

Method Statement for AMT Test Unit



General

The following method statement provides procedures for the connection and set up for the Motor Test & Inspection for Online AC LV & HV motors. This statement is not meant to be a detailed method of operating the equipment as it is assumed that Artesis personal will have a full working knowledge of operating the test equipment.

Component

AC Motors LV and HV

Affectivity

This method statement covers all types of frames sizes

Original Approvals

	Name	Signature	Date
Written by:	Dr. Izzet Onel		10-12-12
Engineering approved:			10-12-12
QA approved:			10-12-12

Revision History

Rev	Summary	Approval	Date
0	Original Issue	See Above	dd-mm-yy

Equipment/Tools/Materials

- Artesis AMT toolkit
- Hand tool if applicable to secure connections
- Camera to record all connections made to perform task

NOTE: Ensure all equipment used is marked as being in calibration where required. If any materials have a shelf life, ensure they are in date before use.

PPE

- Adhere to site **PPE** instructions and the following may be applicable
- Safety glasses
- Hearing protection
- Safety boots
- Overalls (Call 12 if required)
- Helmet (If required)
- Warning tape/ barriers to cordon off test area (if opening MCC for the test) ?
- HV gloves (if required)
- Voltage probes to check panel is isolated (sometimes needed to check for 3 equal phases prior to connection)

Refer to and abide by Risk Assessments relevant to this process.

The required PPE (Personal Protective Equipment) shall be worn correctly at all times as necessary during the process. The process must be carried out in a responsible manner in accordance with all safety requirements.

Operator requirements

Engineer will have performed the correct required level of training for performing this process with current certified status as applicable.

NOTE: This Method assumes that the operator has working knowledge of and experience using the specified equipment. If you do not have experience using the equipment, do not start work on this process and see Work Leader/Supervisor for training and/or a new work assignment.

Hand tools carried if requested to secure crocodile clips to motor supply connections

Supporting Documentation

NOTE: Always refer to the most current document revision.

- Risk Assessment – Safety walk down and Risk assessment to be completed before testing shall begin. All operators working on the test subject shall sign and agree and adhere to appropriate Risk Assessment.

Prior to Procedure

BEFORE carrying out the process ensure that the following checks have been made:

- Planning documents are on hand and are stamped/signed up to date and that they reference to this Method Statement. And Risk Assessments are adhered to.
- Serial number or plant number of the Motor or motors matches planning and/or tick sheets.

In case of a discrepancy in the above, inform the Work Leader/Supervisor on shift and wait for a resolution before starting work on the part.

Prior to testing:

Note 1:

Artesis requires Station Electricians to provide access and shutdown motor if running and rack out system to allow safe working condition to provide safe access to make manual connections, if using manual application

For this task.

Note 2:


If the motor is LV then if customer requires crocodile connections to be secured then release connections were crocodile clips to be fitted then fit them and secure connections making sure that the new connection cannot get to ground.

Before AMU can be used for the first time it is necessary to change various settings from their default values. Values relevant to the connected motor must be set for the quantities described in the following sections.

If using the AMT system for connections then above procedure will not need to be followed as the connections is made via an external connection allowing safe connection to unit.

After connecting manually, start motor and check the phase ordering, to make sure connections are good.

When using AMT for first time after install, also check connections

	WARNING
<p>Lethal voltages and currents are present at the input terminals of this device. Accordingly, this AMT Toolkit should be installed and maintained only by qualified, competent personnel who have the necessary training and experience appropriate to high voltage and current devices. AMT Toolkit must be used in accordance with all local and national codes for the installation and operation of electrical equipment. Observe all site-specific procedures including local lockout and tagout.</p>	
<p>Recommended safety precautions should be followed at all times. Both current and voltage transformers can present lethal currents and voltages when their primaries are energized and standard practices (i.e. shorting the secondaries of current transformers and removing voltage transformer fuses) must be respected during installation or any subsequent service.</p>	

Procedure for Artesis AMT test unit

Online Testing Installation

If using the manual connection system at the MCC and If motor is 480 V or below then connect directly to incoming supplies. Before connection make sure that motor is not running and there is live connections.

See Note 2 above if required.

Take Photograph where connections are made for future reference

If motor voltage is above 480 V then connections have to be made VTs (Voltage signal) circuits in MCC.

