

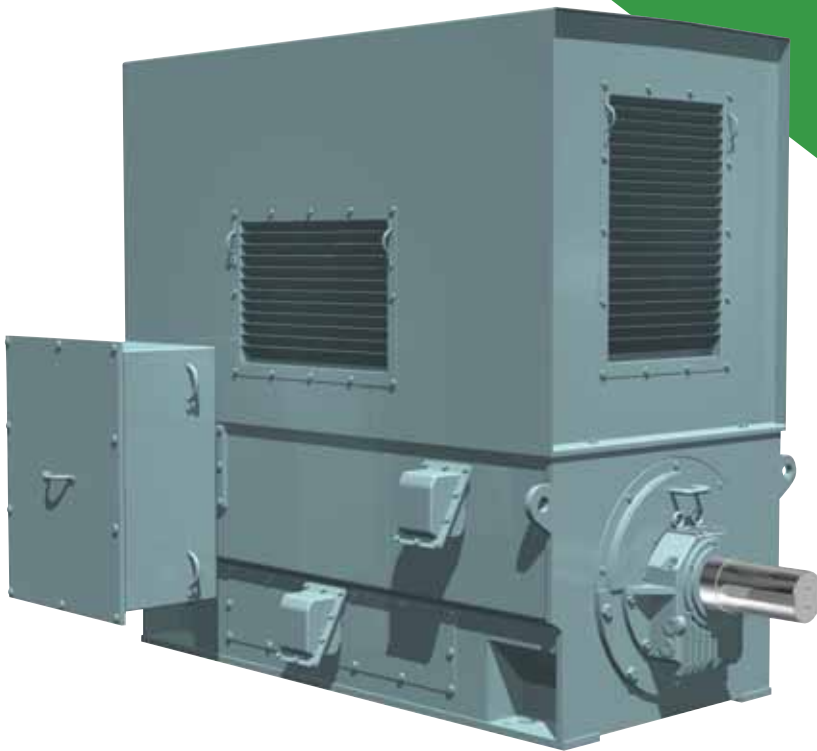


Medium Voltage Induction Motors

# 21-L Series

New High Efficiency Design  
for High Capacity Applications

*450 kW – 18,500 kW  
(600 HP – 25,000 HP)*



**21-L series: Combining over 100 years of experience with innovative new technology makes the 21-L series the right choice for the demanding needs of today's industry.**

## **Superior Electrical Performance, Unsurpassed Reliability**

The 21-L series three-phase high-voltage motors are at the leading edge of motor technology.

- Designs up to 18,500 kW (25,000 hp)
- From 2 pole up to 24 pole designs
- 2,300 – 13,800 Volts, 50 or 60 Hz
- Wide variety of enclosures
- Rugged, high quality fabricated steel construction
- Frame sizes from 450 mm ~ 900 mm shaft height
- Designed to be able to meet worldwide standards (NEMA, IEC, BS, AS and others)

## **Features/Benefits:**

### **Excellent Electrical Performance**

- Higher efficiency than any previous design
- High power factor
- Superior starting characteristics

### **Enclosure Options**

- ODP, WP1, WP2/IP24
- TEAAC, TEWAC, TESV/PIPE/IP55

### **New Compact Design derived Through**

- Extensive electrical magnetic field analysis
- Heat transfer analysis
- Improved ventilation

### **Lower Noise & Less Vibration**

- Advanced techniques in core/frame construction

### **Advanced VPI Insulation System**

- Compatible with VFD voltage supplies and effects of surge voltages

### **Excellent In-Service Availability**

- Low operating and maintenance costs
- High reliability
- Oil-lubricated sleeve bearings or anti-friction bearings
- Extended re-greasing intervals

### **Designs for all Applications and Industries**

### **Compatible with Variable Frequency Drive Applications**

### **Fabricated Copper Bar Rotor Construction**

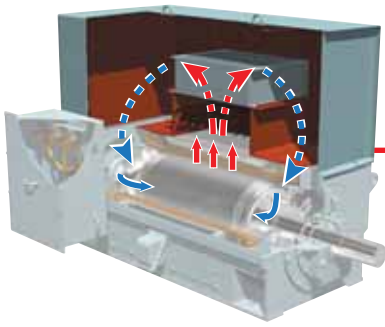
# 21-L Series Motor Enclosures

**Output:** 50 Hz 450 ~ 16,500 kW (600 ~ 22,000 HP)  
60 Hz 450 ~ 18,500 kW (600 ~ 25,000 HP)

**Voltages:** 2,300 V ~ 13,800 V

**Insulation Class:** F Class, with B design temperature rise

**Standards:** IEC, NEMA, BS, AS and others available

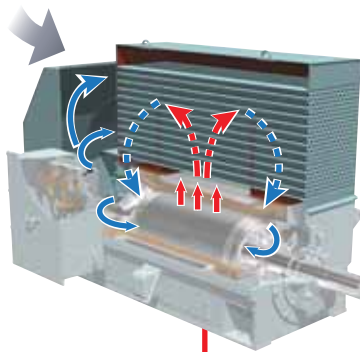


## Totally-Enclosed Air-Water-Cooled Type TEWAC/IP55

This type of motor is especially useful in a location where low noise operation is required or where it is desired to remove heat from the area where the motor is located.

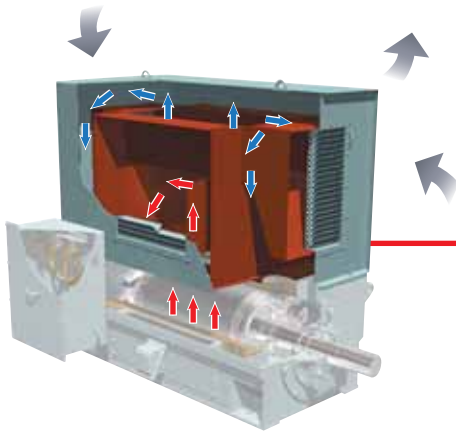
The motor includes an air-to-water heat exchanger in the air housing above the motor.

