YORK®	YORK MILLENNIUMTWO-STAGE ABSORPTION COMPETITIVE GUIDE		
COMPETITIVE DATA	Supersedes: Nothing	896	Form 155.00-CD1

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OVERVIEW OF YORK ABSORPTION

EXPERIENCE

YORK International has been in the absorption chilling business for over 35 years. We began developing our first single-stage low pressure absorber in the late 1950's, and YORK remains second to none as far as general absorption experience is concerned. While Carrier and Trane can claim similar backgrounds, McQuay has virtually no previous experience in this field.

The ParaFlow design built by YORK has been proven in the U.S. market for over 15 years. No other direct-fired absorption chiller can match this claim.

Carrier, Trane, and McQuay all entered into agreements with Japanese manufacturers to sell direct-fired and steam two-stage absorption chillers in the U.S. None of these chillers has faced the operational experience that the ParaFlow has passed. Each of these companies has less than five years experience with this equipment and has yet to prove the durability of their designs.

Carrier and McQuay both began to build their Japanese designs in their factories last year, adding a new element of inexperience, while YORK entered its agreement to manufacture the Hitachi design over five years ago. Trane has developed an all new two-stage design. They will be installing prototypes in 1996.

MADE IN THE U.S.A.

The Houston plant, where YORK's two-stage absorption chillers are manufactured, opened in 1991, and production uses 99% U.S. sourced materials and components. McQuay and Trane have begun building in the U.S. in 1995 (except for Trane's two-stage steam unit which has been built in the U.S. for several years). Carrier began production in Mexico, but is now playing catch-up.

PARALLEL VS. SERIES FLOW

The ParaFlow's unique parallel flow design is unrivaled. Both McQuay and Trane absorption chillers utilize a series design. Carrier used a series for some time and then switched to parallel. With series flow, a single stream of LiBr is concentrated two times as opposed to parallel flow which concentrates two streams of LiBr just one time. This leads to higher solution concentrations in the series flow chiller. Therefore, the risk of crystallization in the ParaFlow is much less.

FACTORY PERFORMANCE TESTING

Only YORK can factory performance test any production ParaFlow chiller. Direct-fired units will be tested with the customer's burner to insure system reliability. Other manufacturers only offer inaccurate and unreliable field tests when asked to demonstrate capacity. Also, units that are tested can be shipped with the factory balanced lithium bromide solution and refrigerant precharged (restricted by shipping weight on larger tonnages). This will save an enormous amount of start-up time. Carrier, Trane, and McQuay will all have to charge their units at the jobsite. For larger tonnages (when restricted by shipping weight), YORK will ship the factory balanced charge in separate drums to help expedite start-up.

GLOBAL DESIGN

Chillers are available modified to meet European CE requirements (EN 292, EN 60204). Steam-fired models come in a variety of pressure vessel codes. ASME is standard for the U.S., ISPESL is available for Italy, and TÜV is available for Germany and other European installations.

NON TOXIC INHIBITORS

The YORK ParaFlow chiller uses lithium molybdate as a corrosion inhibitor. The Carrier/Ebara direct-fired and steam-fired machines use lithium chromate and the Trane two-stage steam unit uses lithium arsenate inhibitors. Arsenates and chromates are classified as hazardous wastes and must be handled and disposed of as such. Molybdates are not classified as a hazardous waste.

ISOLATION VALVES

All ParaFlow chillers come equipped with isolation valves on both the suction and discharge sides of the solution and refrigerant pumps. This allows the pumps to be serviced without having to remove the lithium bromide charge from the unit and prevents air from entering the chiller. Without this feature, the charge would have to be removed and stored prior to pump servicing and then the unit would have to be evacuated and recharged before going back on line. This process can keep a unit off line for as long as 24 hours. Aside from YORK, only McQuay has isolation valves.

RELIABLE PUMPS

The YORK ParaFlow unit has a U.S. sourced pump supplier, Buffalo Pumps, that has designed the solution and refrigerant pumps for 55,000 hours before a service overhaul/bearing check is required. YORK was the first manufacturer to offer this feature on a two-stage absorption chiller. It is rumored Carrier is switching to the

Buffalo pump to replace their Japanese pump, and Trane's new direct-fired design will use the Buffalo Pump, but this only validates Buffalo's design. Not only are the pumps designed to be more reliable than any other pump, but because they are U.S.-built, YORK can supply a replacement pump faster than any Japanese-built pump.

BURNERS

All direct-fired ParaFlow units are shipped with the customer's burner and burner panel mounted and wired at the factory. This will save on installation time and labor. All other manufacturers have the burner and burner panel shipped separately to the jobsite for field assembly and wiring. In addition, YORK supplies contacts in the burner panel to control the opening and closing of fresh air dampers which allow combustion air into the mechanical room.

HEATING

Direct-fired ParaFlow units are capable of producing both chilled water and hot water simultaneously. (Note: This is standard on "G" model chillers and an option on "S" model chillers.) They also can be designed for 140°F or 175°F leaving hot water. Initially, Carrier and Trane did not list these as standard options, but today all of YORK's competitors offer similar options.

LEAD-TIME ADVANTAGE

Early on, YORK had a lead-time advantage because our competition was importing their chillers from Japan. Today, as manufacturing moves to the U.S., YORK maintains the advantage through our aggressive stocking program.

MICROPROCESSOR CONTROLS

Every direct-fired and steam-fired chiller built in the U.S.A. comes equipped with the most sophisticated *Millennium* Control Panel in today's absorption market. Control technology is the most significant advancement in absorption in the last ten years. The YORK control system is designed to be the very best in chiller protection and overall system efficiency.

YORK has added a new generation of features to our microprocessor based system including:

SmartPurge – All absorbers are low pressure chillers that require regular purging. SmartPurge knows when the purge tank is full, **automatically empties the purge tank** without operator assistance, and alerts the operator if the unit is purging too frequently.

Low-Power Dilution – YORK has developed a new system to protect our absorption chillers from crystallization during an extended (over 8 hours) power failure. All that is required is a small amount of back-up power and a signal to the control panel to safely keep all the lithium bromide solution in liquid form.

Concentration Calculator – The *Millennium* Control Panel **tracks the solution concentration in the machine**. In addition to enhancing the protection of the chiller by being built into the safety and warning systems described below, the concentration calculator system has a program mode. In the program mode the calculator allows the operator to input any two of three parameters (lithium bromide solution temperature, saturation temperature, and pressure) and calculate the solution concentration.

Fuzzy Logic Steam-Valve Control – YORK has combined the leading edge of control technology with over 35 years experience using steam valves to control absorption chillers to develop a Fuzzy Logic Steam-Valve Control System. The **Fuzzy Logic Steam-Valve Control System provides much tighter chilled water control** with less "hunting" than old-style systems and actually provides steam consumption savings. YORK's Fuzzy Logic System monitors the leaving chilled water temperature to track where it has been, where it is, how fast it is moving, and accurately predicts where it will go.

Microprocessor Controls – YORK's easy to use *Millennium* Control Panel includes a 40 character alphanumeric display that shows all system parameters in plain English with numeric data in English or metric units. The *Millennium* Control has a wide range of accessible data that includes:

- Entering and leaving water temperatures
- Solution and refrigerant temperatures and pressures
- Heat input rate %
- Number of starts
- Number of purge cycles

The panel incorporates pre-programmed safety parameters that will shut the unit down and close **"safety shutdown"** contacts when these operating limits are passed. The panel will display a unique shutdown message for each type of shutdown. The Control Center also incorporates pre-programmed **warning thresholds** that are designed to prevent a "blind" safety shutdown from occurring. In the event that certain operating parameters are approaching a safety shutdown condition, the control panel will inhibit loading or heat input until the problem has been corrected. The panel will also close warning contacts and display a unique warning message. Conditions that will trigger a warning are:

- Abnormal refrigerant and solution temperatures
- Abnormal generator pressures
- Abnormal condenser water temperature
- Excessive purge

The ParaFlow panel has three levels of **Energy Management System Interface** capabilities:

- Full ISN integration to a YORK supplied Energy Management System through a single shielded cable
- Interface with a third party DDC system using a single shielded cable and a "YORKTalk" translator
- Hardwired input and output

An RS-232 port enables the *Millennium* Control panel to transmit all operating, setpoint, and shutdown information to a remote printer. This **remote data-logging** transmission can occur as needed or on predetermined intervals.

The panel contains an integral **7 day time clock** for weekly start/stop scheduling and holiday scheduling.

Additional features for steam units include a programmable **pull-down demand-limit**, allowing the chiller to ramp-up in accordance with the customers steam-production limitations, and a remote steam limit. The **remote steam limit** allows an operator to prioritize steam usage by limiting the position of the steam valve from a remote location.

WHO'S WHERE: MODEL SIZE BREAKDOWN OF ALL COMPETITORS

DIRECT-FIRED

TONS	YORK	CARRIER	TRANE	MCQUAY
100				DC-11
120				DC-12
135		16DF013		
150		16DF015		DC-13
180		16DF018		DC-14
200	YPC DF 12SC	16DF020		
210				DC-21
230	YPC DF 13SC	16DF023		
240				DC-22
250		16DF025		
280		16DF028		DC-23
300	YPC DF 14SC			
320		16DF032		DC-24
350	YPC DF 15SL			
360		16DF036	ABDA-380 Horizon	DC-31
400	YPC DF 16G/S	16DF040		DC-32
450	YPC DF 16SL	16DF045	ABDA-440 Horizon	DC-41
500	YPC DF 17G/S	16DF050	ABDA-500 Horizon	DC-42
550				
560				DC-51
600	YPC DF 18G/S	16DF060		
630				DC-52
700	YPC DF 19G/S	16DF070		DC-53
800	YPC DF 19GL	16DF080		DC-61
900		16DF090		DC-62
1000	YPC DF 20G	16DF100		DC-71
1100				DC-72
1200				DC-73
1300				DC-81
1400				DC-82
1500				DC-83

STEAM

TONS	YORK	CARRIER	TRANE	MCQUAY
100		16JT810		NC-11
115		16JT812		
120				NC-12
130		16JT814		
145		16JT818		
150				NC-13
170		16JT820		
180				NC-14
200		16JT821		
210				NC-21
225		16JT824		
240				NC-22
260		16JT828		
280				NC-23
300		16JT832		
320				NC-24
350		16JT836	ABTE-385	
360				NC-31
385		16JT841		
400				NC-32
425	YPC ST 16SL	16JT847	ABTE-465	
450				NC-41
475		16JT854	ABTE-527	
485	YPC ST 17S			
500		16JT857		NC-42
530			ABTE-590	
550		16JT865		NC-51
580	YPC ST 18 G/S			
600			ABTE-656	
620		16JT873		
630				NC-52
675	YPC ST 19 G/S	16JT880	ABTE-750	
700				NC-53
760			ABTE-852	
800	YPC ST 19GL	16JT080		NC-61
850			ABTE-935	
900		16JT080L		NC-62
960		16JT090		
1000	YPC ST 20G	16JT090L	ABTE-1060	NC-71
1070		16JT100		
1100		16JT100L		NC-72
1175		16JT110		
1200				NC-73
1250	YPC ST21G	16JT120		
1300		16JT120L		NC-81
1400		16JT135		NC-82
1500	YPC ST22G	16JT135L		NC-83
1600		16JT150		
1700		16JT150L		

CARRIER

CARRIER COMPETITIVE INFORMATION

Carrier assembles an Ebara-designed two-stage absorption chiller in their Monterrey, Mexico manufacturing facility. Carrier began manufacturing units in Mexico in late 1994. The Carrier unit is still an Ebara unit. Carrier uses Japanese pumps (they have recently started offering Buffalo pumps, at least as an option) and valves. They have recently introduced a Carrier-designed micro-processor for the unit. They have a comprehensive product offering. They are especially strong below 250 tons with direct-fired and steam-fired offerings down to 100 tons.

The Carrier unit is generally an inferior unit. They compete primarily on price due to the poor design and inferior quality. The units that have been shipped to the field have been plagued with general quality problems. There are examples of rusting welds, tubes not being rolled, and sight glasses leaking. The general overall appearance of the Carrier unit is terrible. The best sales tool to use against Carrier is to get a perspective customer to take a look at one of their units.

A leak is an absorption unit's greatest enemy. **Leaks Kill**. The Carrier unit has an abundance of leak opportunities. Nearly every valve on the unit is a ball valve with an exposed stem. The stem seal provides a leakage path. YORK uses seal cap globe valves with no leakage path exposed. Carrier solution sample valves are diaphragm-type valves with threaded plugs screwed into the ends. The threaded plugs are leak points. YORK uses a totally sealed sample valve with O-ring caps to keep them leak free. Carrier uses fiber gasket sealed sight glasses. These seals breakdown quickly and require annual replacement.

Carrier also promotes two and three piece shipments. Although some installations will require split shipment due to access or rigging constraints, this should be avoided when possible. **Leaks Kill**. Factory welding is better than field welding. Full penetration welding is critical in the corrosive environment of an absorption chiller. Carrier units that ship in two or more sections should be required to undergo a strenuous leak check procedure before being charged with bromide. A helium leak check should be required and added to the specification to make Carrier conform to the same standards as a YORK factory assembled and leak checked unit. An acceptable leak check procedure is outlined below:

Units shipped without factory bromide charge installed shall be shipped under positive pressure with a nitrogen holding charge of 2.5 psig. The nitrogen charge is required to insure that minor leaks do not occur and allow moisture or noncondensibles into the unit. All units shipped disassembled or without factory charge must be leak checked in the field after installation and prior to charging. Helium leak checking is required. Each component shall be helium leak checked prior to reassembly to insure no damage has occurred during shipment. The unit shall be leak checked after final assembly. Nitrogen and soap testing is not acceptable.