Attached at the end of this Method Statement are schematic drawings for the connection within the MCC unit

Prior to commencement of testing procedure enter all motor nameplate details into AES for AMT Software and machine reference

Note: Artesis requires Station Electricians to provide access and make the required connections for testing procedure.

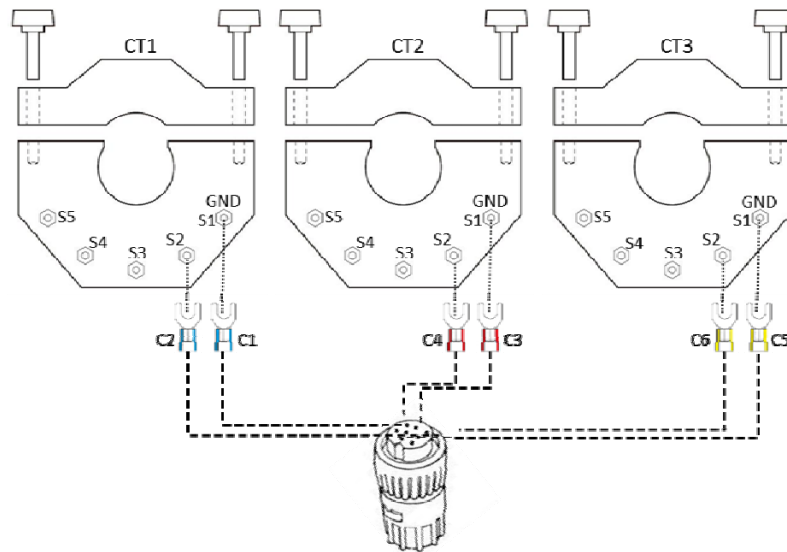
The process of connecting the AMT Toolkit system to the motor requires caution to avoid personal injury and damage to the AMT Toolkit. Follow the steps below to collect all three phases of the current and voltages:

AMT Toolkit Connections

1. Before setting up the AMT Toolkit, ensure that motor is not running and all switches are off.
2. Plug the power cable.
3. Turn power switch of MCM unit on.
4. Connect cross cable to the computer.

Current & Voltage Connections

1. Plug voltage sockets to AMT Toolkit and connect the alligator clips to the motor terminals or other location for direct contact with the conductors.
2. Select appropriate, 1 Amp or 5Amp, AMU for voltage and current connections. AMU for 1 Amp is provided for direct connections to the existing current transformers with 1 Amp secondary outputs of the motors with measurement units.
3. Connections for Low Voltage, Medium Voltage and Inverter Driven equipment are described. Follow the steps appropriate for the motor type.
 - 3.1. **Low Voltage Motors:** For 5 Amp AMU, plug current socket to AMT Toolkit, connect current cables to multi ratio current transformers supplied with AMT Toolkit and connect multi ratio current transformers to equipment's 3 phase supply cables. Connect current cables to multi ratio current transformers as described below according to motor's nominal current;



Connect C1, C3, and C5 current cables to S1 terminals of CT1, CT2, and CT3, respectively.

If nominal current is between 30 - 100 Amps, connect C2, C4, and C6 to S2 terminals as shown in the figure above.

If nominal current is between 100 - 200 Amps, connect them to S3 terminals.

If nominal current is between 200 - 300 Amps, connect them to S4 terminals.

If nominal current is between 300 - 400 Amps, connect them to S5 terminals.

If the motor measurement unit has existing current transformers make direct connections to those current transformers with 5 Amp secondary output.

If the nominal current is between 0 – 30 Amps and current transformers do not exist at the measurement unit of the motor, use current transformers (NOT SUPPLIED) with appropriate turn ratios. Turn ratios will be selected such that current inputs are between 1.5 – 5 Amps for 5 Amp AMU and between 0.3 – 1 Amps for 1 Amp AMU.

