

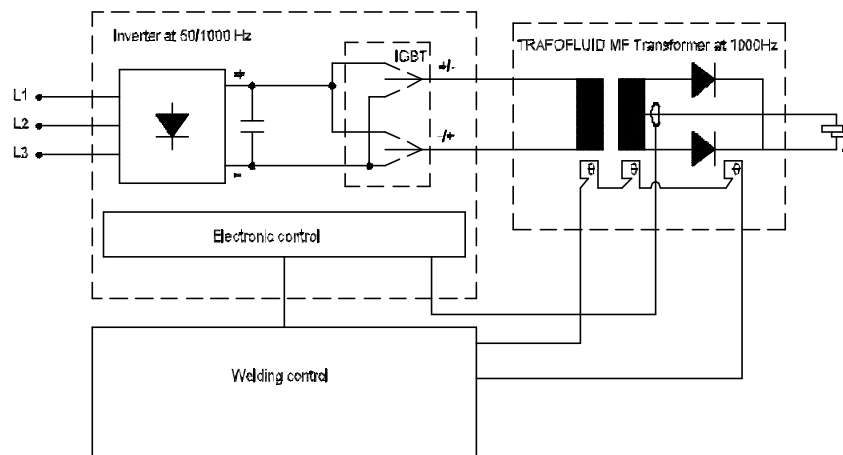
Resistance Welding with Medium Frequency Technology

The use of the direct current resistance welding, obtained by rectifying an alternating voltage at 1000Hz, is increasingly spreading thanks to the numerous advantages it offers compared with other traditional methods such as:

- Alternating current at 50Hz.
- Direct current obtained by rectifying an AC current at 50 Hz.
- Capacitive discharge.

An electronic inverter supplies the power at 1000Hz through the following phases:

- A. Rectification of the three-phase supply voltage at 50Hz, through a three-phase rectifier bridge.
- B. Generation of a square wave at the frequency of 1000Hz with the use of an IGBT, (Insulated Gate Bipolar Transistor Modules).



The inverter is usually fed by the three-phase supply mains at 50Hz and gives a square wave no-load voltage with amplitude of $V_{1000\text{Hz}} = V_{r.ms.} \times \sqrt{2}$ that for a supply mains of 400V and 50Hz is 565.68V.

The transformation and the rectification to the values of DC voltage of 8-16V, is obtained using a centre tap transformer connected to one or more paralleled diodes for every single phase.

Techniques of resistance welding

Concerning the welding techniques please refer to the Trafofluid handbook.

Transformer with built-in rectifier, supplied with 1000Hz frequency

The general technical information regarding the transformer and the meaning of the related technical data, are also available on the Trafofluid handbook.

Reference Standards

The standards dealing with the medium-frequency transformers, with built-in rectifier is in understudy from the technical committee ISO TC 44.

Other applicable reference standards are: ISO 5826, 1999 – ISO 10656, 1996.

Choice of the transformer

The choice of transformer-rectifier assembly should always be done in two separate steps once the necessary technical data are known.

The first step consists on selecting which transformer is able to deliver the current I_w necessary to the welding circuit connected to the rectifier, having a known value of the load resistance R_w . During this first step it is possible to temporarily neglect the welding times because the voltage drops are independent from the welding time (T_{on}) and pause time (T_{off}).

The choice has to be made using the load-curves expressing the values of current I_w depending on the power rating of the transformer and the load resistance R_w of the welding circuit plus rectifier.

The second step consists on verifying if the assembly of transformer and rectifier selected by using the welding current I_w and the load resistance R_w may thermally withstand the currents at the nominal duty cycle X .

