## BALDOR • RELIANCE









## Baldor Adjustable Speed Direct Drive Cooling Tower Motor and Drive System





# **Adjustable Speed Direct Drive Cooling Tower System**

# New Direct Drive Technology – Improves Reliability, Reduces Maintenance, Runs Quieter & Saves Energy

By combining the technologies of the field proven and power dense AC laminated frame RPM AC motor with high performance permanent magnet (PM) salient pole rotor designs and the matched performance of an adjustable speed drive, Baldor Electric can offer high torque direct drive motors for cooling tower applications with all the benefits of variable speed control and eliminating the cost and maintenance required for traditional gearbox or belted solutions. The fan couples directly to the motor and is controlled by a unique AC drive to provide optimal speed and cooling tower performance that runs quieter with reduced energy consumption. The drive is designed to accommodate the most common HVAC communication protocols.



## **Direct Drive RPM AC Synchronous PM Motor Reduces Maintenance Cost**

The RPM AC<sup>TM</sup> synchronous PM motor uses laminated finned frame construction to provide a highly efficient power dense package with flange mounting dimensions that can replace the right angle gearbox and jack shaft installation in many conventional cooling towers. This same technology is offered in conventional, yet power dense, foot mounted designs that can replace the belt and sheave application where more vertical mounting space is available. Derived from one of the toughest motor platforms used in the most demanding industrial applications, the RPM AC motor is the right solution for operation inside the tower's hot and humid environment. The TEAO (totally enclosed air over) RPM AC cooling tower motor is designed for minimal maintenance. Bearings require lubrication only once per year. Water ingress along the shaft is prevented with the use of an Inpro/ Seal® bearing isolator and a slinger. The electrical insulation system is manufactured using a VPI (vacuum pressure impregnation) process that ensures long motor life even in the most extreme environmental conditions. Condensation drains relieve any moisture that may collect inside the motor. No more changing gear oil, lubricating pillow block bearings or changing out belts.

## **Baldor VS1CTD PM Cooling Tower Drive**

The Baldor VS1CTD integrates custom features that have been designed exclusively for the cooling tower industry. The VS1CTD utilizes our Matched Performance philosophy to pair each RPM AC PM motor with a specific control. Critical motor operational parameters are integrated right into the VS1CTD firmware to provide simplified Cooling Tower startups, eliminating the need for users to enter complex information into the control or the need to tune the control to the motor prior to operation. Since the VS1CTD is targeted for use in the cooling tower market, much of the complexity that typically resides in general purpose controls has been eliminated further adding to the simplicity of our Adjustable Speed Direct Drive Cooling Tower Motor and Drive System.



When system automation and control is a requirement for your cooling tower operation, the Baldor drive readily communicates with multiple communication networks including MODBUS-RTU, MODBUS/TCP, LonWorks, Metasys-N2, BACnet, EtherNet/IP, DeviceNet, PROFIBUS and Siemens P1 Apogee.

## Field Tested Reliability

After extensive Lab testing at Baldor's facility, motor and drive systems have been installed and field tested for as long as three years. One system is running under a controlled environment on one of two identical cooling towers at Clemson University. Both towers were instrumented and the traditional geared system was compared to the one converted to use Baldor's Adjustable Speed Direct Drive Motor and Drive System. Each tower had the same 5 blade 18 foot diameter fan. The conversion was made in less than a day. Performance results, which were verified by a third party, measured an input kW power savings of 11.8% compared to a traditional geared system, with high speed noise reduction from 82.3 dBA to 74.4 dBA and reduced vibration.