	<h2 style="margin: 0;">WARNING</h2>
<p><i>CURRENT TRANSFORMERS</i></p> <p>Incoming power must be de-energized before installation.</p> <p>Before wiring, de-energize the CT secondary by shorting it via a shorting block.</p> <p>The current transformer must have its secondary terminals short-circuited or connected to MCU unit, before energizing the primary circuit.</p> <p>Under no circumstances must the CT secondary be left open-circuited, even momentarily, when primary current is flowing. This causes high voltages that will overheat and explode the secondary of the CT and damage the instruments as well.</p> <p>Before disconnecting any MCU unit to or from a current transformer, the secondary terminals of the transformer should be shorted using a link capable of carrying several times the nominal output current (i.e. at least 10A).</p>	

3.2. **Medium Voltage Motors:** The test equipment has a limit of 480 volts. Therefore, testing on medium to high voltage motor and driven equipment is performed by utilizing secondary circuit (low voltage) to access the currents and voltages. Lethal voltages and currents are present at the input terminals of this device. Accordingly, this unit must be used in accordance with all local and national codes for the installation and operation of low voltage electrical equipment.

3.3. **Inverter Driven Motors:** Make sure that voltages are measured at the output terminals of the inverter. Direct connections to the output terminals are made for low voltage inverters. Voltage transformers (NOT SUPPLIED) are needed for medium voltage inverters. .

4. Ensure that current and voltage ranges of the equipment to be tested are within the range of AMT Toolkit range.

Input Voltage 480 Volts RMS AC maximum.

Input Current 400 Amps RMS AC maximum.

5. Turn the power switch of the AMU unit on.

6. Ensure that AMU's Power led is on.

7. Ensure that "IDLE" message appeared in the AMU's LCD display. If the unit is not in IDLE mode, press clear button until IDLE message appears in the LCD display.

8. Refer to section 3 for detailed information for the use of AMU unit.

AMT toolkit unit is pulley passive when not is use

Testing

Actual testing requires 30 minutes per motor after connection. Before start testing and after completing installation following configurations must be done.

Configuring AES for AMT Software

This section describes configuration of AMU unit using the "set up wizard". Alternative configuration is possible from the front panel by using the buttons of the AMU unit as described in section 3.

1. Before configuring AES Configuration Application, ensure that motor is running and voltage & current sockets are connected.

2. Select AMU model on the AES panel according to secondary amps value of current transformers (AMU 1A or AMU 5A).

3. Right click on it.

4. Select the 'Setup Wizard' menu item.

5. Click 'Next' button.

6. Enter equipment's 'Nominal Voltage', 'Nominal Current', 'Frequency' and 'Motor Speed'.

7. Choose connection type.

8. Click 'Next' button.

9. Enter voltage transformers' conversion ratio (Default value is 1). If there are no voltage transformers used, leave the conversion ratio as 1.

10. Click 'Next' button.

11. Enter current transformers' conversion ratio (Default value is 1). If the 100/5A is used, set the conversion ratio as 20.

12. Click 'Next' button.

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13. Wait for 90 seconds.
14. Click physical parameters button to see the measured parameters.
15. Ensure that electrical values (currents, voltages) are same as expected and phase ordering (see section 3.4.4) is right.
16. Click 'Close' button.
17. Click 'Next' button.
18. Click 'No' button.
19. Wait for the AMU device to finish 'Learn' and 'Improve' modes, and to get into 'Monitor' mode.
20. Right-click on the device and select "Waveform..." submenu. Download waveform data and save it to a text file. Close the waveform window.
21. By clicking the 'AMT Report' menu, open reporting user interface.
22. If the company information was not recorded before, click on 'Companies' group on the left bottom on the reporting user interface or 'Company' menu.
23. Click 'New Company' button on the 'Company' ribbon bar and fill the company information on the right pane.
24. Click 'Save' button on the ribbon bar.
25. On the motor pane, click 'Add New Motor' button.
26. Fill the motor information on new motor card.
27. Click 'Save Motors' button.
28. A motor can be removed by clicking 'Remove Motor' button.
29. Motor adding, editing operations can be cancelled by clicking 'Cancel Editing' button.
30. Click 'Report' menu or 'Reports' group on the left bottom. The companies and their motors will be listed on the left pane.
31. Click the 'New Report from DB' button. The AMU devices and their data are listed on the right pane.
32. Assign waveform text file by clicking the folder icon.
33. Drag a data from that list and drop into the related company's motor on the left so that the data can be assigned to a specific motor and a report is opened.
34. If you do not assign a waveform, you can assign it by selecting a report on the left and clicking 'Assign Waveform File' button.
35. A report can be viewed by double-clicking on it. The report will appear on the right pane.
36. A report can be exported as pdf file, e-mailed as attachment or previewed to print using the 'Export', 'E-Mail', and 'Preview and Print' buttons on the ribbon bar, respectively.
37. The PSD and waveform graphs of a report can be viewed by clicking 'PSD' and 'VI Waveform' tabs, respectively.