1. Evacuate the unit or subassembly to 1,000 microns of mercury.

2. Allow for the circulation of helium through the tube side of all tube bundles.

3. Calibrate the Helium Mass Spectrometer (Standard Leybold Inficom UL 100)

   Acceptance criterion:

   2.0×10^{-5} cc/sec maximum leakage rate.
   Readings should be stable for at least 15 minutes.

4. Perform an initial leak check using a helium spray gun to spray all welds, tube joints, and threaded connections. Measure and record the leakage rate. Acceptance criteria is listed in para 3.

5. Enclose the entire assembly in an impervious shroud with the shroud held in close contact to the floor.

6. Fill the shroud with helium so that the shroud is filled out and not resting on top of the unit.

7. Measure and record the leakage rate with the mass spectrometer. The acceptance criteria is defined in para 3.

8. Leak rates in excess of the maximum allowable will require locating the leak or leaks, repair, and retest.

The Carrier unit is not user or maintenance friendly. The unit has only two sight glasses which are very small. It is not possible to observe spray patterns or solution levels in critical areas. Some valves are located in areas that are virtually impossible to access. Special long valve handles must be used to turn the valves. Future repair or valve replacement is nearly impossible. The current Japanese pumps require overhaul every 20,000 hours. The YORK (Buffalo) pumps require an overhaul every 55,000 hours. Carrier has started offering Buffalo as an option and will probably switch to Buffalo within the next year. The Carrier unit does not include pump isolation valves. Any pump service, repair, or replacement requires the solution and refrigerant charge be removed

from the unit. This can add days to the repair of the Carrier unit.

Carrier uses a Palladium Cell purge system to rid the unit of Hydrogen (it will not rid the unit of other non-condensibles). A palladium cell allows hydrogen to be automatically removed from the purge tank. The palladium cell requires a heater to be energized which consumes energy. The heater must be replaced every two years. A unit that is operating properly produces very little hydrogen. Hydrogen is also a byproduct of corrosion. If a unit is producing excess hydrogen, it is an indicator of leaks and requires corrective action. You will never know if your unit is being consumed by corrosion with a palladium cell. The YORK Smart Purge is a completely automatic purge system that monitors the amount of non-condensibles being produced to let the operator know the moment there is an indication of leaks.

CARRIER DIRECT-FIRED

Model	013	015	018	020	023	025	028	032	036	040	045	050	060	070	080	090	100
Nominal Tons	135	150	180	200	230	250	280	320	360	400	450	500	600	700	800	900	1000
Rigging Weight																	
Absorber/Evap	7,940	7,940	9,260	9,260	11,245	11,245	12,570	12,570	14,335	14,335	18,520	18,520	23,595	27,565	30,870	33,075	35,720
2G/Condenser	2,645	2,645	3,085	3,085	3,530	3,530	4,410	4,410	5,070	5,070	6,175	6,175	6,615	7,720	8,820	9,925	10,585
Generator	2,865	2,865	3,310	3,310	3,970	3,970	8,600	8,600	8,820	8,820	8,820	8,820	15,215	17,640	22,050	25,360	28,665
Total 13,450	13,450	15,655	15,655	18,745	18,745	25,580	25,580	28,225	28,225	33,515	33,515	45,425	52,925	61,740	68,360	74,970	
Operating Weight	17,200	17,420	20,285	20,510	24,920	25,140	32,635	33,075	37,045	37,485	43,660	44,100	63,285	74,970	84,895	92,610	105,840
Bromide Charge (gal)	170	170	217	217	264	264	357	357	434	434	527	527	829	1045	1289	1348	1524
Refrig. Charge (gal)	63	63	92	92	105	105	132	132	150	150	121	121	158	227	251	243	243
Connection Size (in)																	
Evap 5	5	5	5	6	6	6	6	8	8	8	8	8	8	10	10	10	
Cond 6	6	6	6	8	8	8	8	10	10	10	10	10	10	12	12	12	
Aux HW	5	5	5	5	6	6	6	6	8	8	8	8	8	8	10	10	10
Gas 1.5	2	2	2.5	2.5	2.5	2	2	2	2.5	2.5	2.5	3	3	2.5	3	3	
Exhaust	12 x 14	12 x 14	14 x 15	14 x 15	14 x 18	14 x 18	20 x 21	20 x 21	20 x 23	20 x 23	20 x 27	20 x 27	16 x 20	20 x 26	22 x 34	22 x 34	22 x 34
Dimensions (ft–in)																	
Length	12'–6"	12' – 6"	12'–6"	12'–6"	12'–6"	12'–6"	15'–11"	15'–11"	15'–11"	15'–11"	15'–11"	15'–11"	19'–7"	19'–7"	23'–5"	23'–7"	23'–7"
Width 6'–8"	6'–8"	7'–8"	7'–8"	8'–6"	8'–6"	8'–11"	8'–11"	9'–4"	9'–4"	9'–11"	9'–11"	11'–8"	12'–2"	13'–5"	13'–9"	14'–3"	
Height	7'–9"	7'–9"	7'–8"	7'–8"	8'–3"	8'–3"	8'–6"	8'–6"	8'–10"	8'–10"	9'–8"	9'–8"	9'–4"	10'–2"	10'–2"	10'–6"	11'–2"

CARRIER STEAM

Model	810	816	821	832	836	841	847	854	857	865	873	880	80	080L	090	090L	100
Nominal Tons	100	145	200	300	350	385	425	475	500	550	620	680	800	900	960	1000	1070
Rigging Weight																	
Absorber/Evap	8,595	11,460	11,680	13,885	14,325	16,090	16,530	18,295	22,040	22,480	23,005	26,010	29,755	35,265	34,160	40,335	37,470
2G/Condenser	3,085	4,630	4,850	6,390	6,610	7,275	7,495	8,155	9,700	9,920	11,460	12,125	14,325	15,430	15,430	16,530	16,970
Generator																	
Total	11,680	16,090	16,530	20,275	20,935	23,365	24,025	26,450	31,740	32,400	35,265	38,135	44,080	50,695	49,590	56,865	54,440
Operating Weight	17,200	21,610	22,050	27,110	27,990	31,960	32,840	36,365	44,080	45,180	48,490	50,690	61,710	70,530	70,530	79,345	79,345
Bromide Charge (gal)	137	200	200	309	314	366	400	440	463	514	560	623	754	823	846	922	903
Refrigerant Charge (gal)	87	106	106	114	114	137	137	165	165	203	232	285	177	197	201	211	215
Connection Size (in)																	
Evap	4	5	5	6	6	8	8	8	8	8	8	8	10	10	10	10	10
Cond	5	6	6	8	8	10	10	10	10	10	10	10	12	12	12	12	12
Steam	2.5	2.5	2.5	3	3	3	3	3	3	3	4	4	4	4	4	4	5
Dimensions (ft.–in.)																	
Length	12'–6"	13'–9"	13'–9"	17'–7"	17'–7"	17'–9"	17'–9"	17'–9"	22'–9"	22'–9"	22'–9"	22'–9"	22'–10"	25'–10"	22'–10"	25'–10"	22'–10"
Width	6'–8"	5'–9"	5'–9"	6'–3"	6'–3"	6'–9"	6'–9"	6'–11"	6'–8"	6'–8"	7'0"	7'–3"	8'–1"	8'–1"	8'–6"	8'–6"	8'–11"
Height	7'–9"	7'–7"	7'–7"	8'–4"	8'–4"	9'–1"	9'–1"	9'–9"	9'–8"	9'–8"	9'–5"	9'–11"	9'–10"	9'–10"	10'–5"	10'–6"	11'–0"

Model	100L	110	110L	120	120L	135	135L	150	150L
Nominal Tons	1100	1175	1200	1250	1300	1400	1500	1600	1700
Rigging Weight									
Absorber/Evap	42,980	41,875	45,845	47,385	50,690	51,795	59,510	55,100	62,845
2G/Condenser	17,630	17,630	19,175	18,735	20,715	19,835	24,245	22,040	24,245
Generator									
Total	60,610	59,505	65,020	66,120	71,405	71,630	83,755	77,140	87,090
Operating Weight	85,955	85,955	94,770	94,770	105,790	105,790	116,810	114,610	130,035
Bromide Charge (gal)	1,006	1,017	1,114	1,097	1,200	1,264	1,380	1,377	1,504
Refrigerant Charge (gal)	225	202	219	206	238	238	277	271	304
Connection Size (in)									
Evap	10	10	10	12	12	12	12	12	12
Cond	12	14	14	14	14	16	16	16	16
Steam	5	5	5	5	5	5	5	5	5
Dimensions (ft–in)									
Length	25'–10"	23'–2"	26'–2"	23'–2"	23'–6"	23'–6"	26'–6"	23'–6"	23'–6"
Width	9'–2"	9'–2"	9'–8"	9'–8"	10'–2"	10'–2"	10'–2"	10'–9"	10'–11"
Height	11'–7"	11'–7"	12'–3"	12'–3"	13'–0"	13'–0"	13'–0"	13'–8"	13'–8"

CARRIER - STRENGTHS AND WEAKNESSES

This section will concentrate on features you can expect Carrier to sell and what we should use against them. The items discussed are those you can expect Carrier to stress in order to get a specification or secure an order. Some of their claims of competitive strengths are perceived strengths and will be addressed in the text.

Strengths

1. Product Offering

Carrier has a very comprehensive product offering. They offer 31 steam-fired models between 100 and 1700 tons and 17 direct-fired models between 135 and 1000 tons.

2. Price

Since the Carrier unit is an inferior unit to others in the marketplace they depend very heavily on price. Carrier has a very good cost structure for units manufactured in Mexico. They are especially aggressive on units below 500 tons.

3. Split shipment

Carrier offers two and three piece shipments for tight rigging applications. This is a true strength. Their machine is very modular and is easily disassembled. Reassembly is required at the job site. YORK discourages split shipment. Factory welding and leak check procedures are far superior to those used in the field. These are more critical for absorption units than for other types of chillers because of the internal corrosion caused by air reacting with LiBr. If Carrier offers to split ship a unit a very detailed inspection of the welding and a very stringent leak check procedure should be specified.

4. Ship units without bromide charge.

Carrier specifies this because they cannot factory performance test units. This allows them to take liberties with their quoted efficiency levels. YORK ships most of our absorption units with a bromide charge. Many of our units are factory run tested prior to shipment. The charge remains in the unit. The unit is shipped with a nitrogen holding charge to prevent any leakage into the unit during shipment.

Weaknesses

The items listed below are Carrier weaknesses. Use them in specification or quotations to gain a competitive advantage over Carrier.

1. Purge Unit

The YORK SmartPurge is the most effective and sophisticated purge system offered by any absorption unit manufacturer. Carrier uses a palladium cell purge system that requires periodic manual purging. The Carrier system purges the unit of Hydrogen automatically (it will not rid the unit of other noncondensibles). The palladium cell requires a heater to be energized which consumes energy. The heater must be replaced every two years. Hydrogen is a byproduct of corrosion. If a unit is producing excess hydrogen it is an indicator of leaks and requires corrective action. You will never know if your unit is being consumed by corrosion with a palladium cell.

2. Inhibitor

Carrier uses Lithium Chromate inhibitor. YORK also offers this inhibitor in our single-stage units. Lithium chromate is a very effective inhibitor at the lower operating temperatures of a single-stage unit. It breaks down at the higher temperatures found in two-stage units. It is also environmentally unfriendly requiring special handling and disposal. Chromate is considered a carcinogen. YORK provides molybdate exclusively in two-stage absorption units. Molybdate is a much better inhibitor at the higher temperatures found in two-stage machines and is environmentally friendly. We also offer molybdate in our single-stage units for customers concerned about chromate. Carrier has offered Molybdate on one large job when forced; it doesn't appear to be a standard option, but could pop up when the dollar volume is big enough.

3. Isolation Valves

The Carrier unit does not include pump isolation valves. Any pump service, repair, or replacement requires the solution and refrigerant charge be removed from the unit. This can add days to the repair of the Carrier unit. We expect Carrier will change their design to include Buffalo pumps, but still without isolation valves.

4. Design

The Carrier unit is prone to leaks. Leaks kill absorption units. The unit is designed with excessive threaded connections and valves without seal caps. The unit is also designed to operate at higher temperatures than the YORK unit. The max high temperature generator temperature in a YORK unit is 330 degrees compared to 338 degrees for Carrier. Higher temperatures mean more corrosion. This is not a design built to last.

REVIEW OF CARRIER TWO-STAGE STEAM ABSORPTION SPECIFICATION AGAINST THE YORK MILLENNIUM ABSORPTION CHILLER

Following is a formal review of the Carrier Two-Stage Absorption Steam Specification when selling the YORK ParaFlow Steam Absorption Chiller.

