

Getting Started Guide For Cathodic and Anodic Paints



Mission Statement

UFS Corporation is dedicated to providing quality, innovative solutions to the electrocoating industry. We have over 20 years experience and leadership in finishing system consultation, Membrane Electrode Cell manufacturing, Membrane Electrode System design, on-site service and installation assistance.

Customer Satisfaction Pledge

The employees of UFS Corporation are looking forward to serving the needs of your company and customers in a professional and courteous manner. Here is our pledge. . .

- ◇ We **add value** to our customers products
 - ◇ We **listen** to our customers
 - ◇ We **deliver** on time
 - ◇ We **act** in a safe manner
 - ◇ We **recognize** each person's individuality
 - ◇ We **believe** the future is important
 - ◇ We **build** our reputation one step at a time
-

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INTRODUCTION

Safety is something that can not be overlooked!

Please observe all your appropriate safety regulations before and during work on the Membrane Electrode (ME) Cells and related electrical equipment. As a general rule, always use your own lock and key to lockout the DC rectifier before installing or working with any component of the anolyte system.



This manual provides general operating and maintenance instructions for the One + C-Cells that share the following characteristics:

Electrodes composed of 316L stainless steel or other optional materials made from more inert materials and rolled membrane (PTAR).

DESCRIPTION AND FUNCTION

A unitary-construction semi-circular One + C- Cell, designed to meet the needs of automotive E-coat paint systems. This cost-effective design also includes an improved electrolyte flow pattern providing for longer ME Cell life. Flange nuts and bolts which are proven to be typical leak points are eliminated. It has more electrode & membrane surface area than competitive C -Cells, improved anolyte flow pattern, and no leaks. The One+ C Cell is a superior design for automotive E-coat paint systems.

The One + C-Cell is a flushable anode Cell used in an electrocoating (ED) paint system with most types of paint. It serves as the opposing electrode and simultaneously removes solubilizer, or neutralizer (usually a common organic acid) from the paint to maintain chemical balance.

SYSTEM REQUIREMENTS

If UFS Corporation provides the Cell Circulation System (CCS), a separate manual will be furnished. The following are some general guidelines for system design:

A. See appendix page 17 “Recommended Electrolyte Pump Flow Rate,” for the recommended circulation pump specification. The foregoing criteria assumes that the Cell Circulation tank and pump are a maximum of 3 m (10 Ft.) below the tops of the ME Cells. Increase the friction head equipment, if necessary. The CCS should include a suitable rotameter and pressure gauge to confirm that these criteria are being met.

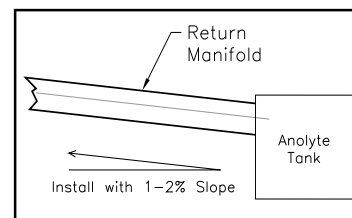
NOTE: As paint can get into the electrolyte and cause seal failure in a horizontal pump, we recommend using vertical pumps or magnetic drive horizontal.

B. See appendix page 16 “Recommended Electrolyte Tank Volume,” to determine the Cell Circulation tank capacity.

C. A 1/2” valve with a flow indicator is recommended to regulate the electrolyte supply to each ME Cell. A valve of this size gives reasonable control in the recommended flow rate range.

D. The electrolyte supply manifold branch should be 102 mm (4”) PVC Pipe (Schedule 80) minimum or so sized not to exceed a velocity of 0.25-0.5 m/sec. (3-5 ft/sec.). A siphon breaker at the termination point of each leg will prevent siphoning of the ME Cells after anolyte pump shutdown. This will prevent excessive electrolyte tank draw-down when the anolyte pump is restarted. Main trunk (at anolyte pump discharge) should be one pipe size larger.

E. The electrolyte return manifold branch should be at least 152 mm (6”) PVC pipe (Schedule 40), minimum and sloped toward the electrolyte tank at a pitch of not less than 1-2% slope (1/4” per foot). Size so that it is NO more than 3/4 full at the lowest point. To prevent vapor lock, it should be vented at the high end at each termination leg. Main trunk (at anolyte pump return) should be one pipe size larger.



F. Cable connectors to individual ME Cells should be designed for fifteen (15) amps of current flow per meter (5 amps/foot) of effective ME Cell length. **Only stainless steel nuts, bolts, and compression washers should be used.** UFSc supplies a set with each Electrode so that high resistance problems due to corrosion are avoided.

G. It is desirable to have an amp-hour meter on the rectifier feed to the One + C- Cells and ammeters on the entrance zone ME Cells. Information from these meters is often very helpful in diagnosing ME Cell performance problems. UFSc has a range of products that can assist current monitoring needs to maximize optimal results from your e-coat tank.

INSTALLATION

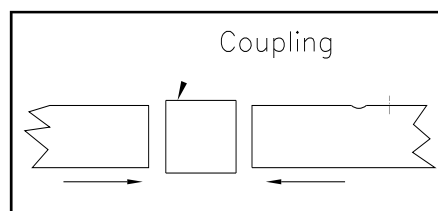
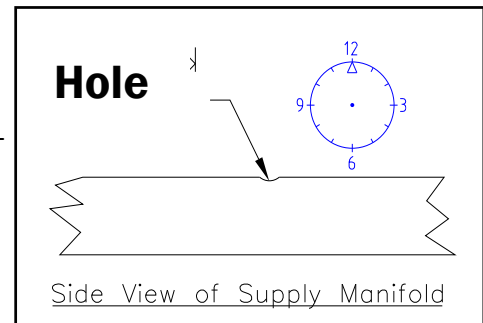
STEP ONE:

ELECTROLYTE SUPPLY MANIFOLD

The electrolyte supply manifold is normally a 102 mm (4") diameter Schedule 80 PVC pipe. Couplings and caps are supplied to join the sections; however, and the customer must supply the PVC primer (purple schedule 80 tape) and cement (heavy body Schedule 80 tape). Support PVC Manifolds every 1.5 m (5').

The spacing of the electrolyte valves on the electrolyte supply manifold is usually indicative of the actual spacing of the One +C- Cells in the e-coat tank. Each section of the manifold is labeled on a particular end with a sequence number and either a left or right notion. For example, if three sections of pipe are required to run the length of the tank, six pieces would be supplied (e.g. three pieces per side). The "A" and "B" notion differentiates the two sides and are not necessarily specific. The match marks make sure the individual sections of pipe have the proper alignment. Insure that the drilled holes in the pipe are in the 12 o'clock position.