Reporting

Upon completion of the site inspection and testing Artesis will generate a comprehensive report detailing all tests and results contained within this particular work scope. Reports will also include suggested corrective actions (Immediate and future maintain ace requirements) and will be simplified with Digital photos and illustrations depicting problem areas.

Artesis AMT Toolkit was developed to meet a market requirement for a portable condition assessment product that can provide simple and accurate maintenance scheduling information, without the need for interpretation by highly trained personnel. It aims to be very simple to install, set up, and operate, and to require little or no user intervention until an equipment fault is detected.

Once the AMU unit is switched on, it requires minimal user configuration before entering an automated 'learn' mode during which the complete normal operating condition of the connected system is established. When this is complete, after 30 minutes, the AES for AMT software creates a complete Condition Assessment Report for the connected equipment.

Unlike conventional systems, this information is provided to the user immediately without having to wait for data trends to be collected and analyzed over an extended period. This report identifies any existing mechanical or electrical problems and recommends corrective actions and how soon such actions should be carried out.

The report also provides measured electrical parameters such as power factor, active and reactive power, voltages, currents and their imbalances as well as harmonics. If these electrical parameters are above their expected values, warning is issued for the attention of the user. These parameters can be used to help determine efficient operation of the equipment.

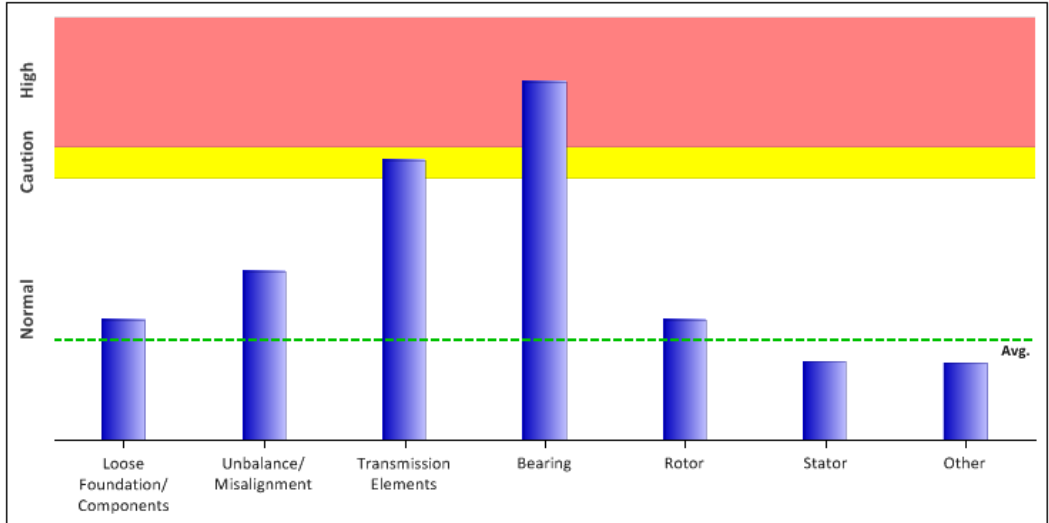
Many users are aware of the connection between deteriorating condition and reduced efficiency. Excessive misalignment, voltage imbalance or mechanical unbalance can have serious impact, as can heating caused by bearing or electrical problems. For example, efficiency is dependent on pulley size, driven torque, under and over belting, V belt design and construction. Efficiency deteriorates as much as 5% over time if slippage occurs. Getting the most out of your assets involves parallel improvements in both efficiency and effectiveness.

Artesis condition monitoring systems now provide benefits that go beyond traditional fault diagnosis to help users deliver in both these critical areas. The report provided by the AES for AMT software considers these deteriorations and informs the user. A sample report is provided on the following page:

CONDITION ASSESSMENT REPORT



Equipment Name	Motor A	Nominal Voltage	230 V
Equipment Type	Generator	Nominal Current	175 A
DB Start & End Date	2011-09-09 16:54:12 - 2011-10-19 22:02:21	Motor Speed	1953 rpm
Frequency	40 Hz		



Equipment comparison with worldwide MCM monitored equipment

WATCH EXISTING FAULTS These faults should be checked for verification and corrective action should be taken at the next scheduled maintenance but no later than three (3) months.