**RPM AC Direct Drive Cooling Tower Features & Benefits** 

## **Direct Drive Motor**

- Eliminates the need for a gearbox, jack shaft, pillow block bearings and couplings
- Reduces maintenance and provides improved reliability
- Eliminates cooling water contamination by eliminating gearbox oil and leakage
- Reduces power consumption
- Results in increased safety because there are fewer mechanical components
- Water-tight motor design operates in the air stream
- Eliminates the alignment of mechanical components for guicker installation and reduced installation costs

## **Bearings and Seals**

- Oversized to maintain longer bearing life exceeding L-10 100,000 hours
- Grease lubricated for long life
- Handles fan loads with improved reliability
- Proven Inpro/Seal® bearing isolator with slinger umbrella over seal
- Only one ingress point
- Insulated opposite drive end bearing on FL440 and FL5800

## **Adjustable Speed Control**

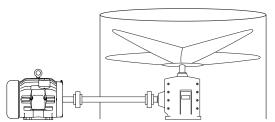
- Designed specifically for the Cooling Tower Industry and can be set at the optimum speed point
- Sensorless Permanent Magnet motor control operates without an encoder or resolver
- Trickle heating eliminates need for motor space heaters
- No tuning is required due to the Matched Performance of the motor and control
- Allows for a soft start (controlled ramp)
- Saves energy and reduces mechanical stress on the system
- Improves system reliability and extends life
- Reduces noise
- Allows for optimized return water cooling temperature for optimized compressor operation
- Trickle current for braking prevents fan windmilling when not in operation
- System resonance speeds can be bypassed

## **Communication Protocols**

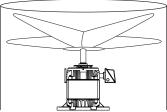
- Utilizes MODBUS-RTU, MODBUS/TCP, EtherNet/IP, LonWorks, Metasys-N2, BACnet, DeviceNet, PROFIBUS or Siemens P1 Apogee protocols
- Interfaces with existing building automation systems

## **Retrofit or New Tower Designs**

RPM AC cooling tower motors are available in either flange mount or foot mount designs for mounting in the air stream. The flange mount units are designed to be interchangeable with many popular gearbox bolt hole mounting configurations. Shaft height, diameter and flange mounting dimensions can be directly interchangeable with some existing cooling tower gearbox designs. Higher motor torque ratings are available using taller motors when space is available. In addition, traditional foot mount construction is available. Both flange and foot mount designs are available in a wide torque range in frame sizes FL250, FL280, FL440 and FL5800.



**Conventional Tower Design** 



**New Direct Drive Tower Design** 

A typical conventional fan drive arrangement of a gearbox mounted

arrangement of a gearbox mounted under the fan.

Baldor's Direct Drive motor eliminates many components of a right angle geared system.





## **RPM AC Cooling Tower Motor and Drive Specifications**

## **Motor**

#### Minimum \*Est. Motor Motor Max. Torque Required Approx. Catalog Height Air Velocity Wgt. (lb) Number **Frame Size** (lb. ft.) "M" (in.) (ft/min) FL2554 375 15 90 Custom FL2562 440 17 155 Custom 500 FL2570 215 515 19 Custom FL2578 290 590 21 Custom FL2873 305 610 19 Custom 415 705 21 FL2882 Custom 750 FL2890 510 790 23 Custom FL2898 590 860 25 Custom FL4477 700 1290 19 Custom FL4485 1050 1515 21 Custom FL4493 1400 1730 23 Custom FL4402 1980 25 1926 Custom 750 FL4413 2626 2290 28 Custom FL4421 2801 2510 30 Custom 32 FL4429 3151 2730 Custom FL4440 3852 3035 35 Custom FL5816 3326 5445 37 Custom FL5818 5880 39 3851 Custom FL5820 4376 6315 41 Custom 6750 43 FL5822 4902 Custom FL5824 250 5427 7185 45 Custom FL5826 5952 7620 47 Custom FL5828 6652 8055 49 Custom 8490 51 FL5830 7178 Custom FL5832 7702 8925 53 Custom

Select motor frame size as determined by required fan torque.

Fan Torque = (HP \* 5252) / Fan Speed.

Use existing motor HP and fan speed to calculate required torque.

