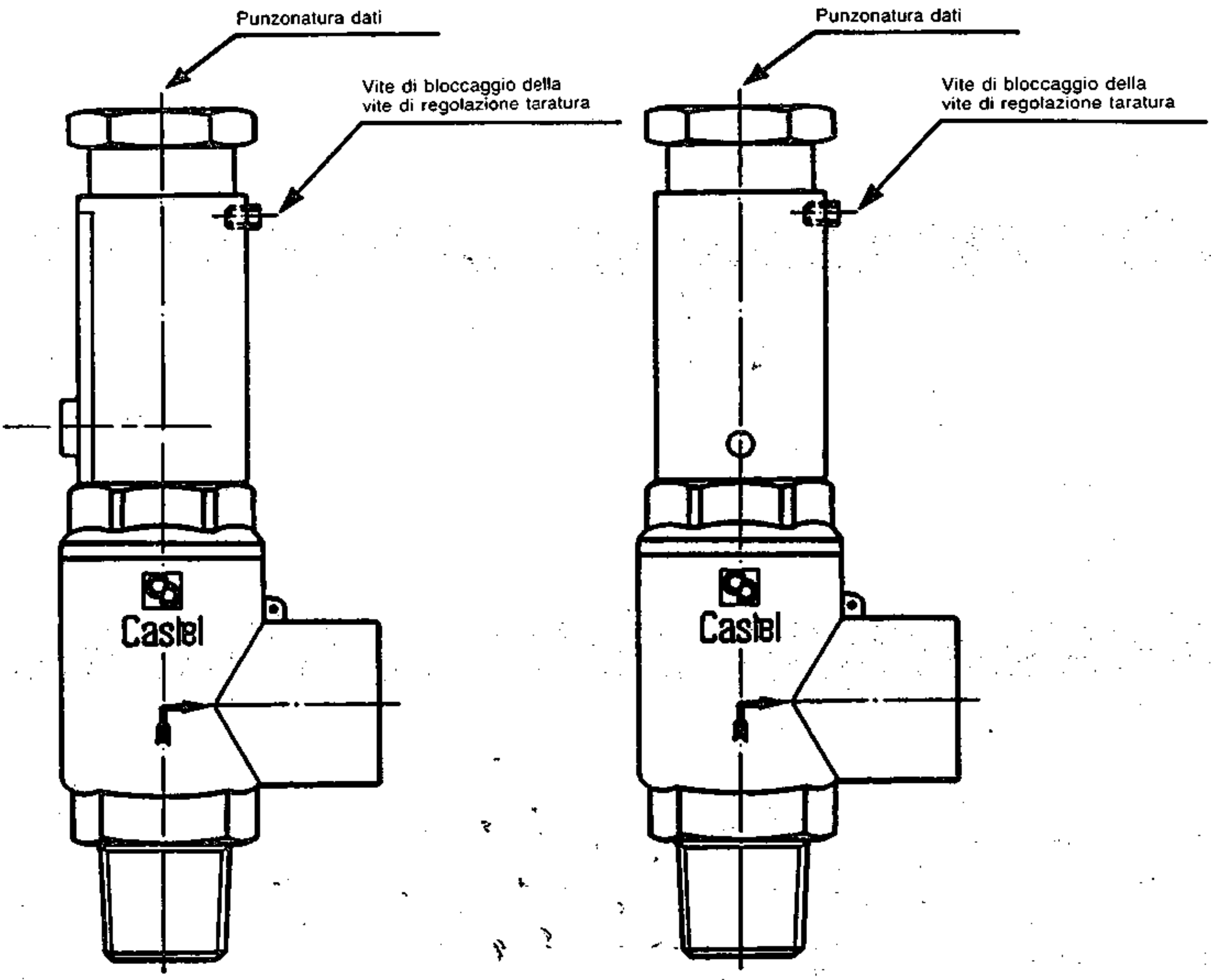
2.4. – La guarnizione di tenuta in teflon è tale che, anche in prolungato esercizio, conserva buone caratteristiche di resistenza e non provoca fenomeni di incollamento nell'otturatore sulla sede.

2.5. – L'otturatore è guidato nel suo movimento.

