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Minimum allowable values of energy efficiency and energy efficiency grades for welding machine

电焊机能效限定值及能效等级

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Minimum allowable values of energy efficiency and energy efficiency grades for welding machine

1 Scope

This Standard specifies the energy efficiency grades, minimum allowable values of energy efficiency and test methods for arc welding machine and resistance welding machine.

This Standard is applicable to the arc welding machine and resistance welding machine that are designed for industrial and professional use, not exceeding the voltage specified in GB/T 156.

The resistance welding machine to which this Standard applies specifically refers to the resistance welding transformer which is finally installed with the frame, the input circuit and the secondary circuit.

This Standard is not applicable to AC TIG arc welding machine, AC and DC TIG arc welding machine, power frequency secondary rectification resistance welding machine, seam welding machine, resistance butt welding machine, flash butt welding machine, energy storage resistance welding machine, inverter AC resistance welding machine, separately-sold resistance welding transformer and mechanical equipment driven welding machine.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 156, *Standard Voltages*

GB/T 2900.22, *Electrotechnical terminology - Electric welding machine*

GB/T 8118, *The general specification for arc welding machines*

GB/T 8366, *Resistance welding - Resistance welding equipment - Mechanical and electrical requirements*

GB/T 14549-1993, *Quality of Electric Energy Supply - Harmonics in Public Supply Network*

GB 15578, *Safety requirements for resistance welding machine*

GB/T 15579.1, *Arc welding equipment - Part 13: Welding clamps*

GB/T 25301, *Resistance welding equipment - General specifications applicable to all transformers*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 2900.22, GB/T 8118, GB/T 15579.1, GB/T 8366, GB 15578, and GB/T 25301 as well as the followings apply.

3.1 minimum allowable values of energy efficiency for welding machines

The maximum guaranteed value of allowable efficiency of an arc welding machine in the rated state, the maximum limit of short circuit loss allowed by a resistance welding machine in the rated gear, under standard-specified test conditions.

3.2 no-load loss for resistance welding machine

The active power when the secondary winding of a resistance welding machine (where applicable, including a rectifier) is in an open circuit, and at the rated gear position, the rated voltage of the rated frequency is applied to the primary winding of the resistance welding machine and input to the resistance welding machine.

3.3 short circuit loss for resistance welding machine

The active power input to a resistance welding machine when the secondary winding of the resistance welding machine (where applicable, including a rectifier) is in the best short circuit condition, and at the rated gear position, an appropriate voltage at the rated frequency is applied to the primary winding of the resistance welding machine, when the current flowing through the primary winding is the continuous input current I_{1P} of the resistance welding machine.

4 Energy efficiency grades of welding machine

The energy efficiency grade of welding machine is divided into 3 grades, where grade 1 is the highest energy efficiency. The energy efficiency indicators of arc welding machines at all grades shall comply with corresponding provisions in Table 1 ~ Table 6. The energy efficiency indicators of resistance welding machines at all grades shall comply with corresponding provisions in Table 7 ~ Table 10. If the nominal load duration of resistance welding machine is 50%,

temperature of 10°C ~ 40°C. Welding machines that use liquid cooling shall be tested under the liquid cooling conditions specified by the manufacturer. The energy efficiency of a welding machine shall be measured under the following conditions:

a) Achieve thermal equilibrium under rated operating conditions;

b) An arc welding machine shall be adjusted to the rated maximum welding current;

c) A resistance welding machine is at the rated capacity gear corresponding to 50% load duration;

d) When the load duration is below 100%, at the midpoint of the load time;

e) Auxiliary equipment (such as wire feeder) is in no-load operation.

6.2 Measuring device

The measuring device shall meet the following requirements:

a) The measuring device shall meet the relevant standards and shall be calibrated or verified at a prescribed interval.

b) The accuracy or precision of the electrical measuring device is grade 0.5 (± 0.5% of full scale), and the temperature measuring instrument is ±2K.

c) The measuring device shall meet the measurement requirements of the measured parameters. Select a correct measurement device according to the voltage and/or current waveform. The influence of at least the following factors on the measurement results shall be excluded:

- Harmonics of input current of inverter welding machine;
- Frequency of inverter welding machine;
- Non-sinusoidal and/or non-periodic voltage and/or current;
- Large ripple factor DC voltage and/or current.

d) The measuring device of input power shall be a direct measuring device.

e) The load used to measure the arc welding machine shall be an actual non-inductive constant resistance load with a power factor of not less than 0.99.

6.3 Power supply

6.3.1 Classification and parameters of power supply mode

$$R_s = \frac{U_{1no\text{-}load} - U_{1load}}{I_{1load} - I_{1no\text{-}load}} \quad \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (2)$$

Where,

R_s - Power supply impedance, in ohms (Ω);

$U_{1no\text{-}load}$ - Power input voltage when the welding machine is no-load;

U_{1load} - Power input voltage when welding machine is load;

I_{1load} - Input current of the welding machine under load;

$I_{1no\text{-}load}$ - Input current of the welding machine at no load.

When determining the impedance of the power supply, ensure that the input voltage difference between no-load and load is more than 1%, and all voltage regulation or voltage stabilization functions of the power supply shall be turned off.

c) The input voltage of the welding machine shall be its nominal rated input voltage value.

d) The input power frequency of the welding machine shall be the rated frequency of its nominal input power.

e) The allowable unbalance of three-phase voltage shall not be greater than ±1.5%.

6.3.3 Variable frequency power supply

When measuring the energy efficiency of an inverter resistance welding machine, it requires variable frequency power supply or power supply by variable frequency controller of resistance welding machine. In addition to self-power supply by inverter controller that supports the resistance welding machine, the inverter power supply to the inverter resistance welding machine shall meet the following requirements:

a) When the frequency is within ±1% of nominal frequency of resistance welding machine, the voltage waveform shall be a full-rectangular rectangular wave with alternating polarities with a duty cycle of not less than 85%. The rise and fall times of rectangular waves must not exceed 1% of the cycle. The difference between the maximum value and the minimum value of the rectangular wave amplitude must not exceed 5% of the sum of the maximum and minimum values of the rectangular wave amplitude;

b) When measuring the no-load current and no-load loss of the resistance welding machine, it shall be able to provide the nominal rated input voltage value at the nominal frequency of the resistance welding machine;

c) When measuring the short-circuit loss of the resistance welding machine, it shall be able to provide continuous input current (I_{1P}) at nominal frequency of resistance welding machine.

6.4 Test site layout

6.4.1 Welding machine layout

When conducting the energy efficiency test on welding machines, the test site layout of welding machines shall meet the following requirements:

a) A welding machine and its auxiliary equipment shall be arranged according to the actual conditions of use;

b) In order to keep a welding machine in normal ventilation and heat exchange, in addition to the support surface, there must be no shelter or strong air convection within 1m from the periphery of the welding machine;

c) There must be no magnetically permeable material that affects the test accuracy within 1m from the periphery of a welding machine;

d) When measuring the no-load current and no-load loss of a resistance welding machine, the output end of the resistance welding machine is open-circuit state;

e) When measuring the short-circuit loss of a resistance welding machine, the output of the resistance welding machine is the best short-circuit state.

6.4.2 Input cable layout

When conducting the energy efficiency test on welding machines, the input cable layout shall meet the following requirements:

a) Minimize the inductance due to input cable layout;

b) The input cable shall be folded into a harness with a length of no more than 40cm.

6.4.3 Measuring device layout

When conducting the energy efficiency test on welding machines, the measuring device layout shall meet the following requirements:

a) All input currents fed into an arc welding machine or resistance welding machine can be measured;

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