700297

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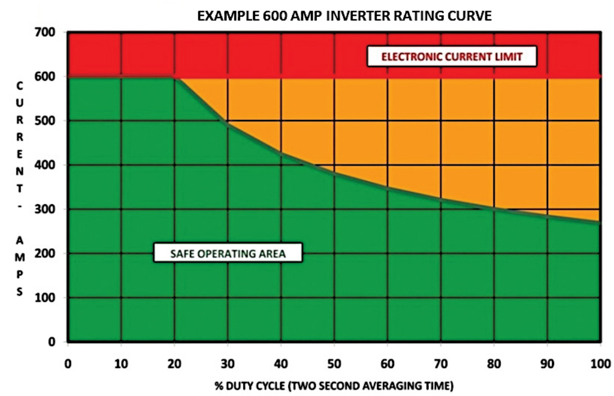
Q: *What is the duty cycle rating of a resistance welding mid-frequency direct current inverter?*

A: A duty cycle rating is defined by how long a mid-frequency direct current (MFDC) inverter can be operated in a given period at its maximum designed output current. This time period is typically a 2000 ms (2 s) cycling period.



(Left) The iPAK2 600AWBv2 inverter; (right) 600 AMP inverter graph.

Q: *Why is duty cycle important?*

A: The duty cycle defines the maximum weld time at the maximum primary current output of the MFDC inverter. If the maximum duty cycle of the MFDC inverter is exceeded, the probability of premature failure increases. Typically, an inverter with a higher duty cycle rating can output longer weld times at higher currents and operate at higher production rates.

For example, if an inverter is rated at 600 A (the maximum primary current output), there will be a maximum weld time that the inverter can run. Typical duty cycles range between 5 and 20% of maximum primary output current and vary by manufacturer and model.

Q: *How is duty cycle calculated?*

A: The percent duty cycle is calculated by dividing the total weld time of all weld pulses by 2000 ms then multiplying by 100. The percent duty cycle is then evaluated based on the average primary current output during the weld.

The example graph to the right demonstrates how the MFDC inverter duty cycle rating is directly linked to primary current output and welding time in any 2000 ms (2 s) cycling period (e.g., if we run the MFDC inverter at 600 A, the maximum weld time is 400 ms).

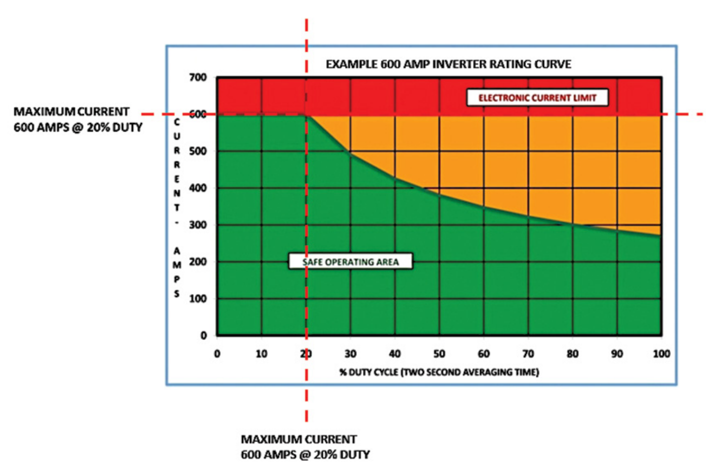


Fig. 1 — 600 AMP inverter with 20% duty cycle.

Example:

Maximum primary output current: 600 A

Weld time: 400 ms

Calculated percent duty cycle: 20%

The MFDC inverter is at its absolute duty cycle limit.

(400 / 2000) * 100 = 20% (Fig. 1)

Q: *How do you use duty cycle to select the correct MFDC inverter for your application?*

A: When sizing the MFDC inverter for a production process, it is recommended not to operate it at its maximum limit. An appropriate safety factor should be considered.