Grasp the sections labeled "A" or "B", Number 1 on the end with the marking. The first threaded hole from the end with the marking should be located at the proper distance (see reference drawing attached or note on pipe) back from inside of the e-coat tank. This distance is generally written on Section 1. Grasp the section labeled "A" or "B", Number 2 on the end that is marked and attach that to the back of the first section. The end with the marking should always point toward the front of the ED tank. Join the two sections of the manifold using the couplings supplied. Continue until all the sections are installed on both sides of the tank.



Siphon Breaker Kit

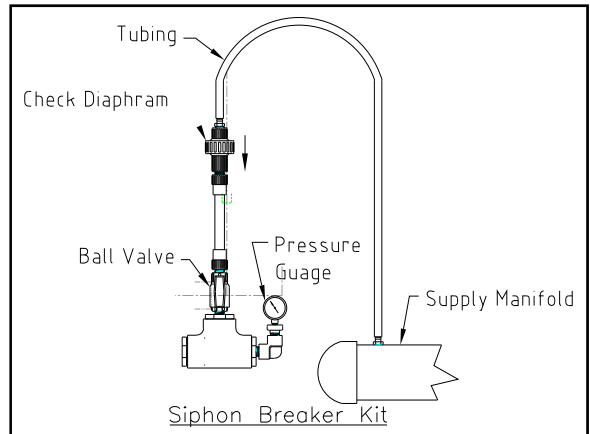
When the circulation pump is turned off, it is possible that the electrolyte can be siphoned from the ME Cells, if a siphon breaker is not used. If siphoning has occurred, the operator, upon restarting the circulation pump, may get a low level alarm in the electrolyte tank, since the pump has to first fill all the One + C- Cells before any fluid is returned to the tank.

Install the check valve with arrow pointed down so that it is closed when the pump is turned on. (See diagram) When the pump is turned off, the check valve opens, air enters the supply

INSTALLATION

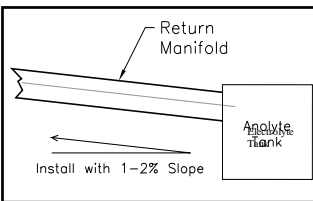
manifold from the connection to the return manifold and breaks the siphon.

A siphon breaker should be installed at the termination of each supply manifold. Also included is a pressure gauge which can be used when troubleshooting. The bottom of the check valves must be located at least 150-300 mm (6" to 12") above the top of the ME Cell. See your General Arrangement Drawing.

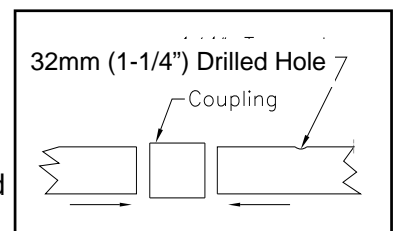


STEP TWO: ELECTROLYTE RETURN MANIFOLD

The electrolyte return manifold, usually 152 mm (6") is laid out and assembled the same as the electrolyte supply manifold. Since this is a gravity return system, the flow of the return header should be toward the CCS tank at about 2% slope (1/4" per foot). The high end of the return manifold must be vented at least 150 mm (6") above the top of the ME Cell for proper operation to avoid vapor lock. Support the PVC Manifold every 1.5m (4' to 5').



Grasp sections "A" or "B", Number 1 on the end with the marking. Place towards the electrolyte tank. The first drilled hole from the end with the marking should be located at the proper distance (Ref: General Arrangement or note on the pipe) back from the inside front edge of the ED tank. Grasp section "A" or "B", Number 2 on the end that is marked and attach to the back of the first section. The end with the marking should always point toward the entrance of the tank. Join the two sections of the manifold using the couplings supplied. Continue until all sections have been installed on both sides of the tank.



Note: Proper care should be taken when installing the supply and return manifolds. The centers of the connection holes in each manifold should line up exactly with the centers of the ME Cells.

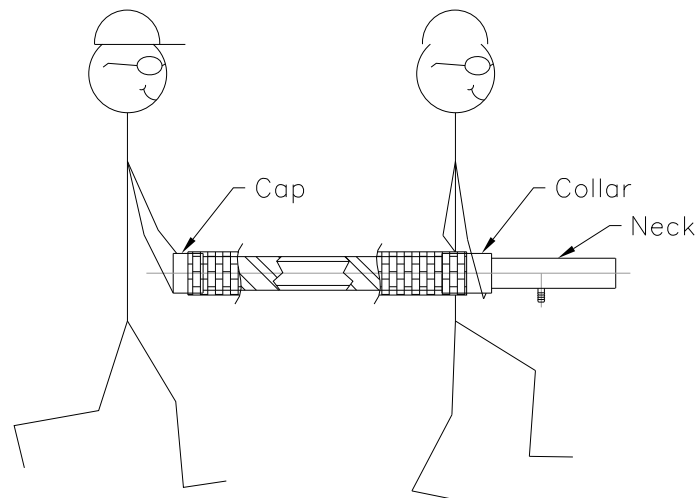
Also, PVC DWV long sweep elbows and tees should be used on the return manifold to lessen the chance of restricting the gravity flow.

INSTALLATION

STEP FOUR:

UNPACKING THE CRATE

Remove the lid and any hold-down blocks along with any exposed nails, staples etc. that might puncture the Shells. Do not remove the cardboard or plastic packing at this time as it will protect the Shell as it is taken from the crate into the ED system. Remove the cardboard and plastic packing right before you install the ME Cell in the tank. **TAKE CARE NOT TO PUNCTURE OR DAMAGE THE One + C-Cells.** Significant cuts or punctures generally cannot be repaired and render the entire C-Cell unusable. The One + C-Cells should always be supported at the bottom and top to avoid damage to the membrane. Carefully inspect each One + C-Cell for possible defects and report any defects immediately to UFS Corporation. Cuts or punctures due to improper handling are the responsibility of the owner/installer. ME Cells with manufacturing defects will be repaired/replaced free of charge by UFS Corporation, upon return of the defective item. (Note: Items that are sent back to UFS for inspection must be sent prepaid and require prior authorization.)¹



Note: Initial installation of the ME Cells should be done immediately **before** the tank is filled with paint so the ME Cells can be checked for leaks with either DI or RO water. The less time the ME Cells are in the tank before the paint fill, the less likely they will be damaged. **If paint tank is full the cells must be filled with DI or RO water before they are installed.**

INSTALLATION

STEP FIVE:

Mechanical Support

Mount the One + C-Cell to the Square bar found on rim of tank. Adjust universal bracket accordingly so that the One + C-Cell hangs level. See Installation Reference #993172.

