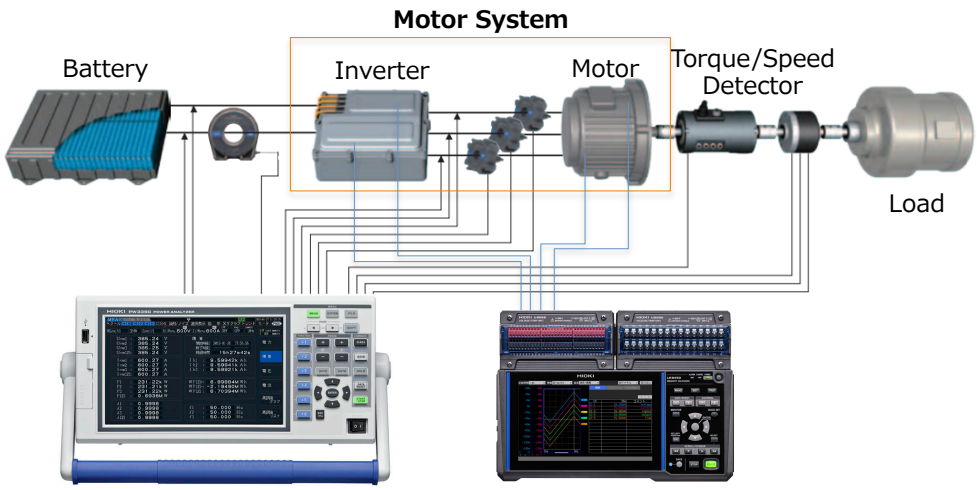
The New ISO21782 Standard



Electrically Propelled Road Vehicles

Test specification for electric propulsion components

Introduction

"ISO 21782: Electrically Propelled Road Vehicles -Test Specification for Electric Propulsion Components" was published on August 29, 2019. There are several regulations and standards for motor systems used in vehicles such as JIS D1302, UN R85, TRIAS-99-017-01, and GB/T 18488.1/2, but until recently, no international standard for motor systems existed.

Previously, existing international standards for industrial motors were only adapted for testing motors at stop or steady states. In contrast, this new international standard outlines test sequences of dynamic movement (acceleration and deceleration) for electrically propelled road vehicles. With it, we can fairly compare and evaluate the performance and reliance of automotive components.

*This document is created by HIOKI based on research regarding ISO 21782 and should not be considered a legal guide to the standard. Please see the ISO website for further information to verify the details of this standard.

Structure of Standard

ISO 21782 consists of 7 parts and parts 1, 2, 3 and 6 have been published.

- ISO 21782-1: 2019 Part 1: General test conditions and definitions
- ISO 21782-2: 2019 Part 2: Performance testing of the motor system
- ISO 21782-3: 2019 Part 3: Performance testing of the motor and inverter
- ISO 21782-4 Part 4: Performance testing of DC/DC converter (under development)
- ISO 21782-5 Part 5: Operating load testing of motor system (under development)
- ISO 21782-6: 2019 Part 6:Operating load testing of motor and inverter
- ISO 21782-7 Part 7: Operating load testing of DC/DC converter (under development)

Outline of the Tests

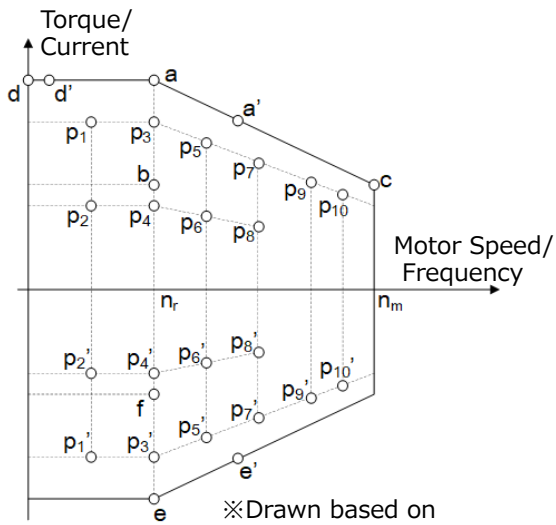
- Part 2 describes the test for a motor-system, which is defined as an inverter and a motor. It defines the measurement of total loss and total efficiency between the input power of the inverter and the output power of the motor, the temperature rise test of each component, the torque characteristic test, and the torque ripple test.
- Part 3 describes how to separately test the motor, inverter, and chopper. It defines the measurement of loss and efficiency, and the test of temperature rise for each component. It also describes the torque characteristics test and cogging torque test for the motor.
- Part 6 describes the operation endurance tests of the motor and inverter, and breakdown strength verification test of the motor.

Operating points

ISO21782 defines the operating points for the tests.
To execute the tests above, the operating points are set based on:

1) Motor speed or frequency
2) Motor torque or current or output power of the inverter

In addition, test times are stipulated for each test point, such as 2, 10 or 1800 seconds.