2.6. – L'otturatore è privo di premistoppa.

2.7. – Le spire della molla, escluse quelle terminali, sono distanziate tra di loro del minore tra mezzo diametro del filo e 2 mm. quando l'otturatore raggiunge l'alzata. La freccia della molla, quando l'otturatore è in posizione di blocco meccanico, non è superiore all'85% della freccia totale.

2.8. – Il sistema di taratura è meccanicamente bloccato tramite la vite.



3030/44 3030/88

Castel s.r.l. Sede soc. e amm.: Via Pordenone, 38
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tel. 215.38.28 - fax 264.132.95
Tribunale di Milano
Registro Imprese 113702
Cod. Fisc. 00779080159
Cap. Soc. L. 500.000.000

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Telefax 957.413.17
C.C.I.A.A. Milano 590866
Mecc. MI 019956

PER QUANTO CONCERNE LE VERIFICHE ISTITUZIONALI (ISPESL e/o USSL), IL CERTIFICATO DI TARATURA AL BANCO EFFETTUATA ALLA PRESENZA DELL'ISPESL, HA VALIDITÀ DI 1 ANNO

VALVOLA DI SICUREZZA - CERTIFICATO DI FABBRICAZIONE

(Decreto ministeriale 21 maggio 1974)
(Norma ANCC, raccolta E, fascicolo E1D, edizione gennaio 1979 punto 10.1)

In base alle norme di cui sopra, si certifica quanto segue:

a) Ditta fabbricante: CASTEL s.r.l.

b) Numero di Modello (catalogo) della valvola	:	3030/44
c) Numero di matricola della valvola (n. di fabbrica) e numero del certificato di fabbricazione	:	17651
d) Pressione nominale per le connessioni di ingresso e di uscita della valvola	: PN	40/40
Diametri nominali per le connessioni di ingresso e uscita della valvola	: DN	1/2" / 1/2"
e) Diametro dell'orifizio	: D_o, mm.	12,00
Area "A" della sezione trasversale minima netta dell'orifizio	: cm.^{2}	1,13
f) Alzata "h"	: mm.	4,10
Coefficiente "K"	:	0,90
(Prot. 21916 del 28/06/1982) Sez. Lombardia Centr. Certificato Omologazione n. 21757 A Riconferma Omologazione VS/88/92 Del 10/06/82 (per 3030/44 - 3030/44 A) Certificato Omologazione n. 21757 B Riconferma Omologazione VS/89/92 Del 10/06/82 (per 3030/88 - 3030/88 A)		
g) Campo di variabilità pressione di taratura a contropressione atmosferica	: bar	13,40/17,40
Campo di temperatura	: °C	(–50) ÷ (+150)
h) Sovrappressione espressa in % della pressione di taratura	: %	5%

i) materiali impiegati:
- corpo valvola e otturatore: OT 58 UNI 5705
- molla: Acciaio Classe C UNI 3823
- guarnizione otturatore: Teflon (Politetrafluoroetilene)

l) esito dei collaudi:

– controllo dimensionale	positivo
– collaudo finale	positivo
– prova idraulica lato ingresso e lato uscita a 60 bar	positivo

m) Scarto di richiusura espresso in % della pressione di taratura : % 15%
- Fluidi: Aria - Freon - Cloruro di metile
- Stato fisico: vapore o gas

Pessano, li 01/09/97

Castel

I.S.P.E.S.L.
Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro
Sede di Milano, Via Mangiagalli 3

Certificato N. 17651

Certificato di taratura al banco di valvola di sicurezza presso il fabbricante

Località, Pessano con Bornago

li 04/09/97

La valvola di sicurezza di cui al presente certificato, fabbricante CASTEL s.r.l. - n.f. vedi a fianco corrisponde al modello 3030/44 di cui al certificato di fabbricazione n. vedi a fianco del vedi a fianco ed al certificato cumulativo di taratura n. 776 del 04/09/97 (solo per le valvole costruite in serie), con diametro dell'orifizio D_o = 12,00 mm.