STEP Six:

Electrical Connections

Electrical supply involves the connection of power from the local bus bar to each One + C- Cell with an appropriate cable lead and the supplied stainless steel hardware set. The cable lead should be sized by the system designer, with the expected current draw of each One + C-Cell, as specified by the paint supplier, taken into account.

Connect the electrical cable to the inside part of the tab with the 1/2" SS nut, bolt, and lock washer set provided. See Installation Reference #993172.



Diodes are normally recommended on the lower voltage zone of a multiple voltage zone ED system to avoid reverse power conditions. Contact UFSc Technical Department on this matter.

STEP Seven:

Manifold Supply Hook Up

Electrolyte solution supply is conveyed to each One + C- Cell from the supply manifold via 12.7 mm (1/2") I.D. flexible PVC tubing attached to the C-Cell. The flow of anolyte to each One + C- Cell is usually controlled by a 1/2" PVC valve with flow indicator. Electrolyte solution overflows from the electrolyte overflow nozzle. The wall thickness of the PVC return tubing should be about 2 mm (3/32") to avoid kinks.

Note: Cut the electrolyte supply tubing, attached to the One + C-Cell, to the appropriate length (e.g., leave about 300 mm (12") of slack). Connect the tubing to the corresponding flow indicator on the supply manifold.

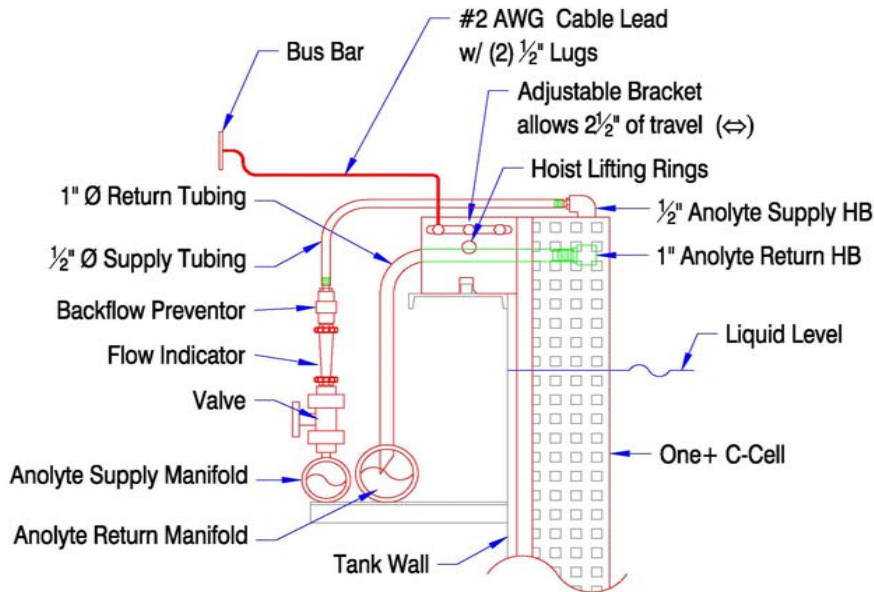
STEP Eight:

Return Tubing Preparation

Cut the return tubing at a 45 degree angle for the end to be inserted into the return manifold cut a piece of return tubing of correct I.D. to a length that will not kink when installed and will

INSTALLATION

also allow for 25 mm (1") of insertion into the return manifold hole for One + C- Cells. Cut the other end off at 90 degrees and lubricate the inside with a little water (**Do not use any lubricant containing silicone.**) Connect this end of the tubing to the One + C- Cell overflow nozzle, and push the other end no more than 25 mm (1") into the corresponding hole in the return manifold.



Partial Side View

STEP Nine:

Leak Testing Before Start-up (All One + C-Cells have been leak checked before shipment)

After all One + C-Cells are installed and the electrolyte piping has been flushed, turn on the Cell Circulation System and adjust the flow rate to each ME Cell for approximately 8.0 lpm/sm (2.0 gpm/sf) of Electrode area no less than 1.5 lpm/cell (1/3 gpm). Do not exceed 7 psi in inlet manifold. Check each One + C- Cell for leaks. The One + C-Cells are warranted against leakage due to materials and workmanship (see warranty). The Membrane does have a finite water permeability, and it is normal for it to become wet and "sweat" after several minutes. Report any defective Membrane Shells, or shells that have excessive Membrane permeability, immediately to UFS Corporation. UFS Corporation will tolerate 500ml/hr for PTAR Membrane.

OPERATION

The essentials of normal operating procedures are:

- Establish and maintain proper anolyte flow and conductivity to each One + C-Cell.
- Periodically inspect the anolyte overflow tubing for signs of paint leakage into the anolyte
- Monitor the total current draw and voltage
- Check the color of the anolyte each shift (See appendix page 26)

During the first several weeks of operation, close attention should be paid to the color of anolyte. Occasionally 316 SS Membrane Electrodes will be attacked by some contamination in the paint bath of the anolyte circuit. If this is occurring, Membrane Electrodes will become pitted and the anolyte will be discolored (brown or black, rather than a normal clear, pale-yellow color). If these conditions are observed, it is important that prompt action be taken. Contact UFSc for assistance. UFSc strongly recommends the use of any anti-corrosive additive that your ED paint supplier might suggest.

A. Electrolyte Fluid Conductivity

Conductivity of the electrolyte should be maintained in accordance with the paint manufacturer's recommendations. Electrolyte conductivity is a qualitative, not a quantitative, indication of acid concentration. During the painting process, the acid concentration and the conductivity of the electrolyte will continuously increase. The conductivity is controlled by purging the electrolyte from the Cell Circulation System and replacing it with fresh deionized water. The electrolyte purge can be accomplished manually or automatically with a conductivity controller and electric ball valve. On smaller systems, it can be done on a batch basis.

B. Electrolyte Fluid Flow

It is very important that proper electrolyte flow be maintained to each individual One + C-Cell. C- Cells should be individually inspected every day to confirm that the flow is adequate.