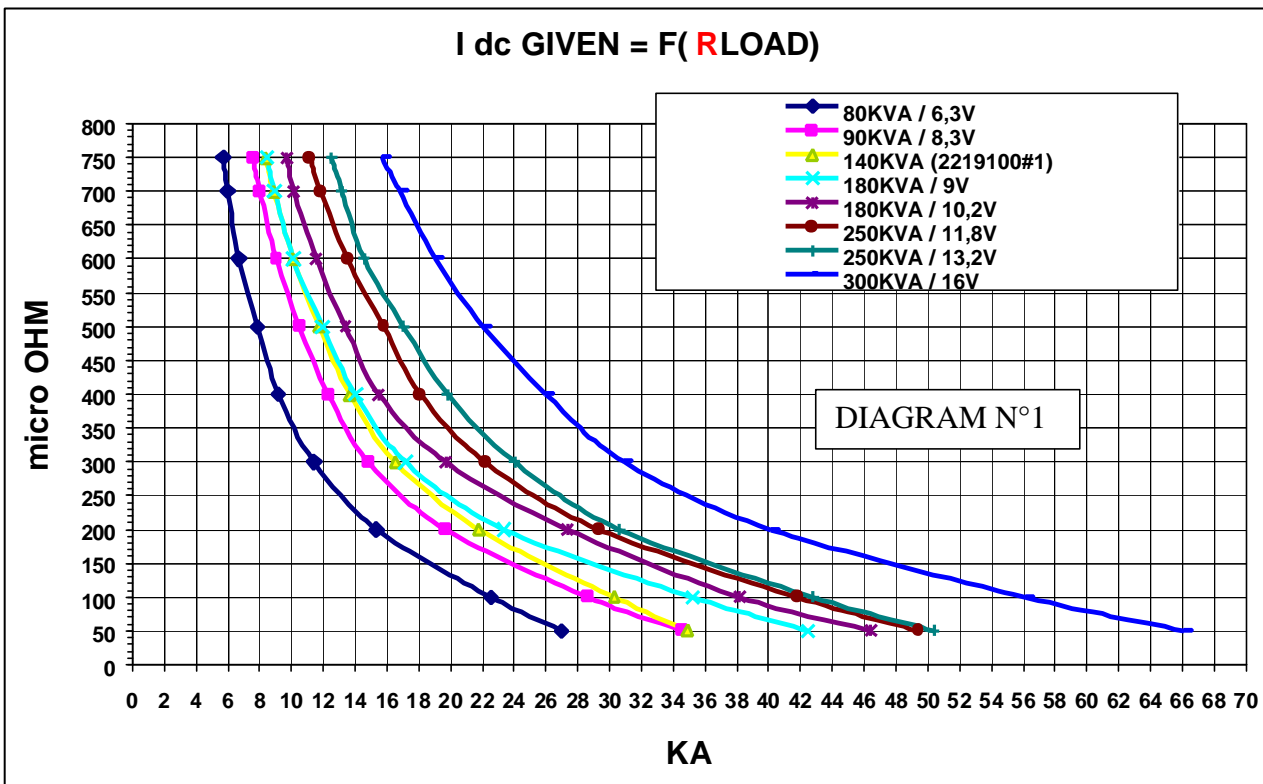
When determining the overall duty cycle two separate calculations have to be done, one for the duty cycle of the diodes and one for the duty cycle of the transformer.

