Roundtable recommendation #2

This document is a recommendation of the *OEM roundtable for electrified construction equipment* to Non-Road Mobile Machinery (NRMM) OEMs selling in the European market. It constitutes a recommendation to voluntarily standardize the described aspects for the benefit of end-users' ability to operate electric machines easily and safely. All recommendations and further details on the roundtable process are publicly available at https://www.emissieloosnetwerkinfra.nl/english/oem-roundtable.

Name:

Light indicators of the charging process on the machine

Executive Summary:

Light indicators are recommended to be used on all machines, in uniform coding where possible

The diversity of manufacturers and models in the range of heavy duty machines using DC charging is increasing. Operators and people tasked with charging machines also encounter various models of chargers and might not even see their displays when containers are used to manage access. That makes light indicators on the machine highly relevant.

To ensure safe and reliable operations it is recommended to a.) use light indicators to inform end-users about the charging state, b.) apply as much uniformity in lighting as possible to align with the majority of light regimes already in place in the (truck) market and c.) make use of accompanying labels at the place of the charging inlet.

Given the development towards bi-directional charging, the roundtable also recommends to use different colours and frequency to be used when de-charging is in progress.

State	Light Indication
Ready to charge / connecting:	Solid yellow or white
Charging in progress:	Pulsating blue or green
De-charging of vehicle in progress:	Different colouring and pulse frequency than with charging
Charging completed:	Solid Green
Error:	Red

Problem:

Machine operators - and other people that might be tasked to charge machinery with a DC charger - can encounter very different situations when it comes to charging light indicators: no light indicators, one light, multiple lights with different colours, either pulsating or static. The absence of any indication on the machine of a charging session in operation poses a potential safety risk, as someone might try to force the cable out of the socket assuming that there is no current flowing when in fact there is.

Where indicators are visible, the correct interpretation of light signals can be hampered by a lack of labels and by the fact that the same signal might mean different things on different machines. Sometimes, lights are explained by labels on the machine, sometimes they are not.

Next to diversity of light signals amongst machinery, there is also a variety of such regimes in passenger cars, trucks, busses and on chargers as well. This diversity increases risks of erroneous operations when people don't notice or misinterpret light signals. E.g. assuming that charging has

started where in fact it is only 'ready to charge', resulting in operational disruptions when the machine is not ready to work at the expected end time of the charging cycle.

That diversity is not supportive of easy adoption and dependable operation of electric plant.

Solution:

The roundtable of ENI and ElaadNL has discussed possible solutions to the problem described above. The participants arrived at the following recommendation.

Light indicators on the machine

It is strongly recommended to place differing light signals on the machine to indicate the current status of a charging process.

Recommended lights

There are already various colour codes in use throughout existing models of passenger cars, busses, trucks and construction equipment. It is therefore difficult to prescribe a specific colouring and the roundtable resorts to mentioning common regimes to invite others to follow:

We distinguish the most relevant states and the preferred light indication:

State	Light Indication
Ready to charge / connecting:	Solid yellow or white
Charging in progress:	Pulsating blue or green
Charging completed:	Solid Green
Error:	Red

Labels

It is recommended to support interpretation of the light signals next to the indicators by labels. Icons/pictograms are preferrable from an OEM perspective to reduce localisation needs. If text is used, local language is recommended. In order to allow colour blind people to correctly interpret the labels and signals, position, shape and colour should in combination make for a unique interpretation understandable to all.

Forward compatibility with MCS and V2X standards

Looking forward to the expected development of Vehicle to X and MCS (Megawatt Charging System, designed for bi-directional operation) on Off-highway machinery, we recommend to prepare for compatibility in this respect as well. The current documentations on MCS and V2X do not detail light indicators. Therefore, we recommend the following:

State	Light Indication
De-charging of vehicle in progress:	Different colouring and pulse frequency than with charging

Call to Action: To accelerate the deployment of reliable and interoperable charging solutions, we urge all stakeholders to take the following actions for all new product launches:

1. **Construction Equipment OEM**
   All OEM machines that utilize DC charging should feature light indicators to communicate the status of a charging process at the place of the charging plug. They should use multiple colours and frequency coding as described above and provide clear labels close to the inlet that give locally understandable definitions of the indicators.

2. **Standardization Leadership**
   Industry associations and regulatory bodies should formally take this recommendation to a binding industry standard to clarify this end-user relevant aspect across the whole sector. Furthermore, the roundtable would welcome coordination with other sectors like trucks and charging equipment manufacturers.

By adopting this recommendation, we help operators to easily and reliably operate charging sessions across the variety of brands, models and equipment types.

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Roundtable participants that support this recommendation in alphabetical order:
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