A drain in the air housing protects the motor from damage should any water leakage ever occur.



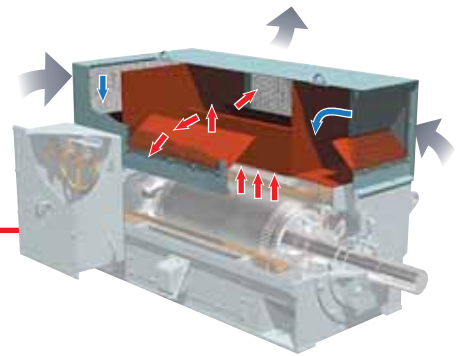
## Totally-Enclosed Air-Air Cooled Type TEAAC/IP55

In an environment containing corrosive or harmful gas, a totally-enclosed fan-cooled motor can be applied. An external fan mounted on the opposite drive end shaft directs fresh air through the pipes in the air housing above the motor. The pipes serve as a heat exchanger in which outside fresh air passing through cools the hot air inside.



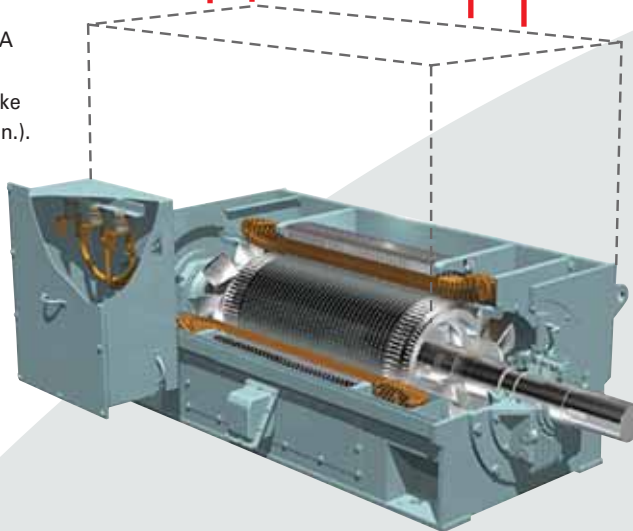
## NEMA Weather-Protected WP/II/IP24

This motor is designed for outdoor operation. In accordance with NEMA WP/II, the housing air path includes right-angled turns, dropping air intake air velocity below 3 m/sec (600 ft/min.). This traps water, dust, and foreign materials. A section is provided that allows air to pass through without being forced into the motor.



## Open Drip Proof Type ODP/IP22

A drip-proof type motor is a common choice for a protected, well-ventilated room. Cooling air intake and hot air exhaust windows are located at the top of the hood. Openings are covered by screens and enclosure is constructed to prevent intrusion of water drips and other foreign materials into the motor meeting NEMA WP-I requirements.



## Common Foundation Base

IC01, IC61 and IC81W cooling per IEC Standard construction are available by changing the top-mounted air housing.

The main terminal box can be rotated through 90° angles, and is large enough for easy cable connection.

A shaft current protection insulator in the non-drive end bearing on 450 frame and larger, and all sleeve bearing machines, is included as standard.

# Features of 21-L Series Motors

## Reliability & Easy Operation/Maintenance

### Main Terminal Box

NEMA Type II terminal box is standard. Boxes including surge protection and/or differential CT's are readily available.

Standard main terminal box can be rotated every 90°. Adequate space is allowed below main terminal box for cable connection.

### Stator Core

Stators use high grade electrical steel with low magnetic losses.

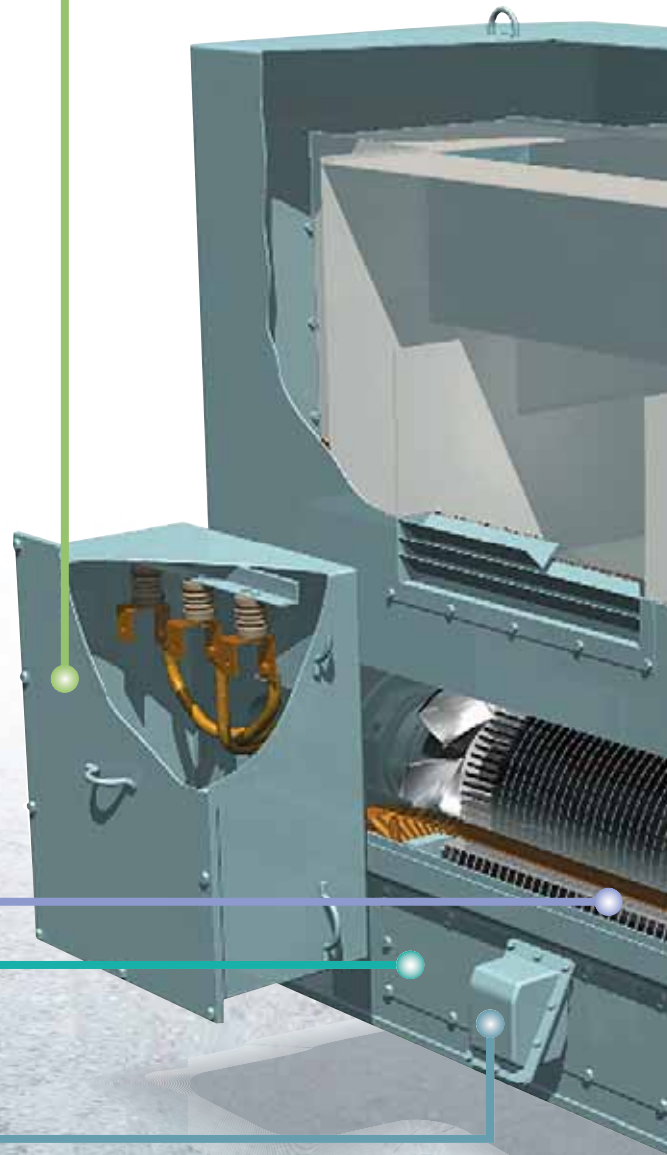
Stator assembly is easily removed from the stator frame if ever necessary.

