ABB Performance Evaluation Program

Analysis report

Report data

Report	
Date of report	2011-06-18
Prepared by	Regional technical center, Mumbai
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Measurement date	2011-06-17
Motor name	Lean Amine Recirculation Pump
Serial number	N69047-2000
Tag number	AIUN438
Report number	123910

Customer	
Company name	XYZ Ltd
Contact	John Doe
Phone	2190329
E-mail	John.doe@test.com
Country	USA

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Input information

Nameplate details	
Power (kW)	2000
Voltage (V)	3300
Current (A)	44
Line frequency (Hz)	50
Poles (-)	4
Speed (RPM)	1487.9
Efficiency (%)	95.83
Power factor (-)	0.83
Rotor bar material	Copper
Ambient temperature (deg C)	28
Temperature rise class	B

Load point 1 (mandatory)	
Measured load point (%)	45.2
Stator winding resistence (ohms)	0.3877
Voltage (V)	3509.7
Current (A)	24.4
Line frequency (Hz)	50
Running speed (RPM)	1495
Power factor (-)	0.6333
Temperature rise (deg C)	32.62
Derating factor	99.094
Torque ripple content (%)	2

Load point 2 (optional)	
Measured load point (%)	45.2
Voltage (V)	3509.7
Current (A)	24.4
Line frequency (Hz)	50
Running speed (RPM)	1495
Power factor (-)	0.6333
Temperature rise (deg C)	32.62
Derating factor	99.094
Torque ripple content (%)	2
Others	
Desired load point (%)	45.2

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Regenerated performance curves

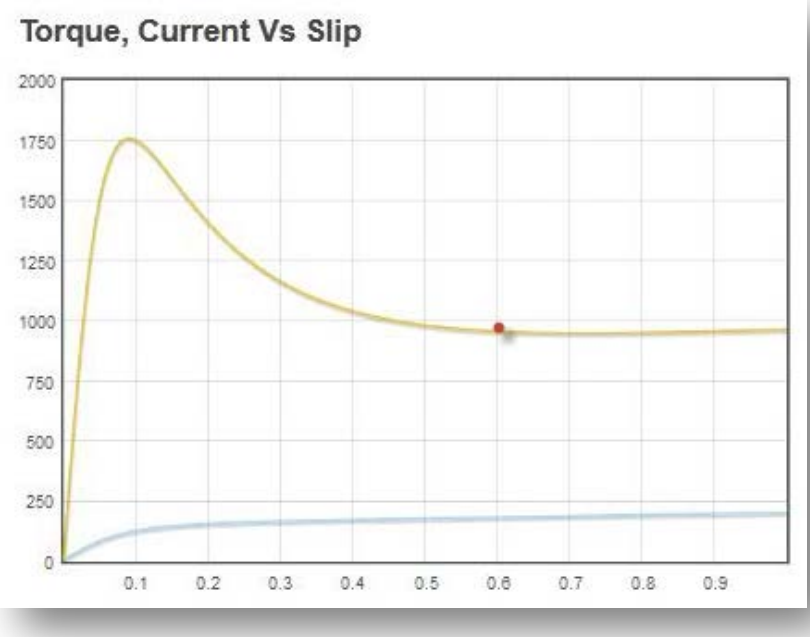
Performance parameters

	100% load (nameplate)	75% load	50% load	45.2%
Slip (%)	0.34	0.75	0.75	0.75
Current (A)	25.55	43.05	43.05	43.05
Speed (RPM)	1494.90	1488.75	1488.75	1488.75
Torque (Nm)	1199.63	2562.83	2562.83	2562.83
Efficiency (%)	94	96	96	96
Power factor (-)	0.66	0.83	0.83	0.83
Stator temperature (deg C)	62.81	78.29	78.29	78.29

The performance curves of the motor have been regenerated in accordance with the measurements taken. The following types of curves are available:

