IE4 Motors on the Horizon

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Outline

- Global MEPS
- Ready with IE3 Motors Today
- Improvements in Motor Efficiency
- Annual Savings
- Cooling Tower Permanent Magnet Technology
- Summary

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Global MEPS Legislation

- Standards
  - IEC 60034-2-1 testing method is comparable to IEEE 112 and CSA 390
  - IEC 30034-30 establishes new IEC efficiency levels
- EU- Regulations
  - IE2 2011 IE3 2015/17

IEC 60034-30	Similar to
IE1	Standard Efficiency Not allowed in North America
IE2	Energy Efficient EPAct MG 1 Table 12-11
IE3	NEMA Premium® MG 1 Table 12-12 12-13 Medium Volt
IE4	Above Premium

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Ready with IE3 Motors Today

- NEMA manufacturers are ready with motors that comply with MG 1 Table 12-12 today
  - NEMA Premium® = IE3
  - 0.75 – 375 kW (1 – 500 HP)
- Such motors may be used in IEC frames to supply motors for global markets today
- Older EPAct level motor designs (MG 1 Table 12-11) may be used for IE2 levels
- No need to wait for 2015 to adopt these motors to save energy today

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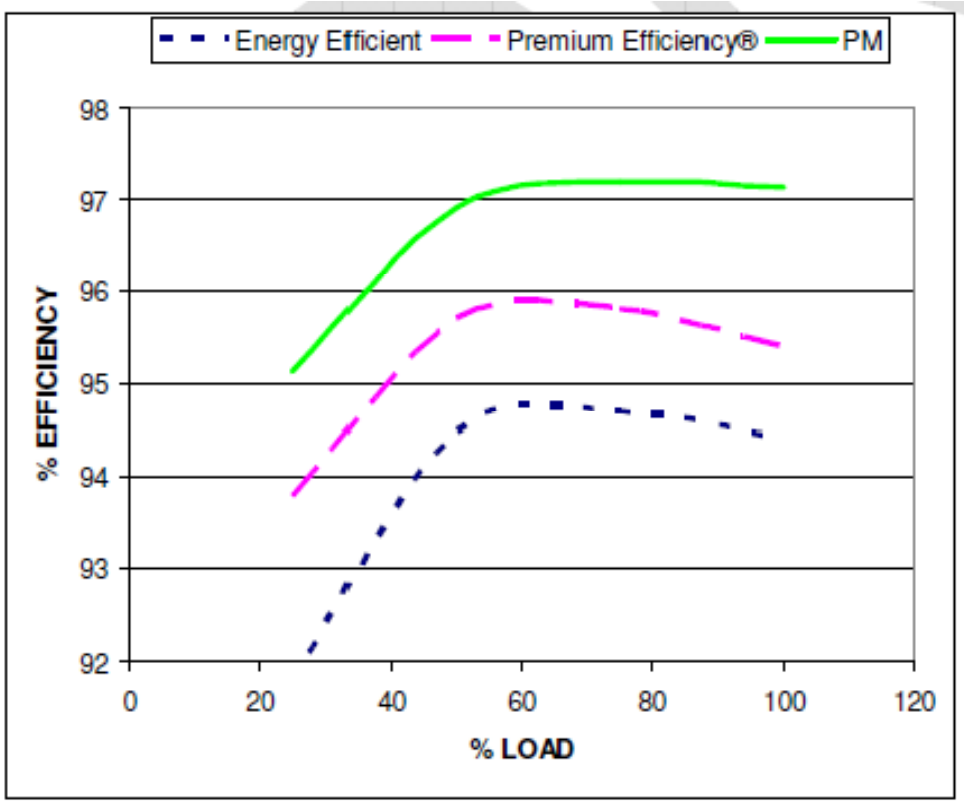
Improvements in Motor Efficiency Comparison

Permanent Magnet (PM) motors have long been recognized as providing higher efficiencies.

Limitations in terms of motor control, as well as magnet material performance / cost have severely restricted their use.

Dramatic improvements in magnetic and thermal properties plus present day cost advantages represent viable alternative today.



Typical Partial Load Efficiencies of
55 kW / 75 HP, TEFC, 1800 RPM Motors

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Above NEMA Premium® Efficient Motors

400 HP TEFC Compressor

Eff. Level	Efficiency	Annual Savings
Energy efficient	95.8%	Baseline
Premium	96.2%	$1134
Internal PM	98.3%	$1134 + 5805 $6939 total