La taratura della valvola è stata eseguita con aria compressa a temperatura ambiente e contropressione atmosferica alla pressione di 15,50 bar

Dispositivo di blocco della taratura:
- caratteristiche: vite di bloccaggio
- posizione: inserimento sulla parte superiore del corpo valvola
- inamovibilità: assicurata dal piombo

Sulla vite di regolazione di taratura o sul corpo, risultano punzonati i seguenti dati:
- numero di modello (catalogo) della valvola: 3030/44
- pressione di taratura 15,50 bar
- numero di fabbrica: vedi a fianco
- sul corpo risultano ricavati per stampaggio il marchio del costruttore e il senso di percorrenza del fluido
- punzone ISPESL N. 178 sul piombo

I.S.P.E.S.L. DIPARTIMENTO DI MILANO MINISTERO DELLA SANITÀ

IL TECNICO
Dott. Ing. Alfonso DE LUCIA

Dichiarazione di cui al punto 2 della disposizione E.1 D. ed. gennaio 1979

2.1. – Valvola a molla diretta.

2.2. – La costruzione ed i materiali impiegati sono idonei per le condizioni di funzionamento, temperatura, corrosività ed altre proprietà dei seguenti fluidi: - Cloro fluoroderivati "Freon" per usi frigoriferi, Cloruro di Metile, aria compressa.

2.3. – Sedi piane.

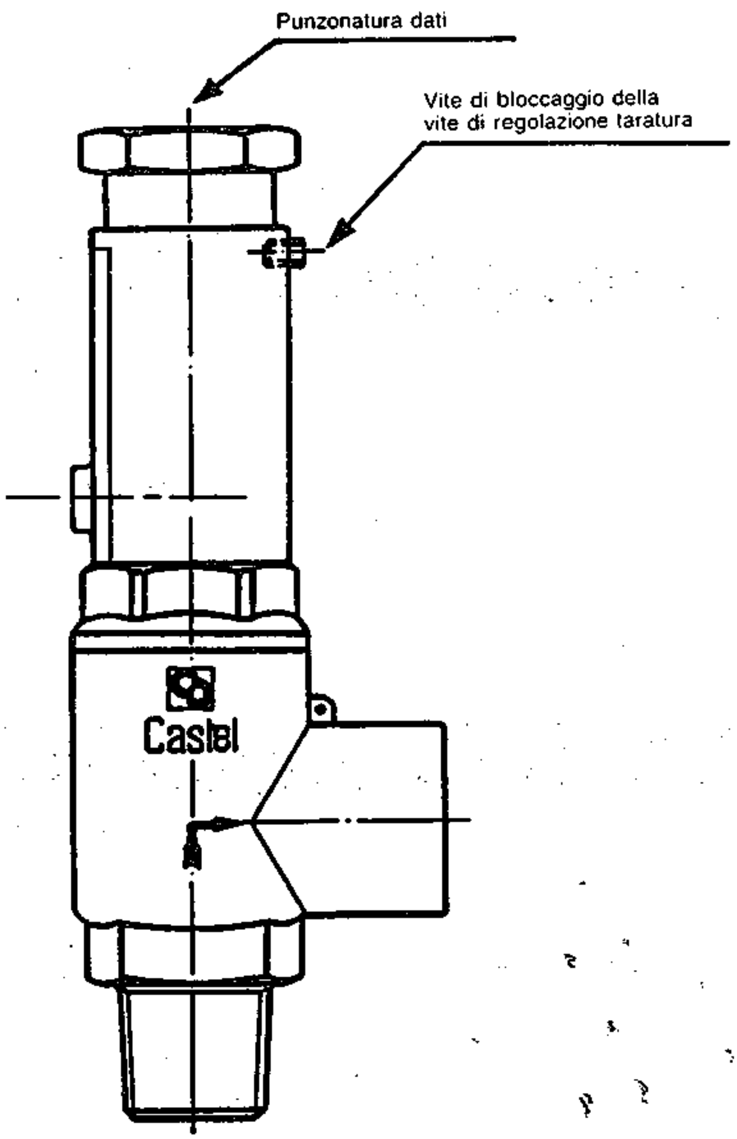
2.4. – La guarnizione di tenuta in teflon è tale che, anche in prolungato esercizio, conserva buone caratteristiche di resistenza e non provoca fenomeni di incollamento nell'otturatore sulla sede.

