

Skeleton Technologies

SkelCap

**Industrial Ultracapacitor Cells
Welding Guidelines**



**TECHNICAL
NOTE**

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This document provides welding guidelines for SkelCap Industrial Ultracapacitor Cells.

Date	Revision	Description
14.11.2017	02-SCA-170608-1B	initial revision
06.02.2018	02-SCA-170608-1C	Updated weld depth tolerances, Updated busbar tolerancing, Equipment parameters changed. Points added to "Laser welding guidelines chapter"

General Safety Information

- + Overheating the cell continuously can cause decrease in cell performance and can cause the safety vent to open, which results in catastrophic failure.
- + Caution must be used when welding in order to not crack or shrink the plastic sleeve of the cell due to excessive heat.
- + The parameters described in this technical note were developed for specific equipment used at Skeleton and may require adjustment to achieve optimal results with other equipment.
- + Please ensure all safety recommendations and considerations are followed when welding.
- + Your welding equipment provider will be able to assist you in proper safety procedures.

DO NOT BREAK THROUGH THE CELL WALL!

Piercing the cell wall may result in catastrophic failure or otherwise damage the cell and reduce its performance and lifetime. The SkelCap cell wall has a thickness of a minimum 3.0mm vertical and sidewall thickness of a minimum 0.7mm.

Laser Welding Guidelines

The purpose of laser welding is to:

- + provide a reliable electrical connection, and
- + minimize contact resistance.

Special consideration should be given to the application of the cells to make sure the weld is robust enough to withstand the environmental factors the cell might be subjected to.

- + SkelCap terminal material is AW1050, which contains 99.5% of aluminium and has very good weldability.
- + The suggested design for the busbar can be seen in Figure 2.
- + Figure 1 illustrates welding assembly. The resulting gap between the cell terminal and the bus bar will be maximum 0.12 mm, which is the total diametrical gap between the terminal post and the busbar. Aluminium alloy AW1050 is suggested. If a different material is used, the parameters will also be different and all measurements must be recalculated.
- + In order to achieve a good and consistent weld, special consideration should be given to the material purity and material composition of the busbar.
- + Generally, there is no need for filler material in the weld gap.
- + Prior to welding the ultra-capacitors and busbars must be at room temperature to reduce the risk of cracking of the weld after the weldment.
- + The depth of the weld should be 1...2 mm as shown in Figure 1. If welding depth is over 2 mm, there is a great chance of damaging the cells.
- + 100% minimum (may overlap) around of the terminal post must be always welded. Pay attention to shock and vibration requirements, as well as weld stresses on the cell caused by torque during installation or operations.

- + For both terminal size 8mm and 12mm it is allowed to have maximum of 2mm defective weld from the overall weld length. Single defect size cannot exceed 1mm.
- + Maximum force applied to cell while attaching busbars must not exceed 500N.
- + Welded surface must be smooth, without any protruding sharp edges or burrs to avoid the risk of damaging the electrical isolation when welded pack is used in a module or in a system

Equipment

- + Technological parameters used for successful welding:
 - + Laser power: 1825W (terminal diameter 12mm) or 1250W (terminal diameter 8mm)
 - + Focal length: 255mm
 - + Focus depth: +1mm
 - + Heat input for busbar welding; 730J (terminal size 8mm) or 375J (terminal size 8mm)
- + The use of a continuous wave laser is highly preferable, but a pulse laser can also be used.
- + In order to ensure the laser spot alignment and focus, frequent and careful maintenance of the laser optics is recommended, as well as protecting the laser optics from back splatter.
- + Wobbling laser geometry for highest welding quality.
- + The use of a continuous wave laser is highly preferable, but a pulse laser can also be used.
- + In order to ensure the laser spot alignment and focus, frequent and careful maintenance of the laser optics is recommended, as well as protecting the laser optics from back splatter.

Above suggested welding parameters are illustrated, but welding parameters may vary depending on the machine used. It is important to achieve minimum weld penetration of 1 mm.

Process

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- + Center the laser spot over the gap between the cell terminal and the busbar. The laser can be aligned with a mechanical fixture or with a vision system, in which case the sharp edge of the bus bar should be used as reference.
- + Use laser power as process control parameter and take power measurement downstream of laser optics.
- + Adjust laser setup parameters to achieve the required weld depth of 1...2 mm from top of the cell terminal (see Figure 1).
- + Check weld characteristics against application requirements. The diagram in Figure 1. should be used as a general guideline only.

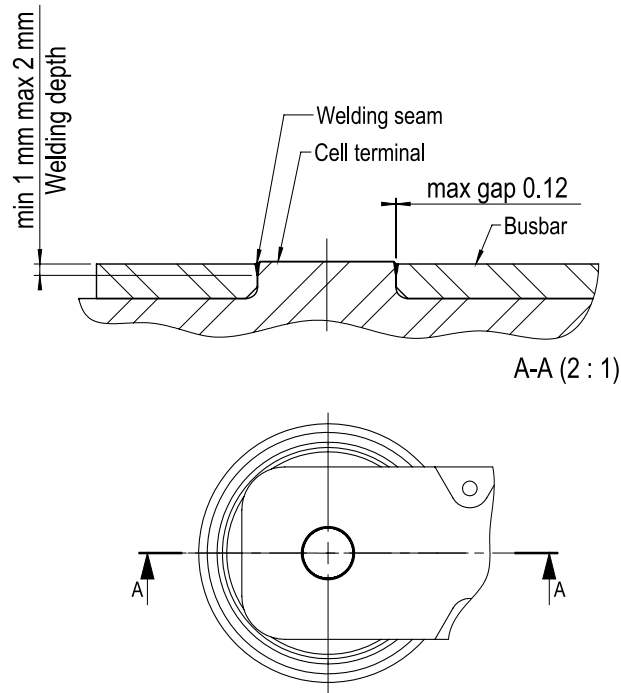
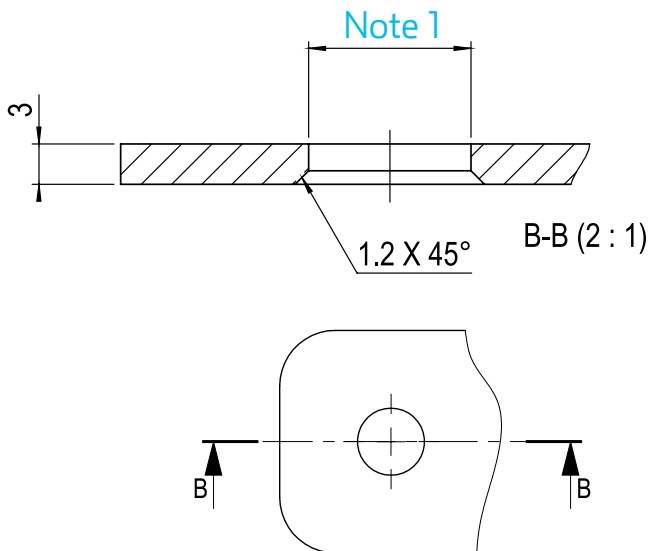


Figure 1. Busbar-SkelCap laser welding assembly



Note 1.

SCA0500, SCA0750 - $\phi 8.06 \pm 0.03$

SCA1200, SCA1800, SCA3200, SCA4500 - $\phi 12.06 \pm 0.03$

Figure 2. Recommended bus bar design, dimensions (mm)



Figure 3. Welding example