1. Torque vs slip
2. Current vs slip
3. Efficiency vs load
4. Power factor vs load
5. Temperature vs load

Torque and current vs. slip



Efficiency vs. load

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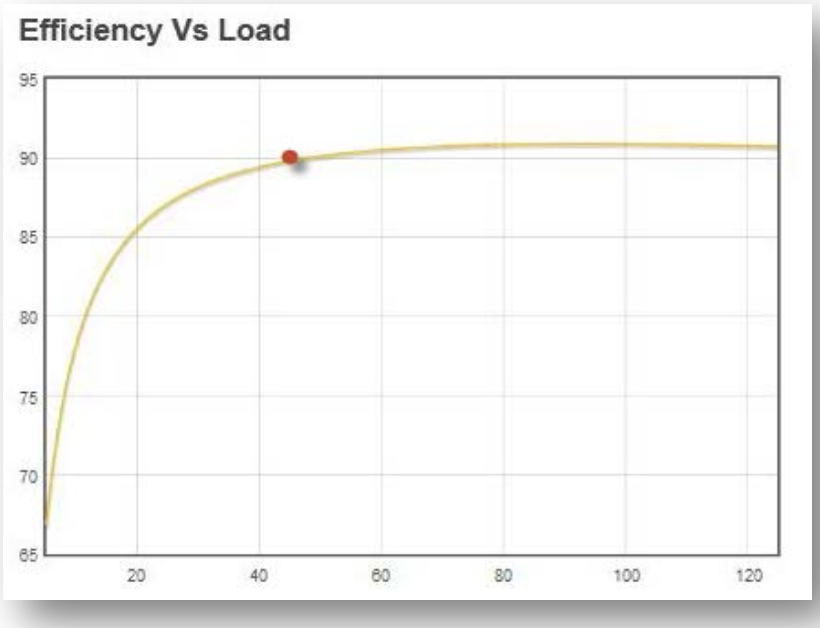
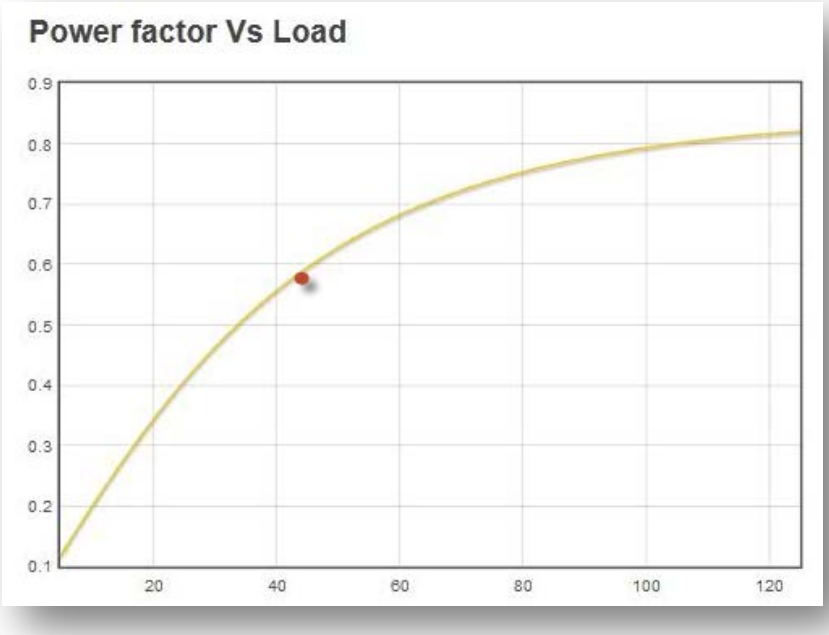


Power factor vs. load



Temperature vs. load

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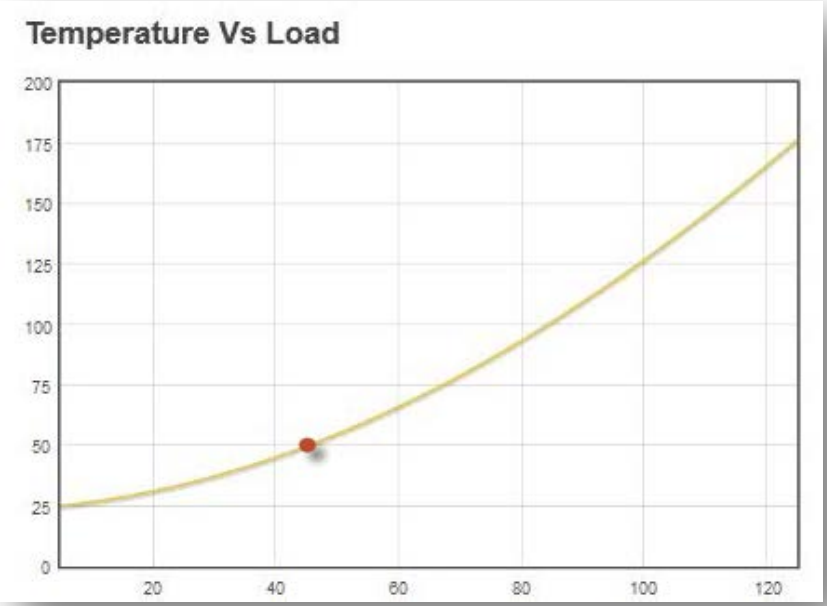

Loss estimations

Loss estimations	
	100% load (nameplate)
Iron losses	2.99
Friction and windage losses	1.66
Stator I^2R losses	0.50
Rotor losses	0.33
Stray losses	0.48
Total losses	5.96

Validation of performance parameters

Supply voltage validation

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Provides an indication of whether the motor is operating in the preferred operational zone as per IEC 600034-1 design standards. Operating in the non-preferred zone impacts the general operation of the motor (power factor, losses, operating temperature etc).