It is possible to provide electrolyte flow indicators with each One + C-Cell. With a little experience, however, an operator can establish suitable flow rates by eye. The exact flow rate is not critical. However, in general (so long as the C- Cell does not overflow) the higher the flow rate, the better. With normal Cell Circulation System pressure a 1/2" ball valve will usually produce a suitable electrolyte flow near the "3/4 open position." It is difficult to tell if the electrolyte is flowing by looking at the anolyte supply tubing, but the flow can always be confirmed by inspecting the electrolyte overflow tubing.

C. Electric Current Draw

Workforce safety is always a foremost concern. Directly measuring current is very risky and requires a significant amount of prior planning and safety consciousness. Baselines are necessary for lowest lifetime cost operation. It is critical for an ED system's successful operation to establish a baseline for each important parameter. The minimum baseline for an individual

OPERATION

One + C- Cell relates to the smallest load and largest load. With each, the peak and valley (or minimum for a hoist system) should be established. (Each C- Cell will have four baselines recorded.)

To measure One + C- Cell performance, it is important to know your wiring infrastructure, specifically how your C- Cells are connected to the electrical distribution bus. If each C- Cell has an individual cable lead, it is possible to measure its current flow. If C- Cells are connected by a “daisy chain,” you will need to upgrade wiring by installing a single cable lead for each c- cell before you implement most current measuring methods.

Valuable information can be gained by connecting measuring equipment. UFSc has developed a Current Monitor™ System that allows tank ED system personnel to monitor individual One + C-Cells. A flip of a switch will confirm that a ME Cell is operating within normal parameters. Current Monitor Panels are available in 16, 32, 48, and 64 point versions. If you did not purchase a Current Monitor System with your initial system, please contact your Sales Engineer for more information.

Installing a Current Monitor System will provide visualization for electric flow. Every ED system has some amount of fault tolerance so when equipment begins to weaken, it may not be apparent if only the ED film thickness is used as the guide to performance of the One + C- Cells. Current monitoring will provide an early warning system that will provide data that the fault tolerance of the ED system has been compromised. Current monitoring will assist in producing a good estimate of when a danger point may be reached. Equipment budgets can then be prepared in a timely manner to avoid downtime.

The amount of current delivered by each One +C- Cell determines the total amount of ED film deposited on the ware. Individual C- Cells should draw no more than 55 amps/sm (5 amps/SF). If the entrance zone One + C-Cells draw more than this amount, these C- Cells should be moved closer together to reduce the current draw of the first C- Cell.

OPERATION/MAINTENANCE

Regular logging of system data is essential to diagnose operating problems and plan the orderly replacement of ME Cells. The following key data should be recorded at least once a day:

1. Electrolyte Conductivity
2. Paint Bath pH and conductivity
3. Total Electrolyte Flow (gpm)
4. Rectifier Voltage (each zone)
5. Rectifier Amperage (each zone)
6. Electrolyte Color

This data should be taken at the same time each day, with the same work load in the paint bath.

Optional data, useful for more detailed analysis, include:

1. Amperage of individual C- Cells .
2. Acid additions to the bath (gal/wk)
3. Amps-hours of operation (amp-hr/wk)

MAINTENANCE

The routine maintenance required for the One + C- Cell is minimal. This section will address the maintenance procedures.

A. C-Cell Removal

To remove the ME Cell for maintenance, inspection, replacement or long-term storage, do the following:

1. **MAKE SURE THE POWER IS TURNED OFF AND LOCKED AT THE MAIN PANEL!** Never attempt to remove work on a “live” ME Cell.
2. Turn off the electrolyte supply valve and remove the electrolyte supply and return tubing from the valve.
3. Disconnect the cable lead from the One + C-Cell. .
4. If removing One + C-Cell from e-coat tank the anolyte must be siphoned out. Do not let it siphon if e-coat tank is full.
5. Use a hoist to slowly lift C-Cell out of tank. While C-Cell is being lifted make sure it is thoroughly rinsed with either DI or RO water. **DO NOT ALLOW THE MEMBRANE TO DRY OUT.**



MAINTENANCE/STORAGE

LONG TERM STORAGE

As the e-coat tank level is lowered, spray the outside of the One + C- Cells with a D.I. water hose to rinse off paint solids. Remove the C-Cell and immediately store in a long poly sleeve (measuring (20”) wide when flat and (6 mil.) thick and completely seal both ends to preserve moisture. **Do not let the C-Cell dry out. Store C-Cells in the vertical position in order to protect them from being crushed by a heavy object.**

REINSTALLATION OF THE CELLS

Reverse the sequence for reinstallation. However, it is important to note that the One + C-Cell will be buoyant and difficult to submerge if it is not filled with D.I. Remember to lower the One + C-Cell slowly into the e-coat tank.

MEMBRANE ELECTRODE INSPECTION AND CELL ROTATION

One + C-Cells have a limited life, and it is normal for them to deteriorate over a period of time. The Electrode itself erodes naturally as part of the electrochemical process. The ion-selective membrane also deteriorates. It will slowly lose its acid removal capability, and its electrical resistance will increase. The rates of deterioration of the Membrane and Electrode are functions of current density (amps/sf), paint chemistry, and other operating conditions such as anolyte chemistry and flow rate.

Under normal conditions and proper operating procedures, the ME Cell will last at least two to four years before it has deteriorated to the point that it must be replaced. With a well operated and maintained system (proper electrolyte flow rate and paint chemistry, etc.) and paint chemistry, the One + C- Cell life normally becomes a function of current density and operating time only. It is normal for One + C- Cells near the entrance zone of a mono-rail, conveyor-type electrocoat tank to deteriorate more rapidly than One + C- Cells near the exit end.

UFS Corporation recommends annual inspection of One + C-Cells at the same time as moving the Electrodes forward. Entrance One + C- Cells that show signs of significant Electrode wear, or that have declined significantly in current draw, should be replaced.

SPARE PARTS AND ACCESSORIES

Membranes do eventually wear out and Electrodes will eventually erode. The usable life will vary with service conditions and maintenance practice. Spare or replacement parts are available from :

UFS Corporation

330 North 400 East

Valparaiso, IN 46383 USA

Tel: (219) 464-2027 ext. 28 / Fax: (219) 464-8646

See your “Recommended Spare Parts List,” attached to manual.

WARRANTY

WARRANTY

We warrant all equipment manufactured by UFSc to be free from defects in material and manufacture at the time of shipment for a period of one (1) year from the date of shipment. We will furnish without charge, but not install, replacements for such parts as we find to have been defective.

