

## ACX(HP)-R Series 50Hz

Air Cooled Screw Flooded Chillers/ Heat Pumps Cooling Capacity: 95 to 450 TR (347 to 1582 kW) Heating Capacity: 95 to 450 TR (347 to 1582kW)



## Products that perform...By people who care



## INTRODUCTION

For more than 100 years, Dunham-Bush has focused on innovative product development. Today, we provide a full portfolio of HVAC/R products from Fan Coil Units to large centrifugal chillers as well as many other innovative green solutions. Our commitment to innovation, matched with an aggressive attitude toward growth, makes Dunham-Bush a leader in global markets. Our product development is tailored to meet the specific needs of customers, building-by-building, country-by-country and region-by-region. No other HVAC/R manufacturer takes this approach to meeting your performance expectations.

The Dunham-Bush name is synonymous worldwide with the Rotary Screw Compressor Chillers technology. With over 45 years of proven experience and track records in manufacturing and installation of Rotary Screw Compressors and chillers, thousands of our Chillers have clocked more than 100,000 operating hours without any compressor tear-out or overhaul! As a pioneer and industry leader in the Rotary Screw compressor technology for HVAC/R systems, Dunham-Bush now introduces the Air Cooled Rotary Screw Flooded Heat-pumps with unsurpassed performance and reliability.

ACX(HP)-R, Air Cooled Screw Flooded chillers/ heat pumps, have a cooling and heating capacity range from 95 to 450 TR [347 to 1582 kW] in 50Hz version using environmentally sound R134a refrigerant. The entire product line features high energy efficiency, installation ease, control flexibility, high reliability and advanced controller.

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## NOMENCLATURE





## **GENERAL CHARACTERISTICS**



## **UNIT FEATURES**

#### General

- T3 models from 95 to 450 TR [347 to 1582 kW]
- Multiple compressors models with independent refrigerant system per compressor provide redundancy, and superior part load efficiency
- The unit is designed to operates with R134a, the environment friendly refrigerant with zero <u>ODP</u> (Ozone Depletion Potential)

### Compressor

- New generation of Dunham-Bush MSC Vertical Screw Compressors with Unique Patented Twin Screw compressor technology, offers further improved reliability and stability, with lower sound level
- Optimized oil management with up to 2 integral oil separators. Multi-layered mesh element effectively separates oil from the gas stream
- No external oil pump required
- Patented screw profile design which is specially made for R134a application, to assure operation at highest efficiencies
- Optimized volume ratio, VI port position and geometry for best efficiency
- Consistent loading and unloading with hydraulically actuated slide valve mechanism; a rugged and trouble-free design
- Hermetic design eliminates casing leakage, with no requirement for internal parts service, no periodic compressor tear down and overhaul
- Direct driven design eliminates gear set; improve efficiency and reliability
- Discharge service valves is provided to each compressor for the ease of servicing

### **Evaporator**

- Shell-and-tube flooded type heat exchanger
- Integral finned copper tubes to maximized heat transfer area
- Cleanable copper tubes for maintaining high efficiency
- Removable water heads for easy service
- Victaulic groove water connection (refer Dimensional Data)
- Standard with 1" thick closed cell insulation
- ✤ Standard relief valve(s) standard
- Pressure test up to 220psig for refrigerant side, and 195psig for water side
- Isolation valves for refrigerant filter dryers are provided to allow filter core replacement without pump down the chiller. This greatly improve the servicing expenses and time

### **Condenser and Fans**

- Constructed with seamless inner-grooved copper tubes expanded into die-formed aluminum slit fins in staggered configuration
- Leak and pressure test at 450psig [31bar]
- W" v" coil design to increases condensing surface area to maximized heat rejection
- "V" coils arrangement with internal baffle for fan cycling and staging
- IP55 fan motors for outdoor applications



#### **Electronic Expansion Valve**

- Advanced electronic expansion valve (EEV) is used for precise control of liquid refrigerant flow into the evaporator
- Evaporation of liquid refrigerant in evaporator is controlled at precise level for optimum performance

#### Economizer

- The economizer circuit consists of plate type heat exchanger, expansion valve and solenoid valve
- Liquid refrigerant is sub-cooled at economizer before entering the evaporator; the flash refrigerant from economizer is fed into vapor injection port of the compressor
- The economizer increased cooling capacity by means of the sub-cooling

### **MICROCOMPUTER CONTROLLER**

Advanced PLC microcomputer controller is standard device of Dunham-Bush Rotary Screw compressor heat pumps. Through the analog and digital input and output, the operation of the unit can be precisely controlled and protected. The unit's operating conditions, control settings and alarm conditions recorded on the LED monitor.