Part 1 – General

1.01 SYSTEM DESCRIPTION

Electronically controlled, double-effect (two-stage) absorption liquid chiller utilizing hermetic refrigerant and solution pumps, lithium bromide solution as the absorbent, and water as the refrigerant. High-pressure steam shall be supplied to the generator as the heat source.

This is the basic description of the chiller and would apply to the ParaFlow design.

1.02 QUALITY ASSURANCE

A. Chiller performance shall be rated in accordance with ARI Standard 560 (latest edition).

The ParaFlow Chiller is rated in accordance with ARI 560.

B. Chiller shall be manufactured in accordance with JIS B8622 (Japanese Industrial Standard).

In most cases this standard will not be referenced. We manufacture our machines in the United States in accordance with codes such as ASTM, U.L., and ARI 560-92.

C. The high-stage generator (steam side) shall be designed, constructed, and stamped in accordance with ASME Section VIII, Division 1 requirements. The condensate drain heat exchanger and float trap shall also be designed, constructed and carry the ASME code symbol stamp when required.

The steam side of the first-stage generator on the ParaFlow is ASME. The ParaFlow's drain cooler, or condensate drain heat exchanger, is exempt from code.

D. Each chiller shall undergo a series of standard factory tests to ensure that the unit is leak tight, that all electrical components operate as intended, and that every aspect of the unit fabrication meets stringent quality standards in accordance with good practice and the manufacturer's quality assurance requirements.

1. The shell side of each chiller shall be leak tested by pressurizing to 11 psig (76 kPa) with nitrogen and then checked by spraying a soap and water mixture on all welds, tube joints, and/or gasketed joints to identify any major leaks. Afterward, a mass spectrometer test shall be performed by evacuating the unit .001 mm Hg absolute, covering the machine with a vinyl tent and introducing helium gas under the tent. Any remaining leaks will allow the helium to be drawn into the shell side of the machine. The acceptable leak rate as measured by the mass spectrometer test shall not exceed .00002 cc/sec standard air.

Houston will leak test by pressurizing the unit to 12 psig of nitrogen and will then spray a soap and water mixture on all welds and joints to identify any major leak. The mass spectrometer test will be performed to the same maximum leak rate listed above. The unit will not be evacuated to as low a pressure as Carrier (we go < 0.2 mm Hg), but this has no negative effect on our test. The important number to be concerned with is the maximum allowable leak rate, which is the same for both YORK and Carrier.

2. The tube side of the evaporator, absorber, condenser, and high-stage generator shall be hydrostatically tested at 1.5 times rated design pressure and held for one hour.

All water circuits will be tested at 150% of design pressure.

3. The refrigerant and solution pump/motors shall undergo standard factory tests to ensure proper head flow, and motor output characteristics.

The solution and refrigerant pumps are tested.

4. All machine wiring shall undergo an insulation resistance test. The machine control panel and all electrical components shall also be functionally tested to verify continuity and proper electrical operation.

YORK will perform an insulation resistance test on all machine wiring.

5. Final assembly inspection shall consist of verifying that all valves, controls, instrumentation, pumps, purge components, and all other machine components have been properly installed on the machine.

Final assembly inspection is performed.

6. Each unit shall then be checked for overall appearance and dimensional accuracy.

7. Final inspection shall be performed on each unit to check that painting of the unit is as specified, nameplate data is correct, and that all accessories are furnished as required.

The same applies to the ParaFlow.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be stored and handled in accordance with the manufacturer's recommendations.

The same applies to the ParaFlow.

B. Unit shall not be factory-charged with lithium bromide solution to prevent possible internal corrosion damage from occurring should the inside of the machine be accidentally exposed to air during shipment and/or installation. Charging of lithium bromide solution shall be performed at the jobsite in accordance with the manufacturer's written instructions.

All "S" models and models -19GL and smaller will ship from the factory with the balanced solution and refrigerant pre-charged to expedite start-up. The units will also have a nitrogen holding charge (5 psig) to prevent air from entering into the unit in the event that a leak occurs. There is an option to ship these size units without the solution and refrigerant charges inside. Models -20G and larger always ship uncharged. Precharging saves time at the jobsite, and an accidental loss of pressure will be recognized upon receipt of the unit.

C. Machines shipped in one piece shall be shipped under vacuum on the shell side. Machines shipped in two pieces shall be pressurized with nitrogen to 5 psig (34 kPa).

All ParaFlow chillers, regardless of the number of pieces shipped, will contain a nitrogen holding charge (5 psig).

D. Chiller shall be shipped with nameplates indicating name of manufacturer, model size, serial number, and all other pertinent data.

The same applies to the ParaFlow Chiller.

1.04 WARRANTY

Manufacturer shall guarantee the chiller against defects in materials or workmanship for a period of one year from date of initial operation or 18 months from date of shipment, whichever occurs first. Manufacturer shall provide the labor to repair or replace any part found to be defective in material or workmanship within the warranty period.

YORK's standard warranty is the same as above.

Part 2 – Products

2.01 EQUIPMENT

A. General:

Absorption liquid chiller shall include evaporator, absorber, condenser, high and low-stage generators, solution heat exchangers, condensate drain heat exchanger, float trap refrigerant solution pumps, purge system, piping, wiring, controls, and auxiliaries. Shipment of the machine shall be in one or two pieces depending on model size. Initial charge of lithium bromide shall be included with the chiller for charging at the jobsite. The high-stage generator shall be located above the evaporator/absorber to minimize the machine footprint and to ensure gravity drainage of the lithium bromide from the generator to prevent crystallization in the event of a power failure.

The ParaFlow Chiller meets much of the above description with the following notes:

The ParaFlow unit does not have a float trap. The condensate leaving the drain cooler is subcooled, eliminating the need for a steam trap.

All "S" models and models -19GL and smaller ship with the solution and refrigerant precharged in the unit.

The first-stage generator is located beside the main shell, not above it. Gravity drainage of the lithium bromide is not an effective action in the event of a power failure. The solution needs to be circulated to prevent concentrated areas from crystallizing. With the YORK ParaFlow Chiller the customer needs only to supply back-up power to the solution pumps(s) to ensure that the solution is thoroughly mixed to prevent crystallization.

B. Operating characteristics:

1. Chiller operation shall be characteristic of a double-effect absorption cycle with split solution flow. The weak solution from the absorber shall be split before entering the high-temperature solution heat exchanger

with approximately 50% going to the high-stage generator and the remaining 50% to the low-stage generator. A control valve shall automatically regulate the flow at all operating conditions, resulting in part-load efficiency and eliminating the need for manual set-up adjustments of the solution flow. By splitting the flow, the machine operating temperature shall be reduced, thereby minimizing internal high temperature corrosion and improving operating economy.

It is interesting to notice that Carrier now has a parallel flow design just like the ParaFlow.

2. Unit shall be capable of continuous operation from 100 to 10% capacity, with entering condenser water temperatures as low as 59°F (15°C).

The ParaFlow Chillers can operate with condenser water temperatures as low as 68°F. Regardless of the minimum temperature, the customer must still install some means of condenser water control (such as a 3 way valve). Minimum load is 20% (unit will cycle on/off below 20%).

C. Heat Exchangers:

1. All heat exchangers shall be of shell and tube construction with shells, tubesheets, tube support sheets, and waterboxes fabricated of carbon steel. All heat exchangers shall incorporate straight tubes, except for the high-stage generator which shall use U-tubes. All tubes shall be rolled into grooved tubesheets and expanded into tube support sheets, and shall be individually replaceable.

The above also applies to the ParaFlow design with one exception. YORK does not use grooved tubesheets; in place of this we use an anaerobic sealing compound (called Loctite). In either case, grooved or Loctite, the purpose is to prevent the tube from working loose under thermal stress loads. The rolled expansion of the tubes alone is sufficient to seal the tubes. Grooved tubesheets and the use of Loctite are equivalent methods of holding the tube in place. YORK has been using Loctite in the tubesheets of their chillers for over 25 years and has had no problems.

2. The evaporator, absorber, and condenser waterboxes shall be designed for 150 psig (1034 kPa) working pressure and shall be hinged to permit access to all tubes from either end. Nozzle-in-head (NIH) type waterboxes shall be supplied on the evaporator while the absorber-condenser waterboxes shall be either NIH or marine type depending on model size. All waterboxes shall be provided with vent and drain connections. Epoxy-painting of the waterboxes and tubesheets shall be provided for corrosion protection. ANSI 150 psig R.F. flanges shall be furnished on all waterbox nozzle connections.

The ParaFlow Chillers do not have hinged waterboxes. Hinged waterboxes do not work well in the field. Due to the weight of the waterboxes they will not line-up with the bolt holes once the waterboxes have been opened. A hoist, or winch, will still be required to lift the waterboxes up in order to line-up the bolt holes. Hinged waterboxes are not an added benefit. Marine waterboxes are available as an option (150 psig design only) and ANSI R.F. flanges are also optional. Unless specifically required, we do not epoxy coat water boxes.

3. The high-stage generator tube bundle shall consist of U-bend tubes secured to the tube sheet on one end only to allow for thermal expansion and contraction. The high-stage generator waterbox shall be designed for 150 psig (1034 kPa) working pressure. The steam inlet shall be provided with an ANSI 150 psig R.F. flange connection. An ASME Section VI11, Division 1 U-stamp shall be provided on the high stage generator steam side.

The above also applies to the ParaFlow unit.

4. A steam condensate drain heat exchanger shall be factory mounted and piped on the machine to reduce the steam rate by pre-heating the weak solution while cooling the condensate for easier condensate return handling. An ASME Section VIII, Division 1 U-stamp shall be provided when required by code. The steam condensate outlet connection shall be located above grade, in proximity to the bottom of the generator overflow chamber, thereby permitting a greater allowable pressure drop to be considered in the design of the condensate return system piping before flashing occurs.

We meet the wording of this section because ASME guidelines make the ParaFlow's drain cooler design exempt from code. It appears that Carrier's design may require a steam trap on the condensate return system. This can be a major advantage for the Para Flow which does not require a steam trap because the condensate is subcooled.

5. A high-temperature and low-temperature solution heat exchanger shall be an integral part of the machine to increase efficiency by pre-heating weak solution on the tube side with strong solution on the shell side. Tube material for both heat exchangers shall be carbon steel.

The same applies to the ParaFlow design.

6. Spray heads for the evaporator, absorber, and gen-

erator shall be of a non-clogging design, specifically designed for the intended duty, and shall be fabricated of a corrosion-proof material to ensure continuous, high efficiency operation.

On ParaFlow Chillers the spray nozzles are of a self-cleaning design constructed of stainless steel.

7. Heat exchanger tube material and minimum wall thickness shall be contingent on the type of corrosion inhibitor used in the machine. For lithium chromate systems, the following tube specifications shall apply to ensure long machine life and continuous operation:

Evaporator	copper, externally-finned
Absorber	copper, prime surface
Condenser	copper, prime surface
Low-Stage Generator	copper, prime surface
High-Stage Generator	90/10 CuNi, prime surface

If chiller manufacturer requires the use of tube materials other than as listed above due to the use of a less effective inhibitor, the chiller manufacturer shall guarantee performance of the machine for its design life and shall replace tubes and/or tube bundles as necessary during this period at no additional cost to the owner.

The standard tube specifications for the ParaFlow Chiller are as follows:

Evaporator	**copper, externally finned**
Absorber	**copper, externally finned or prime surface**
Condenser	**copper, prime surface**
Low-Stage Generator	**copper, prime surface**
High-Stage Generator	**70/30 CuNi, prime surface**

The tubes in the high and low temperature generators are more corrosion resistant in the ParaFlow unit than in the Carrier unit. Lithium Chromate is classified as carcinogenic and must be specially handled when being disposed of or when spilled. The inhibitor used in the ParaFlow unit is Lithium Molybdate, which is not classified as carcinogenic.

The ParaFlow units have a long operating history in the U.S. with its existing tube specifications without any record of tube problems. YORK will not guarantee the tubes for the life of the chiller. Will Carrier guarantee to cover the costs of handling the spills and/or disposal of Lithium Chromate?

D. Pump/motors:

Refrigerant and solution pump/motors shall be self-contained, leakproof, hermetic type, without pump seals, isolation valves, or external seal water system to minimize air leakage into the machine. Each pump casing shall be welded into suction and discharge lines and factory installed. Lubrication and cooling shall be accomplished by the fluid being pumped; auxiliary water piping for cooling and lubrication shall not be acceptable. Pump/motor assemblies shall be designed for a minimum of 5 years (or 20,000 hours) normal operation between inspections. If pump/motor assemblies are furnished with less than a design of 20,000 hours between inspections, they must be provided with isolation valves and a bearing monitor system to aid in diagnosing and performing on-going maintenance.

The pumps specified above are inferior to the Buffalo pumps used on the ParaFlow units manufactured in the U.S. Buffalo pumps are designed for 55,000 hours of operation between inspections. All ParaFlow units are supplied with isolation valves on both the suction and discharge sides of the pumps. The ParaFlow does not have a bearing monitor system, nor does it require one.

E. Purge System:

An automatic motorless purge system shall be furnished to provide a continuous purging action whenever the chiller is in operation to assure long machine life and efficient performance. Noncondensables shall be removed from the absorber by a liquid eductor, which shall use flow from the solution pump to create a suction. Noncondensables shall be stored external to the unit and shall be prevented from diffusing back into the ma-chine when the unit is not operating. Evacuation of the external storage chamber shall be accomplished by manually positioning valves to pressurize the chamber with lithium bromide solution and exhausting it to atmosphere. If the purge system is such that it requires a vacuum pump, then it shall be factory mounted on the chiller and wired to the control panel by the chiller manufacturer.