Calculated at continuous operation at $0.10/kWh

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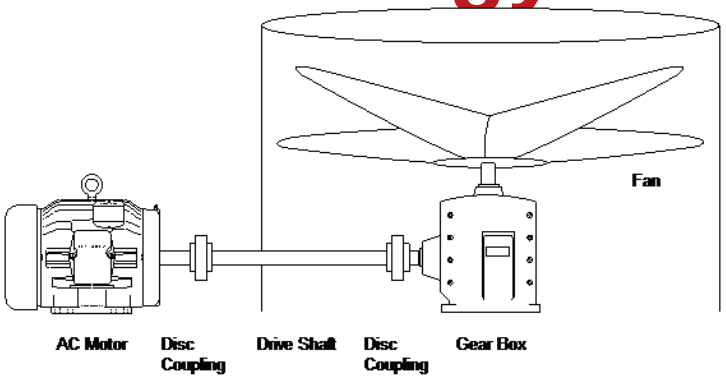
Cooling Tower PM Technology



- On the campus of Clemson University in Clemson, SC

CLEMSON UNIVERSITY

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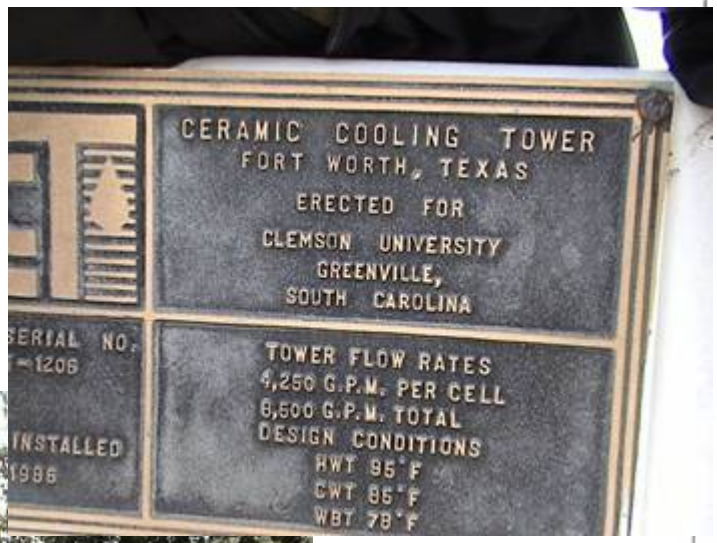
Clemson Cooling Tower

Cooling Tower Information

Built in 1986

Ceramic Cooling Tower Job # CT-1206

2 Fan Units



THE FOLLOWING
MECHANICAL EQUIPMENT
COMPONENTS
WERE FURNISHED FOR

CLEMSON UNIVERSITY
GREENVILLE, SOUTH CAROLINA

1. Motor:
   - A) Manufacturer: Reliance
   - B) Frame Size: 326 T
2. Driveshaft:
   - A) Manufacturer: Formsprag
   - B) Model: A5-35
3. Gear Reducer:
   - A) Manufacturer: Amarillo
   - B) Model: #155
   - C) Ratio: 8.5 to 1
4. Fan:
   - A) Manufacturer: Hudson
   - B) Model: APT-18B-5
   - C) Diameter: 18'-0"
5. Miscellaneous Hardware:
   - A) Murphy Model: EL-175-EX Oil Level Switch
   - B) Robertshaw Model: 366 Vibration Switch
   - C) VSM Module: STD 230/115-15 Vibration Start Time Delay Module

COOLING TOWER INSPECTION, MAINTENANCE AND PROCEDURES GUIDE

SECTION	REVISION 0	CERAMIC COOLING TOWER COMPANY	JOB NO. CT-1206
CT-1206-200	4/02/86	a subsidiary of Justin Industries, Inc.	