Rated voltage (V)	415	OK
Per phase RMS voltage (V)	3509.7	

ACTIONS IF NOT OK:

- If possible, correct problem in the transformer tap changer
- Ensure that this doesn't impact other connected electrical equipment

Supply frequency validation

Provides an Indication of whether the motor is operating in the preferred operational zone as per IEC 600034-1 design standards. Operating in the non-preferred zone impacts the general operation of the motor (power factor, losses, operating temperature etc). However, if the operating frequency is > 0.5% more than the rated frequency (i.e operating frequency is > 1.005*rated frequency), then it means that the motor is drawing more power from the system. The increase in power could be to the tune of about 1.5% for quadratic torque loads and 0.5% for constant torque loads. This additional power drawn is not not utilized for useful work and gets included in system losses.

Rated frequency (Hz)	50	OK
Operating frequency (Hz)	50	

ACTIONS IF NOT OK:

- If plant power supply is isolated from the grid, then change the frequency of the supply
- Explore use of VFD if changing frequency is not possible

Power factor validation

Provides an indication of whether the magnetic wedges have been previously replaced with materials of appropriate properties and quality. If the rotor has incorrectly been machined in the past, air gap may have abnormally increased, which would mean additional losses among other things. Also may indicate high saturation in the stator/rotor teeth of the motor in certain parts.

Rated PF (-)	0.83	OK
Recalculated rated PF (-)	0.83	

ACTIONS IF NOT OK:

- Magnetic wedges may have to be used (if not already used)
- Rotor may have to be replaced
- Power factor compensating capacitors can be installed

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Under-loading (current)

Provides an indication of whether the motor is oversized

Operating load (%)	45.20	NOT OK

ACTIONS IF NOT OK:

- Explore replacement opportunities or installation of VFDs

Under-loading (power factor)

Provides an indication of whether the motor is oversized

Operating power factor	0.633	NOT OK

ACTIONS IF NOT OK:

- Explore replacement opportunities and installation of VFDs
- Magnetic wedges may have to be used (if not already used)
- Rotor may have to be replaced
- Power factor compensating capacitors can be installed

kW overload

Provides an indication of whether the motor is being operated beyond its design parameters

Rated power (kW)	2000	OK
Derating factor	99.094	
Operating power (kW)	904	

ACTIONS IF NOT OK:

- Try to reduce the loading on the motor or take steps to eliminate harmonics in the motor system
- Explore upgrade possibilities if desired

Efficiency erosion

Provides indication of any reduction of efficiency from nameplate. If there is a reduction, then this is a cause for concern as it indicates additional losses that are not so evident.

Rated efficiency (%)	95.83%	CHECK

Recalculated rated efficiency (%)	95.77%	

ACTIONS IF NOT OK:

- Explore replacement opportunities especially if recalculated efficiency is < 2% of nameplate efficiency
- Explore use of VFDs or any other upgrades

Rotor losses

Provides an indication of whether the losses in the rotor are on the higher side due to various reasons

Rated slip (-)	0.0081	OK
Recalculated rated slip (-)	0.0075	

ACTIONS IF NOT OK:

- In Ex environments (especially Ex-e motors), relook at the rotor temperature settings/protection in the relays
- Analyze rotor winding defects (see ABB MACHsense-P report if already performed)
- Check for possible motor overload

Stator losses

Provides an indication of whether losses in the stator are on the higher side due to various reasons. Do note that currents could increase because of an increase in the operating slip, decrease in operating power factor or decrease in operating voltages. In this case, there is no cause for concern.

Rated current (A)	44	OK
Recalculated rated current (A)	43.05	

ACTIONS IF NOT OK:

- Check for possible motor overload
- Magnetic wedges may have to be used (if not already used)
- Rotor may have to be replaced
- Power factor compensating capacitors can be installed

Oscillating loads

Provides an indication of whether there are any oscillations from the loads/supply side. If these exist, then they will contribute to the total losses.

Torque ripple content (%)	2%	OK

ACTIONS IF NOT OK:

- Check maintenance history for damage to couplings/bolts
- Check maintenance history for rotor winding failures

Cooling effectiveness

Provides an indication of whether there is a need to investigate the motor cooling system and losses

Recalculated rated temperature (deg C)	78.29	OK

ACTIONS IF NOT OK:

- Check stator core for defects
- Check existing and investigate new heat-exchanger retrofits

Assumptions

- All data related assumptions can be found under the 'Input information' section
- There are no standards currently available for field testing of efficiency of electric motors. The analysis in this report is broadly based on the IEC 34-2-1 (1996) and IEEE 112 (2004)
- Stator winding resistance is calculated for different loads based on measured temperature and customer provided resistance measurements
- Fixed losses are calculated based on the measured load points

Appendix 1: Data for various loads

Load	Torque (Nm)	Current (A)	Efficiency (%)	Power factor	Temperature (deg C)
50%	1.88	5.69	94.17%	0.69	63.66
60%	1.92	5.95	94.76%	0.73	65.82
70%	1.96	6.21	95.20%	0.77	68.59
80%	1.98	6.42	95.45%	0.79	71.28
90%	1.99	6.63	95.65%	0.81	74.64
100%	2.00	6.79	95.76%	0.83	77.82

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