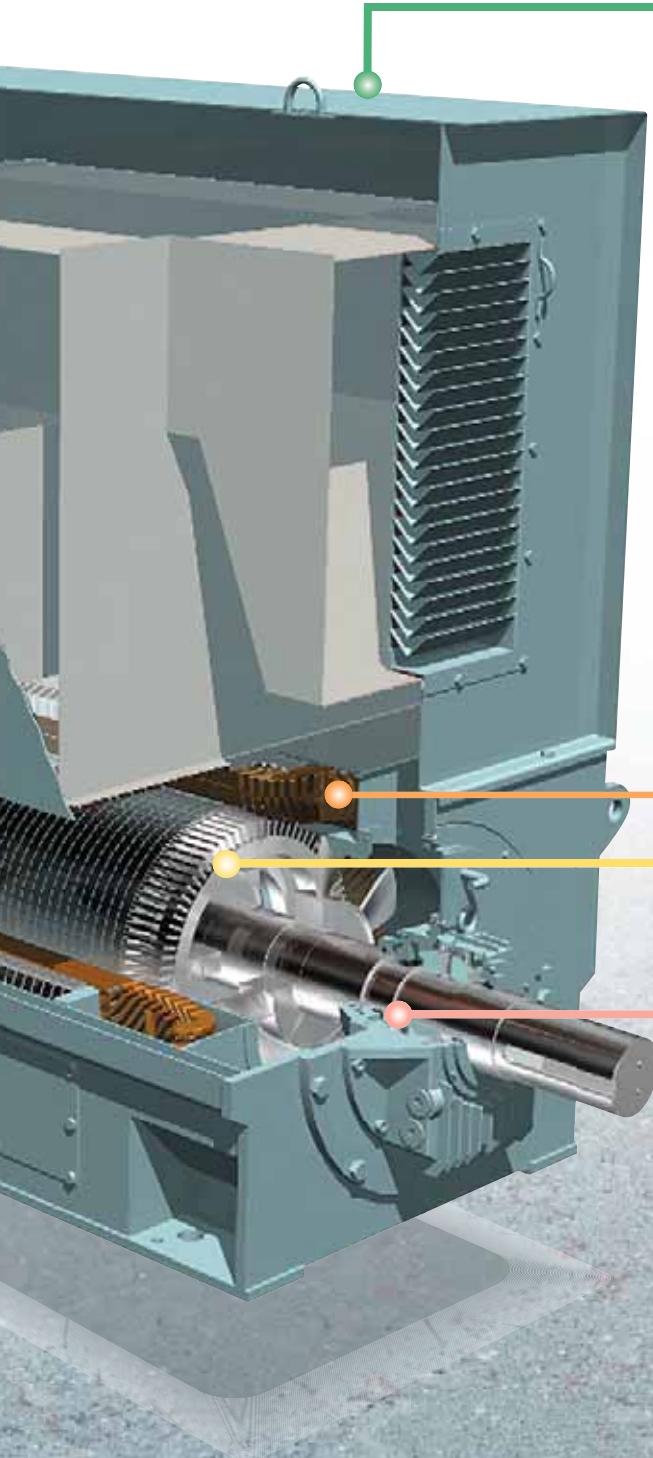
### Frame

Increased rigidity of stator frame and lower vibration are achieved through frequency analysis.

### Auxiliary Terminal Box

Modular arrangement for accessory connections allows flexibility with standardized mechanical construction.





## Air Housing

NEMA Open Drip Proof (IP22) construction provides protection from dripping liquids and foreign materials.

NEMA WPI (IP24) top hood construction prevents intrusion of rain water and foreign matter.

IP55 protection is standard on TEAAC (air-cooled) and TEWAC (water-cooled) motors, and isolates the motor interior from environmental contamination.

## Stator Coil

Utilizes a highly reliable, vacuum pressurized impregnation (VPI) insulation system providing firmly-fixed coil ends and the ability to withstand most environments.

Bracing ensures long life despite the stresses imposed by starting and duty cycles.

## Rotor

Copper rotor bars are standard. They are shaped to provide excellent torque characteristics and mechanical strength.

Bars are fixed firmly in the slots by continuous swaging of each rotor bar.

## Bearing

Antifriction and sleeve bearings are easily maintainable.

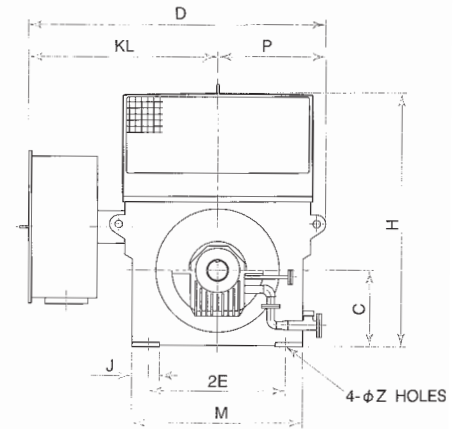
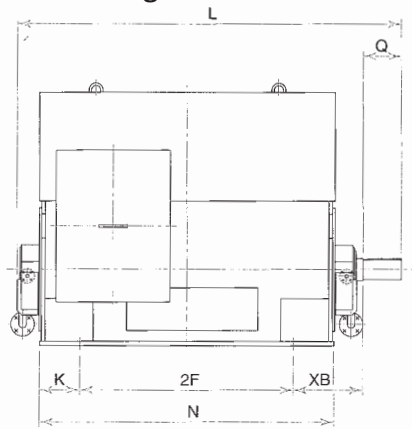
Antifriction (ball, roller) bearings use a refined lubrication design that makes regreasing simple.