## **Drive**

Max. Amps	НР	Frame	Catalog Number
	24	40 Vac	
19.4	5	AA	VS1CTD25-1B
19.4	7.5	AA	VS1CTD27-1B
37.0	10	В	VS1CTD210-1B
47.5	15	В	VS1CTD215-1B
59.8	20	В	VS1CTD220-1B
70.4	25	С	VS1CTD225-1B
91.5	30	С	VS1CTD230-1B
104.0	40	С	VS1CTD240-1B
147.5	50	D	VS1CTD250-1B
154.0	60	D	VS1CTD260-1B
	4	80Vac	
11.9	10	AA	VS1CTD410-1B
23.0	15	В	VS1CTD415-1B
28.9	20	В	VS1CTD420-1B
34.0	25	В	VS1CTD425-1B
44.2	30	С	VS1CTD430-1B
55.3	40	С	VS1CTD440-1B
65.5	50	С	VS1CTD450-1B
90.8	60	D	VS1CTD460-1B
116.6	75	D	VS1CTD475-1B
136.3	100	D	VS1CTD4100-1B
143.8	125	D	VS1CTD4125-1B
204.0	150	Е	VS1CTD4150-1T
256.7	200	Е	VS1CTD4200-1T
325	250	Е	VS1CTD4250-1T
	6	00Vac	
9.4	10	AA	VS1CTD510-1B
18.7	15	В	VS1CTD515-1B
23.0	20	В	VS1CTD520-1B
27.2	25	В	VS1CTD525-1B
33.6	30	С	VS1CTD530-1B
42.6	40	С	VS1CTD540-1B
50.8	50	С	VS1CTD550-1B
72.8	60	D	VS1CTD560-1B
93.1	75	D	VS1CTD575-1B
117.5	100	D	VS1CTD5100-1B
132.8	125	D	VS1CTD5125-1B
173.6	150	Е	VS1CTD5150-1T
218.8	200	Е	VS1CTD5200-1T
289	250	Е	VS1CTD5250-1T

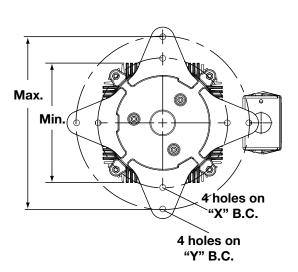
Select drive based upon motor full load amps.

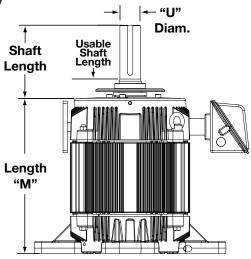
For line and load reactors see the Baldor 501 catalog.

## **RPM AC Cooling Tower Motor Dimensions**

Select motor frame size based upon required fan torque

## **FL Family**





Motor Frame Size	* Typical Shaft Length	Usable Shaft Length	* Typical Shaft Dia. "U"	"X" Min. Bolt Circle (in.)	"Y" Max. Bolt Circle (in.)	Number of holes per bolt circle
FL25XX	8.5	6.94	1.999	14	16	4
FL28XX	8.0, 8.5	5.75, 6.25	2.374	15-16 Slot	20	4
FL44XX	8.5, 9.0, 9.5	6.38, 6.88, 7.38	2.999	22	25	4
FL58XX	12.0	6.88, 11.75	4.999	_	34	8

<sup>\*</sup>Shaft length and diameter can vary by application requirements.

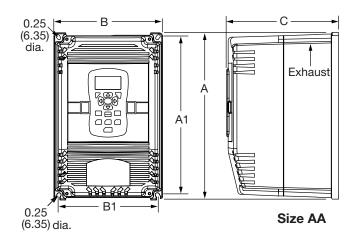
Tapered shafts are also available. Typical taper is 1/2" per foot. Special non-standard shaft requirements must be defined on the order.

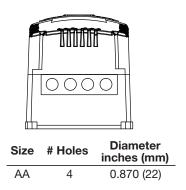
## **Motor Features**

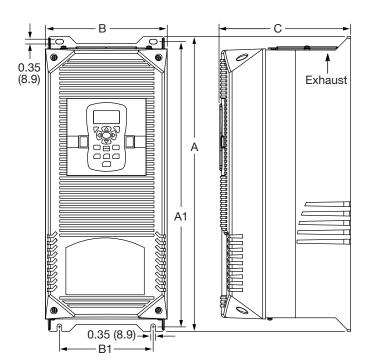
- · Mounting pad for vibration sensor
- Thermostats one per phase normally closed
- Heavy build external coatings
- Proven Inpro/Seal® bearing isolator with slinger umbrella over seal
- Proven insulation system technology used in off-shore drilling applications

