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Frequently Asked Questions
Bare Floor Electrodes and Flushable Floor Cells

1. **What is the difference between a Bare Floor Electrode and a Flushable Floor Cell?**
   With a Bare Floor Electrode, the actual surface of the electrode (I.E. anode for cathodic ED paint) is in direct contact with the ED paint. With a Flushable Floor Cell, an ion-exchange membrane surrounds the Electrode and the ED paint never touches the surface of the Electrode. Both require an electrical connection and the Flushable Floor Cell requires electrolyte supply and return connections.
2. **What is a dry anode?**
   This is another term for a bare anode (I.E. used with cathodic ED paints).
3. **Why use the word 'electrode'?**
   Electrode is the opposing pole to the ware being painted and is a generic term. For cathodic ED paints, the ware is the cathode and the electrode is the anode. For anodic ED paints, the ware is the anode and the electrode is the cathode.
4. **Why use the word 'electrolyte'?**
   Electrolyte is an aqueous solution containing ions and is a generic term. For cathodic ED paints, the electrolyte is called anolyte. For anodic ED paints, the electrolyte is called catholyte.
5. **Why are 316L steel anodes sacrificial in a cathodic ED bath?**
   The electro-chemical reaction at the anode in an aqueous solution (I.E. water-based) is one where water is broken down as follows:
   $$2H_2O \rightarrow 4H^+ + O_2 + 4e^-$$
   A majority of the liberated electrons come from the breakdown of water. However, some of the electrons also form because the iron in the 316L stainless alloy is also broken down. The oxygen gas is very reactive and creates a tough opperating environment for ferrous-based metals. Iron-oxides are formed the entire time electrical current flows off the surface of the anode; thereby resulting in a continual loss in mass of the stainless steel anode.
6. **What happens to the iron degradation by-products that are released into the cathodic ED bath from a Floor Electrode?**
   These generally carry a positive charge and thus are attracted to the ware. Some of the iron oxide is trapped in the ED film and the rest remains in the ED bath. If there is a significant level, then there can be defects visible in the cured ED film.
7. **What is the most common anode material?**
   316L stainless steel has always been the most economical choice. Even though the material is sacrificial and does wear away, it is the most commonly used. 316L has become the de-facto standard for anode materials, except in cases where the presence of iron in the ED paint film can create defects, such as color change.
8. **Are there other anode materials?**
   In addition to 316L stainless steel, there are more inert materials available for use as anodes. First, there are precious metal oxides coated over titanium. These precious metal oxide materials are more insoluble as an anode, but they too can suffer a short life. Sometimes there is a break in the precious

metal coating and the titanium substrate is exposed to oxygen. The titanium surface is then oxidized because the voltage is greater than 12 to 16 volts.

9. **What do you mean by 'more inert'?**
   More inert means less sacrificial in the environment of an anode in an aqueous solution. 316L is the most soluble anode material, followed by precious metal oxides..

10. **Why is 316L stainless steel the most common anode material?**
    The 'L' indicates low carbon. The presence of carbon can increase the likelihood of iron loss, especially near the grain boundaries of the stainless alloy. Many stainless steel makers only make 316L now. 316 stainless steel can be used as a substitute. 316L and 316 stainless steel form a 'protective-passivation' layer on the surface when current is flowing. The elements that make up this protective layer are the elements found in the alloy itself, such as Cr, Mo, C, etc. and others such as oxygen from the hydrolysis of water. This passivation layer acts to moderate the loss of iron and prolong the life of the anode. However, in some cases 316L can suffer a short life if the Corrosion Factor (CF) is high.

11. **What is 'CF'?**
    CF is a term used by UFS to quantify the level of corrosion the anode is exposed to. Under ideal situations, the lowest loss rate is less than 10 micrograms/Coulomb. On the other end of the scale, the loss rate can exceed 250 micrograms/Coulomb. Current density, temperature, and CF all contribute to the final loss rate.