Example 1:
Single weld at 200 A for 200 ms
The MFDC inverter is operating well within the calculated 10% duty cycle.
(200 / 2000) * 100 = 10% (Fig. 2)

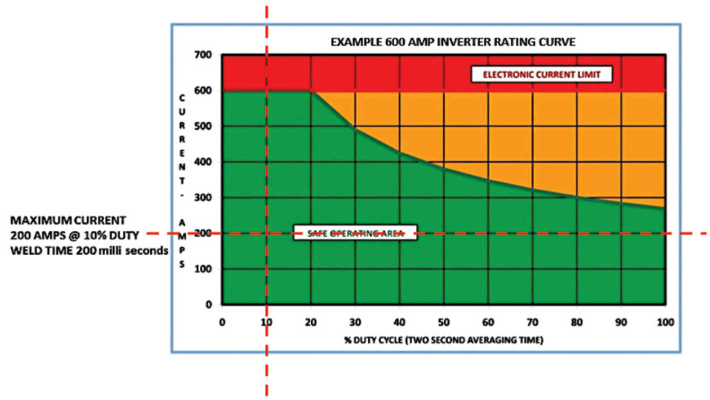


Fig. 2 — 600 AMP inverter with 10% duty cycle.

Example 2:
Pulsed weld (5 × 200 ms) at 300 A
Total weld time: 1000 ms
Duty cycle: 50%
The MFDC inverter is working within its calculated 50% duty cycle.

However, this welding parameter configuration is getting close to the MFDC inverter's duty cycle limit (Fig. 3).

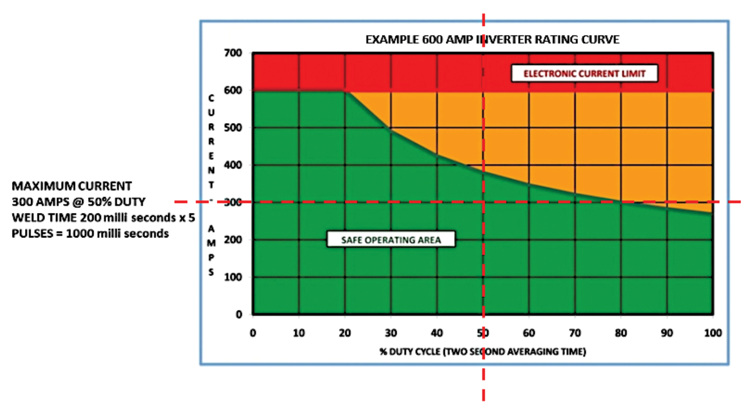


Fig. 3 — 600 AMP inverter with 50% duty cycle.

Example 3:
Continuous seam welding process (exceeding 2000 ms) at 300 A
Continuous weld time: 8000 ms (4 s)
Duty cycle: 400%

(8000 / 2000) * 100 = 400%

This welding configuration exceeds the permissible calculated 100% duty cycle and will lead to premature MFDC inverter failure (Fig. 4).

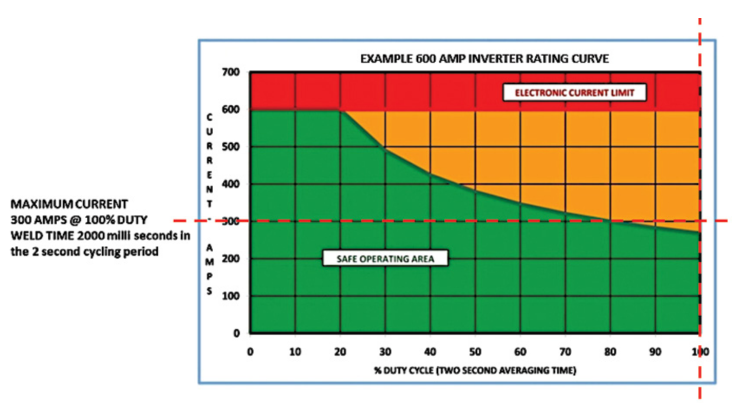
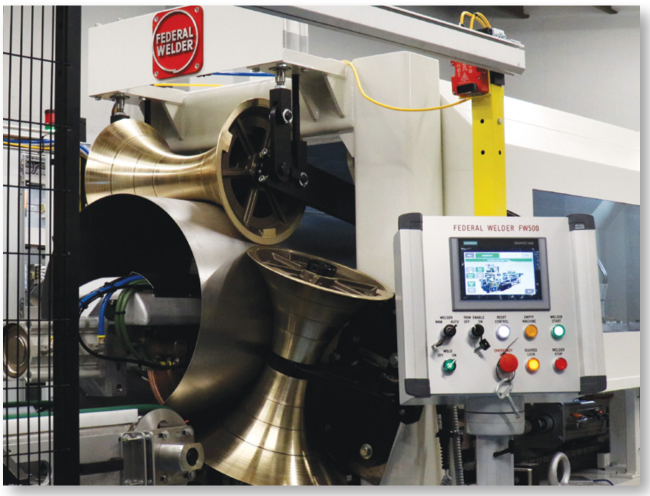