Mechanical Fault Indications

- Transmission Element / Drive Equipment. Check for transmission element(s) coupling, driven equipment, belt, pulley, gear box, and fan / pump impeller. **EEE:** Efficiency is dependent on pulley size, driven torque, under or over belting, and V belt design and construction. Efficiency deteriorates by as much as 5% over time if slippage occurs.
- Bearing Problem. Bearing(s) should be checked. **EEE:** The presence of bearing defects often results in reduced efficiency, or even severe damage, of the motor under consideration.

Status	Name	Value
OK	Power Factor	0.98
OK	Active Power [kW]	139
OK	Reactive Power [kVar]	25
Watch	Vrms [V]	185
Watch	Irms [A]	285
OK	V Imbalance [%]	1.1
Watch	I Imbalance [%]	34
OK	Frequency [Hz]	40
Watch	THD [%]	7.3
Watch	3th Harmonic [%]	6.5
OK	5th Harmonic [%]	0.32
OK	7th Harmonic [%]	0.05
OK	9th Harmonic [%]	0.12
OK	11th Harmonic [%]	0.03
OK	13th Harmonic [%]	0.04
WATCH ELECTRICAL VALUES	Electrical values are outside of their expected range. They should be noted and watched to identify the cause.	

WATCH ELECTRICAL VALUES Electrical values are outside of their expected range. They should be noted and watched to identify the cause.

Current and Voltage

Voltage variation is beyond (+/-10%) normal limits. Its source should be determined and corrected.

The average RMS value of the phase currents exceeds 10% of the nominal current values. Monitor for increased hot spot temperature.

Current and Voltage Unbalance

Current unbalance exceeds 5%. Check for stator problems, short circuits, isolation problems, partial discharge, etc. **EEE:** Voltage and current unbalance cause heat and up to 3% energy efficiency problems.

Harmonic Distortion

There is high harmonic distortion. If Total Harmonic Distortion (THD) is more than 5%, this causes heating and vibration. A high third harmonic can cause heating in the stator windings. A high fifth harmonic can cause vibration. Use harmonic filter if feasible.

NOTES Additional check is performed for bearing, carefully. This motor will be checked within short periods.

Safety Warnings

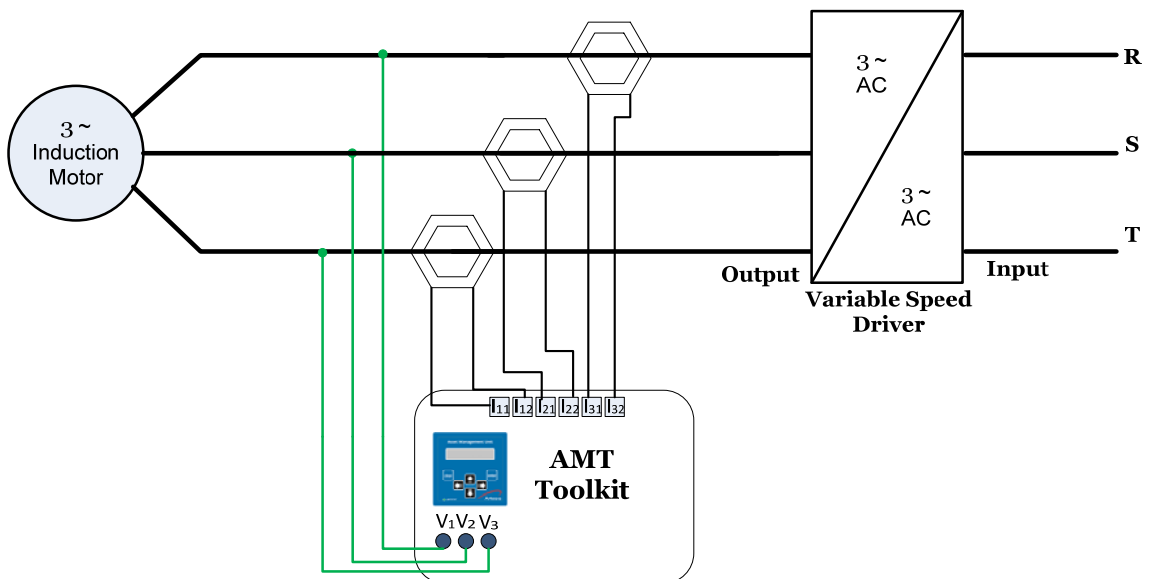
1. Ensure all stored energy sources electrical, mechanical and pneumatic are locked and tagged.