# Open Drip Proof Induction Motor DP/IP22

Forced feed lubricated sleeve bearings

Four Pole, 6.6 kV, 60 Hz

- Example outlines for 4 pole machine specifications shown below.
- 2 pole to 24 pole designs available



\* Example, not for construction

Frame	Poles	Dimensions (mm)											
		C	D	2E	2F	H	J	K	L	M	N	P	Z
450-1400	4	450	1830	800	1400	1505	160	265	2550	1000	1930	650	48
450-1600	4	450	1830	800	1600	1505	160	265	2750	1000	2130	650	48
500-1600	4	500	1950	900	1600	1675	180	265	2800	1120	2130	710	56
500-1800	4	500	1950	900	1800	1675	180	265	3030	1120	2330	710	56
560-1800	4	560	2115	1000	1800	1880	225	265	3120	1260	2330	805	66
560-2000	4	560	2115	1000	2000	1880	225	265	3320	1260	2530	805	66
630-2000	4	630	2275	1120	2000	2115	250	265	3320	1420	2530	885	66
630-2240	4	630	2275	1120	2240	2115	250	265	3757	1420	2770	885	66

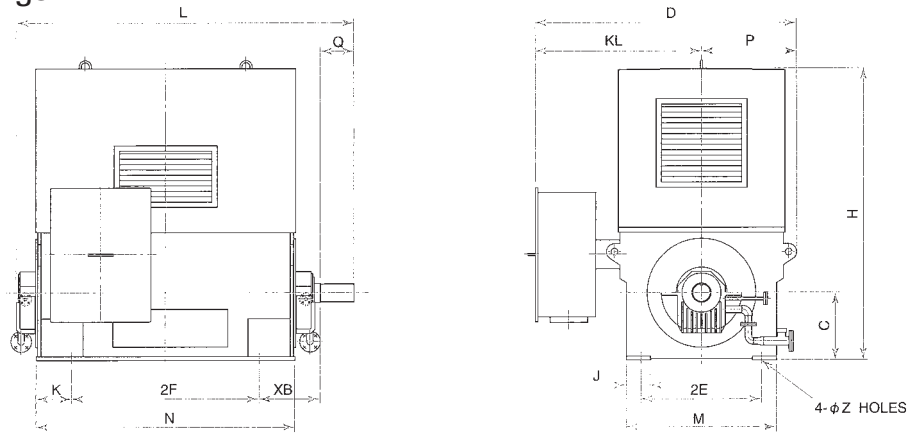
Power (kW)	Frame	Weight (kg)	Speed (rpm)	Current		Torque		Efficiency (%)			Power Factor (%)			Safe Stall Time (SEC)	
				(A) Rated	(%) Starting	(%) Starting	(%) Max.	F.L.	3/4 L	1/2 L	F.L.	3/4 L	1/2 L	Hot	Cold
1800	450-1400	4500	1775	185	500	60	190	96.6	96.4	95.6	88.3	87.5	84.0	12	15
2000	450-1400	4700	1775	205	500	60	190	96.7	96.5	95.8	88.4	87.7	84.5	12	15
2250	450-1400	4700	1775	230	500	60	190	96.8	96.6	95.9	88.5	87.9	84.8	12	15
2500	450-1400	4900	1775	255	500	60	190	96.9	96.8	96.1	88.5	88.1	85.0	12	15
2800	450-1400	5100	1775	285	550	60	190	97.1	96.9	96.3	88.6	88.2	85.1	12	15
3150	450-1600	5900	1775	320	600	60	220	97.2	97.1	96.5	88.8	88.3	85.6	12	15
3550	450-1600	5900	1775	360	600	60	200	97.3	97.2	96.6	88.9	88.3	86.2	12	15
4000	500-1800	6800	1775	405	500	60	160	97.3	97.2	96.7	89.9	88.7	86.9	12	15
4500	500-1800	7300	1775	452	500	60	170	97.5	97.3	96.7	89.4	88.9	87.5	12	15
5000	500-1800	7700	1780	502	500	60	170	97.6	97.4	96.8	89.4	89.0	87.7	12	15
5600	500-1800	8000	1780	560	500	60	170	97.7	97.5	96.8	89.6	89.0	87.8	12	15
6000	500-1800	8200	1780	299	500	60	170	97.6	97.5	96.9	89.8	89.3	87.9	12	15
6300	560-1800	9500	1780	629	500	60	180	97.7	97.5	96.8	89.8	89.4	88.2	10	15
6500	560-1800	9500	1780	648	450	60	170	97.7	97.5	96.9	89.9	89.4	88.4	10	15
7100	560-2000	9800	1780	708	450	60	170	97.7	97.5	96.9	89.9	89.4	88.5	10	15
7500	560-2000	10300	1780	747	450	60	170	97.7	97.5	96.9	89.9	89.4	88.5	10	15
8000	560-2000	10700	1780	797	500	60	180	97.8	97.6	96.9	89.8	89.4	88.6	10	15
8500	560-2000	11000	1780	847	500	60	180	97.7	97.6	96.9	89.8	89.5	88.6	10	15
9000	630-2000	12400	1780	897	500	60	170	97.7	97.6	96.9	89.8	89.4	88.6	10	15
9500	630-2000	12400	1780	948	500	60	170	97.7	97.6	97.0	89.8	89.5	88.7	10	15
10000	630-2000	12800	1780	997	500	60	170	97.8	97.6	97.1	89.8	89.6	88.6	10	15
10500	630-2000	12800	1780	1046	500	60	170	97.8	97.7	97.1	89.8	89.7	88.8	10	15
11000	630-2240	14600	1780	1094	550	60	170	97.9	97.7	97.1	89.9	89.8	88.9	10	15
11500	630-2240	14600	1780	1143	550	60	170	97.9	97.7	97.1	90.0	89.9	89.0	10	15