During normal operation, the ParaFlow unit is continuously purging noncondensable gases from the absorber into a separate purge tank. The purge tank must be evacuated by the use of a motor driven purge pump. Carrier's design is very sloppy. If a careless operator left the valves open too long, lithium bromide solution could spill all over the equipment room floor. Furthermore, with a chromate inhibitor, which is carcinogenic, any spill would have to be reported to the local authorities or the EPA for clean-up. We do not factory mount or wire the purge system, but this operation only takes 30-45 minutes for the service person to perform.

F. Controls:

1. Each chiller shall include a factory mounted and wired control panel with lockable door. Machine opera-

tion shall be continuously controlled and monitored with the chiller operational status and fault indication displayed via multiple LEDs (light-emitting diodes) on the front of the panel. Panel components shall be UL-listed and shall include a microprocessor-based temperature indicating controller, molded case circuit breaker, pump contactors, ambient-compensated 3-phase pump overloads, multi-tap control power transformer, automatic steam demand limiter, elapsed time indicator, alarm buzzer, terminal blocks, relays, auto/manual capacity control switch, remote start/stop switch, and all other necessary safeties and controls for proper machine operation.

All ParaFlow Chillers are equipped with a 40 character alphanumeric display that displays all messages in plain English. The micropanel and power panel contain a microprocessor-based temperature indicating controller, pump contactors, pump overloads, control power transformer, programmable steam demand limiter, elapsed time indicator, terminal blocks, relays, auto/manual capacity control, remote start/stop, and all other safeties and controls for proper machine operation. The power panel includes a non-fused disconnect (a contractor supplied fused switch must be supplied) and the micropanel contains terminals for remote trouble indication.

2. Capacity of the machine shall be electronically controlled by regulating the flow of steam to the generator in response to the leaving chilled water temperature. The output from the microprocessor based temperature controller shall be 4-20 mA signal. The valve actuator shall either be electric or pneumatic as specified on the equipment schedule.

The steam control valve shall be factory supplied and field installed.

The ParaFlow unit uses a 0-120V PWM signal to modulate the steam control valve. The actuator is electric only. The steam control valve is factory supplied for field installation.

3. Provisions for interlocking control of the chilled water pump, condenser water pump, and cooling tower fans shall be included in the panel as standard.

Pump contacts are provided in the micropanel, but there is no specific provision for any other auxiliary equipment, such as the cooling tower fans. This can be hardwired into the panel.

4. A dry set of contacts in the panel shall be provided for remote fault indication.

The micropanel contains both remote safety shutdown-contacts and remote warning contacts.

5. Unit shall include an automatic concentration control system to prevent over-concentration and over-dilution of the lithium bromide solution at all operating conditions. Operation shall be based on monitoring concentration (via refrigerant level in the evaporator) and temperature of the solution, and transferring water from the evaporator to the absorber to limit concentration when conditions warrant. Over-dilution shall also be controlled via a low level switch in the evaporator.

The micropanel is designed to monitor all operating parameters and to initiate corrective procedures in the event that unsafe conditions are approached (warning conditions) and to initiate a safety shutdown if the condition does not correct itself. An overflow weir is provided in the evaporator section of the unit that will transfer refrigerant from the evaporator to the solution in the absorber in the event that the refrigerant level is too high. Over dilution is prevented by a float valve in the refrigerant tank. At low refrigerant levels in the tank this valve closes, recirculating refrigerant that leaves the refrigerant pump back into the refrigerant tank.

6. Automatic dilution cycle shall lower the concentration on the lithium bromide solution to prevent possible crystallization in the heat exchanger. Control shall be turned off when the refrigerant level falls to a preset level in the evaporator. Control shall be activated by chiller shutdown.

The dilution cycle in the ParaFlow Chiller will be turned off when the solution temperature falls below a preset level. The dilution cycle is initiated by chiller shutdown or as needed by the micropanel to operate the unit in a safe manner.

G. Machine Safety Devices

1. Machine safety and limit devices shall be included as follows:

a. High refrigerant level – evaporator (limit)
b. Low refrigerant level – evaporator (limit)
c. High solution level – generator (limit)
d. Low chilled water temperature
e. High solution temperature – generator
f. High motor winding temperature – refrigerant solution pump
g. High motor amperage – refrigerant solution pump; and vacuum pump (if supplied)
h. High pressure – generator
I. Low chilled water flow
j. Low cooling water flow

The ParaFlow units contain the above mentioned safeties with the following notes or, exception:

a. The ParaFlow does not contain a low refrigerant level limit, but does use a float valve to prevent the refrigerant level from falling below the point at which the refrigerant pump would have sufficient suction head.

b. The ParaFlow uses a float valve that will constantly maintain the solution level in the first-stage generator.

Due the parallel flow design, excess solution will be sent to the second-stage generator.

2. Chiller shall include a rupture disk and fusible plug to protect against accidental over pressure and over temperature.

All ParaFlow units are supplied with a rupture disk that will protect against overpressure. A fusible plug is not supplied.

H. Electrical Requirements:

1. Power supply to the unit shall be 3-Ph, 60Hz with voltages of 208, 230, 460, or 575 as specified on the equipment schedule. A multi-tap transformer shall provide 110 single-phase secondary power for the control panel.

The ParaFlow Chillers are designed for 3 phase, 60Hz with voltages of 208, 230, 460 and 480.

2. Contractor shall supply and install the electrical power line and all auxiliary electrical a protection devices per local code requirements and as indicated necessary by the chiller a manufacturer.

The same applies to the ParaFlow unit.

3. Contractor shall supply and install electrical wiring and devices required to interface the chiller controls with the building control system if applicable.

The same applies to the ParaFlow unit.

I. Piping Requirements:

1. Piping and instrumentation for the chilled water, cooling water, steam, and condensate piping shall be supplied and installed by the contractor/owner.

The same applies to the ParaFlow unit with the exception that the chilled and cooling water thermistors (temperature sensors) are factory installed in the water nozzles.

2. A steam condensate float trap shall be furnished by the chiller manufacturer and shall be unit mounted and piped, alleviating the need to supply a separate steam trap in the condensate return piping.

The condensate leaving the ParaFlow unit is subcooled and a steam trap is not required.

3. Absorber-condenser crossover piping shall be furnished by the chiller manufacturer if provided as standard with the machine. Installation of the crossover piping shall be factory installed by the chiller manufacturer if normally included as standard on the machine.

All "S" models include the crossover pipe. The "G" model ParaFlow unit is <u>not</u> supplied with the absorber-condenser crossover pipe. This pipe is to be supplied by the contractor and has not been a selling disadvantage. If it became necessary, YORK could provide this pipe on a case-by-case basis as a contract special.

4. Chilled water flow switch shall be factory supplied and factory installed in the evaporator water nozzle. Condenser water flow switch shall be field installed and supplied by either the chiller manufacturer or the contractor/owner.

A chilled water flow switch is supplied for field installation with every ParaFlow unit. A condenser water flow switch can be factory supplied as an option for field installation.

5. Piping from the rupture disk and fusible plug shall be provided and installed by the contractor/owner and piped in accordance with the chiller manufacturer's written instructions and any local jurisdictional requirements.

The rupture disk piping is to be provided and installed by the contractor. A fusible plug is not provided on the ParaFlow units.

J. Thermal Insulation:

Insulation of cold or hot surfaces shall be field supplied and field installed on the machine. Chiller manufacturer shall specify the recommended material and surface area to be insulated.

The same applies to the ParaFlow units.

K. Sound Level:

The overall sound pressure level of the chiller shall not exceed 75 dbA when measured per ARI Standard 575 (latest edition).

The sound level data listed in the engineering guide, Form 155.19-EG2, was prepared by Hitachi. It represents data that was measured in their factory with background noise that was not screened out.

L. Start-up:

1. Unit manufacturer shall provide a factory-trained service representative, employed by the chiller manufacturer, to perform and/or supervise chiller pressure test (when required), charge chiller with refrigerant (water) and lithium bromide solution, place unit into operation.

2. After unit start-up has been performed, the same factory representative shall be available for a period of instruction not to exceed 4 hours to instruct the owner's personnel in the proper start-up, operating, and maintenance procedures.

The above mentioned start-up procedures would be included with the standard TCA. A list of the procedures performed by YORK Service at start-up includes:

Check that the unit arrived on site with the factory nitrogen charge.

Check that unit is leveled within 1 inch in 1000 inches.

Supervise the installation of the rupture disk piping.

Check the installation of the vacuum pump.

Evacuate the unit.

Charge the unit with its required amount of solution and refrigerant (if shipped uncharged).

Check the rotation of the pumps.

Check the operation of the purge pump.

Check all of the valve settings.

Install the valve identification tags.

Confirm the operation of the chilled water flow switch.

Check the installation of the steam control valve.

Check the steam condensate back pressure.

Check the steam pressure/temperature per factory test report.

Perform bubble test (leak test) after unit is at full load.

Customer personnel instructed on: vacuum pump care purging procedures refrigerant reclaim procedure and frequency.

Programmable setpoints logged.

After a suitable period of operation, YORK Service will return to take a solution sample for analysis.

3. Manufacturer shall provide the following literature:

a. Installation Instructions

b. Start-up, Operating and Maintenance Instructions

c. Field Wiring Diagrams

The above can be found in the ParaFlow IOM, the unit wiring diagrams, and the field wiring diagrams (Forms 155.17-NM1, 155.19-W1, and 155.17-PA2).

M. Options and Accessories:

1. Marine Waterboxes:

Marine waterboxes rated for 150 psig (1034 kPa) working pressure (when not factory supplied as standard) or 250 psig (1724 kPa) working pressure, with hinged covers to facilitate tube cleaning and maintenance shall be furnished when specified on the equipment schedule.

Marine waterboxes are optional in 150 psig design only. 250 psig marine waterboxes are not available. Hinged waterboxes (marine type or standard) are not available (see 2.01 C2 above).

2. High-pressure Waterboxes:

Waterboxes rated for 250 psig (1724 kPa) working pressure with hinged covers shall be furnished when specified on the equipment schedule.

Optional 300 psig compact waterboxes are available. Hinged waterboxes are not available (see above).

3. Double Drain Heat Exchanger:

A second steam condensate drain heat exchanger, factory mounted and piped, to further reduce the chiller steam rate, shall be furnished when specified on the equipment schedule.

YORK does not have an option to increase efficiency by adding an additional drain cooler. Models -21G and -22G are equipped with two drain coolers as standard. All other units have one drain cooler as standard.

4. Special Tubing:

Tubing of non-standard materials and/or wall thickness shall be provided when specified on the equipment schedule.

Special tube materials and/or wall thickness are optional.

5. Absorber-Condenser Crossover Piping:

Crossover piping connecting the absorber to the condenser (when not factory-supplied as standard) shall be furnished when specified on the equipment schedule.

The crossover pipe is to be provided and installed by the contractor. If this became a selling disadvantage YORK could provide this pipe on a case-by-case basis as a contract special.

6. Unit-Mounted Vacuum Pump:

A unit-mounted vacuum pump, factory piped and wired, shall be furnished when specified on the equipment schedule.

The purge pump will be shipped loose for field installation. This installation is very simple and has not been a selling disadvantage.

7. Shipping Configuration:

Chiller shall ship in either one or two pieces as specified on the equipment schedule.

All steam ParaFlow Chillers ship in one piece as standard. Consult Marketing on special knocked-down shipments.

8. Chilled Water Temperature Reset:

Chilled water temperature reset, allowing adjustment of chilled water temperature set point based on an external signal, shall be furnished when specified on the equipment schedule.

All ParaFlow units are capable of accepting a 1 to 11 second pulse width modulated (PWM) signal for remote reset of leaving chilled water temperature. Optional input signals are 4-20 mA, 0-10 VDC, and contact closure.

9. Pneumatic Steam Valve:

A pneumatic steam valve, actuated by a 3 to 15 psig (21 to 105 kPa) air signal, shall be provided with a valve positioner when specified on the equipment schedule.

All ParaFlow Chillers are supplied with an electric steam valve. There is no option for a pneumatic valve. If it became necessary, YORK could provide a pneumatic valve on a case-by-case basis as a contract special.

10. Isolation Package:

A vibration isolation package consisting of machine soleplates and neoprene isolation pads shall be furnished when specified on the equipment schedule.

Neoprene isolation pads, if required, must be provided by the contractor.

11. Thermometer Set:

A package of 5 adjustable angle thermometers shall be factory supplied for field installation when specified on the equipment schedule. Each shall have a in. scale with a working range of 0 to 120°F (–20 to 50°C) and shall be equipped with a 3/4-in. NPT brass well.

Carrier's control panel does not display entering and leaving chilled and condenser water temperatures. Therefore, thermometers must be installed in the piping near the inlet and outlet of the chiller. This is an option for Carrier to provide the thermometers for the contractor installed thermowells. This includes the chilled water inlet and outlet, the condenser water inlet and outlet, and the absorber-condenser crossover pipe. The U.S. built ParaFlow Chillers utilize factory installed thermistors in the inlet and outlet of the chilled and condenser water circuits, eliminating the need for the contractor to install the thermowells. The micropanel on the ParaFlow will display the entering and leaving water temperatures.