This warranty shall not apply to any equipment which has been subjected to misuse, neglect or accident, or has been altered or tampered with, or if corrective work has been done thereon without our specific written consent. No allowances will be made for such corrective work done without such consent. Improper maintenance, deterioration by chemical action, and wear, do not constitute defects.

Equipment manufactured by others, and included in our offering, is not warranted in any way by us but carries only the manufacturer's warranty, if any. All ME Electrodes (and or cathodes), of any material, are not warranted by us in any way since they by nature are sacrificial and will erode or corrode away with time.

All warranty claims must be submitted within ten (10) days of discovery of defects or shall be deemed waived. All parts returned for inspection must be sent prepaid. No representative of our company has any authority to waive, alter, vary or add to the terms hereof without prior approval in writing. The foregoing is in lieu of all other warranties (including that of merchantability), whether express or implied.

LIABILITY

It is expressly understood that our liability, including that for breach of contract, negligence, strict liability in term, or otherwise for our products is limited to the furnishing of such replacement parts, and that UFSc will not be liable for any expense, injury, loss or damage, whether direct or consequential, including but not limited to loss of profits, production, increased cost of operation, or spoilage of material, arising in connection with the sale or use of, or inability to use, our equipment or products for any purpose, except as herein provided.

Recommended Electrolyte Tank Volume

One+ C Cell Cell Effective Length

1. If your Cell length is not shown, than use the next longer Cell length.
2. Electrolyte tank volumes should be approximately that shown above; however, tanks can be oversized by up to 50% if so desired.
3. Example: ED System with 22—1400 mm Cells. Recommended tank volume 353 liter.

mm	910	1400	1900	2300	2900
inches	35.83	55.12	74.80	90.55	114.17
Est. Volume/Cell					
liters	3.9	6.2	8.8	11.3	13.5
Gallons	1.02	1.64	2.33	2.99	3.57

T	liters	gallons	liters	gallons	liters	gallons	liters	gallons	liters	gallons
12	100	26	100	26	106	28	136	36	162	43
14	100	26	100	26	124	33	158	42	189	50
16	100	26	100	26	141	37	181	48	216	57
18	100	26	112	30	159	42	204	54	243	64
20	100	26	124	33	177	47	226	60	270	71
22	100	26	137	36	194	51	249	66	298	79
24	100	26	149	39	212	56	272	72	325	86
26	100	27	161	43	230	61	294	78	352	93
28	108	29	174	46	247	65	317	84	379	100
30	116	31	186	49	265	70	339	90	406	107
32	124	33	199	52	283	75	362	96	433	114
34	131	35	211	56	300	79	385	102	460	121
36	139	37	224	59	318	84	407	108	487	129
38	147	39	236	62	336	89	430	114	514	136
40	155	41	248	66	353	93	453	120	541	143
42	162	43	261	69	371	98	475	126	568	150
44	170	45	273	72	389	103	498	132	595	157
46	178	47	286	75	406	107	521	138	622	164
48	185	49	298	79	424	112	543	143	649	171
50	193	51	311	82	442	117	566	149	676	179
60	232	61	373	98	530	140	679	179	811	214
70	270	71	435	115	618	163	792	209	947	250
80	309	82	497	131	707	187	905	239	1082	286
90	348	92	559	148	795	210	1018	269	1217	322
100	386	102	621	164	883	233	1132	299	1352	357
120	464	122	745	197	1060	280	1358	359	1623	429
140	541	143	869	230	1236	327	1584	419	1893	500
160	618	163	994	262	1413	373	1811	478	2164	572
180	696	184	1118	295	1590	420	2037	538	2434	643
200	773	204	1242	328	1766	467	2263	598	2705	715

Recommended Electrolyte Pump Flow Rate

One+ C Cell

Base Rate = 8 lpm/sm (2.0 gpm/sf)
 Electrode Area = 0.429 sm/m (1.407 sf/foot)
 Min Cell Flow Rate = ~4 lpm (1 gpm)

Notes:

1. If your Cell length is not shown, then use the next longer Cell length.
2. Recommended pump discharge pressure should be at least 1.5 bar (22psi) . If Low Profile Cells in use, limit pressure to 0.5 bar (7 psi).
3. Select pump by taking figure from above and increasing by 20% for reserve.

Cell Effective Length

	910		1400		1900		2300		2900	
mm										
inches	35.83		55.12		74.80		90.55		114.17	
# of Cells	lpm	gpm	lpm	gpm	lpm	gpm	lpm	gpm	lpm	gpm
100		100		125		175		215		250

Trouble shooting Guide

Anolyte System Troubleshooting for One + C-Cell

This guide can help identify and solve problems with electrode position anolyte systems equipped with regular One + C- Cells. If you are experiencing a problem that is not identified here, or that you cannot seem to solve, please call UFSc for personalized service.

Problem	Possible Cause	Remedies
I. Cloudy or Paint-Colored Anolyte from all Cells	<ul style="list-style-type: none"> - Cut, torn, or ripped Membrane Shell - Installed dry - Overspray or splash. - Loose anolyte supply connection at bottom of cell. 	<ul style="list-style-type: none"> - Turn off anolyte pump and use flashlight to locate liquid inside the Cell. Cells with a low level should be pulled for further investigation. - Install splash guards. - Reconnect with 316 marine clamp.
II. Anolyte Color Change	<ul style="list-style-type: none"> - Paint contamination. - Dark color (like coffee) usually is from rapid deterioration of stainless steel electrodes. - D.I. Water solenoid valve is not adding water to the anolyte tank. 	<ul style="list-style-type: none"> - See I & VII. - Reduce level of contaminants by dumping anolyte tank, lower conductivity set point and have anolyte checked for chlorides. - Check conductivity controller, conductivity sensor, solenoid valve, and D.I. Water supply.
III. Left blank intentionally		
IV. No anolyte return from a Cell	<ul style="list-style-type: none"> - No supply. -Blockage at bottom of Cell. - Vacuum lock in return manifold. 	<ul style="list-style-type: none"> - See V, VI, & VII - Use 1/3 br (5 psi) air line connected to supply tubing to gently clear obstructions. - Increase vent opening or add breather stand pipe.
V. Anolyte overflowing from top of cell .	<ul style="list-style-type: none"> - Cell overflow nozzle blocked. - Return tubing kinked. - Blocked strainer bag. 	<ul style="list-style-type: none"> - Clean or remove obstruction. - Shorten or lengthen as appropriate. - Clean.