### **Display Function**

Through the menu, user can read various operating parameters from the display, for example:

- Chilled Water outlet temperature
- Compressor's total running hours
- Compressor's start times
- Compressor contactor status
- Water temperature setpoint
- Water flow switch status
- External start/stop command status Fan status etc.

#### **Capacity Control**

Leaving chilled water temperature control is accomplished by entering the water temperature setpoint and placing the controller in automatic control. The unit will monitor all control functions and move the slide valve to the required position to match the building cooling load.

The compressor ramp (loading) cycle is programmable and may be set for specific building requirements. Remote adjustment of the leaving chilled water setpoint is accomplished either through High Level Interfacing (HLI) via BMS communication, or Low Level Interfacing (LLI) via an external hardwired, 4 to 20mA chilled water reset control signal. Remote reset of compressor current limiting function can be accomplished in a similar fashion.

### System Control

The unit may be started or stopped manually, or using an external signal from a Building Automation System. In addition, the controller may be programmed with seven-day operating cycle or other Dunham-Bush control packages may start and stop the system through inter-connecting wiring.

### **System Protection**

The following system protection controls will automatically act to ensure system reliability:

- Low evaporator pressure
- High condenser pressure
- Freeze protection
- Low suction-discharge pressure differential
- Low compressor oil level
- Compressor run error
- ֎ Power loss
- Chilled water flow loss
- Sensor error
- Compressor over current
- Compressor Anti-recycle
- High motor temperature
- Compressor overload

The controller can retain lots of alarm conditions complete with time of failure together data stamping on critical sensor readings in an alarm history. This tool will aid service technicians in troubleshooting tasks enabling downtime and nuisance trip-outs to be minimized.

# Remote Monitoring And Control (Option)

Dunham-Bush, the leader of HVAC solution provider understands the arising focus on chiller plant performance and optimization. Several solutions as below are offered to the building owner to achieved optimized chiller plant room controls, operation and performance.

#### Dunham-Bush Chiller Plant Manager (CPM)

DB Chiller Plant Manager (*CPM*) is a trustworthy and headache-free solution for building owners and users on chiller plant control and automation system. *CPM* is advanced controllers monitor and control equipments in chiller plant such as chillers, primary and secondary chilled water pumps, variable frequency drives (VFD), motorized valves, bypass modulating valves, and etc. Field devices such as flow meters, BTU meters, digital power meters, sensors & transducers can be interfaced with *CPM* via HLI or LLI. CPM controls chillers and pumps sequencing, as well as lead-lag, duty-standby and alarm changeover operations.

<u>NetVisorPRO</u> – Monitoring software of <u>CPM</u> system which allows system monitoring, historical trending, and alarm logging to be carry out at a PC terminal. Graphical animations on system operation, temperature and flow rate trend graphs, historical data and alarm history logs, settings changes are all available with <u>NetVisorPRO</u>.

Chiller plantroom control and automation by Dunham-Bush <u>CPM</u> provides the owners with a chiller system in stable operation, optimized performance and energy efficiency.

## DB-LAN Master Slave Sequencing Control (MSS)

In a chiller system with multiple Dunham-Bush chillers, controller of each chiller can be connected to the DB-LAN network via a communication bus without additional controller, to enable Master-Slave Sequencing Control of this chiller system. <u>MSS</u> will stage in/out chiller in operation to match building required cooling capacity. Chiller Lead-lag, duty-standby and alarm changeover controls are come with <u>MSS</u>, as well as the chilled water pumps control. Each <u>MSS</u> DB-LAN network can be connected up to 8 numbers of chillers.

#### Building Management System (BMS) Communication

Controller is able to communicate to BMS through the add-on communication card via various common protocols as:

- Modbus RTU RS485, ModBus TCPIP
- BACnet over IP, MS/TP, or PTP
- ✤ LONworks FTT 10

## **OPERATING BENEFITS**

## EFFICIENCY AND RELIABILITY

#### **Energy Efficiency**

- Designed to provide the greatest amount of cooling for the least power input over the entire operating range of your building
- Delivers outstanding efficiency and total energy savings through the utilization of economizer cycle and advanced controller staging; to produce greater capacity with fewer compressors
- Maximized performance through optimized components matching and multiple compressors
- High efficiency oil recovery system guarantees removal of oil carried over in the refrigerant and maintains the heat exchangers at their maximum efficiency at both full and part load

### **Refrigerant Compatibility**

- Designed to operate with environmentally sound and economically smart HFC-134a with proven efficiency and reliability
- ✤ Consult Factory for use of other HFC refrigerants.