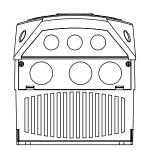
## **Adjustable Speed Drive Cooling Tower Dimensions**

Select drive rating and frame size based upon motor full load amps









Size	# Holes	Diameter inches (mm)
В	3 3	1.115 (28.3) 1.362 (34.6)
С	3 3	1.115 (28.3) 1.680 (42)
D	3 2 1 1	1.115 (28.3) 2.470 (62.7) 1.362 (34.6 0.500 (12.7)
E	3 2 1 1	1.115 (28.3) 4.000 (102) 1.680 (43) 0.500 (12.7)

Sizes B, C, D and E

_	Dimensions inches (mm)					
Frame Size	Outside			Mounting		Weight Ib (kg)
	Height (A)	Width (B)	Depth (C)	Height (A1)	Width (B)	in (kg)
AA	12.27 (311)	7.97 (202)	8.21 (208)	11.75 (298)	7.38 (187)	20 (9.1)
В	18 (457)	9.10 (231)	9.75 (248)	17.25 (438)	7.00 (178)	30 (13.6)
С	22 (559)	9.10 (231)	9.75 (248)	21.25 (540)	7.00 (178)	60 (27.2)
D	28 (711)	11.50 (292)	13.00 (330)	27.25 (692)	9.50 (241)	120 (54.4)
E	42.81 (1087)	18.75 (476)	16.06 (407)	39.75 (1010)	15.75 (400)	250 (113.4

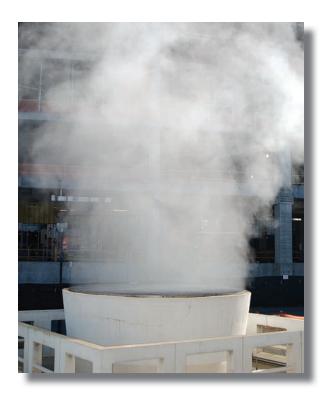
Custom enclosures including NEMA 4X are available.

## **Easy Field Installation**

Below is a motor fan assembly being lowered into position.



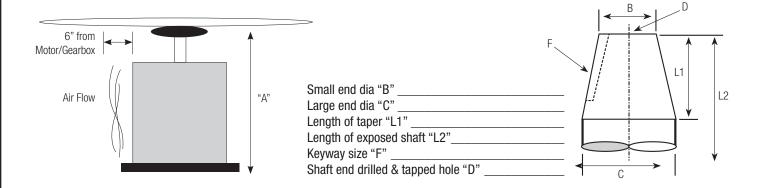






## **Baldor Cooling Tower Motor RFQ**

Company Name:	Project:			
an Diameter (ft.) Air Flow		(cfm)		
Fan Speed (RPM)		Temp		
Existing Motor Hp	Static Pro	essure (inches of H <sub>2</sub> 0)		
Fan Shaft Hp(This is normally an odd number ex: 42.3 Hp based on operating conditions)	Air Density (lb/ft³)			
Voltage Required	_ Fan mfq	P/N		
Height Restrictions YES / NO	_ No. Fan E	Blades		
"A" inches	n (see diagram - "A -			
(shaded area shown below)		Fan Shaft Diameter (in.)	Keyway (in.)	
If retrofit		1.999" ± .0005"	1/2" x 1/4"	
Gearbox Manufacturer		2.374" ± .0005"	5/8" x 5/16"	
Gearbox Model No		2.624" ± .0005"	5/8" x 5/16"	
The Baldor Solution requires a Baldor CTPM VFD		2.999" ± .0005"	3/4" x 3/8"	
Approximate distance from motor to VFD location	Feet	Other Shaft Dia. Req	uirements	
Drive location: Control Room Outside:				



Required information to quote properly Questions regarding above information Please contact your local Baldor District Office



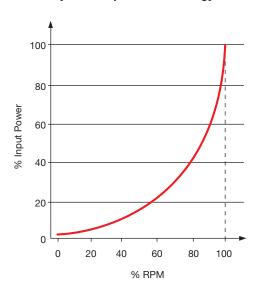
## V\*S Control Provides Optimized Cooling Tower Performance and Energy Savings Even Under Low Load Conditions

By optimizing motor speed considerable energy can be saved. The entire cooling tower system must be designed for the "Worst Case" (or highest air flow) scenario. For optimum system performance the fan may need to operate at reduced speed.