Troubleshooting Guide

Problem	Possible Cause	Remedies
VI. Electrolyte supply pump not operating.	<ul style="list-style-type: none"> - No electrical supply. - Lost prime. - Blocked suction. - Cavitation - Pump/impeller motor failure. 	<ul style="list-style-type: none"> - Check controls, connections, fuses. - Reprime pump, check anolyte tank level. - Clear obstruction - Check suction piping for possible air leaks. - Replace failed device.
VII. No electrolyte supply to a Cell.	<ul style="list-style-type: none"> - See V. - Discharge control valve turned off. - Blocked or broken supply manifold. - Blocked 1/2" individual Cell supply valve. - Rotometer float stuck in "up" or pegged position. - Plugged anolyte bag filter. - Kinked supply tubing. 	<ul style="list-style-type: none"> - Open - Clear obstruction or repair as needed. - Clear obstruction. - Partially close discharge control valve, recheck individual Cell flows and fully open discharge control valve afterwards. Replace rotometer if range is too low. - Replace at 1/3 to 2/3 bar (5-10 psi) differential. - Replace supply tubing if necessary.
VIII. Leaking Cell	<ul style="list-style-type: none"> - Membrane Cut from fallen work or from fishing work out of tank. - Abrasion from another object in paint tank. 	<ul style="list-style-type: none"> - Immediately isolate Cell by closing supply valve and disconnecting cable lead. Remove Cell and rinse inside and out. Do not let dry out. Fill Membrane Shell with D.I. Water. Place in 55 gallon drum (secured to hoist) and measure volume of leak for one hour (record every 15 minutes). - Move Cells so that there is at least 150 mm (3") of side to side clearance.

Troubleshooting Guide

Problem	Possible Cause	Remedies
IX. Broken PVC channel.	<ul style="list-style-type: none"> - Dropping cell onto floor. 	<ul style="list-style-type: none"> - Perform leak check to see if joint is leaking. Contact UFSc if leak is found.
X. Low Electrolyte Tank Level	<ul style="list-style-type: none"> - Drain valve open. - Evaporation loss. - Membrane permeability. - Cut membrane. - Malfunction in siphon-breaker (pump has to fill all Cells first). - Return manifold blocked. - Manifold leak. - Cell overflowing out top. 	<ul style="list-style-type: none"> - Completely close drain valve. - Normal - Normal - See VII - Check siphon-breaker - Clear - Check all piping. - See XII
XI. Bacteria/Fungus Growth	<ul style="list-style-type: none"> - From D.I. Water or other source 	<ul style="list-style-type: none"> - Have sample analyzed. - Add UV light to D.I. Water system. - Raise conductivity to 1,800–2,000 $\mu\text{Mho/cm}$. Get paint vendor approval first. - Use approved biocides. - Consult with local water treatment and D.I. Water system vendor.
XII. Paint solids build up on outside of C-Cell.	<ul style="list-style-type: none"> - Reverse electric current flow in a multi-zone tank. - Loss of anolyte flow (no cooling). - Loose electrical connection (more resistance). 	<ul style="list-style-type: none"> - Add diodes to Zone 1 Cells and clean Membrane Shells as required. - Look for kinking of anolyte tube, etc. Clean - Tighten bolted bolts. Clean.

Troubleshooting Guide

Problem	Possible Cause	Remedies
XIII. Cell overflowing top.	<ul style="list-style-type: none"> - Blocked overflow nozzle. - Vacuum lock in return manifold - Too much anolyte flow into Cell via supply tubing. - Tubing stuck too far into manifold. 	<ul style="list-style-type: none"> - Clear obstruction. - Increase vent opening or add breather stand pipe. - Measure flow and adjust individual 1/2" valve as needed. - Cut end at 45-degree angle and stick only 25mm (1") into return manifold.
XIV. Paint/rinse entering top of Cell.	<ul style="list-style-type: none"> - Spray rinse or paint dripping from work. 	<ul style="list-style-type: none"> - Use splash guard.
XIV. Low rectifier current output.	<ul style="list-style-type: none"> - Loose bus bar or Electrode tab connections. - Poor grounding contact. - Fouled Membrane Shell / Electrode. - Low paint or anolyte conductivity. - Rectifier problem. - Blown fuse to Cell. 	<ul style="list-style-type: none"> - Tighten as required. - Clean/replace contacts. Clean racks. - Clean as required. - Investigate. - Investigate. - Repair/replace as necessary.
XV. Low individual Cell electric current draw.	<ul style="list-style-type: none"> - Loose connection. - Corrosion at Electrode tab. - High current density. ◇ Not filled with anolyte. ◇ Anode is worn away. - See XIV. 	<ul style="list-style-type: none"> - Compression washer should be flat. - Use only stainless steel hardware. - Replace Membrane Shell. - Confirm proper slope to insure Cell does not fill with oxygen gas bubbles. - Replace Cell
XVI. Low pump pressure.	<ul style="list-style-type: none"> - Backwards motor rotation. - Loose impeller. - Blocked suction piping. - Lost pump prime. - Wide-open by-pass valve. 	<ul style="list-style-type: none"> - Change phase connections. - Adjust clearances as necessary. - Clear. - Prime pump. - Close valve until about 4 lpm (1gpm) goes through by-passing piping.

Troubleshooting Guide

Problem	Possible Cause	Remedies
XVII. Low pump flow.	<ul style="list-style-type: none"> - Closed valves. - Blocked supply manifold. - Supply manifold too small. - Pump capacity. - See V. 	<ul style="list-style-type: none"> - Adjust. - Clear. - Increase size. - Check specifications of pump against recommended flow / pressure rates.
VXIII. High analyte conductivity.	<ul style="list-style-type: none"> - Sensor malfunction. - Set point too high. - Controller malfunction. - D.I. Water valve malfunction. - See XIX 	<ul style="list-style-type: none"> - Inspect and clean. - Adjust. - Test and calibrate or repair. Read controller manufacturers' manual. - Investigate.
XVIV. Low analyte tank level.	<ul style="list-style-type: none"> - Evaporation - Open tank drain. - See XXII, IV, XIII - Malfunctioning siphon breaker. 	<ul style="list-style-type: none"> - Add more D.I. Water. - Close valve. - Inspect and repair.
XIX. Conductivity controller malfunction.	<ul style="list-style-type: none"> - Blown fuse. - Sensor. - Relay contacts. - General failure. 	<ul style="list-style-type: none"> - Check for continuity. - Clean and check for alignment with flow. - Check for continuity. - See manufacturers' manual.
XX. Back cover is cut or torn.	<ul style="list-style-type: none"> - Handling. 	<ul style="list-style-type: none"> - Cover exposed anode plate with 2 part epoxy to insulate from e-coat bath.
XXI. Low electrolyte Conductivity.	<ul style="list-style-type: none"> - See XIX. - D.I. Water valve stuck open. - Tank has been recently filled with D.I. Water. 	<ul style="list-style-type: none"> - Investigate - Add enough acid to rinse conductivity to 80% of normal specifications.