2. Only execute work in accordance with that permitted within work scope.
3. Only trained Artesis personnel allowed to carry out electrical and mechanical test procedures.
4. Correct hand protection to be worn when during any possible lifting & manual handling operations
5. Maintain a clean environment and clean up any spillages immediately.

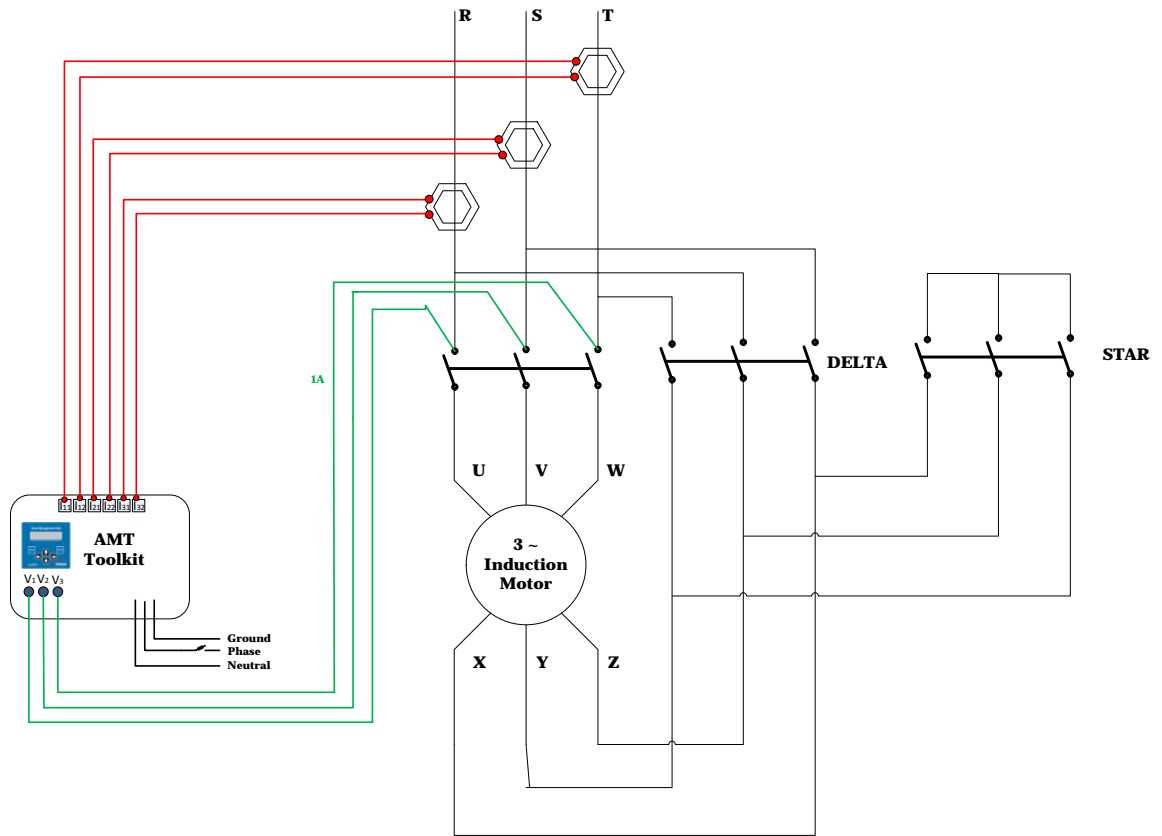
On the following pages are schematic drawings of methods of connecting to CT and VT circuits for Artesis AMT toolkit

Appendix : Connection Diagrams

1. Low voltage line driven motors with current transformers
2. Low voltage inverter driven motors with current transformers



3. Low voltage line driven star/delta connected motors



4. SoftStarter