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Clemson Cooling Tower

Existing Motor Nameplate Information

Both Units were Reliance Motors

Motor 1 S/O: 1MOF26353-G1-WM

Motor 2 S/O: 1MOF26353-G2-WM

Frame Size: 326T

Rating: 50HP @ 1765 RPM / 12.5 HP @ 885 RPM

480 V / 3 Phase / 60 Hz

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Clemson Cooling Tower

Amarillo Gear Box Information

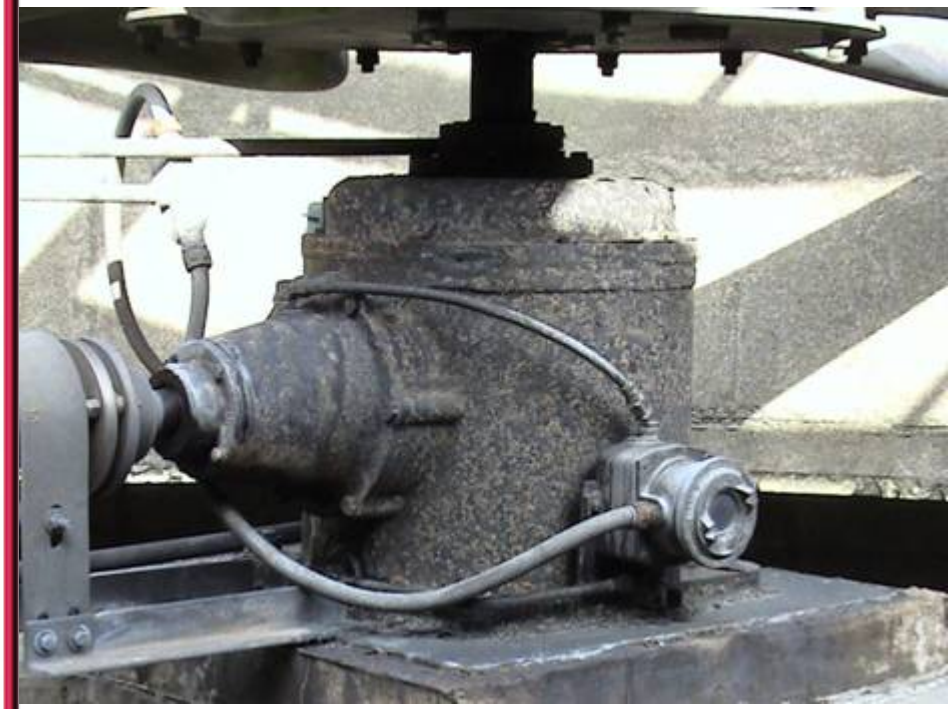
2 Units

Model: 155 (single reduction)

Gear Ratio: 8.5 to 1

Pinion: 8 Teeth

Ring Gear: 68 Teeth



Amarillo Gear Company

TABLE I - SINGLE REDUCTION

Service Horsepower Ratings (Service Factor = 2.0)

Model	Input RPM	Ratio 2.0	2.5	3.0	3.25	3.5	3.79	4.0	4.25	4.5	4.79	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5
65	1750	29	25	20	18	17		15		12		10									
	1450	21	21	17	15	14		12		10		8									
	1160	17	17	13	12	11		10		8		7									
85	1750	50	48	43	43	39	36	33	32	28	27	25	20	18	15	15					
	1450	41	40	37	36	32	30	27	26	23	22	21	17	15	12	12					
	1160	33	32	30	29	26	24	22	21	19	18	17	13	12	10	10					
110	1750					75	74	72	71	69	64	60	46	40	33	30	25	24			
	1450					62	61	60	59	57	53	50	38	33	27	25	21	20			
	1160					50	49	48	47	46	42	40	30	27	22	20	17	16			
135	1750					120	117	110	100	93	88	83	71	65	59	48	43	42	35	30	
	1450					99	97	91	83	77	73	69	59	54	49	40	36	35	29	25	
	1160					80	78	73	66	62	58	55	47	43	39	32	29	28	23	20	
155	1750							133	125	119	114	110	100	90	80	75	65	64	50	45	
	1450							110	104	99	94	91	83	75	70	62	54	53	41	37	
	1160							88	83	79	76	73	66	60	56	50	43	42	33	30	
175	1750									145	140	133	126	112	105	100	80	80	60	60	50
	1450									120	116	110	104	92	87	83	66	66	50	50	41
	1160									96	93	88	84	74	70	66	53	53	40	40	33

Choose models & ratios in outlined area for standard price and delivery. Contact factory for all others.

Amarillo Gear Company reserves the right to make design modifications to our gear drives that may change the given dimensions. The dimensions shown in this brochure may not exactly reflect the dimensions of gear drives currently being offered. Request a Certified Dimension Print for construction use.