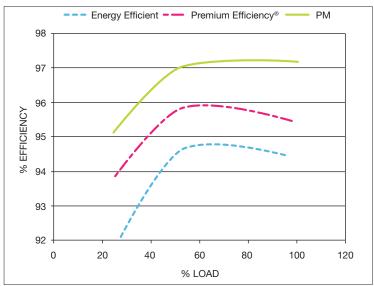
As the speed of the motor is decreased, the air flow drops in a corresponding linear fashion. So, for example, if the motor runs at only 50% speed, the air flow is correspondingly reduced to 50% of maximum air flow.

However, the input power to the motor varies with the cube of the motor speed. For example, if a motor is run at half-speed, the power consumed by the motor is 12.5% or 1/8 [i.e. (½)³] of the power consumed at full speed. So, if the needed airflow can be achieved by running at half-speed, it is possible to save a large amount of energy (see energy chart below).

## **Adjustable Speed Saves Energy**

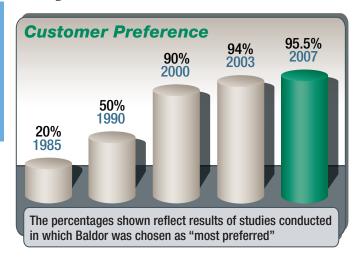


## Permanent Magnet Maintain Efficiency Over Wide Load Range



Another important aspect of the PM motor design versus a traditional induction motor is its ability to maintain high efficiency performance when operating under low load conditions which are typical for variable speed fan applications.

## Why Baldor?



For nearly 100 years, Baldor has strived to provide customers with the best value and reliability in industrial electric motors. That dedication shows in customer preference for Baldor•Reliance motors. To be considered as the most preferred...

**Baldor offers the industry's broadest line of stock products.** Save valuable time with just one call to Baldor. We offer more than 10,000 stock motors, drives, gearboxes, bearings and PT components.

Energy-efficiency leader. Baldor began lowering the energy consumption of our motors in the 1920's, long before others were even talking about it. Today, Baldor's expansive line of Premium Efficiency motors extends from 1 through 15,000 Hp. Baldor's motors offer customers the highest overall efficiency levels in the industry, including Baldor●Reliance Super-E<sup>®</sup> (1 through 500 Hp) motors that exceed NEMA Premium<sup>®</sup> efficiencies.

Baldor continually looks for applications where improvements in energy efficiency is possible. By replacing conventional cooling tower fan drive systems with Baldor's adjustable speed direct drive motor and drive system, significant improvements in energy efficiency are possible.



## Baldor products are available at more locations than any other brand.

Our 35 district offices across North America and offices around the world, offer immediate and local availability of Baldor products to thousands of customers.

## Continuous innovation to improve reliability.

Baldor leads the motor industry in applying new technologies to improve motor reliability. Recent improvements to the line of Severe Duty motors are further proof that Baldor is the leader in motors for process industry applications. These improvements are explained in detail in the following pages.

# Industry's shortest lead times/Flexible manufacturing.

Baldor has the industry's shortest lead times on custom motors. Our unique LEAN FLEX FLOW<sup>TM</sup> manufacturing process lets us produce any order in



any quantity, quickly and efficiently.

**Industry's best information.** Only Baldor offers customers so many choices for product information with a wide variety of catalogs and product brochures, the Baldor Web site at www. baldor.com, or you may talk to a Baldor customer service person at one of our sales offices.

## Leadership in Premium Efficiency

Called a "key breakthrough" by the Consortium for Energy Efficiency, the CEE in 1998 recognized Baldor's Super-E as the first premium efficient motor line to meet their stringent efficiency criteria, citing "For the first time, one manufacturer will carry all qualifying products."