2.5. – L'otturatore è guidato nel suo movimento.

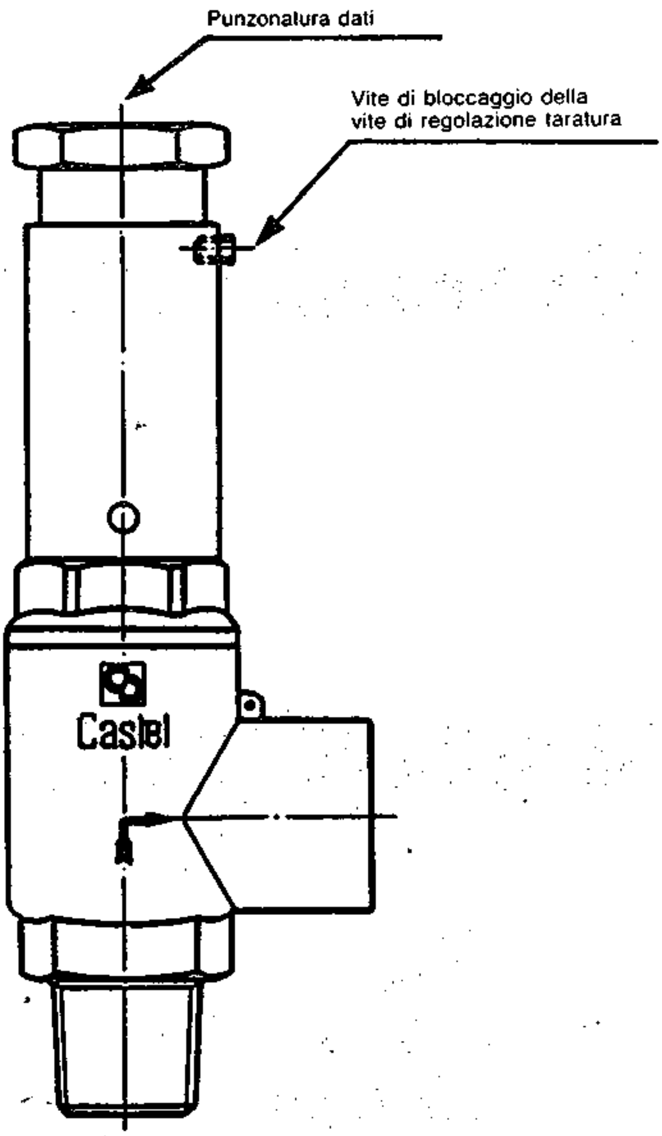
2.6. – L'otturatore è privo di premistoppa.

2.7. – Le spire della molla, escluse quelle terminali, sono distanziate tra di loro del minore tra mezzo diametro del filo e 2 mm. quando l'otturatore raggiunge l'alzata. La freccia della molla, quando l'otturatore è in posizione di blocco meccanico, non è superiore all'85% della freccia totale.

2.8. – Il sistema di taratura è meccanicamente bloccato tramite la vite.



3030/44



3030/88

Castel

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tel. 215.38.28 - fax 264.132.95
Tribunale di Milano
Registro imprese 113702
Cod. Fisc. 00779080159
Cap. Soc. L. 500.000.000

Stabilimento e Magazzini: Via Provinciale N. 2-4
20060 Pessano con Bornago (MI)
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Telefax 957.413.17
C.C.I.A.A. Milano 590966
Mecc. MI 019856

PER QUANTO CONCERNE LE VERIFICHE ISTITUZIONALI (ISPESL e/o USSL), IL CERTIFICATO DI TARATURA AL BANCO EFFETTUATA ALLA PRESENZA DELL'ISPESL, HA VALIDITÀ DI 1 ANNO

VALVOLA DI SICUREZZA - CERTIFICATO DI FABBRICAZIONE

(Decreto ministeriale 21 maggio 1974)
(Norma ANCC, raccolta E, fascicolo E1D, edizione gennaio 1979 punto 10.1)

In base alle norme di cui sopra, si certifica quanto segue:

a) Ditta fabbricante: CASTEL s.r.l.