Fig. 4 — 600 AMP inverter with 400% duty cycle.

Q: *What resistance welding applications benefit from higher duty cycle inverters?*

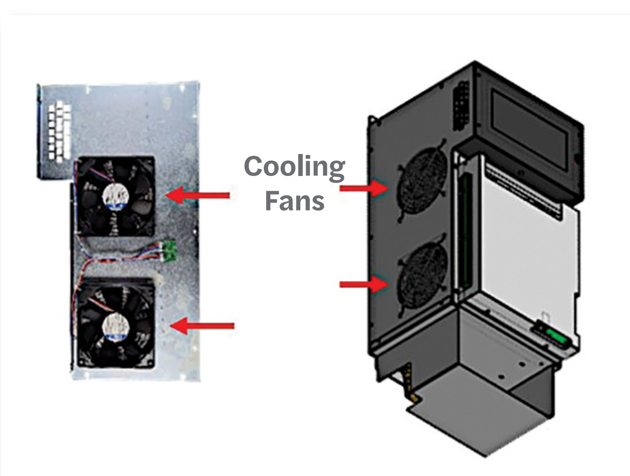
A: Continuous seam, pulsed seam, sintering, cascade, and multiple or repeat spot welding applications benefit from using a higher duty cycle inverter.



Seam welding machine.

Other factors that can affect the designed duty cycle of a resistance welding MFDC inverter are listed below:

- **MFDC Inverter Cooling Mechanisms:** MFDC inverters with internal cooling fans and water-cooled heat sinks cool down faster, improving their duty cycle.



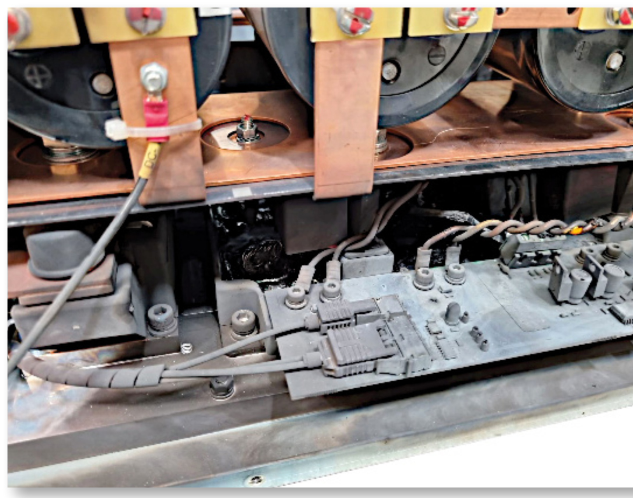
Inverter cooling fans.

- **Ambient Temperature:** Duty cycles are usually determined at a specific ambient temperature. If the working environment is hotter than the manufacturer's recommendation, it can reduce the actual duty cycle.

- **Welding Process:** Different welding processes, such as single spot, pulsed spot, linked programs, projection, and continuous seam, have different demands on the MFDC inverter and will influence the duty cycle.

- **Humidity:** High humidity can affect heat dissipation, reducing the duty cycle of the MFDC inverter.

- **Cleanliness:** Dust and debris can block airflow vents, leading to faster overheating of insulated gate bipolar transistors (IGBTs) and reduced duty cycle.


A dirty inverter board.

Conclusion

Understanding and adhering to the manufacturer's duty cycle of an MFDC inverter is vital for achieving efficient, high-quality, and safe welding operations. Considering all the factors that influence the duty cycle and leveraging the capabilities of MFDC resistance welding technology will result in an extended lifespan of the equipment. WJ

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