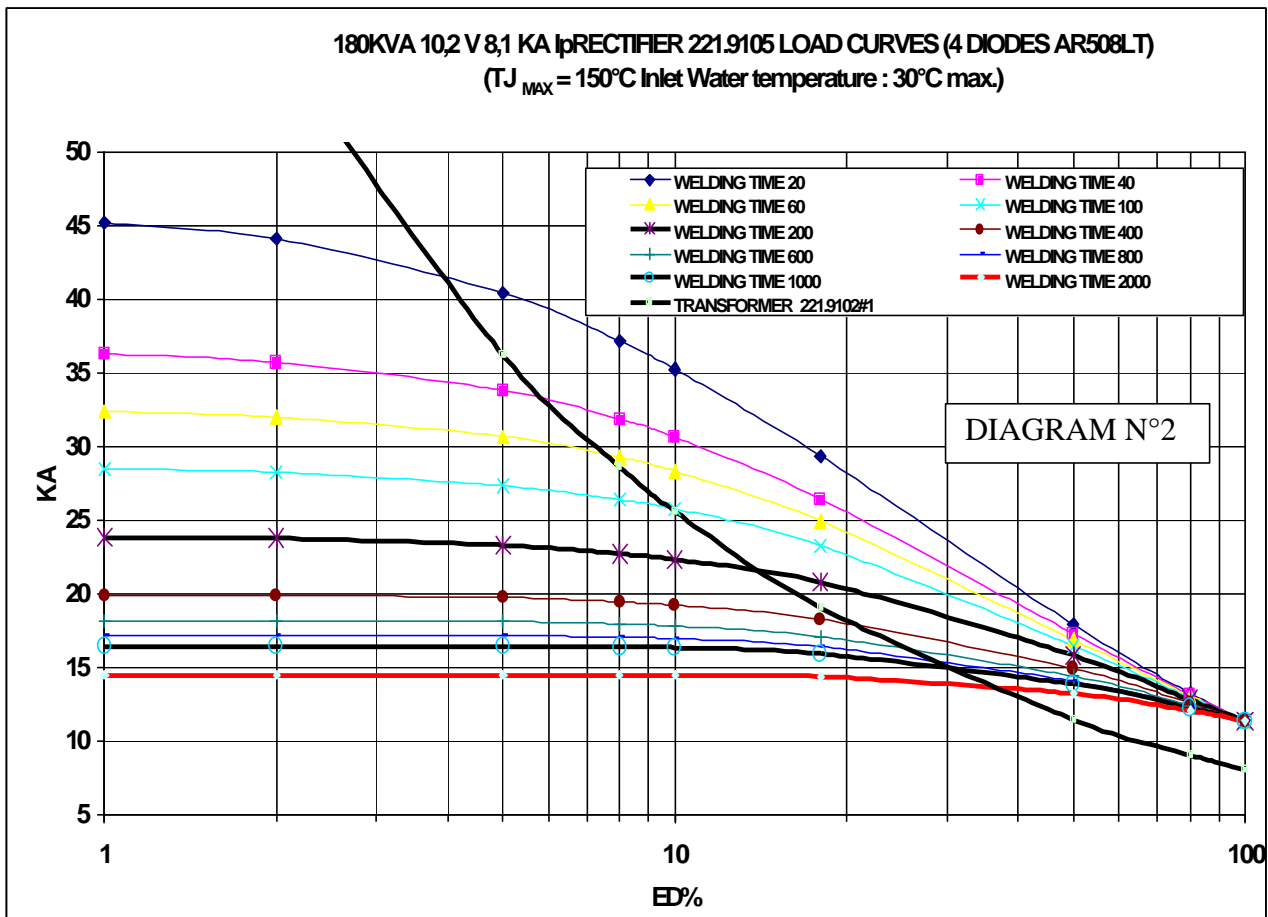
This is necessary because of the different time intervals to be considered for the ON and OFF status.

From the definition of duty cycle we have $X = \frac{ts}{ts + tp} \times 100$ where ts = welding time and tp = pause time.

Where: $ts + tp \leq 2 \text{ sec.}$ for the diodes
 $ts + tp \leq 60 \text{ sec.}$ for the transformer

As a result for some type of welding the two duty cycles can be completely different, as the values of the current thermally deliverable from each element (rectifier and transformer).





Example:

We are required to carry out the a welding process with the following data:

1. Welding current $I_w = 26\text{KA}$.
2. Resistance of the welding circuit (including the material to be welded) = $200\mu\text{O}$
3. Welding time $t_s = 100\text{ms}$.
4. Pause time $t_p = 3000\text{ms}$.
5. First step:
 - a. Using the diagram N°1 we see that the transformer capable to deliver 26KA with a resistance of $200\mu\text{O}$ is the type $180\text{K}, 10,2\text{V}$.

6. Second step:

- a. We calculate the duty cycle of the diodes: $X = \frac{100}{2000} \times 100 = 5\%$

Note: If we had used a time interval of 4000ms, we would have made a mistake because, the integration time of the diodes can be maximum two seconds.

- b. We calculate the duty cycle of the transformer: $X = \frac{100}{1000 + 3000} \times 100 = 3,225\%$.

- c. On the diagram N° 2, which refers to the $180\text{K } 10,2\text{V}$ transformer, check whether the current of 26KA can be delivered by the rectifier for a time interval of 100ms and a duty cycle (X) of 5% .

The current deliverable by the rectifier under these operating conditions is higher than the necessary value.

- d. On the same diagram N°2 check if the transformer may withstand a current of 26KA with a duty cycle (X) of 3,3%.

Also the transformer can largely deliver the requested current.

In case the transformer or the rectifier are not able to deliver the requested currents a greater power must be chosen.