b) Numero di Modello (catalogo) della valvola : 3030/44

c) Numero di matricola della valvola (n. di fabbrica) e numero del certificato di fabbricazione : 17429

d) Pressione nominale per le connessioni di ingresso e di uscita della valvola : PN 40/40

Diametri nominali per le connessioni di ingresso e uscita della valvola : DN 1/2" / 1/2"

e) Diametro dell'orifizio : D_o, mm. 12,00

Area "A" della sezione trasversale minima netta dell'orifizio : cm.^{2} 1,13

f) Alzata "h" : mm. 4,10

Coefficiente "K" : 0,90

(Prot. 21916 del 26/06/1982) Sez. Lombardia Centr.
Certificato Omologazione n. 21757 A Del 10/06/82 (per 3030/44 - 3030/44 A)
Riconferma Omologazione VS/88/92
Certificato Omologazione n. 21757 B Del 10/06/82 (per 3030/88 - 3030/88 A)
Riconferma Omologazione VS/88/92

g) Campo di variabilità pressione di taratura a contropressione atmosferica : bar 13,40/17,40

Campo di temperatura : °C (−50) + (+150)

h) Sovrappressione espressa in % della pressione di taratura : % 5%

i) materiali impiegati:
- corpo valvola e otturatore: OT 58 UNI 5705
- molla: Acciaio Classe C UNI 3823
- guarnizione otturatore: Teflon (Politetrafluoroetilene)

l) esito dei collaudi:
- controllo dimensionale: positivo
- collaudo finale: positivo
- prova idraulica lato ingresso e lato uscita a 60 bar: positivo

m) Scarto di richiusura espresso in % della pressione di taratura : % 15%
- Fluidi: Aria - Freon - Cloruro di metile
- Stato fisico: vapore o gas

Pessano, lì 01/09/97

Castel s.r.l.
Castelli

I.S.P.E.S.L.
Istituto Superiore per la Prevenzione e la Sicurezza del Lavoro
Sede di Milano, Via Mangiagalli 3

Certificato N. 17429

Certificato di taratura al banco di valvola di sicurezza presso il fabbricante

Località, Pessano con Bornago

lì 04/09/97

La valvola di sicurezza di cui al presente certificato, fabbricante CASTEL s.r.l. - n.f. vedi a fianco corrisponde al modello 3030/44 di cui al certificato di fabbricazione n. vedi a fianco del vedi a fianco ed al certificato cumulativo di taratura n. 776 del 04/09/97 (solo per le valvole costruite in serie), con diametro dell'orifizio D_o = 12,00 mm.

La taratura della valvola è stata eseguita con aria compressa a temperatura ambiente e contropressione atmosferica alla pressione di 15,50 bar

Dispositivo di blocco della taratura:
- caratteristiche: vite di bloccaggio
- posizione: inserimento sulla parte superiore del corpo valvola
- inamovibilità: assicurata dal piombo

Sulla vite di regolazione di taratura o sul corpo, risultano punzonati i seguenti dati:
- numero di modello (catalogo) della valvola: 3030/44
- pressione di taratura 15,50 bar
- numero di fabbrica: vedi a fianco
- sul corpo risultano ricavati per stampaggio il marchio del costruttore e il senso di percorrenza del fluido
- punzone ISPESL N. 178 sul piombo

DIPARTIMENTO DI MILANO

IL TECNICO
Dott. Ing. Alfonso DE LUCIA

ALL. 6

Dichiarazione di cui al punto 2 della disposizione E.1 D. ed. gennaio 1979

2.1. – Valvola a molla diretta.

2.2. – La costruzione ed i materiali impiegati sono idonei per le condizioni di funzionamento, temperatura, corrosività ed altre proprietà dei seguenti fluidi: - Cloro fluoroderivati "Freon" per usi frigoriferi, Cloruro di Metile, aria compressa.

2.3. – Sedi piane.