Troubleshooting Guide

Problem	Possible Cause	Remedies
XXII. Membrane sweating (observed with paint tank empty.)	<ul style="list-style-type: none"> - Condensation due to humidity. - Membrane permeability. 	<ul style="list-style-type: none"> - Normal. - If excess, check rate for an hour, measuring every 15 minutes. Contact UFSc.
XXIII. Anolyte overflowing rim of anolyte tank.	<ul style="list-style-type: none"> - Blocked overflow/skimmer. 	<ul style="list-style-type: none"> - Clear skimmer and piping.
XXIV. Cell does not hang straight.	<ul style="list-style-type: none"> - Square bar stock is not straight. 	<ul style="list-style-type: none"> - Fix universal bracket accordingly.
XXV. Increased levels of dirt bits in the ED bath.	<ul style="list-style-type: none"> - Failed diode. - Loose electrical connection. 	<ul style="list-style-type: none"> - Check with diode tester and replace as needed. - Tighten as needed.

Anolyte Color Evaluation

Topic: Anolyte Color Evaluation for TECTRON™ Membrane Electrode Cells with Stainless Steel Electrodes

Please read all the instructions listed below carefully to familiarize yourself with the project before attempting to perform any of the work or unpacking any further.

Required Materials

- Daily Log Sheet

Required Tools

- None

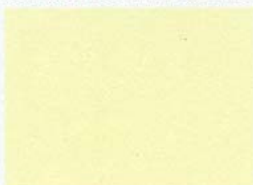
Anolyte color is a valuable preventive maintenance tool in an e-coat system. Anolyte flows through each Cell and the anolyte system itself, so its color is often an early indication of a problem. By regularly observing and recording the color of an e-coat system's anolyte, an e-coat tender can keep the Membrane Electrode Cells operating at peak performance.

The color chart below ranges from a clear, light yellow color ("normal") to a dark color, similar to coffee. Your anolyte color will be somewhere within this range. Compare your daily anolyte sample to the color chart and record the color on your daily log sheet. The color should always be "normal". The pale yellow color at the left or the slight darker yellow (Stage One) is typical anolyte color. If anolyte begins to turn darker, yellower, or reddish, that is generally an indication of iron particles in your anolyte system. This is an early warning sign of rapid electrode deterioration. The darker your anolyte, the greater the amount of erosion. **If you notice a change, contact your UFSc Sales and Service Representative for a consultation immediately.**

Some problems that anolyte color can indicate are listed here. This list is not exhaustive, and should be used only as a tool to help you use anolyte color to predict problems.

1. If your anolyte color is **Cloudy or Opaque:**
 - Cut Membrane Shell
 - Biological Contamination
 - Overspray or splash from the paint tank
2. If your anolyte color is **Paint Colored:**
 - Cut Membrane Shell
 - Overspray or splash from the paint tank
3. If your anolyte color is **Clear and Dark Colored, similar to coffee:**
 - Rapid deterioration of stainless steel electrodes. (Refer to the color chart below.) This can be from a variety of causes, such as low flow, high anolyte conductivity, contaminants in the paint bath, etc.
4. **Quick Change in Anolyte Color** - Rapid change in color (in any way) can be indicative of a problem. **NOTE:** TECTRON Cells with non-stainless Electrodes generally have a crystal clear anolyte color.

For more information see the original manual that came with the equipment or call UFSc at the phone number shown above.



Normal



Stage One



Stage Two



Stage Three

Glossary of Terms

4 to 1 Rule: Commonly referred to method used to estimate electrode area. In the case of a Cathodic ED system, multiply the painted throughput by 2 minutes and divide by 4.

-A-

AC: Alternating Current. Usually available at 480 or 600 volts.

Acetic Acid: Typical Cathodic paint solubilizer.

Acetate Ion: Negative solubilizer ion produced in the ED process which passes through the membrane of the Membrane Electrode Cell into the electrolyte fluid.

Acidity: See pH.

Acrylic Coatings: Coatings comprised of acrylic polymers characterized by excellent stability and UV exposure resistance.

Amine: Chemical used widely in anodic EDP paints to make the paint water dispersible. See neutralizer.

Amps: Flow of electricity in coulombs/second.

Anions: Negatively charged ions that are attracted to the positively charged anode.

Anodic Paint: An ED paint that forms on the anode.

Anode: Positively charged electrode.

Anode Area: See Electrode area.

Anolyte: Solution surrounding the anode in the anolyte Cell: sometimes referred to as solubilizer, it is essentially acetic acid and deionized water.

Anolyte Cell: An anode enclosed in a plastic housing and separated from the paint with a semi-permeable membrane; the membrane allows concentrated solubilizer to pass through, while excluding passage of paint molecules.

ANSI: American National Standards Institute

ASTM: American Society for Testing and Materials

Auxiliary Electrodes: Often portable, they are placed inside cavities of large objects. Increases the paint film build in specific areas of the part.

-B-

Glossary of Terms

Bacteria: Often composed of a single cell micro-organisms that can contaminate some paint baths.

Bare Electrode: An Electrode that makes close contact with ED paint bath.

Bath: A low solids (typically less than 25%) dispersion of paint solids combined with D.I. Water and other compounds.

Biologicals: Broad category applied to any organism (fungus, bacteria, etc.) that can thrive and multiply in any of the process fluids of the ED system.

Box Cell: Rectangular Cell where the electrode is equal to the membrane area.

Bulkhead: Device used to separate or close off a region yet allows a passage way for fluid or electrical current.

Bus Bar: Rectangular copper bar that allows multiple Electrode connections.

-C-

Cable Lead, Long Half: Usually longer portion of the Cable Lead that connects to the bus bar.

Cable Lead, Pigtail: Usually shorter portion of the Cable Lead that connects to the Electrode.