12. Condenser Water Flow Switch:

A condenser water flow switch, rated for either 150 or 250 psig (1034 or 1724 kPa), shall be factory supplied for field installation when specified on the equipment schedule.

A condenser water flow switch, for field installation, can be supplied as optional.

McQUAY

BACKGROUND

McQuay uses a Sanyo designed chiller. The Sanyo design includes only two-stage absorption. McQuay, unlike the other manufacturers, has no single-stage absorber design of their own. The lack of a single-stage machine leaves McQuay without the experience YORK gained by designing and building our IsoFlow chiller. McQuay, having no in-house experience, has to rely heavily on the Japanese for engineering support.

The Sanyo design has 23 individual model numbers from 100 to 1500 Tons. Each model is available in either steam-fired or direct-fired. Both direct-fired and steam-fired chillers have U.L. listing. U.L. listing, generally necessary for combustion equipment, is overkill for steam-fired units, but it can't hurt them.

The chillers sold by McQuay have mostly been imported units built by Sanyo in Japan. In 1995, they began assembling the units in their Stanton, VA plant. They claim to meet the Buy American Act, but it may be a close call. The final assembly is in the U.S., but many of the components are still coming from Japan. From the outside the pumps, sensors, control devices are visibly Japanese. The tube wall thickness specified in their literature is not a standard U.S. wall thickness, so the tubes are likely coming from Japan. How much of the steel sub-assemblies are fabricated here vs. Japan is very difficult to tell. In any case, they advertise the ability to meet the Buy American Act, but they are far from YORK's standard of made in the U.S.A.

YORK has taken the Hitachi design and reworked it from the ground up. Every manufacturing drawing has been converted from millimeters to inches, and every component (except for two or three for which we can't find a U.S. vendor) has been sourced from the U.S. Our unit is built in the U.S., by Americans, using U.S. components, and is backed by a U.S. company with over 35 years of absorption experience.

OPERATIONAL DATA

The McQuay chillers have a minimum chilled water temperature of 41°F, although we have not seen them push it very often. Very few absorption jobs are for less than 42°F water. They can accept a minimum of 67°F tower water, but they recommend that it be kept at 75°F to allow for fluctuations. They have two types of models, the "Y" type and "Z" type. The "Y" type of unit is designed for 10°F tower water splits. The "Z" type of unit is designed for the same nominal capacity of as the "Y" type, but with a 15°F tower water split. They can do hot water at 140°F on standard models, and have the option to go up to 175°F. Heating is available as simultaneous or heating only, similar to YORK. The steam units have a range of acceptable steam pressure from 57-142 psig. Just like the YORK steam two-stage design, the chiller requires 115 psig to achieve nominal capacity.

DESIGN FEATURES

Burner: The burner is supplied by Gordon-Piatt, and is not mounted on the machine at the factory. The burner is a forced draft combustion burner, capable of dual fuel arrangements, similar to all direct-fired absorption chillers on the market today. They also have an option for low NOx, as do all our competitors. They may offer a Coen (instead of Gordon-Piatt) burner for jobs with strict low NOx requirements.

Heating: The heating can be 2-pipe using the evaporator bundle, or 4-pipe using a separate heat exchanger. They have all the options available that YORK offers. Their simultaneous heating system contains more controls than what is supplied by YORK. They supply internal piping and controls to try to control the heating and the cooling temperatures. However, both YORK and McQuay suggest that the customer supply mixing control between the inlet and outlet hot water lines. This must be done to vary the flow of the hot water, because both chillers give priority to the cooling load. When the cooling load goes up the hot water flow must go down to keep the leaving hot water temperature the same. McQuay presents their system as containing all the pipes and valves for simultaneous operation, but the waterside pipe/valve requirements are the same for the YORK and McQuay units. Only one temperature controller is required by YORK to be customer supplied that McQuay supplies as standard.

Building Pump Interlocks: McQuay supplies building (chilled and tower water) pumps. These interlocks tell the pumps when to be on and when to be off. YORK also supplies the same ability.

Dispersion Trays: McQuay uses trays with holes in them to spread solution and refrigerant over the tubes. They claim that spray nozzles will clog. The stainless steel spray nozzles we use are self-cleaning nozzles. We have not experienced clogging problems with our spray nozzles. Only negligent maintenance of the solution chemistry could result in spray nozzle clogging, and this type of clogging would also affect drip (dispersion) trays.

General: McQuay uses molybdate inhibited solution, requires insulation to be applied in the field, and has isolation valves around the pumps – all the same as YORK. McQuay has a variable speed drive solution pump (see strength and weaknesses section). McQuay uses an "auto de-crystallization" method that uses overflow from the evaporator to the absorber, again similar to the YORK design.

MCQUAY DIRECT-FIRED

Model DC-	11	12	13	14	21	22	23	24	31	32	41	42
Nominal Tons	100	120	150	180	210	240	280	320	360	400	450	500
Rigging Weight (uncrated)												
Main Shell	6,700	6,900	8,200	8,400	10,800	11,100	12,600	13,000	16,100	16,600	19,900	20,800
Generator	2,700	2,900	3,600	3,800	4,400	4,900	5,300	5,800	6,200	6,400	7,300	7,800
Total/1 Piece Shipment	9,400	9,800	11,800	12,200	15,200	16,000	17,900	18,800	22,300	23,000	27,200	28,600
Operating Weight	12,500	13,300	16,100	16,900	20,800	22,300	24,900	26,700	31,400	32,900	38,500	40,600
Connection Size (in)												
Evap	4	4	4	4	5	5	6	6	6	6	8	8
Abs/Cond	5	5	5	5	6	6	8	8	8	8	10	10
Gas	1.5	1.5	2	2	2	2.5	2	2	2	2	2.5	2.5
Exhaust	11 x 8-1/4				12-1/4 x 12-1/4				14-1/8 x12-1/4		16-1/8 x 12-1/4	
Dimensions												
Length	116	116	154	154	153	153	194	194	196	196	196	196
Width	88	88	93	93	99	99	99	99	105	105	113	115
Height	78	78	78	78	85	85	85	85	95	95	103	103

Model DC-	51	52	53	61	62	71	72	73	81	82	83
Nominal Tons	560	630	700	800	900	1000	1100	1200	1300	1400	1500
Rigging Weight (uncrated)											
Main Shell	30,200	32,200	33,800	43,700	46,300	51,000	54,100	56,700	62,400	65,300	69,000
Generator	9,100	9,700	10,400	14,800	16,100	19,400	21,000	22,700	24,700	25,800	27,400
Total/1 Piece Shipment	39,300	41,900	44,200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Operating Weight	54,500	58,600	62,300	83,700	90,000	101,700	108,500	115,200	127,600	133,900	141,500
Connection Size (in)											
Evap	8	8	8	10	10	12	12	12	14	14	14
Abs/Cond	12	12	12	14	14	16	16	16	16	16	16
Gas	2	2	2.5	2.5	3	3	2.5	2.5	3	3	3
Exhaust	13-3/4 x 19-5/8			15-3/4 x 24-3/8		15-3/4 x 35-3/8					
Dimensions											
Length	204	225	245	250	270	252	271	291	276	296	316
Width	131	131	131	147	147	170	168	170	186	186	186
Height	119	119	119	142	142	143	143	143	150	150	150

MCQUAY STEAM

Model NC-	11	12	13	14	21	22	23	24	31	32	41	42
Nominal Tons	100	120	150	180	210	240	280	320	360	400	450	500
Rigging Weight (uncrated) Total/1 Piece Shipment	7,900	8,000	9,800	10,100	12,800	13,100	15,300	15,900	19,700	20,000	24,100	25,000
Operating Weight	10,500	10,800	13,400	14,000	17,600	18,200	21,100	22,300	27,300	28,100	33,500	34,900
Connection Size (in)												
Evap	4	4	4	4	5	5	6	6	6	6	8	8
Abs/Cond	5	5	5	5	6	6	8	8	8	8	10	10
Steam Inlet	2	2	2	2	2.5	2.5	2.5	2.5	3	3	3	3
Condensate	1	1	1	1	1	1	1	1	1.5	1.5	1.5	1.5
Dimensions												
Length	114	114	154	154	153	153	193	193	196	196	196	196
Width	75	75	69	69	80	80	74	74	85	85	91	91
Height	79	79	79	79	90	90	90	90	95	95	105	105

Model NC-	51	52	53	61	62	71	72	73	81	82	83
Nominal Tons	560	630	700	800	900	1000	1100	1200	1300	1400	1500
Rigging Weight (uncrated) Total/1 Piece Shipment	34,800	37,300	39,000	50,100	53,300	59,100	62,300	65,400	72,800	76,400	79,700
Operating Weight	47,900	51,700	54,500	70,600	75,400	83,600	88,600	93,400	103,900	109,400	115,000
Connection Size (in)											
Evap	8	8	8	10	10	12	12	12	14	14	14
Abs/Cond	12	12	12	14	14	16	16	16	16	16	16
Steam Inlet	4	4	4	5	5	6	6	6	6	6	6
Condensate	2	2	2	2.5	2.5	3	3	3	3	3	3
Dimensions											
Length	205	227	246	251	272	254	275	294	276	296	317
Width	101	101	101	113	113	120	120	120	128	128	128
Height	119	119	119	134	134	142	142	142	144	144	144

MCQUAY - STRENGTHS AND WEAKNESSES

This section will concentrate on features you can expect McQuay to sell and what we should sell against them. The items discussed are those you can expect McQuay to stress in order to get a specification or secure an order. Some of their claims of competitive strengths are perceived strengths and will be addressed in the text.

Weaknesses

1. Purge System

McQuay uses a purge system, like all manufacturers, that purges the chiller during operation and stores the noncondensables in a holding chamber. The McQuay system includes a palladium cell, but still requires periodic manual purging (although they advertise "automatic purge"). The McQuay palladium cell system purges the unit of hydrogen automatically (it will not rid the unit of other nonconden-sibles). The palladium cell requires a heater to be ener-gized which consumes energy. The heater must be replaced every two years. Hydrogen is a by-product of corrosion. If a unit is producing excess hydrogen it is an indicator of leaks and requires corrective action. You will never know if your unit is being consumed by corrosion with a palladium cell.

The YORK SmartPurge is the most effective and sophisticated purge system offered by any absorption unit manufacturer. It includes a true automatic purge system, that requires no manual operation at any time. The tank that stores our noncondensables is automatically emptied by the vacuum pump whenever it is full. Additionally, the micropanel counts the purges, picking up any increase in noncondensable production. The YORK system gives the earliest warning of corrosion.

2. Control Panel

From the outside the sensors and control devices are visibly Japanese. The panel itself contains Japanese components. From a service standpoint it can be very difficult to get components. They can only be sourced from McQuay, because they are not standard components readily available in the U.S. Very often long lead times can occur if the part needed is out of stock. Another example of inconvenience in using Japanese components is the chilled-water setpoint. The chilled water is set in increments of 0.9°F; a quick conversion tells you that this is 0.5°C. The YORK chilled water is programmable to 0.1°F increments.

3. Burner Not Mounted

The burner ships separately from the burner manufacturer to meet the chiller at the job site. YORK is in a good position to know how difficult the field set up of the burner can be because we shipped the burner separately for imported Hitachi chillers. The burner must be mounted and attached to the chiller. The burner must be fully wired into the chiller control panel. The power supply must be wired to the burner system. This process adds at least a day to the start up of the chiller system.

Strengths

1. TRG Bearing Monitor System

The Japanese pumps used for absorption chillers are primarily made by two manufacturers. Both build a similar style of pump, and both require a rebuild at least once every two years. The bearings used on those pumps wear quickly. As a result McQuay/Sanyo put a TRG bearing monitor system on the pump bearings which allows the owner to plot the wear of bearings and schedule pump maintenance.

YORK uses Buffalo Pumps, built in Buffalo, New York. The Buffalo pumps we use are designed for long life and use a sophisticated conical bearing. The YORK pumps are designed to operate 55,000 hrs before requiring a service inspection. That means the pumps should run hassle free for 12-15 years (depending annual operating hours) in chiller applications without requiring any attention. The bearing monitor that McQuay claims takes the trouble out of scheduling routine inspections and teardowns simply isn't necessary with the YORK design.

2. Variable Speed Solution Pumps

The McQuay chillers have a variable speed solution pump that increases part load efficiency; their IPLV is about 10% higher. They also mention that variable speed allows them to prevent cycling the solution pump on and off during operation. YORK does not cycle the solution pump either so this is not an advantage. McQuay states that start up and dilution times are shorter with the variable speed design. The dilution cycle may be quicker, but they do not take full advantage of the heat that is already in the system to provide cooling; that cooling is available during the YORK dilution cycle. Start up time to a low load may be quicker because they can greatly limit the flow to the generator, but the time to heat up all the solution (the time to reach full load) will be little different than a start up that fills the generator.