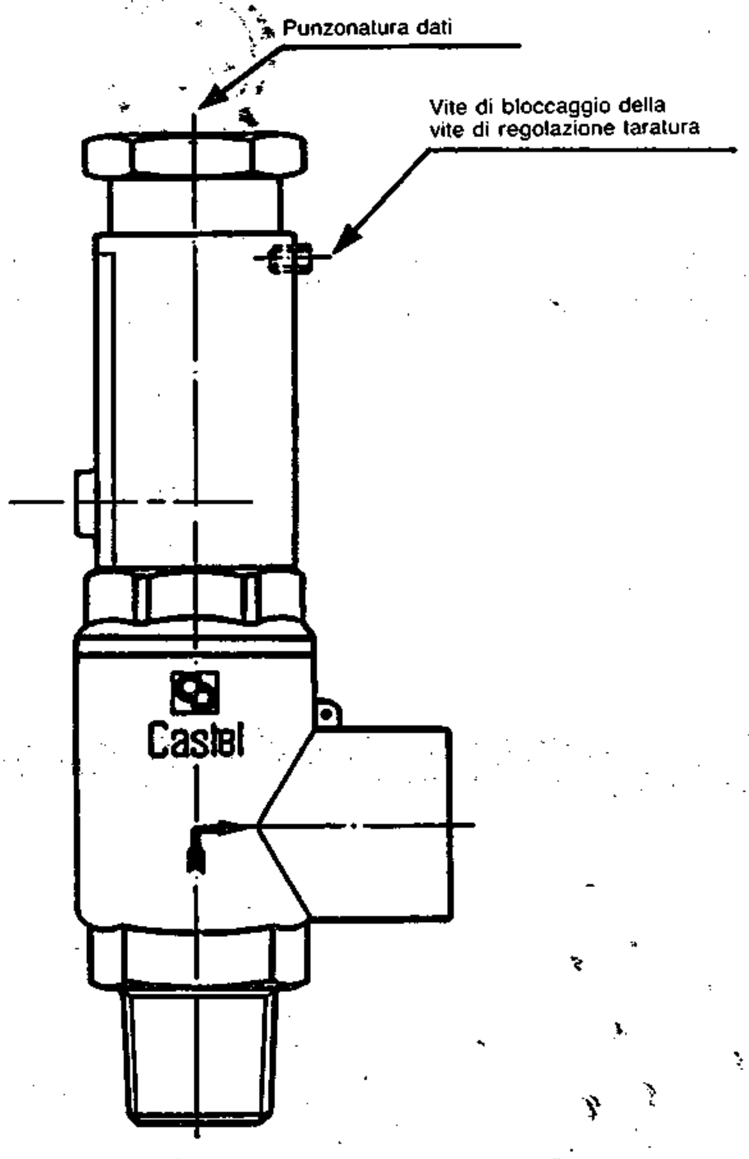
2.4. – La guarnizione di tenuta in teflon è tale che, anche in prolungato esercizio, conserva buone caratteristiche di resistenza e non provoca fenomeni di incollamento nell'otturatore sulla sede.

2.5. – L'otturatore è guidato nel suo movimento.

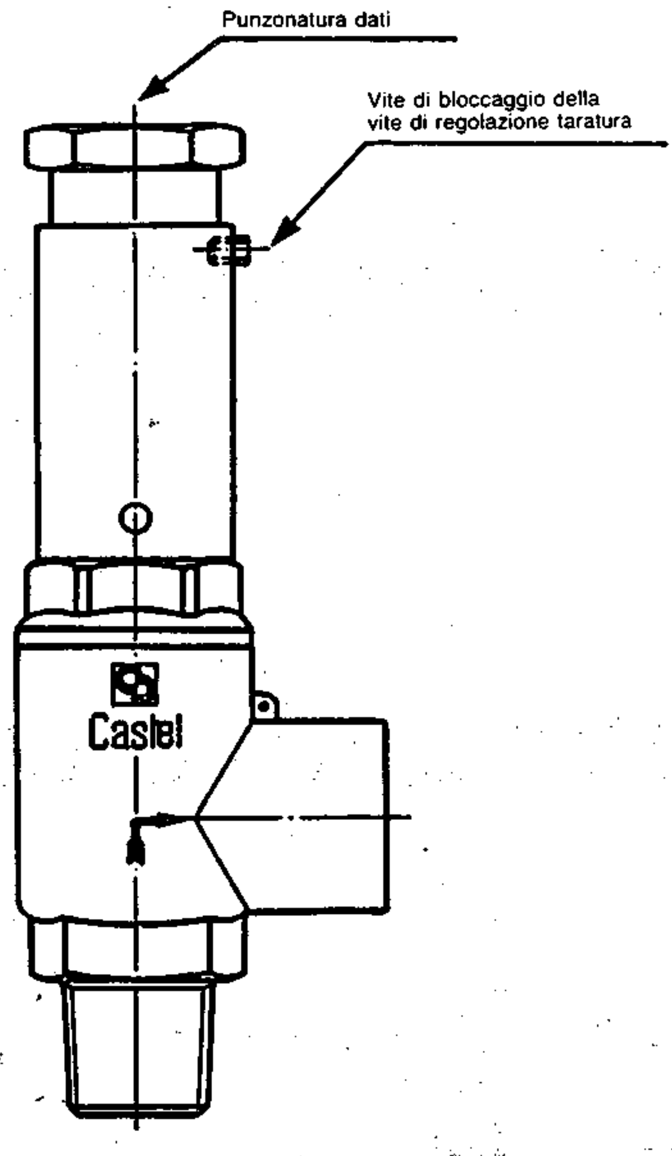
2.6. – L'otturatore è privo di premistoppa.