# Outdoor Induction Motor WPII/IP24

Forced feed lubricated sleeve bearings

Four Pole, 6.6 kV, 60 Hz

- Example outlines for 4 pole machine specifications shown below.
- 2 pole to 24 pole designs available



\* Example, not for construction

Frame	Poles	Dimensions (mm)											
		C	D	2E	2F	H	J	K	L	M	N	P	Z
450-1400	4	450	1830	800	1400	2135	160	265	2550	1000	1930	650	48
450-1600	4	450	1830	800	1600	2135	160	265	2750	1000	2130	650	48
500-1600	4	500	1950	900	1600	2375	180	265	2800	1120	2130	710	56
500-1800	4	500	1950	900	1800	2375	180	265	3030	1120	2330	710	56
560-1800	4	560	2115	1000	1800	2665	225	265	3120	1260	2330	805	66
560-2000	4	560	2115	1000	2000	2665	225	265	3320	1260	2530	805	66
630-2000	4	630	2275	1120	2000	2995	250	265	3320	1420	2530	885	66
630-2240	4	630	2275	1120	2240	2995	250	265	3757	1420	2770	885	66

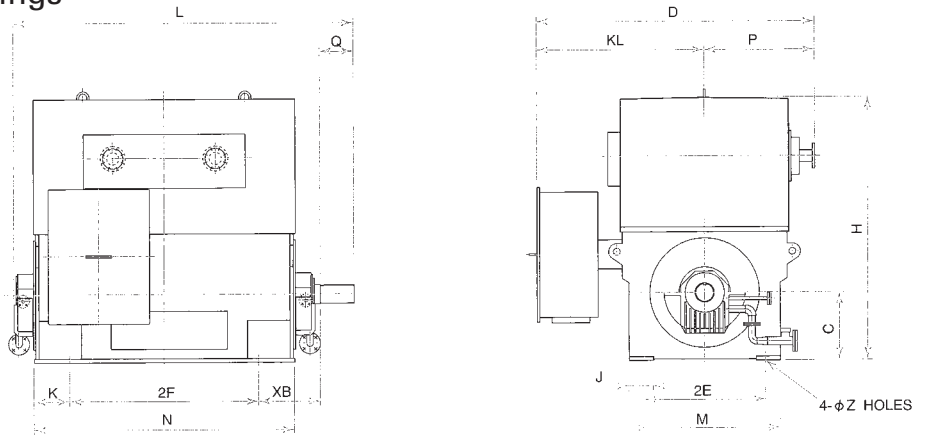
Power (kW)	Frame	Weight (kg)	Speed (rpm)	Current		Torque		Efficiency (%)			Power Factor (%)			Safe Stall Time (SEC)	
				(A) Rated	(%) Starting	(%) Starting	(%) Max.	F.L.	3/4 L	1/2 L	F.L.	3/4 L	1/2 L	Hot	Cold
1800	450-1400	4800	1775	185	500	60	190	96.6	96.4	95.6	88.3	87.5	84.0	12	15
2000	450-1400	5000	1775	205	500	60	190	96.7	96.5	95.8	88.4	87.7	84.5	12	15
2250	450-1400	5000	1775	230	500	60	190	96.8	96.6	95.9	88.5	87.9	84.8	12	15
2500	450-1400	5200	1775	255	500	60	190	96.9	96.8	96.1	88.5	88.1	85.0	12	15
2800	450-1400	5400	1775	285	550	60	190	97.1	96.9	96.3	88.6	88.2	85.1	12	15
3150	450-1600	6200	1775	320	600	60	220	97.2	97.1	96.5	88.8	88.3	85.6	12	15
3550	450-1600	6200	1775	360	600	60	200	97.3	97.2	96.6	88.9	88.3	86.2	12	15
4000	500-1800	7100	1775	405	500	60	160	97.3	97.2	96.7	89.9	88.7	86.9	12	15
4500	500-1800	7600	1775	452	500	60	170	97.5	97.3	96.7	89.4	88.9	87.5	12	15
5000	500-1800	8100	1780	502	500	60	170	97.6	97.4	96.8	89.4	89.0	87.7	12	15
5600	500-1800	8300	1780	560	500	60	170	97.7	97.5	96.8	89.6	89.0	87.8	12	15
6000	500-1800	8600	1780	299	500	60	170	97.6	97.5	96.9	89.8	89.3	87.9	12	15
6300	560-1800	9900	1780	629	500	60	180	97.7	97.5	96.8	89.8	89.4	88.2	10	15
6500	560-1800	9900	1780	648	450	60	170	97.7	97.5	96.9	89.9	89.4	88.4	10	15
7100	560-2000	10200	1780	708	450	60	170	97.7	97.5	96.9	89.9	89.4	88.5	10	15
7500	560-2000	10800	1780	747	450	60	170	97.7	97.5	96.9	89.9	89.4	88.5	10	15
8000	560-2000	11100	1780	797	500	60	180	97.8	97.6	96.9	89.8	89.4	88.6	10	15
8500	560-2000	11400	1780	847	500	60	180	97.7	97.6	96.9	89.8	89.5	88.6	10	15
9000	630-2000	12900	1780	897	500	60	170	97.7	97.6	96.9	89.8	89.4	88.6	10	15
9500	630-2000	12900	1780	948	500	60	170	97.7	97.6	97.0	89.8	89.5	88.7	10	15
10000	630-2000	13300	1780	997	500	60	170	97.8	97.6	97.1	89.8	89.6	88.6	10	15
10500	630-2000	13300	1780	1046	500	60	170	97.8	97.7	97.1	89.8	89.7	88.8	10	15
11000	630-2240	15100	1780	1094	550	60	170	97.9	97.7	97.1	89.9	89.8	88.9	10	15
11500	630-2240	15100	1780	1143	550	60	170	97.9	97.7	97.1	90.0	89.9	89.0	10	15