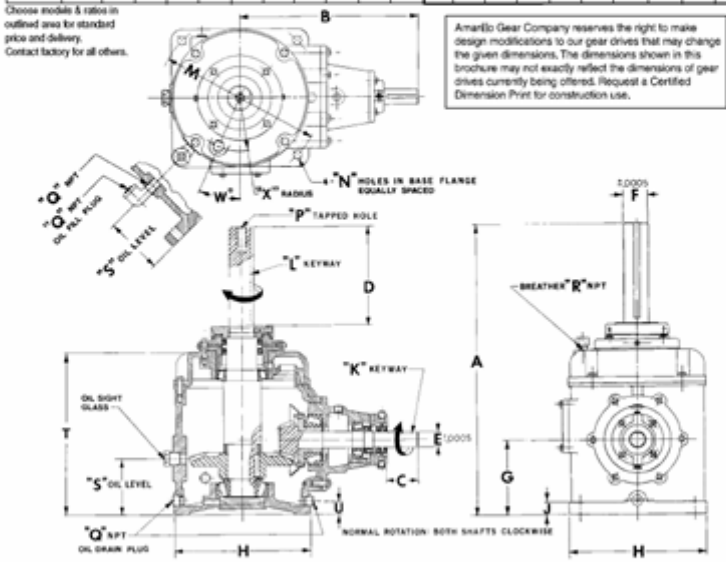


TABLE II - DIMENSIONS

Model	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	W	X	WEIGHT
* 65	17⅝	10⅞	2¼	2¼	6	.999	1.749	5	10	⅝	5/16 x 5/16	5/8	⅝	⅝-10NC	⅜	⅜	5	9⅝	⅞	15	3¾	90
85	23⅝	14⅞	2⅞	1⅝	8	1.249	1.999	6	11	1	¾ x ⅝	13	⅞	⅝-10NC	½	½	4⅝	13¾	1⅝	0	4⅝	195
110	26⅛	17⅝	3⅝	2⅛	8⅝	1.499	2.374	7	13⅞	1⅛	¾ x ⅝	16	⅞	⅝-10NC	½	½	5⅞	15⅝	1⅝	0	4⅝	325
135	29⅝	21	3⅝	2⅝	9	1.874	2.624	8	16	1¼	¾ x ⅝	20	⅞	⅝-10NC	½	½	6	18⅛	1⅝	54	5	500
155	31⅞	23¼	3⅝	2⅛	9⅝	1.874	2.999	9½	19	1⅛	¾ x ⅝	22	⅞	⅝-10NC	½	½	7	19⅝	1⅝	54	6⅝	675
175	33⅝	23¼	3⅝	2⅛	9⅝	1.874	2.999	9½	20⅞	1⅛	¾ x ⅝	25	⅞	⅝-10NC	½	½	7⅝	21⅞	1⅝	54	7	825

* Model 65 has a 10" Diameter Base

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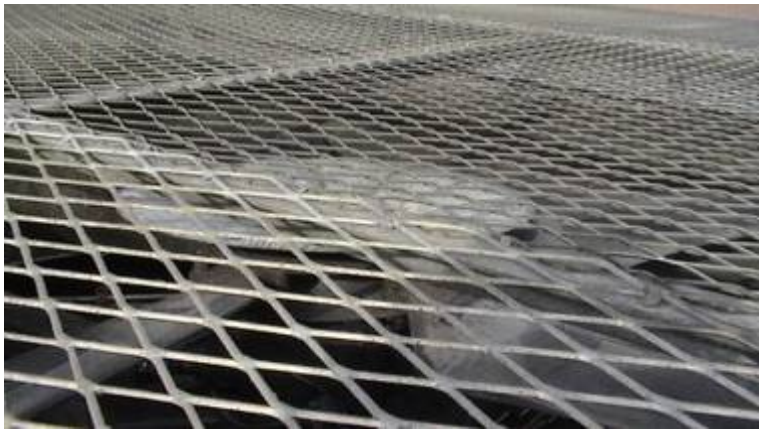
Clemson Cooling Tower

Fan Information (Both Units)

Manufacturer: Hudson Fans

Model: APT-18B-5

Diameter: 18’ - 0”



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Clemson Installation Test Data

	2-Speed, 326T Induction Motor	RPM AC, FL4493 PM Motor
Fan Load	41.5 Hp	41.5 Hp
Gearbox and couplings Efficiency	90.2%	N/A
Motor Horsepower	46.0 Hp	41.5 Hp
Motor Efficiency	90.0%*	93.1%
Drive	N/A	98.8%
Input HP	51.1	45.1
Total Efficiency	81.2%	92.0%

6 HP Savings

- Existing motor is 22 years old, new induction motor today is 93.6% efficient.
- Gearbox manufacturer states gearbox efficiency at 96%, but test data indicates mechanical system (gearbox, couplings, driveshaft) is 90.2%.
- Data verified by Clear Air Engineering on site at Clemson University

*Published Data

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Clemson Installation Test Data

Loaded Noise Levels (A-weighted)		
Average	**High Speed**	**Low Speed**
Induction NEMA Motor Tower	**82.3 dBA**	**74.4 dBA**
Laminated Frame IPM Tower	**77.7 dBA**	**69.0 dBA**

Data verified by Clear Air Engineering on site at Clemson University

50 HP @ 207 RPM 1670 lbs.

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Summary

- ***Laminated Frame Interior PM*** **motor technology enables direct drive gearless system.**
  - **Gearbox low speed lubrication issues are eliminated.**
  - **No drive shaft**
  - **No couplings**
  - **No guards**
  - **No alignment**
- **Motor can be configured to be drop in replacement for gearbox, as was the case at Clemson University Beta site.**
  - **Clemson was 6 hour conversion.**

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Summary (cont'd)

- Vastly simplified system greatly improves reliability and maintainability.
- Significant improvements in overall system efficiency can be realized.
- Elimination of gearbox provides biggest improvement in overall fan drive system efficiency.
- Although a Baldor V*S drive is required, the majority of cooling towers are being retrofitted with VFDs for overall cooling tower system efficiency improvement.
- Direct motor reduces noise level of cooling tower.

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Thank you! Questions?

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