2.7. – Le spire della molla, escluse quelle terminali, sono distanziate tra di loro del minore tra mezzo diametro del filo e 2 mm. quando l'otturatore raggiunge l'alzata. La freccia della molla, quando l'otturatore è in posizione di blocco meccanico, non è superiore all'85% della freccia totale.

2.8. – Il sistema di taratura è meccanicamente bloccato tramite la vite.



3030/44



3030/88

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CENTRIFUGAL CHILLER WITNESS TEST [illegible]

CUSTOMER	:	ACKNO.	: 381365
UNIT	: WHS 220.3	UNIT SERIAL N°	: 981365/2
REQUIRED COOLING CAP.	: 699 kW	MAIN VOLTAGE	: 390 V (Tested)
DATE	: 12/11/98	REFRIGERANT	: R407C

[illegible] DATA

	EVAPORATOR				CONDENSER				COMPRESSOR MOTOR		
	Water				Water						
Time	t °C	t °C	Δt °C	Q	t °C	t °C	Δt °C	Q	U V	I A	P kW
10.25	12.11	7.21	4.97	33.45	40.2	45.15	4.95	42.82	393	398	208
10.35	11.97	6.96	5.01	33.42	39.4	44.5	5.1	42.7	395	385	207
10.45	11.9	6.88	5.02	33.46	40.2	44.99	4.79	42.8	393	388	210
10.55	12.6	7.4	5.2	33.4	39.1	44	4.9	42.7	394	380	209
11.05	11.9	6.85	5.05	33.4	41	46.1	5.1	42.7	392	380	208
11.15	11.6	6.68	4.92	33.52	40.3	45.4	5.1	42.8	392	380	209
AVERAGE	12.02	[illegible]	[illegible]	[illegible]	40.03	45.02	4.99	[illegible]	[illegible]	385.1	[illegible]

Cooling capacity.: 701.3 kW

Evaporator pressure drop: 45 kPa

Condenser pressure drop: 39 kPa Circ 1
29 Circ 2

The above readings are accordance with the specifications and as such are acceptable for the factory performance test.

Client signature/date: [illegible] For [illegible] Representing McQuay: [illegible] 12/11

McQuay Italia S.p.A.
Sede Amm.va S.S. Nettunense Km 12+800
00040 Cecchina (Roma) Italia
Tel. 06-9374000 Fax 06-9374014

CENTRIFUGAL CHILLER WITNESS TEST

CUSTOMER	:	ACKNO.	: 98/365
UNIT	: WHS 220.3	UNIT SERIAL N°	: 98 r3 65 /2
REQUIRED COOLING CAP.	:	MAIN VOLTAGE	: 380 V(rated)
DATE	: 19/11/98	REFRIGERANT	: R 407

Circ 1 and 3 on 75% ; Circ.2.. on 100%

CH. UNIT DATA

	EVAPORATOR				CONDENSER				COMPRESSOR		
	Water				Water				MOTOR		
Time	t_{ew} °C	t_{uw} °C	Δt_w °C	Q_{ew} m³/h / kg/s	t_{ec} °C	t_{uc} °C	Δt_c °C	Q_{mc} m³/h / kg/s	U V	I A	P kW
AVERAGE	10.52	7.0	3.52	33.12	10.19	23.72	5.53	22.98	380		111

Cooling capacity : 437 kW

Heat rejection : 631 kW

Evaporator pressure drop: kPa

Condenser pressure drop: kPa

The above readings are accordance with the specifications and as such are acceptable for the factory performance test.