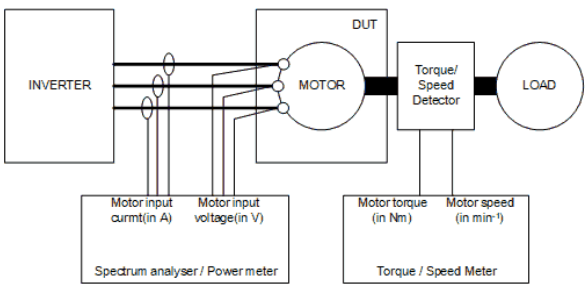


※Drawn based on ISO21782-1, First Edition 2019-08

Measurement parameters

The following are some of the parameters measured based on test diagram provided by the standard:

1. Room temperature and humidity as defined by ISO 21782-1:2019 5.4.
2. Voltage and current of the motor or inverter as input; voltage and current of the inverter and chopper as output
3. Motor torque and speed as output
4. Temperature of each component and temperature rise test
5. Inverter output frequency
6. Rotor speed



※ Drawn based on ISO21782-3, First Edition 2019-08

Measurement accuracy

ISO 21782-1 defines measurement accuracy as follows:

- Current: ±1.0 %
- Voltage: ±0.5 %
- Torque: ±0.2 %
- Motor speed: ±0.5 %
- Temperature: ±2K
- Relative humidity: ±5 %

All measurement values, except temperature and relative humidity values, shall be measured with and recorded at a frequency of no less than 10 Hz. For temperature and relative humidity values, a measurement frequency of 1 Hz is sufficient.

Test Reports

Examples of test reports are shown in the annex of ISO 21782-2, -3 and -6.

1. Common conditions											
	Items			Value			Remark				
	Ambient temperature(in ℃)			23							
	Ambient humidity(in %)			50							
	Cooling type			(Liquid) / Air / Others							
	Coolant temperature										
	Coolant flow rate(in l/min)										
2. Results and individual conditions											
	Items			Value							Remark
	Operating points			a	a'	b	p_1	p_2	p_3	p_4	
	Operating time(in s)			2		1,800	2	1,800	2	1,800	
	Input	Current(in A)		125		80	53	26	106	53	
		Voltage(in V)	Target	370		370	370	370	370	370	
			Measured	370		370	370	370	370	370	
		Power(in kW)		46		30	20	10	39	20	
	Output	Torque(in Nm)	Target	350		220	280	140	280	140	
			Measured	350		220	280	140	280	140	
		Speed(in min^{-1})	Target	1,200		1,200	600	600	1,200	1,200	
	Operating points			p_5	p_6	p_7	p_8	p_9	p_{10}		
	Operating time(in s)			2	1,800	2	1,800	2	2		
	Input	Current(in A)		86	43	84	41	82	80		
		Voltage(in V)	Target	370	370	370	370	370	370		
			Measured	370	370	370	370	370	370		
		Power(in kW)		32	16	31	15	30	30		
	Output	Torque(in Nm)	Target	168	84	132	63	104	92		
			Measured	168	84	132	63	104	92		
		Speed(in min^{-1})	Target	1,650	1,650	2,100	2,100	2,550	2,820		

*Drawn based on ISO21782-2, First Edition (2019-08)

What measurement instruments do you need?

Measurements of currents and voltages referencing the test diagrams should be done using power meters. In addition, a torque/speed meter with a torque/speed detector should be used to measure the motor's torque and speed.

By using a Hioki Power Analyzer, you can measure all four of those elements with just the one device. In addition, a multi-channel thermometer which can measure the temperature of the required measurement points, and a set of a thermometer and hygrometer to measure room temperature/humidity, are recommended.

*For the testing system, a DC power supply, electric road, dynamometer, and other devices are also recommended.

Important points to consider when choosing measurement instruments

The motor speed range of the operating points are very wide, from 50% of rated speed to “the rated speed plus 90% of the difference between rated speed and the maximum speed.” In addition, the motor torque or inverter currents are from 40% to 100% of the rated values.

In light of this requirement, power meters should be equipped to measure from DC to high frequencies with an accuracy of 1.0% for currents and 0.5% for voltages.

Current sensors that have the frequency characteristics and accuracies above to measure high currents are required. Furthermore, the accuracy to be considered must be the accuracy of the current sensor and measurement device used in combination.

For example, the accuracy of the current should a maximum of 1.0% with the sensors and measurement device combined.

In the standard, using the three-wattmeter method is recommended for measuring AC power, which requires a power meter that has at least three channels. In addition, since DC input is necessary, it is ideal to use an AC/DC power meter with four channels.

Recommended Instruments

POWER ANALYZER: PW3390

- ±0.04 % rdg. ±0.05 f.s. basic voltage accuracy
- 200 kHz measurement bandwidth with flat amplitude and phase accuracy that extend to high frequencies
- Easy power measurement using clamp-on current sensors
- High accuracy, high speed calculation of transient-state power in 50 ms

For Higher Accuracy Measurement

POWER ANALYZER: PW6001

CURRENT SENSOR (High Accuracy Pass-through Type)

CT6862

CT6904

CT6877

- **CT6862**
  Rated current: 50 A AC/DC
  Frequency band DC to 1 MHz (-3dB)
  Core diameter Φ 24 mm (0.94 in)
- **CT6904**
  Rated current: 500 A AC/DC
  Frequency band DC to 4MHz (-3 dB)
  Core diameter Φ 32 mm (1.26 in)
- **CT6877**
  Rated current: 2000 A AC/DC
  Frequency band DC to 1 MHz (-3 dB)
  Core diameter Φ 80 mm (3.15 in)

Current Sensor Lineup

MEMORY HiLOGGER: LR8450

- Connect up to 4 plug-in units
  (select from 5 types; e.g. U8552)
- 120 channel multipoint measurement with 4 units
- Further increase channels with wireless LAN model
  (LR8450-01: scheduled for release at a later date)

For Faster Measurement

MEMORY HiCORDER: MR8740-50

VOLTAGE/TEMPERATURE UNIT: U8552

- 30 channels (isolated scanning method)
- MAX sampling period (data is scanned each period):
  10 ms (when 15 channels or less)
  20 ms (when 16 to 30 channels)
- Measure voltage, temperature (thermocouple), and humidity (using HUMIDITY SENSOR Z2000)
- Input terminal: Push-button terminal block