# Totally Enclosed Air to Water Cooled Induction Motor TEWAC/IP54

Forced feed lubricated sleeve bearings

Four Pole, 6.6 kV, 60 Hz

- Example outlines for 4 pole machine specifications shown below.
- 2 pole to 24 pole designs available



\* Example, not for construction

Frame	Poles	Dimensions (mm)											
		C	D	2E	2F	H	J	K	L	M	N	P	Z
450-1400	4	450	1940	800	1400	1865	160	265	2550	1000	1930	760	48
450-1600	4	450	1940	800	1600	1865	160	265	2750	1000	2130	760	48
500-1600	4	500	2065	900	1600	2015	180	265	2800	1120	2130	825	56
500-1800	4	500	2065	900	1800	2015	180	265	3030	1120	2330	825	56
560-1800	4	560	2225	1000	1800	2130	225	265	3120	1260	2330	915	66
560-2000	4	560	2225	1000	2000	2130	225	265	3320	1260	2530	915	66
630-2000	4	630	2380	1120	2000	2330	250	265	3320	1420	2530	990	66
630-2240	4	630	2380	1120	2240	2330	250	265	3757	1420	2770	990	66

Power (kW)	Frame	Weight (kg)	Speed (rpm)	Current		Torque		Efficiency (%)			Power Factor (%)			Safe Stall Time (SEC)	
				(A) Rated	(%) Starting	(%) Starting	(%) Max.	F.L.	3/4 L	1/2 L	F.L.	3/4 L	1/2 L	Hot	Cold
1800	450-1400	5000	1775	185	500	60	190	96.6	96.4	95.6	88.3	87.5	84.0	12	15
2000	450-1400	5200	1775	205	500	60	190	96.7	96.5	95.8	88.4	87.7	84.5	12	15
2250	450-1400	5200	1775	230	500	60	190	96.8	96.6	95.9	88.5	87.9	84.8	12	15
2500	450-1400	5400	1775	255	500	60	190	96.9	96.8	96.1	88.5	88.1	85.0	12	15
2800	450-1400	5600	1775	285	550	60	190	97.1	96.9	96.3	88.6	88.2	85.1	12	15
3150	450-1600	6400	1775	320	600	70	220	97.2	97.1	96.5	88.8	88.3	85.6	12	15
3550	450-1600	6400	1775	360	600	70	200	97.3	97.2	96.6	88.9	88.3	86.2	12	15
4000	500-1800	7300	1775	405	500	60	160	97.3	97.2	96.7	89.9	88.7	86.9	12	15
4500	500-1800	7800	1775	452	500	60	170	97.5	97.3	96.7	89.4	88.9	87.5	12	15
5000	500-1800	8300	1780	502	500	60	170	97.6	97.4	96.8	89.4	89.0	87.7	12	15
5600	500-1800	8500	1780	560	500	60	170	97.7	97.5	96.8	89.6	89.0	87.8	12	15
6000	500-1800	8800	1780	299	500	60	170	97.6	97.5	96.9	89.8	89.3	87.9	12	15
6300	560-1800	10200	1780	629	500	60	180	97.7	97.5	96.8	89.8	89.4	88.2	10	15
6500	560-1800	10200	1780	648	450	60	170	97.7	97.5	96.9	89.9	89.4	88.4	10	15
7100	560-2000	10500	1780	708	450	60	170	97.7	97.5	96.9	89.9	89.4	88.5	10	15
7500	560-2000	11000	1780	747	450	60	170	97.7	97.5	96.9	89.9	89.4	88.5	10	15
8000	560-2000	11400	1780	797	500	60	180	97.8	97.6	96.9	89.8	89.4	88.6	10	15
8500	560-2000	11700	1780	847	500	60	180	97.7	97.6	96.9	89.8	89.5	88.6	10	15
9000	630-2000	13200	1780	897	500	60	170	97.7	97.6	96.9	89.8	89.4	88.6	10	15
9500	630-2000	13200	1780	948	500	60	170	97.7	97.6	97.0	89.8	89.5	88.7	10	15
10000	630-2000	13600	1780	997	500	60	170	97.8	97.6	97.1	89.8	89.6	88.6	10	15
10500	630-2000	13600	1780	1046	500	60	170	97.8	97.7	97.1	89.8	89.7	88.8	10	15
11000	630-2240	15300	1780	1094	550	60	170	97.9	97.7	97.1	89.9	89.8	88.9	10	15
11500	630-2240	15300	1780	1143	550	60	170	97.9	97.7	97.1	90.0	89.9	89.0	10	15