3. Simultaneous Operation

McQuay's simultaneous heating system claims to contain more controls than what is supplied by YORK. They supply internal piping and controls to try to control the hot and chilled water temperatures. However, we both suggest that the customer supply mixing control between the inlet and outlet hot water lines. This must be done to vary the flow of the hot water, because both chillers give priority to the cooling load. When the cooling load goes up the hot water flow must go down to keep the leaving hot water temperature the same. McQuay presents their system as containing all the pipes and valves for simultaneous operation, but the waterside pipe/valve requirements are the same for the YORK and McQuay units. Only one temperature controller is required by YORK to be customer supplied, that is integral to the McQuay chiller.

REVIEW OF MCQUAY/SANYO DIRECT-FIRED ABSORPTION CHILLER-HEATER AGAINST THE YORK MILLENNIUM ABSORPTION CHILLER

The following is the standard specification for the McQuay/Sanyo direct-fired absorber and a competitive analysis to be used when selling the U.S. built YORK ParaFlow Direct-Fired absorbers against this spec. The specification is written in **bold** type. The format may differ slightly.

UPPER SHELL (LOW TEMPERATURE GENERATOR AND CONDENSER)

1. The upper shell shall be of the shell-and-tube type. Water side shall be rated at 150 PSIG working pressure and hydrostatically pressure tested at 1.5 times working pressure.

This is standard on all absorption chiller-heaters for all of the manufacturers. If higher pressure water circuits are required, there is an option for 300 PSIG.

2. Each tube in the low temperature generator shall be externally enhanced finned seamless copper and each tube in the condenser shall be externally and internally enhanced seamless copper. Low temperature generator tube diameter shall be 3/4" nominal with 0.028 inch wall thickness at finned section and .045 inch wall thickness at the ends. Condenser tube diameter shall be 5/8" nominal with .024 inch wall thickness. Tubes shall be individually replaceable with tube ends rolled into the tube sheets.

In the "G" style ParaFlow chiller-heaters both the condenser and second-stage generator tubes are a nominal 5/8" O.D., 0.025" wall (Models -18G – -22G have 3/4"O.D., 0.028" wall condenser tubes). The condenser and second-stage generator tubes are bare copper and replaceable from either end.

In the "S" style ParaFlow chiller-heaters both the con-denser and second-stage generator tubes are a nominal 5/8" O.D., 0.025" wall for Models -12SC – -14SC and 3/4" O.D., 0.028" wall for Models -15SL – -19S. The condenser and second-stage generator tubes are bare copper and replaceable from either end.

3. The low temperature generator and condenser shall be enclosed in a single shell separated by eliminators to allow refrigerant vapor to enter the condenser.

The same holds true for the ParaFlow design.

4. Condenser shall be equipped with hinged marine water box complete with drain and vent connections to facilitate ease of maintenance. Water connections shall be ANSI 150 PSIG flanged.

There are no hinged water boxes on the U.S. built ParaFlow's. While this feature looks nice on paper, in actuality it does not work well. When opened, the water boxes are too heavy to remain on the hinged axis and will not easily line up with the bolt holes when closed. A hoist or winch will still be required to lift the water boxes up and in-line with the bolt holes. Marine water boxes are available as an option. Victaulic connections are standard on the ParaFlow chiller-heaters with an option for ANSI flanges.

LOWER SHELL (EVAPORATOR AND ABSORBER)

1. The lower shell shall be of the shell-and-tube type. Water side shall be rated at 150 PSIG working pressure and hydrostatically pressure tested at 1.5 times the working pressure.

This is standard on the ParaFlow units. Option for 300 PSIG water circuits is available.

2. Evaporator and absorber tubes shall be externally and internally enhanced seamless copper. The evaporator and absorber tube diameter shall be 5/8" nominal with .024 inch wall thickness. Tubes shall be individually replaceable with tube ends rolled into the tube sheets.

The evaporator and absorber tubes are copper, 5/8" nominal with a wall thickness of .025 inch (except -15SL – -19S which have 3/4" nominal with a wall thickness of 0.028 inch). The tubes, which are replaceable, are externally enhanced only.

3. The evaporator and absorber shall be enclosed in a single shell separated by eliminators to allow refrigerant that has evaporated to pass from the evaporator into the absorber, while at the same time preventing concentrated and dilute lithium bromide solution from passing through to the evaporator.

This holds true for the ParaFlow units.

4. Stainless steel dispersion trays shall uniformly distribute the liquid refrigerant on the evaporator tubes and concentrated solution on the absorber tubes through the entire length of the shell. Systems utilizing pressurized spray head liquid dispersion systems shall include a 5-year parts and labor guarantee against failure due to clogging.

All "G" series, and -15SL – -19S "S" model Para Flow design utilize spray headers. The spray headers are carbon steel but the spray nozzles are stainless steel. The Hitachi units that have been in operation in the U.S. for over 13 years have had no history of problems, such as clogging.

Models -12SC – -14SC dispersion trays similar to the McQuay design, but the trays are carbon steel not stainless.

5. Water connections for both the evaporator and absorber shall be 150 PSIG flanged. The absorber shall be equipped with hinged marine water box to facilitate ease of maintenance, complete with vent and drain connections.

The U.S. built ParaFlow units do not have hinged water boxes (see comments on 4 on the upper shell above). Marine water boxes and ANSI flanges are optional.

HIGH TEMPERATURE GENERATOR

1. The high temperature generator shall be gas fired boiler type with a steel construction two-pass arrangement. The first pass shall have a combustion chamber supplied with suitable volume for complete combustion. Second pass shall be steel boiler tubes, .18 inch wall thickness with internally enhanced turbolators.

The design of the ParaFlow's first stage generator is similar. The generator has a combustion chamber, where the fuel is combusted, generating the heat required to drive the absorber, and a series of carbon steel boiler tubes, .138 inch thick. The hot combustion gases are blown across the tubes heating the LiBr solution within.

2. All direct-fired chiller/heaters shall be supplied with a Gordon Piatt Turbo Ring Forced Draft Burner. Burner shall be capable of operation with natural gas, No. 2 fuel oil, or natural gas or No. 2 fuel oil (dual fuel option). Unit shall be capable of capacity modulation from 25% to 100% (natural gas), 35% to 100% (No. 2 fuel oil) of full load.

YORK's standard burner vendor is PowerFlame. This burner was chosen for two reasons: it was determined that the PowerFlame burner had better combustion characteristics in the ParaFlow units, and PowerFlame has a Low NOx burner option that can reduce NOx emissions to 30 ppm (3% O2). The ParaFlow Chiller-Heaters are capable of capacity modulation from 30% to 100% regardless of the fuel source. PowerFlame burners are capable of firing on other fuels such as propane and diesel.

3. The burner shall be supplied with a control panel to monitor and control the operation of the burner. The burner control panel shall be interlocked with the chiller's main control panel, and shall be supplied with all necessary safety controls, regulators, switches and indicator lights to ensure trouble-free operation.

The same applies to the ParaFlow units. The burner panel also includes contacts to tie in fresh air dampers. This will allow the unit to tell the dampers when to open or close to allow combustion air into the mechanical room.

4. Burner shall be supplied with the gas train and/or fuel train piping. Gas train and/or fuel piping shall contain all necessary safety devices to prevent improper operation. The dual fuel option is supplied with a fuel transfer switch allowing the burner to be switched from natural gas to No. 2 fuel oil and back, either manually or automatically. Burner shall be U.L. listed as standard, with optional Factory Mutual (FM) and/or Industrial Risk Insurers (IRI) listing of burner and gas train available.

The same holds true for the ParaFlow units. The fuel changeover switch is manual but there is an option for an automatic changeover. An added feature for the U.S. built ParaFlow Chiller-Heaters is the preinstalled and prewired burners and burner control panels. The McQuay units will ship with the burner separate for field assembly.

HIGH AND LOW TEMPERATURE HEAT EXCHANGERS

1. The low and high temperature heat exchangers shall be of shell-and-tube type.

The same applies to the ParaFlow units. The ParaFlow design has three solution heat exchangers; a low, an intermediate, and a high temperature heat exchanger.

2. Each tube in the low and high temperature exchanger shall be externally and internally enhanced finned seamless copper-nickel. Heat exchanger tube diameter shall be ½" nominal with .028 inch wall thickness.

"G" style chillers – The solution heat exchanger tubes are carbon steel, ½" O.D. nominal with a wall thickness of .049 inches.

"S" style chillers – The solution heat exchanger tubes are Copper-Nickel, 5/8" O.D. tubes for the Models -12SC – -14SC, and 0.578" O.D. tubes for the -15SL – -19S.

3. The low and high temperature heat exchangers shall be enclosed in separate shells.

The three solution heat exchangers are separate, but contained within one overlapping shell. The heat exchangers are grouped this way in order to minimize heat loss and space requirements.

HIGH PERFORMANCE PURGE SYSTEM

1. To combat the intrusion of noncondensable gases and maintain proper vacuum levels, each absorption chiller/heater shall utilize an exclusive continuous purge system. This ejector system shall circulate absorbent through absorber and condenser to draw noncondensables from the condenser/absorber into a purge tank. The purge system shall be in use whenever the unit is in operation. Hydrogen shall be continuously eliminated from the purge tank through palladium cell heated to approximately 300°F.

The purge eductor in the ParaFlow design is similar. Noncondensables are purged automatically, while the unit is in operation, and stored in a purge tank. The ParaFlow does not use a palladium cell (see below).

2. All units shall be supplied with a rotary purge pump to eliminate all other noncondensable gases and to periodically restore proper vacuum level. The purge pump shall be a two-stage oil rotary vacuum pump assembly factory mounted, wired, tested and piped to the external purge pump.

The YORK SmartPurge system automatically removes the noncondensables that are stored in the purge tank whenever the tank is full. The pump is also of an oil rotary design. The number of purge cycles is recorded on the ISN Control Center both total for the unit life and total for the last seven days.

Only the YORK SmartPurge system requires no operator interaction to empty the purge tank. The McQuay unit still requires periodic manual operation of the purge pump to remove all noncondensible gases other than hydrogen.

It must be understood that Sanyo's palladium cell selectively attacks hydrogen gas, which is a by-product of corrosion. With a palladium cell continuously removing hydrogen gas from the unit, the rate of corrosion cannot be properly monitored. In the case of the ParaFlow design, the hydrogen gas will still be removed through the purge pump but the ISN Control Centers automatically doing so and is monitoring the frequency of purge cycles. In the event that the unit is purging too often, the panel will send out a warning. This is an early form of leak and corrosion detection that cannot be possible with the palladium cell.

REFRIGERANT AND ABSORBENT PUMPS

1. Each unit shall be equipped with radial air-gap, self-lubricating pump motor assemblies. The pumps shall be factory mounted, wired and tested. All pumps shall be supplied with TRG Bearing Monitor System. The TRG system enables the pump bearings to be evaluated for wear by measuring AC voltage between two electrical terminals, thus eliminating the need for routine visual and mechanical inspection.

The ParaFlow Chiller-heaters do not have a bearing monitor system. The U.S. built ParaFlow units use Buffalo Pumps, a U.S. pump manufacturer, that has designed their pumps for 55,000 hours of operation before a service over-haul is required. Lead-times for replacement pumps are faster than McQuay's (McQuay may stock some pumps but in the event that they are not available, the replacement pump will have to come from Japan).

2. All units shall be equipped with isolation valves on both the suction and discharge sides of the refrigerant and absorbent pumps.

This feature is standard on all ParaFlow units.

INVERTER DRIVE ABSORBENT PUMP

Each unit shall be furnished with a microprocessor controlled inverter for the No. 1 absorbent pump. This

inverter control permits absorbent flows to vary with cooling load, enabling significant energy savings. Accelerated startup times and reduced dilution times will be accomplished utilizing inverter controlled absorbent pump.

This feature enables McQuay to vary the amount of solution being sent to the high temperature generator. At reduced loads, this can improve the unit's heat input. The ParaFlow design incorporates a float valve to regulate solution flow to the first-stage generator. Therefore, while McQuay/Sanyo may benefit from lower electrical consumption at lower loads (electrical requirements are very small with absorption chillers to begin with), they do not gain a significant advantage on fuel consumption.

CONTROLS

1. Each unit shall be provided with a complete factory wired and mounted microprocessor-based control system. The control system shall feature PID digital control, complete with continuous and self-diagnostic capability, plus full display functions. The following features shall be included as standard in each control panel:

a. Terminal blocks for power and interlock wiring.

b. On-off operation switch.

c. Purge pump operation switch.

d. Safety alarm buzzer with bell.

e. Emergency stop switch.

f. Microprocessor-based chilled water controller.

g. Control transformer, auxiliary relays and timers for safety controls.

h. Magnetic contactors for absorbent, refrigerant, and purge pumps.

The Direct-Fired ParaFlow ISN Control Center uses PI, proportional plus integral digital control, rather than PID. Due to the relatively slow response time of absorbers the PID digital controller tends to over control the unit. An alarm bell is not provided in the ISN Control Center (see "d" above) but could be field supplied. The control panel meets the rest of the above specifications.