12. **What is 'Anode Current Density'?**
    The current passing through a Floor Electrode/Cell divided by the surface area for that Floor Electrode/Cell. For design purposes, with a high painted throughput system (I.E. automotive or appliance) the anode current density should not exceed 35 amps/square meter (3.3 amps/SF). For an overall average, the anode current density should not exceed 50 amps/square meter (4.7 amps/SF).

13. **What if my first Floor Electrode/Cell exceeds the recommended anode current density figures?**
    Generally, the first Floor Electrode/Cell will exceed the recommended figures and about the only thing to do is move the second one closer. By doing this, the load is shared more between the two. In any event, the first unit will wear out first and need to be replaced sooner.

14. **Can I use a lower grade of stainless steel?**
    No. Use of 304 stainless steel and lessor grades can lead to extremely fast wear rates, sometimes measured in weeks.

15. **How long can I expect an electrode to last?**
    *In an **anodic** ED paint, the electrode is the cathode and its life is indefinite because the electro-chemical reaction at the cathode is not a tough environment for a metal. On the other hand, with a **cathodic** ED paint the electrode is the anode, which is a severe environment for metals because oxygen is created on its surface. For typical heavy duty cycle applications such as an auto body ED system or job shops, the life of the anode can be as short as 6 to 9 months or as long as 1-1/2 to 2 years at the best.*

16. **Why should I place the Floor Electrode/Cell perpendicular to the travel of the ware?**
    A perpendicular orientation presents the greatest amount of the electrode's surface area to the ware, especially when the ware does not have any or much ED film thickness started. In contrast, an electrode that is placed with its long dimension in the same direction as the travel of the ware will suffer because the ends will perform a lot of work and the center will become lazy. Current would always want to flow off from an edge first. In this situation the ends of the Floor Electrode/Cell are the 'edges' and thus will always show the greatest wear.

17. **What if I want to place a Floor Electrode/Cell right underneath a hole in the rocker panel?**
It is possible to do this. However the first several Floor Electrode/Cells should be placed perpendicular in order to start a film on the entire bottom surface first. The later Floor Electrode/Cells can be placed underneath the location of important access holes. There are some tricks to reduce the 'end effect.' Ask your UFSc sales engineer for guidance.

18. **When should Floor Electrodes be replaced?**
As a general rule, once a Floor Electrode/Cell has lost about 60% of its original mass, it should be replaced in the next 6 to 9 months.

19. **How do I estimate the lifetime of an anode?**
The loss rate of an anode can be measured with great accuracy. For the purposes of this question, the method to arrive at an estimate is simplified as to how long an Electrode will perform. Given perpendicular orientation, 2" Schedule 80 316L material, cathodic ED paint, less than 50 amps/square meter of anode current density, 19 days/month, and 16 hours/day. If you have a file copy of this document, then use Excel to make changes and see the results. (See the comments in the fields with the red corner ID):

1.5	= length of Floor Electrode (meters)
11.25	= orignal mass of Floor Electrode (kg)
10	= loss rate (micrograms/Coulomb)
50	= current draw (amps)
0.5472	= loss per month (kg)
12.33553	= # of months before 60% of original mass is lost

20. **Do Floor Electrode/Cells always have to be in the second half of the ED tank?**
Traditionally most Floor Electrode/Cells have been in the second half (I.E. exit side) as a matter of practice. However, it is possible to place Floor Electrode/Cells in the first half of the ED tank.

21. **What benefits can I expect if Floor Electrode/Cells are placed in the first half of the ED tank?**
Several positive things happen because the bottom (and other recessed regions such as the rocker panel) of the vehicle is painted sooner rather than later. The first is that the side cells can concentrate on the interior once the exterior verticals are started. In many cases Zone 1, and maybe Zone 2, voltages can be slightly reduced.