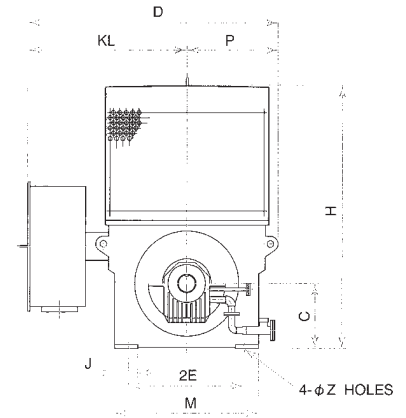
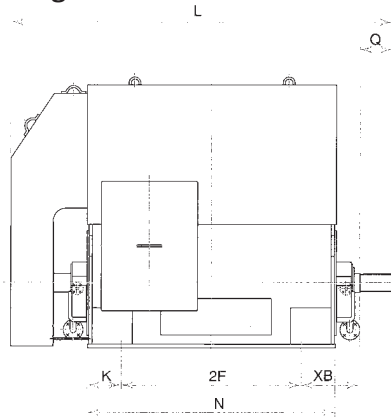


# Totally Enclosed Air to Air Cooled Induction Motor TEAAC/IP54

Forced feed lubricated sleeve bearings

Four Pole, 6.6 kV, 60 Hz

- Example outlines for 4 pole machine specifications shown below.
- 2 pole to 24 pole designs available



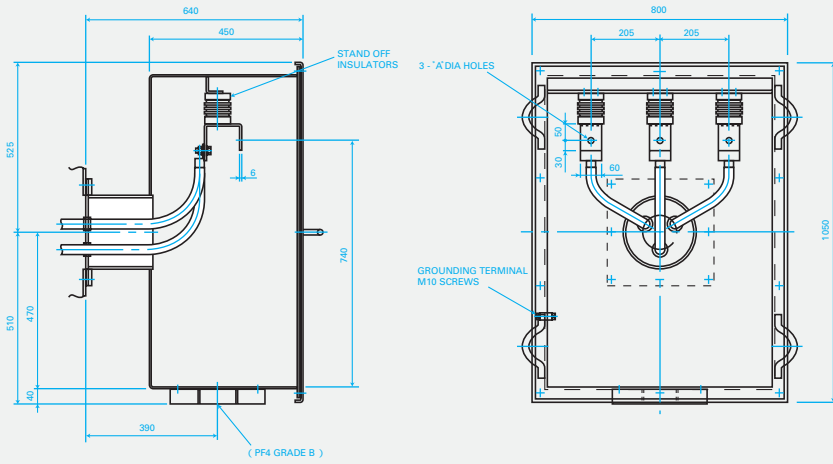
\* Example, not for construction

Frame	Poles	Dimensions (mm)											
		C	D	2E	2F	H	J	K	L	M	N	P	Z
450-1400	4	450	1830	800	1400	1920	160	265	3015	1000	1930	650	48
450-1600	4	450	1830	800	1600	1920	160	265	3215	1000	2130	650	48
500-1600	4	500	1950	900	1600	2090	180	265	3215	1120	2130	710	56
500-1800	4	500	1950	900	1800	2090	180	265	3465	1120	2330	710	56
560-1800	4	560	2115	1000	1800	2280	225	265	3465	1260	2330	805	66
560-2000	4	560	2115	1000	2000	2280	225	265	3695	1260	2530	805	66
630-2000	4	630	2275	1120	2000	2420	250	265	3815	1420	2530	885	66
630-2240	4	630	2275	1120	2240	2420	250	265	4055	1420	2770	885	66

Power (kW)	Frame	Weight (kg)	Speed (rpm)	Current		Torque		Efficiency (%)			Power Factor (%)			Safe Stall Time (SEC)	
				(A) Rated	(%) Starting	(%) Starting	(%) Max.	F.L.	3/4 L	1/2 L	F.L.	3/4 L	1/2 L	Hot	Cold
1400	450-1400	5000	1780	145	550	60	200	96.0	95.5	94.2	88.5	88.0	84.8	12	15
1600	450-1400	5200	1780	164	500	60	190	96.2	95.8	94.6	88.9	88.2	85.6	12	15
1800	450-1400	5400	1780	184	600	60	210	96.4	96.0	94.8	88.9	88.2	85.5	12	15
2000	450-1400	5600	1780	204	600	60	210	96.6	96.2	95.1	89.0	88.3	85.6	12	15
2250	450-1400	5800	1780	229	600	60	210	96.7	96.4	95.3	89.0	88.3	85.6	12	15
2500	450-1600	6300	1780	254	600	60	210	96.9	96.5	95.5	89.1	88.5	85.7	12	15
2800	450-1600	6700	1780	283	600	60	220	97.0	96.6	95.6	89.3	88.6	86.1	12	15
3150	500-1600	7400	1780	317	550	60	190	97.0	96.6	95.6	89.9	89.0	86.7	10	15
3550	500-1600	7900	1780	355	550	60	200	97.2	96.8	95.8	90.2	89.4	87.1	10	15
4000	500-1800	8400	1780	399	550	60	210	97.3	96.9	95.9	90.2	89.4	87.1	10	15
4500	500-1800	8900	1780	448	600	60	220	97.4	96.9	96.0	90.3	89.5	86.9	10	15
5000	560-1800	10400	1780	498	500	60	190	97.4	96.9	96.0	90.2	89.6	87.2	10	15
5600	560-2000	11600	1780	557	550	60	210	97.4	97.0	96.0	90.5	89.6	87.3	10	15
6000	630-2000	12500	1780	598	550	60	190	97.4	97.1	96.1	90.1	89.4	87.3	10	15
6300	630-2000	12500	1780	628	500	60	190	97.4	97.1	96.1	90.2	89.3	87.4	10	15
6500	630-2000	12900	1780	647	600	70	210	97.5	97.1	96.1	90.2	89.4	87.2	10	15
7100	630-2000	13300	1780	706	600	70	210	97.6	97.2	96.2	90.3	89.5	87.2	10	15
7500	630-2000	14200	1780	745	600	70	200	97.6	97.3	93.3	90.3	89.8	87.5	10	15
8000	630-2000	14500	1780	794	600	70	200	97.7	97.3	93.3	90.3	89.8	87.4	10	15
8500	630-2240	15400	1780	844	600	70	200	97.7	97.4	96.4	90.3	89.6	87.2	10	15