### **Flooded Evaporator**

- Flooded evaporator design that fully utilized and maximized the heat transfer area available in the evaporator; operates with lower suction superheat, smaller evaporator approach. These have greatly improved efficiency of chiller with flooded evaporator.
- Flooded evaporator water heads can be removed easily without dismantling the chilled water piping connections, for inspection and for mechanical tubes cleaning with brushes or auto-brush. This will enable low tube fouling factor in the evaporator to be ensured, thus maintaining system efficiency

### **Operational Advantages**

- Dramatic payback in reduced maintenance and overhaul costs both in downtime and in labor expenditures
- Ease of troubleshooting through controller retention of monitored functions

### **Factory Testing**

- Each chiller undergoes the factory testing prior to unit shipment. This assures consistencies of workmanship at highest quality
- Thus, all units shipped are completely factory tested; charged and adjusted according to the design parameters, for ease of installation and minimal field start-up adjustments

## **Control Flexibility**

Controller-based with DDC controller (direct digital control) features precise push button control over

every aspect of operation with built-in standard features that maximized energy savings on start-up and throughout the life of your equipment

- Ensured uniform compressor loading and optimal energy efficiency through controller to controls which utilize pressure transducers to measure evaporator and condenser pressure
- Lower energy costs resulting from automatic load monitoring and increased accuracy and efficiency in compressor staging
- Various communication options for remote monitoring of the unit operation
- Proactive control anticipates problems and takes corrective action before they occur. Controls will unload compressor(s) if head or suction pressure approach limits. This will enable unit to stay on line while warning operator of potential problems
- Stable and efficient operation with precise chilled water temperature control. Chilled water temperature is controlled at ±0.8 °F [0.5 °C] range for your comfort cooling, with best energy saving

## **REFRIGERATION CYCLE**

Dunham-Bush rotary screw air cooled chillers are designed for efficiency and reliability. The rotary screw compressor is a positive displacement, variable capacity compressor that will allow operation over a wide variety of conditions.

The refrigerant management system is shown in the refrigerant cycle diagram.



Liquid refrigerant enters the flooded evaporator uniformly where it absorbs heat from water flowing through the evaporator tubes. The vaporized refrigerant is then drawn into the suction port of the compressor where the positive displacement compression begins.

This partially compressed gas is then combined with additional gas from the vapor injection port at an

## **OPERATING BENEFITS**

intermediate pressure. Compressed gaseous refrigerant is then discharged into the integral oil separator where oil, which is contained in the refrigerant vapor, is removed and returned to the compressor oil sump.

Fully compressed and superheated refrigerant is then discharged into the condenser, where air is being drawn through the condenser tube by the propeller fan cools and condenses the refrigerant. The liquid refrigerant then passes through the economizer. A portion of liquid refrigerant is tapped passes through the expansion valve back into the economizer for further subcooling of main liquid refrigerant flow.

The gaseous refrigerant is then drawn out of the economizer and into the vapor injection port of the compressor. The remaining subcooled liquid refrigerant then passes through electronic expansion valve which reduces refrigerant pressure to evaporator levels where it is then distributed evenly into the evaporator.

With the additional subcooling, the enthalpy of the refrigerant flowing into the evaporator is reduced which increases the refrigeration effect and improves the efficiency of the refrigeration cycle.

## Economizer/ Vapor Injection Cycle for Increase Capacity and Higher EER

The renowned Dunham-Bush screw compressor allows for economizer vapor injection cycle to be incorporated, increasing capacity by significantly with marginal increase in kW-input. Thus, unit EER is improved!

## PART-LOAD PERFORMANCE

Through the use of economizer, electronic expansion valve and multiple compressors, Dunham-Bush air cooled chillers have some of the best part-load performance characteristics in the industry when measured in accordance with AHRI Standard 550/590.

In most cases, actual building system loads are significantly less than full load design conditions, therefore chillers operate at part load most of the time.

Dunham-Bush air cooled chillers combine the efficient operation of multiple compressors with an economizer cycle and advanced controller to yield the best total energy efficiency and significant operating saving under any load.

When specifying air conditioning equipment, it is important to consider the system load characteristics for the building application. In a typical city, the air conditioning load will vary according to changes in the ambient temperature. Weather data compiled over many years will predict the number of hours that equipment will operate at various load percentages.

The Air Conditioning and Refrigeration Institute (AHRI) has established a system, in AHRI Standard 550/590, for measuring total chiller performance over full and part-load conditions. It defines the Integrated Part-Load Value (IPLV) as an excellent method of comparing diverse types of equipment on an equal basis. The IPLV is a single number estimate of a chiller's power use weighted for the number of hours the unit might spend at each part-load point. IPLV's are based on Standard Rating Conditions.