22. **Why can Zone 1 and Zone 2 voltages be reduced if Floor Electrode/Cells are moved into the first half of the ED tank?**
The painting on the bottom surface of the vehicle is started earlier in the process. The majority of the painting is accomplished with the floor electrodes, which are closer to the vehicle bottom than the side cells. Anytime the distance between the electrode and the vehicle is reduced, the voltage is reduced. The voltage in the second half can also be reduced since there will be less work performed.

23. **If I am not happy with the present ED film thickness in the rocker panel (or other regions on the bottom of the vehicle), what can I expect?**
Moving some of the Floor Electrodes/Cells to the first half of the ED tank will probably result in an improvement of the rocker panel ED film thickness. However, the opportunity for voltage reduction is not as strong and may even require more voltage in some cases.

24. **If I put some of the Floor Electrodes/Cells into the first half of the ED tank, will I put too much ED paint on the bottom of the vehicle?**
The express purpose of placing some of the Floor Electrodes/Cells into the first half of the ED tank is

to initiate the ED film build sooner and do it for less energy cost. The purpose is not to put more on the bottom of the vehicle.

25. **If my ED film thickness is too much on the bottom of the vehicle, what can I do?**
The first step is to reduce the voltage in the zones where the Floor Electrode/Cells are located. If this does not produce satisfactory results, then some of the Floor Electrode/Cells can be disconnected.

26. **Should I measure the individual current to each Floor Electrode/Cell?**
Yes. There is no doubt to the amount of work that each Floor Electrode/Cell is doing. A baseline can be established for each Floor Electrode/Cell and this baseline can be used to confirm when a replacement is required. The total current for all the Floor Electrode/Cells can be correlated to the ED film thickness in hard to measure regions (I.E. rocker panel, etc.) and thus fewer bodies need to be cut apart to verify ED film builds.

27. **Should I have a separate rectifier for the Floor Electrode/Cells?**
This would provide for better adjustment and result in the most uniform coating distribution over the entire ware. In some cases, cost studies have demonstrated that the cost of the extra rectifier can be offset in ED paint savings.

28. **How are a Floor Electrode and a Floor Cell different?**
The Floor Electrode has no ability to remove neutralizer from the ED bath. In some cases this is a benefit because the existing side cells are removing too much (I.E. for cathodic ED paint a pH that is too high). In this situation, the Floor Electrode would help balance the pH of the ED bath and reduce the direct addition of more neutralizers.

29. **What are the pros and cons of Floor Electrodes?**
The Floor Electrode is a simple device that is easy and quick to install. If installed in the same direction as the ware travel, then it will suffer a short life and waste a majority of its mass once the ends have worn off, breaking the electrical connection to the remaining center portion. It will release iron oxides into the ED bath that can cause defects.

30. **What are the pros and cons of Floor Cells?**
The Floor Cell requires an electrolyte connection (input and output) and is more complicated to install. If the membrane is cut, then the ED tank must be drained to replace the Membrane Shell. Floor Cells do not release iron oxides into the ED bath and they do not experience as much wear at the ends compared to a bare electrode, due to the extra resistance of the membrane and the insulating properties of the ends of the Floor Cell.

31. **How are Floor Electrodes installed?**
Floor Electrodes can be installed on existing floor structures of the ED tank or they can be lashed to objects like 4" PVC pipe (with open ends to allow flow) lengths. Generally each end is double lashed with a plastic tie wrap. Stainless steel clamps are not recommended because they are not grounded and will slowly dissolve. Use a cable insulation that is rated for wet service and is resistant to oils and solvents. Floor Cells require a more sophisticated support means on either end. In addition, the electrical and electrolyte lines are generally run in a conduit to avoid contact with the ED paint.

32. **Why do you recommend overlapping the ends of Bare Floor Electrodes placed in parallel?**
Bare Floor Electrodes typically have elevated anode current density since there is no ion-exchange membrane. Thus, the ends typically wear out first and the middle portion is wasted. Overlapping the ends will reduce the anode current density to extend the life of the Bare Floor Electrode.