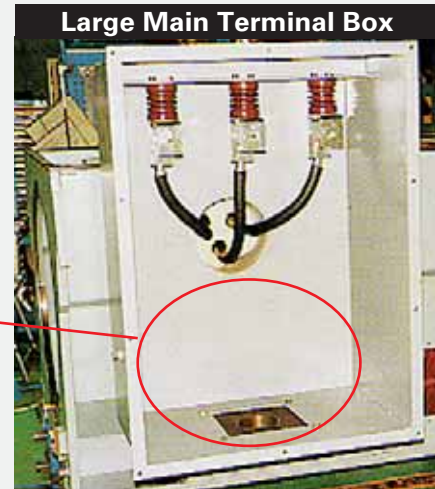
# Main Terminal Box

## Drawing



P. No.	A Dimensions (mm)
1	12
2	15
3	28

Area available for accessories such as arrestors, surge capacitors, CTs, etc.



## Other Accessories Available

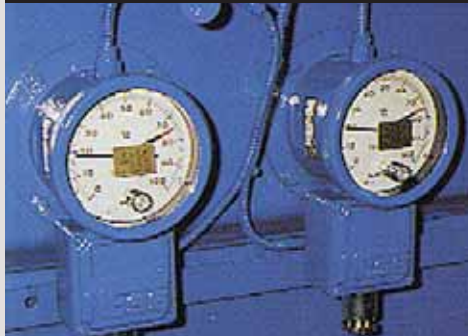
**RTDs**



**Space Heaters**



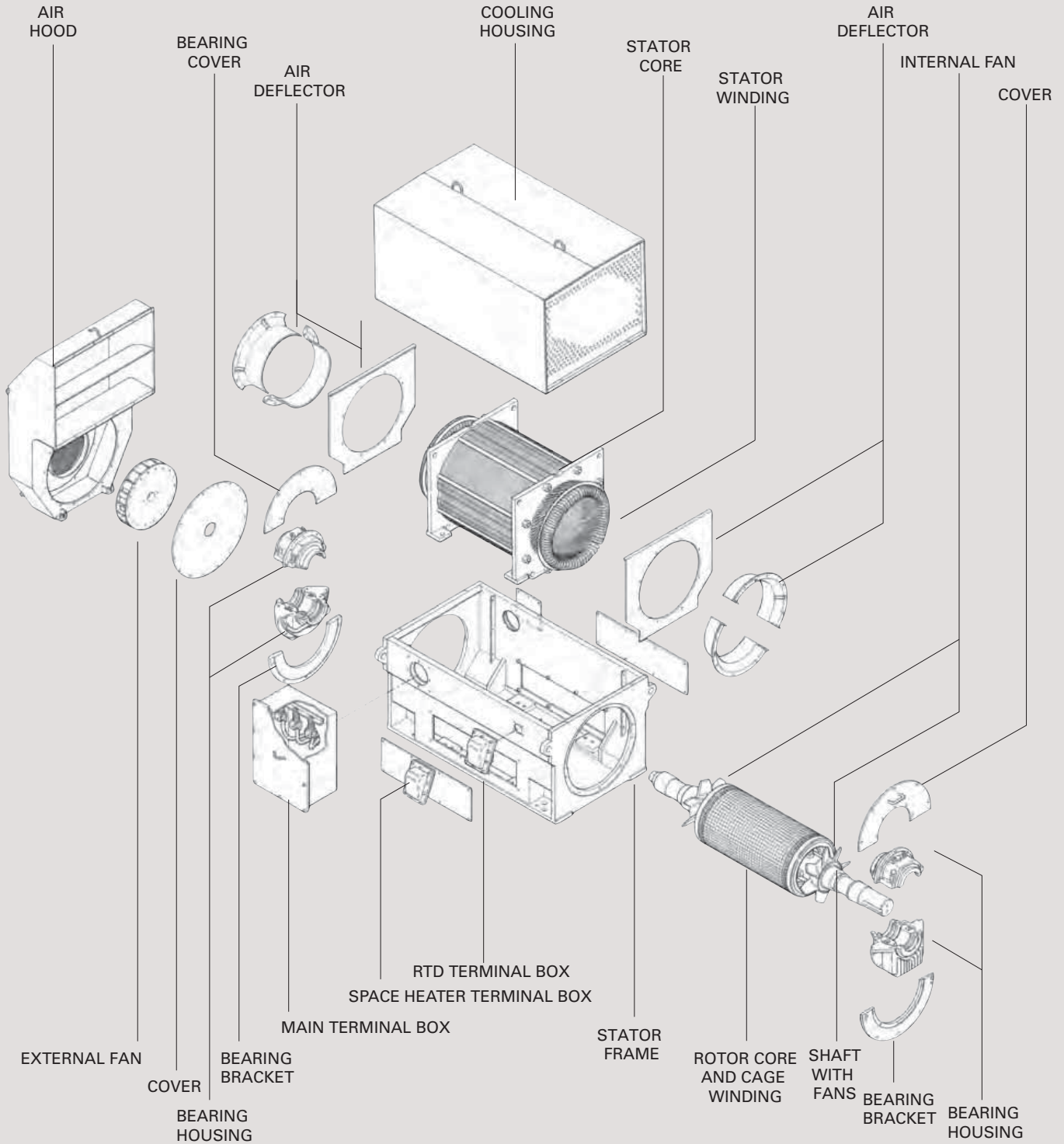
**Dial Thermometer**



**Vibration Detector**



# 21-L Series Internal Details





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