Minimum Efficiency Performance Standards (MEPS) for electric motors are becoming commonplace throughout the world. The first of these was the Energy Policy Act of 1992 (EPAct) that mandated efficiency levels for 1-200 Hp general purpose motors for sale in the U.S. after October 1997. The Energy Independence and Security Act of 2007 (EISA) builds upon EPAct and raises the efficiency level for these motors to NEMA Premium® efficiency adds other configurations and 201-500 Hp ratings for MEPS compliance. Baldor•Reliance Super-E motors manufactured today meet or exceed EISA requirements.

As countries and regions across the world establish minimum efficiency levels for motors, more companies are turning to the Baldor•Reliance Super-E. This includes plant and processing applications, as well as OEM products for shipment overseas. Super-E motors meet or exceed the efficiency levels defined by NEMA Premium®, EPAct in the U.S., NRC in Canada. CEMEP EFF1 in Europe, and the new IE3 level of IEC 60034-30.

A wide selection of premium efficient motors, available from stock, manufactured and sold by a company committed to building better products for industries worldwide. No wonder, since the 1920s, Baldor•Reliance is recognized as the leader in energy efficient industrial motors and drives.



A Baldor Super-E motor and Inverter Control provide premium energy efficiency and improved process control to a municipal water treatment facility.

## Making Energy Efficiency Work For You

## Why is Energy Efficiency Important?

Electric motor-driven systems used in industrial processes consume 63% of all electricity used in U.S. industrial sector according to a U.S. Department of Energy report published in 1998. A 2002 report shows that companies that practiced DOE "best practices" actually averaged 33 percent savings if they were to apply motor and motor system efficiency upgrades, including the use of adjustable speed drives. The potential positive impacts on companies' bottom lines and the environment are significant.

## **Purchase Price is Only a Small Piece of the Pie**

The pie chart to the right shows the typical life cycle cost of a 100 Hp motor operating in continuous duty over a 20-year life. As you can see, the original purchase price is almost insignificant compared to what it will cost to power the motor during its useful life.

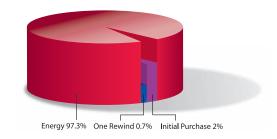
## **How Baldor Super-E® Efficiencies Compare to Industry Standards**

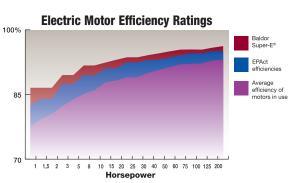
Baldor's line of Super-E motors offers customers the highest level of overall efficiencies available from any motor manufacturer, meeting or exceeding NEMA Premium® efficiency.

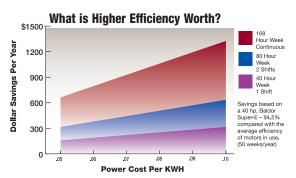
## BE\$T® Baldor Energy Savings Tool Makes Calculating Payback Easy

In order to make payback calculations easier for customers, Baldor developed BE\$T, Baldor Energy Savings Tool. The software helps calculate energy cost and energy savings for motors, as well as payback time frames. A popular feature of BE\$T is that it allows users to make head-to-head comparisons of up to three motors, giving customers the information to make an informed decision through comparative analysis.

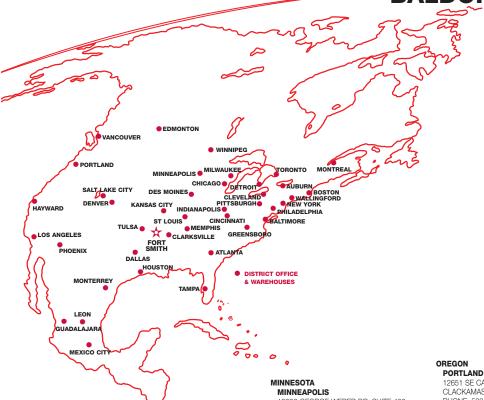
BE\$T, Baldor Energy Savings Tool is available as a download through Baldor's award-winning Web site (www.baldor.com/support/software\_BEST.asp,) as well as a stand-alone CD-ROM, available from your Baldor District Office.







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## оню

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