2. The controller shall monitor and display unit operating parameters including interlocks, unit safeties, system temperatures and pressures. Each of the following safeties will initiate the proper safety response in order to protect operational integrity of the unit and obtain the operator's attention via an indicator light illumination. On the following safety failures, the controller will initiate corrective shutdown procedures.

a. Chilled water pump interlock
b. Hot water pump interlock
c. Cooling water pump interlock
d. Combustion air fan interlock
e. Chilled water flow rate
f. Hot water flow rate
g. Chilled water freeze protection
h. Hot water outlet temperature
i. Cooling water inlet temperature
j. High generator temperature
k. High generator pressure
l. High generator solution level
m. Low generator solution level
n. High exhaust gas temperature
o. Crystallization protection
p. Flame failure
q. Natural gas pressure
r. Combustion airflow
s. Abnormal combustion
t. Absorbent pump(s) overcurrent protection
u. Refrigerant pump overcurrent protection
v. Burner blower overcurrent protection
w. Inverter control protection
x. Flow switch operation

The ISN Control Center on the Direct-Fired Para Flow Chiller-Heaters will also shut down on the above mentioned safeties with the following notes or exceptions:

f. Loss of hot water is a cycling shutdown.

g. Impending low refrigerant temperature will generate a warning condition which will inhibit further loading but will not shut down. If condition does not correct itself a shutdown will occur.

h. High leaving hot water temperature is a cycling shutdown.

l. High entering condenser water will generate a warning condition and inhibit heat input. Low entering condenser water will generate a warning but heat input will not be inhibited.

j-k. High generator temperature and pressure will generate a warning condition and inhibit heat input.

If condition does not correct itself, a shutdown will occur.

l-m. The ParaFlow design utilizes a float valve in the first-stage generator to control the level of solution in the generator. Due to the unique parallel flow design the float valve control will send the excess solution, if the level in the first-stage generator is already high, to the second-stage generator. A series flow absorber, such as the McQuay/Sanyo unit does not have this ability and therefore needs to actively monitor the solution level in the high temperature generator.

o. All of the safe operating parameters have been programmed into the ISN Control Center. The panel is constantly monitoring the operating characteristics and will take corrective measures, such as the warning conditions or safety shutdowns, to assure safe operation.

w. Does not apply. The ParaFlow does not have an inverter drive.

3. The monitor section of the control panel shall display unit setpoints, temperatures, operational records, and will allow data to be displayed by pressing data select keys. The following shall be indicated:

a. Generator temperature
b. Exhaust gas temperature
c. Chilled water outlet temperature
d. Hot water outlet temperature
e. Cooling water inlet temperature
f. Chilled water setpoint
g. Hot water setpoint
h. Chiller operation (hours)
i. Heater operation (hours)
j. Chiller starts (number)
k. Heater starts (number)
l. Refrigerant pump operation (hours)
m. Combustion operation (hours)
n. Burner cycles (number)

The ISN Control Panel will display the above data with the following notes or exceptions:

a. First-stage generator pressure and temperature is displayed.

b. The exhaust gas temperature is not displayed. The Direct-Fired ParaFlow units have an exhaust gas temperature cut-out switch that will shut the chiller-heater down in the event of high exhaust gas temperatures but the temperature is not displayed.

c. Return and leaving chilled water temperatures are displayed.

d. Return and leaving hot water temperatures are displayed.

e. Return and leaving condenser water temperatures are displayed.

h-i. Only the total number of operating hours is displayed. The panel does not distinguish between heating and cooling modes.

j-k. Only the total number of starts is displayed. The heating and cooling starts are not distinguished. The number of heating or cooling starts alone should not be important. The total number of starts and operating hours will give an operator an indication of how hard the burner is working (cooling or heating mode will have no bearing on this).

l. Refrigerant, solution, and purge pump operation is indicated but the number of operating hours is not displayed. Refrigerant and solution pump operating hours equal the operating hours for the chiller.

m. Only unit operation hours.

n. Not displayed.

In addition, the ISN Control Center will display the number of purge cycles within the last 7 days as well as the total cumulative number of purge cycles. This is a good indication of the leak-tightness of the unit. The panel will also display the solution and refrigerant temperatures, the solution concentration, and the burner firing rate (in %). This information is useful in gauging how hard the unit is working under its current operating condition.

4. Indication lights shall be provided via the run-stop section of the operational board to indicate the following component status:

a. Chiller operation
b. Heater operation
c. Refrigerant pump operation

d. No. 1 absorbent pump operation

e. No. 2 absorbent pump operation (280 tons through 1500 tons)

f. Purge pump operation

g. Burner blower operation

Pump operation and mode of operation is displayed on the ISN Control Center. Burner operation is indicated on the burner panel but burner blower, fan, operation is not specifically indicated. The burner operation cannot be indicated without the fan operating.

5. The microprocessor-based controller shall be capable of maintaining constant leaving water temperature by modulating fuel input. Capacity control from 25% to 100% (natural gas), 35% to 100% (No. 2 oil) of full load shall be accomplished by modulating the forced draft burner in response to changing leaving chilled or hot water temperature.

The burners on the ParaFlow units have a 3 to 1 turndown ratio regardless of the fuel source. This means that for both gas and oil (or any other fuels used) the chiller-heater will modulate capacity between 30% to 100%.

6. The control panel shall contain provisions for remote start-stop. When the controller is programmed for remote operation, a signal from a remote source is necessary for unit operation.

The ISN Control Center is capable of remote start/stop either through a remote DDC processor connected to an Integrated Systems Network, or by hardwiring. The Para Flow units are also capable of remote chilled and hot water reset temperatures.

7. The following operational safeties shall be communicated via external contact closures.

a. Operation indication

b. Stop indication

c. Alarm indication

d. Auxiliary equipment operation

e. Combustion indication

f. Cooling operation indication

g. Heating operation indication

Through an Integrated Systems Network <u>all</u> data accessible from the control panel can be communicated to a remote DDC processor. This data includes the above mentioned with the exception of auxiliary equipment operation (d.). Combustion indication is not specifically called out but this ties into the chiller-heater operation. The unit is not operating without combustion. In the event that limited interface is to be used (i.e. hardwiring) the mode of operation is not distinguished and the auxiliary equipment operation is not indicated.

8. The unit control panel shall include the following switches to determine mode of operation.

a. Operation, stop, and buzzer stop buttons

b. Gas control valve auto/manual switch

c. Gas control valve close/stop/open switch

d. Refrigerant pump auto/stop/manual switch

e. Burner blower select switch

f. Cool/heat changeover switch

g. Purge pump on/off switch

Burner related switches (b, c, e) are similar. All Chiller-Heater functions are accessible via the ISN Control Center.

9. Microprocessor controller will continuously monitor system parameters and adjust concentration levels to avoid the possibility of crystallization. If the absorbent concentration rises above 65%, the controller will modulate fuel input to reduce generator temperature and solution concentration. Unit controller will initiate dilution cycle if concentration level is not corrected in the specified time frame.

The control panel is continuously monitoring operating parameters which may lead to crystallization and will inhibit heat input (warning conditions) or enact a safety shutdown if the unit is operating in an unsafe condition. By monitoring first-stage generator pressure and temperature, the ISN Control Center will effectively limit solution concentrations below 65%. In addition, the YORK Concentration Calculator monitors the solution concentration. If the concentration does go above normal conditions the unit will go into a warning mode and inhibit heat input when the concentration reaches 66%. The control system will keep the chiller in a warning mode until the concentration goes below 65%. If the concentration continues to increase during the warning mode then chiller will shut down and go through a dilution cycle when the concentration reaches 66.5%.

STARTUP SERVICE AND WARRANTY

Manufacturer shall furnish a factory trained service technician without additional charge. The service technician shall perform the leak testing, evacuation, and vacuum bubble testing using the high quality vacuum pump furnished with the unit. Leak testing shall only be performed on units shipped in more than one section that require field assembly or single section units that have lost the .2 kg/cm (2.8 PSIG) shipping pressure. Leak testing shall consist of pressurizing the unit with dry nitrogen to 1 kg/cm (14.2 PSIG) and soap bubble testing all joints. The unit shall hold that pressure for a minimum of 12 hours. The unit shall then be evacuated to at least 4 mm Hg and a vacuum bubble test shall be performed 3 times with the average test measuring not more than 15cc leakage in a 10-minute interval depending on unit size. Fluid charging and startup of the chiller shall proceed once the consulting engineer has approved the certified field evacuation and dehydration report. Manufacturer shall provide instruction of the owner's personnel on the oper-ation and maintenance of the unit. Manufacturer shall provide operation and parts list. The warranty period shall commence at the date of initial startup and shall continue for a period of one year not to exceed 18 months from shipment. Manufacturer's warranty shall include all parts and labor to install parts. Lithium bromide, octyl alcohol, inhibitor, and refrigerant shall be included and the labor to charge these fluids into the system.

The same generally applies with the TCA from YORK Service. The Direct-Fired units ship from the factory with a Nitrogen holding charge (approx. 6.0 PSIG). Service will perform leak testing if the unit has lost any of this charge. The warranty period is the same.

INSULATION

It shall be the responsibility of the installing contractor upon completion and installation and operational adjustments to insulate the unit per the factory recommendations and in accordance with appropriate construction practices.

The same applies to the ParaFlow Chiller-Heaters.

SOLUTIONS

Solutions shall be furnished by the manufacturer, installed by a factory trained service technician, and adhere to manufacturer's strict specifications. This includes initial charge of lithium bromide, alcohol, and inhibitor. Additional solutions outside manufacturer's warranty liability period must adhere to manufacturer's strict specification.

The same applies to the ParaFlow units. Note that the U.S. built Direct-Fired units 600 Tons and smaller are shipped, as standard, with the lithium bromide, alcohol, and inhibitor precharged. This benefit can save an enormous amount of time at start-up.

APPROVALS

Unit shall be listed with Underwriters Laboratories Inc. (U.L.).

The Direct-Fired ParaFlow Chiller-Heaters are U.L. approved.

TRANE

BACKGROUND

Trane designed their own two-stage steam-fired unit which has been built in La Crosse, Wisconsin for several years. When Trane got into the direct-fired two-stage market they imported a Kawasaki designed and built machine from Japan. During 1994 and 1995 Trane became uncompetitive using the Kawasaki unit due to high prices and long deliveries. This combined with the fluctuating yen/dollar value forced Trane out of the direct-fired market for 1995.

Trane began a new absorption chiller design program called the Horizon program. The Horizon program is intended to create a new two-stage direct-fired machine (Trane original design, not a Kawasaki licensed design), re-design the two-stage steam-fired chiller, and re-design the single stage steam/hot water fired chiller. Both the old and new design incorporate version of a series flow absorption cycle. Their need to get back into the direct-fired market that was why this was the first portion of the Horizon program completed. Trane released the first of the Horizon line, 380-500 Ton direct-fired chillers, in late 1995.

The remaining Horizon schedule is in the table below.

YORK INGENUITY LEADS TRANE DESIGN

Trane has incorporated the UCP2 control system to their current two-stage steam-fired absorber and the Horizon chillers. This new system includes Adaptive Capacity Control for the absorption chillers. Adaptive Capacity Control will take action to limit load and keep the chiller on line when conditions in the chiller are approaching a safety limit. The YORK Micropanel has done this since it was first released 1992, and it has been installed on every YORK built two-stage absorption chiller. A detailed description of the YORK control system is in the engineering guide. While the Trane panel may display a few data points available that are not measured by the YORK system, the safety controls are a re-invention of the YORK system.

Trane has switched to Buffalo pumps on the current two-stage steam-fired unit and will use Buffalo on all Horizon design chillers. Their pump is very similar to the Buffalo pumps used on YORK absorbers. As we have touted in the past, the Buffalo pump is a very reliable, high quality pump, and it would appear that Trane agrees. However, neither the current steam unit or the Horizon design includes isolation valves for servicing the pumps which are standard in the YORK design.

CURRENT TRANE TWO-STAGE STEAM-FIRED ABSORBER

The Trane unit can fire with high pressure steam or hot water and operate down to 10% load. No other manufacturer offers a two-stage hot water absorber. They show a minimum chilled water temperature of 40°F and minimum tower water temp of 55°F (but capacity is probably reduced below 65°F). All models above 700 Tons require two-piece shipment with the first-stage generator removed (it is expected that the Horizon will ship one piece up to 1000 Tons). This chiller also uses a lithium arsenite inhibitor which is classified as a hazardous waste material.

Trane uses Titanium tubes in their first stage generator. This will often appear in specifications driven by Trane. Trane is the only manufacturer to use Titanium tubes in the generator, all other use Copper-Nickel (YORK: 70/30, Carrier & McQuay: 90/10). The decision to use Titanium is likely caused by differences in their design. YORK and Carrier use a U-tube design that allows for thermal expansion without causing detrimental tube stress. Trane uses a straight tube design with little allowance for tube expansion. The Trane Generator must also be capable of handling the stress of high temperature hot water (up to 370°F) which can only be supplied at very high pressure (>175 psig).There are some questions regarding Titanium's ability to withstand expansion stress without cracking problems, and the possibility Titanium may suffer from galvanic corrosion. Copper-Nickel is proven reliable, is the material of choice among manufactures, and is not inferior to Titanium for this application.

TRANE HORIZON ABSORPTION CHILLERS

Unit Type	Capacity Range	Planned Availability
Two-Stage Direct-Fired	580-750	July 1996
Two-Stage Steam-Fired	380-500	August 1996
Two-Stage Steam-Fired	580-750	November 1996
Two-Stage Steam-Fired	800-1050	Mid-1997
Single-Stage Steam-Fired	Not Known yet	Late 1997

HORIZON DESIGN CHILLERS

The new Horizon includes some "designed-in" disadvantages. The unit only has a one pass arrangement for the absorber/condenser and it has extremely high water pressure drops. The currently released direct-fired units have pressure drops which range from 63 to 73 ft. water at ARI conditions. In an attempt to sell around their weakness, Trane will be pushing customer to use 85/97.5 tower water splits instead of 85/95. Even this will only bring the pressure drops down to 40 to 44 ft. water, and they are pushing the customer towards a lower efficiency chiller.