The formula for calculating an IPLV is:

$$IPLV = \frac{1}{\frac{0.01}{A} + \frac{0.42}{B} + \frac{0.45}{C} + \frac{0.12}{D}}$$

where: A= kW/ton at 100% load point B= kW/ton at 75% load point C= kW/ton at 50% load point D= kW/ton at 25% load point

## **PHYSICAL SPECIFICATIONS**

Model ACX(HP)-R		95	110	135	160	200	225	250	280	310	340	360	400	450
Cooling Capacity	kW	347	415	491	599	685	791	903	982	1090	1198	1284	1370	1582
	TR	98.7	118	139.6	170.3	194.8	224.9	256.8	279.2	309.9	340.6	365.1	389.5	449.8
Cooling Compressor Power	kW	96.4	112.5	134.7	163	184.5	216.3	245.8	269.4	297.7	326	347.5	369	432.6
Heating Capacity	kW	347	415	491	599	685	791	903	982	1090	1198	1284	1370	1582
	TR	98.7	118	139.6	170.3	194.8	224.9	256.8	279.2	309.9	340.6	365.1	389.5	449.8
Heating Compressor Power	kW	91.1	106.8	129.3	154	174.7	204.6	235	258.6	283.3	308	328.7	349.4	409.2
Power Supply	•						38	30V/3P/50	Hz					
Compressor														
Quantity		1	1	1	1	1	1	1	2	2	2	2	2	2
Compressor RLA (Amp)	Cooling	176.9	206.4	247.2	299.1	338.6	396.9	451	494.4	546.3	598.2	637.7	677.1	793.8
	Heating	167.2	196	237.3	282.6	320.6	375.4	431.2	474.5	519.9	565.2	603.2	641.2	750.9
Start Current	Amp	615	679	679	881	946	1464	1712	679/679	679/881	881/881	881/946	946/946	1464/1464
	_	_	_	_	_	Evapor	ator	_	_	_	_	_	_	_
Water Flow Rate	m³/h	59.7	71.4	84.5	103	117.8	136.1	155.3	168.9	187.5	206.1	220.8	235.6	272.1
Water Pressure Drop	kPa	35	80	81	87	86	85	84	89	90	91	92	86	85
Water Connector	Inch	4	5	5	6	6	6	8	8	8	8	8	6/6	6/6
Antifreeze Electric Heater	kW	1.5	1.5	1.5	1.5	1.5	1.5	1.5	3	3	3	3	3	3
Condenser														
No of Fans		5	7	7	9	11	11	13	14	16	16	18	22	22
Fan Motor Power	kW each	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
General														
Shipping Weight	kg	4150	4900	5040	5540	6340	7260	8060	9600	10310	10500	11300	12680	14520
Operation Weight	kg	4270	5070	5230	5740	6540	7480	8310	9850	10610	10800	11700	13080	14960

Notes: 1. Cooling: ambient temp. 35°C chilled water temp. 12/7°C. Heating: Dry bulb temp.7°C, wet bulb temp.6 °C. Hot water outlet temp. 45 °C.

2. Evaporator water side Fouling factor is 0.018m2. °C /kW.

3. ACX(HP) 400R & 450R unit consists of two modules, each module requires a separate power supply.

4. To consult nearest Dunham-Bush sales office for computer selections other than above operating conditions



## **DIMENSIONAL DATA**

## ACX(HP) 095R



## ACX(HP) 110R, 135R



## ACX(HP) 160R





## **DIMENSIONAL DATA**

### ACX(HP) 200R, 225R



## ACX(HP) 250R



## ACX(HP) 280R





## **DIMENSIONAL DATA**

## ACX(HP) 310R, 340R



## ACX(HP) 360R



## ACX(HP) 400R, 450R



## **MOUNTING DIAGRAM**





## WATER PIPE CONNECTION DIAGRAM



#### Note:

- 1. The highest point in the water system should be installed automatic exhaust valve. Before starting the unit, the air inside the system must be drained completely to avoid damage.
- 2. The lowest point should be installed drain valve. In winter, if the unit not be used, water should be drained completely to avoid evaporator frozen.
- 3. Soft connection must be used to connect evaporator with water system.
- 4. Flow switch should be installed in a horizontal straight pipe, and the position should be more than 5 times of pipe diameter from the front or rear valves, elbows and other local resistance elements. Water switch should be interlocked with control system.
- 5 . A bypass tube and a cut off valve should be used between inlet and outlet of evaporator. When cleaning water system, the evaporator should be bypassed.
- 6 . In order to keep evaporator clean, water filter should be used for evaporator inlet tube.
- 7 . In order to improve cooling and heating effect and avoid energy waste, pipeline insulation should be closely.
- 8. To prevent the unit start and stop frequently in the low load operation, tank capacity should be large enough.
- 9. This illustration is for reference only, on-site installation, please refer to design specifications.

## PARALLEL CONNECTION DIAGRAM





## MINIMUM CLEARANCE REQUIREMENTS





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Manufacturer reserves the right to change specifications without prior notice.