Client signature/date: [signature] Maca representing McQuay: [signature] 19/11/

Coppin Ove Arup P.

Re Rainey [illegible] Ltd.

McQUAY

McQuay Italia S.p.A.
Sede Amm.va: S.S. Nettunense Km 12+300
00040 Cecchina (Roma) Italia
Tel: 06-9374000 Fax: 06-9374014

McQUAY INTERNATIONAL WITNESS TEST AND FACTORY INSPECTION

Inspection

Carry out mechanical and electrical inspection of chillers
and complete steps 1 to 3 and 14 (on sheet A & C attached)

TEST 1

TO DEMONSTRATE THE CHILLER FULL LOAD CAPACITY

One chiller will be connected to the test stand and the system will be run and stabilised as described in steps 4 to 13 on sheets A & B attached
Design Full Load conditions:-

Evaporator water flow = 33.4 L/s
Evap. Leaving water temperature = 7°C
Evaporator temperature difference = 5°C
Total cooling fluid flow = 44.6 L/s using 20% E.G. (Water Flow = 42.9L/s)
Evaporator Pressure Drop = 63 Kpa using 20% E.G. (Water P.D. = 57 Kpa)
Cond. Entering fluid temperature = 40°C
Cond. Leaving fluid temperature = 45°C
Condenser temperature difference = 5°C
Total current drawn
Total Kilowatts drawn
Supply voltage applied

The above parameters will be logged every ten minutes and recorded on sheet F attached
The results will be averaged at the end of the test and presented for your signature

TEST 2

TO DEMONSTRATE THE LIMITING OF THE CHILLER CAPACITY

SET-UP

After completion of test 2, fit and wire a variable resistor as shown on the attached diagram
Adjust resistor to limit the steps of machine capacity to 70% of design cooling duty.
This value can be ascertained by observing the temperature difference across the evaporator
i.e. 700Kw = 33.42 L/s with a temp. diff. of 5°C
70% = 490KW = 33.42 L/s with a temp. diff. of 3.5°C

Record operating conditions at 70 % capacity as follows:-

Evaporator water flow	= 33.4 L/s
Evap. Leaving water temperature	= 7°C
Evaporator temperature difference	= 3.5°C
Total cooling water flow	= 42.9 L/s
Cond. Entering water temperature	= 40°C
Cond. Leaving water temperature	=
Condenser temperature difference	=
Total current drawn	
Total Kilowatts drawn	
Supply voltage applied	

TEST 3

TO DEMONSTRATE THE UNLOADING AND LOADING OF THE CHILLER CAPACITY

Gradually reduce evaporator heat load and allow the chiller capacity to reduce automatically
Monitor the stopping of the compressors and manually shut off the respective condenser water flow to simulate actual site running
i.e. circuits 1 and 3 = condenser 1 (R.H.S., viewed from Control Panel)
circuit 2 = condenser 2 (L.H.S., viewed from Control Panel)
Gradually increase the evaporator heat load and open the condenser supply valves as the respective compressors start

TEST 4

FUNCTION TESTING OF SAFETY DEVICES

A Compressor High Pressure Cutout
Run chosen compressor and reduce flow of cooling water
Observe discharge pressure on Microtech display until the compressor stops

B Compressor Low Pressure Cutout
Run chosen compressor and shut of refrigerant liquid supply to the evaporator
Observe suction pressure on Microtech display until the compressor stops

C Compressor Motor Over temp. Cutout
Run chosen compressor and open circuit thermistor wiring of the compressor
Observe tripping of compressor on Microtech display

D Chiller Loss of water flow Cutout
Run any compressor and open circuit wiring to evaporator water flow switch
Observe tripping of compressor on Microtech display

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9

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