The design that is released now has three model numbers from 380-500 Tons that are all the same size. The weights increase with nominal tonnage indicating more tubes; the overall dimensions don't change. As a result their dimensions are quite large compared to the competition. The 380-500 ton Horizon chillers are larger in all dimensions than the YORK YPC-F_-17S (approx. 500 Tons), and heavier at the low end of the tonnage range for each "frame" size. They will offer split shipment for getting to jobsites; the reassembled size is still quite large.

The unit is not designed for two-pipe system heating. It has an external heat exchanger (similar to the YORK high temperature design), which requires a four-pipe system. They can integrate with a two-pipe system only by using additional control valves.

The Horizon chiller's purge system is similar to the YORK system in that it does not use a palladium cell, and it uses a vacuum pump to remove noncondensibles from a storage tank. However, Trane's system requires a 134a vapor-compression system (with hermetic air-cooled condensing unit) mounted on the chiller to provide cooling used for collecting noncondensible gases into the purge tank. This system uses a modified version of the Purifier Purge found on the Trane centrifugal chillers. The addition of a separate vapor-compression refrigeration loop adds complexity, moving parts, increased service requirements, and additional spare parts cost.

Trane has designed in some good features. They have standard low NOx burner made by Weishaupt. The Weishaupt burner is a very high quality, but expensive burner. They are advertising that the burner has 8 to 1 turndown, but they have not stated the minimum capacity of the machine which could be limited by other factors. The chilled water temperatures were originally advertised to go as low as 39°F, but all the literature we've seen since shows 40°F. They have standard marine boxes on the absorber and condenser, and they have included the crossover pipe with the chiller. Variable speed solution pumps similar to the McQuay design for greater low load efficiency will also be standard.

Trane has included stainless steel in several areas. It was used for the generator tubes and tube sheets, which is overkill and expensive, but they will try to sell it. They also have stainless steel eliminators and evaporator pans. The evaporator pan should only see water so it is not obvious why stainless steel would be useful.

TRANE "HORIZON" DIRECT-FIRED

Model ABDA -	380	440	500
Nominal Tons	388	449	510
Rigging Weight (lbs)			
Absorber/Evap	19,520	20,400	21,190
2G/Condenser	7,160	7,420	7,670
Generator	6,180	6,670	7,150
Total	32,860	34,480	36,000
Operating Weight (lbs)	45,830	48,280	50,560
Bromide Charge (lbs)	7,890	8,370	8,798
Refrigerant Charge (lbs)	1,850	1,850	1,850
Connection Size (in)			
Evap	8	8	8
Cond	8	8	8
Abs	8	8	8
Exhaust	12 x 24	12 x 24	12 x 24
Dimensions (ft–in)			
Length	21'–3"	21'–3"	21'–3"
Width	10'–2"	10'–2"	10'–2"
Height	9'–7"	9'–7"	9'–7"

TRANE - STRENGTHS AND WEAKNESSES:

What to expect them to sell, and what we should sell against them.

This section will concentrate on the Trane Horizon design chillers. The Horizon will be the only direct-fired chillers marketed by Trane, and is the future of the two-stage steam product line. The items discussed are those you can expect Trane to put in a specification, or you should put in a specification to increase the chances of getting a job. Some competitor strengths listed are only perceived strengths and will be refuted in the text, but Trane will sell them as strengths.

Weaknesses

Direct-Fired Only

1. The Trane Horizon chiller's burner/gas train is not UL listed, nor is the entire chiller package is UL listed. The YORK unit has a UL listing on both. The Trane burner/gas train (we believe) is ETL listed, but the whole chiller package has no listing. Encourage direct-fired specifications to be written as follows:

> Unit shall conform to UL 795 for Commercial-Industrial Gas Equipment and shall bear the UL label. In the event that the chiller is not UL labelled, the manufacturer shall, at their expense, provide for a field inspection by a UL representative to verify conformance to the UL standards. If necessary, the contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.

2. The burner is not from a U.S. vendor. The Trane burner is a Weishaupt burner which is purchased from Weishaupt Canada. Weishaupt Canada imports the bulk of the parts from Weishaupt's home office in Germany, and then assembles the burner in Canada. The Weishaupt burner is of high quality and is used by YORK on our European export chillers. But if a U.S. customer can be convinced that a local burner vendor with experienced representatives in their area is desirable, it can be used against Trane.

3. Trane's unit is only designed for 4-pipe heating. YORK's standard, low temperature (132-140°F) heating system for the "S" style machines is a 2-pipe system, and the optional, high temperature (155-175°F) is a 4-pipe system.

A two pipe system allows the customer to use the same chiller water connections (the evaporator) for heating and cooling. Of course, the chiller cannot do heating and cooling simultaneously with a 2-pipe system. Since a true building 2-pipe system uses the same air handlers and distribution piping for heating and cooling, simultaneous heating and cooling would not be possible anyway.

A 4-pipe system uses separate piping in the building for heating and cooling and separate heat exchangers on the chiller. Trane's chiller and YORK's high temperature offering both use a separate heat exchanger on the chiller for heating that has its own water connections. This creates a simple piping scenario for building with a four-pipe system.

When a building desires a 2-pipe system Trane suggests using control valves to adapt the separate heat exchanger into the same piping as the chilled water. This requires control valves to switch between the two water connections and additional controls. The result is a more expensive, complex installation for the contractor and customer.

General

4. The Trane unit only has a one pass arrangement for the absorber/condenser and it has extremely high water pressure drops. The currently released direct-fired units have pressure drops which range from 63 to 73 ft. water at ARI conditions. In an attempt to sell around their weakness, Trane will be pushing customer to use 85/97.5 tower water splits instead of 85/95. Even this will only bring the pressure drops down to 40 to 44 ft. water, and they are pushing the customer towards a lower efficiency chiller. Getting the specifications/schedules based on 85/95 and YORK pressure drops will call immediate attention to their high pressure drops.

5. The Horizon chiller's purge system is the same YORK system in that it does not use a palladium cell, and it uses a vacuum pump to remove non-condensibles from a storage tank. However, Trane's system requires a 134a vapor-compression system (with hermetic air-cooled condensing unit) mounted on the chiller to provide cooling used in non-condensible gas collection into the purge tank. This system uses a modified version of the Purifier Purge found on the Trane centrifugal chillers. The use of this purge unit is convenient for Trane because they can use the same parts used for centrifugal operations thus streamlining their operations. However, the addition of a separate vapor-compression refrigeration loop adds complexity, moving parts, increased service requirements, and additional spare parts cost; this provides nothing but inconvenience for the customer. Specify the YORK SmartPurge system and require that no vapor-compression/refrigerant cooled purges be allowed.

6. YORK is still the only manufacturer that has invested the time and money to be able factory test any two-stage

absorption chiller we build. ARI certification has been pushed back until at least the 3rd quarter of 1997, and only YORK offers a factory test as a standard option. Also included in this document is a specification that can be used when competition is expected to bid a field test as an alternate to a factory test. The specification details requirements for instrumentation and measurement to insure the customer gets accurate results.

7. The design that is released now has three model numbers from 380-500 Tons that are all the same size. The weights increase with nominal tonnage indicating more tubes, the overall dimensions don't change. As a result their dimensions are quite large compared to the competition. The 380-500 ton Horizon chillers are larger in all dimensions than the YORK YPC-F_ -17S (approx. 500 Tons), and heavier at the low end of the tonnage range for each "frame" size. Is not always a factor, but if a job hinges on size in the mechanical room YORK could have the advantage.

8. The Horizon design does not include isolation valves for servicing the pumps which is standard in the YORK design. This adds a great deal of time to servicing the pumps since the solution needs to be removed from the machine. In addition when a pump is removed air will get into the machine. Even if the solution could be kept in the machine during pump service, only isolation valves can guarantee no air leakage into the machine. Customers should want and specify isolation valves.

Strengths

1. Standard low NOx burner. The Weishaupt burner Trane uses has a recirculating combustion head that reduces NOx to approx. 30 ppm. YORK now offers a low cost option for low NOx that uses induced flue gas recirculation instead of the forced flue gas recirculation used in the past. Our emissions levels are as low as the Trane unit and the cost is not high.

2. Although the Horizon chillers are very large they will be offering split shipment into as many as three pieces. This will only help them get into buildings, their floor-space requirements will still be quite large when reassembled.

Split shipment requires field assembly of components. Field assembly creates a potential for leaks. Factory welding is much more reliable than field welding; and full penetration welding is critical in the corrosive environment of an absorption chiller. Trane units that ship in two or more sections should be required to undergo a strenuous leak check procedure before they are charged with lithium bromide. A helium leak check should be specified to make Trane conform to the same standards as a factory assembled and leak checked unit. An acceptable leak test spec is outlined in the Carrier competitive information section.

3. The Horizon chillers have a variable speed solution pump that increases part load efficiency. Trane's part load COP is better than YORK's below 50% load and their IPLV is about 10% higher overall.

4. Trane's absorber and condenser water boxes are advertised to be marine style as standard. Marine boxes are available for the absorber, condenser, and evaporator on all YORK absorbers as an option.

5. Trane uses Copper-Nickel (CuNi) tubes in the absorber and evaporator. This has been a longstanding difference between the YORK and Trane design. Trane made the decision to use CuNi years ago and stuck with it. Early (1960's) absorption chiller designs (threaded connections throughout, inferior valve design, etc.) were prone to leaks that would allow air into the machine. This proved to be especially important with inhibitors such as lithium nitrate because they would form ammonia during corrosion. The high leak rates created enough ammonia to be corrosive to copper tubes. Trane, through the years, has chosen to stay with the CuNi tubes, even though improved absorption chiller design has proven the effectiveness of copper tubes (YORK, Carrier, and McQuay all use copper tubes). Today Trane does not even use nitrate inhibitors anymore, but they have been pushing their customers to this design so long they may feel they cannot turn back.

6. Trane has included stainless steel in several areas. It was used for the generator tubes and tube sheets, which is overkill and expensive, but they will try to sell it. They also have stainless steel eliminators and evaporator pans. The evaporator pan should only see water so it is not obvious why stainless steel would be useful.

7. The Trane SDR system. SDR stands for Sensing, Detection, Recovery. The statement is that by Sensing the concentration they can provide early Detection of problems and then automatically Recover. In actuality sensing the concentration cannot provide any earlier warning of impending problems than measuring the pressure and temperature in critical areas. But we agree that for a customer it is an interesting feature to be able to read the solution concentration of the machine. The YORK Concentration Calculator will also sense the concentration of the solution in the machine and be tied into both our early warning and safety control systems. This allows YORK to add concentration to the list of parameters monitored in order to provide safe and reliable operation.

FIELD TEST GUIDE SPECIFICATIONS

The following specification can be used to force competitors to bid a field test that would provide the same level of assurance as a YORK standard factory test:

When substituting a field test for a factory performance test the following conditions must be met.

Conditions:

Field test facility must have the capacity to provide _____ GPM of ____°F water to the evaporator and _____ GPM of ____°F water to the condenser in order to demonstrate the chillers ability to meet capacity at the customers specified conditions. Flows must be main-tained within +/– 5.0% and temperatures must be maintained within +/– 0.5 °F throughout the test. Chiller must be maintained at +/– 5% of _____ Tons of cooling with the above conditions for at least two hours. Condenser, absorber, and evaporator tubes shall be cleaned by the chiller manufacturer, at no expense to the owner, prior to testing.

Instrumentation:

All instruments used for testing must be calibrated against standards traceable to NIST.

Chilled and tower water temp measurements:

Temperature measurements must be taken at least 10 pipe diameters downstream of any mixing or heat exchange device, and shall be taken after a fitting (such as an elbow) to assure adequate mixing.

In no case shall chiller leaving chilled water temperature be made in the water box or water box nozzles.

All temperature sensors shall be insulated.

The procedures of ASHRAE Standard 41.1 shall be followed.

Chilled and tower water flow rate measurements:

Flow must be measured with a turbine flow meter. The flow meter must be located in a straight section of pipe, with an upstream straight length of at least 20 pipe diameters and downstream straight length of at least 5 pipe diameters.

Gas flow measurement:

Gas flow meters shall be in accordance with ARI 560-92 section A5.1.5. Gas pressure and temperature shall be measured at the flow meter so that the flow rate can be converted to standard conditions (as defined by the utility supplying the gas).

Gas higher heating value shall be determined by a gas chromatograph or by calorimeter measurement to assure the variation from assumed heating value is no greater than 2%.

Steam Measurement:

Condensate flow must be measured with a turbine flow meter. The flow meter must be located in a straight section of pipe, with an upstream straight length of at least 20 pipe diameters and downstream straight length of at least 5 pipe diameters. If condensate does not leave the chiller as liquid (contains no flashed steam) a condensate cooler shall be provided to cool the condensate before flow is measured.

Steam pressure must be measured upstream of the manufacturer supplied steam control valve.

Condensate temperature must be recorded.

From the above parameters, heat input shall be calculated.

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