Cap: Part of the TECTRON Membrane Shell that seals the end of the Membrane Shell.

Carrier: Mechanical devices used to contain the substrate being painted as it moves through the paint bath.

Cathode: Negatively charged Electrode.

Cathode Area: See Electrode area.

Cathodic Paint: An ED paint that forms on the cathode.

Cations: Positively charged ions that are attracted to the negatively charged cathode.

Center to Center: Distance from the center of a TECTRON Cell to an adjacent Cell.

Chlorides: Any binary compounds of chlorine (Cl) consisting of chromic phosphate and aluminum oxides.

Chrome Phosphate: Amorphous structure that enhances corrosion resistance.

Cleaner: Chemical that is designed to remove surface contaminants that may interfere with the deposition of the ED paint.

Glossary of Terms

Collar: Part of the TECTRON Membrane Shell that connects the membrane to the upper portion of the Cell.

Compatibility: The ability of different materials to mix or combine together without an adverse reaction.

Conductivity Specific: A property of a material or mixture that describes its ability to transfer electricity. Usually defined as the reciprocal of resistivity and known by symbol 'k'. Expressed as microSiemens/cm (microMhos/cm).

Confined Space: A term defined by USA OSHA that must be checked for the lack of oxygen or the overabundance of other gases. Check with your safety department for more assistance.

Contamination: Any substance present in a solution or on a metal surface which is detrimental to the process being formed.

Conveyor: Device used to move the ware through the various stages of the ED paint finishing system.

Corrosion: To eat away by chemical reaction. (e.g. rust on steel)

Coulombic Yield: The weight of coating deposited per coulomb of current. This is usually expressed as coulomb/gram and is a measure of the electrical efficiency of the ED paint.

Cratering: A bowl-shaped depression (concave) in the ED paint film down to the substrate.

Crescent Shaped Cell: Similar to a box cell except shaped in a semi circle as seen from the top view.

Current: Amount of electrical flow, expressed as amps or coulombs/second.

Current Density: Current flowing per unit area, amps/m² (amps/SF).

Current Draw: The amount electrical current flowing at a specific instant at a given point.

-D-

Darlington Module: Transistorized switching unit.

DC: Direct electrical current.

Dead Entry: The first Electrode is placed a considerable distance away from the LPI point, so that very little current flows to the ware until it moves closer to the first Electrode.

Deionized Water: See D.I. Water

Demineralized Water: Synonym for distilled water.

Glossary of Terms

D.I. Water: Water purified by the removal of virtually all ionic species.

Dialysis: Separation of small molecules from macromolecules in a solution by means of a semi-permeable membrane.

DIN: German industrial standards organization.

Diode: Any electronic device that restricts current flow to one direction.

Dirt: Particles in the ED paint film.

Dirt Bits: Small particles of ED paint solids, sometimes in combination with other contaminants, in the ED paint bath. These objects can cause a defect, usually on horizontal surfaces.

Dry Film Thickness: Measurement of paint film after drying and/or curing.

Dwell Time: The amount of time a part is completely immersed in the paint bath.

-E-

E-coat: See Electrocoating.

ED: See Electrocoating.

EDP: Acronym for electrodeposition of paint.

Eductor: Venturi nozzles located laterally across the floor and down the side walls of the ED tank that help agitate the paint solution.

Electro-chemical Equivalent: The weight of paint solids (in grams) deposited under the influence of one coulomb of electricity passed through the paint bath.

Electrocoating: An electrochemical process where a voltage difference is applied across two electrodes in an aqueous solution of organic material. The organic material migrates to one of the electrodes and forms a film on the electrode.

Electrodip: See Electrocoating

Electrodeposition: See Electrocoating

Elpo: See Electrocoating

Electroendosmosis: The movement of water and solvent away from the depositing electrode through the film during ED.

Electrode: Conductive surface that provides a voltage gradient and opposes ware.

Main Heading Glossary of Terms

Electrode Area: Conductive surface area of the Electrode present in the Cell or Electrode Holder.

Electrode Holder: Non conductive device to hold and shield the Electrode from possible contact with the ware.

Electrode Tab: Thin metal ribbon that is attached to the main portion of the Electrode.

Electrolysis: Passage of current via ions under the influence of a voltage gradient.

Electrolyte: Solution of D.I. Water and ions inside the Cells. In the case of cathodic ED paint, the pH is less than 7.0 for anodic ED paints, the pH is above 7.0.

Electrons: Negatively charged subatomic particles that circle the positive nucleus of atoms. Current flow is caused by the passage of electrons from atom to atom.

Electrophoresis: The movement of ions suspended in a polarized liquid.

Epoxy Acrylics: Replaced epoxy-esters as the best anodic detergent resistance primer.

Erosion: Natural process in the case of a metal anode, where the metal is sacrificed over a period of time by the prevailing electro-chemical reaction.

Evaporation: Conversion of a liquid into a gaseous state.

-F-

Film Thickness: Thickness of the coating after curing, expressed in microns (mils).

First Part Out (FPO): Location where the largest ware starts to break through the liquid level of the bath.

First Electrode: In a monorail conveyor system, the Electrode that is positioned at the entry to the ED tank.

Fish Eyes: Very large craters usually due to silicone, oils, or other contamination prior to the ED bath.

Flat Cell: An anolyte Cell that has a flat, rectangular geometry. Extremely heavy, and difficult to maintain.

Floor Cell: Cell positioned along the floor of the ED tank.

Flow Meter: Mechanical or electrical detection device used to measure the flow rate through a pipe or other known cross section.

Flushable Electrode: See Membrane Electrode Cell.

Glossary of Terms

Freeboard: Vertical distance between tank lip and paint surface in tank.

Fuse: Electrical protection device.

-G-

Ground Electrical: An object so massive that it can gain or lose very large number of electrons without becoming perceptibly charged one way or the other. A good example is an earth ground.

-H-

Hash Marks: A film defect, which sometimes occurs on vertical surfaces as the part is being submerged, generally with live entry.

Heatsink: An aluminum device that allows the transfer of heat away from a component into the atmosphere either by natural convection or forced convection by the means of a fan.

Horizontal Settling: Dirt settling on the top side of horizontal surfaces.

-I-

Ions: Charged particles, either negative or positive.

Ion Exchanged Membrane: Semi-permeable membrane that allows only particles of a certain charge to pass through while rejecting particles of the opposite charge.

Iron Phosphate: Amorphous structure consisting of a mixture of iron phosphate and iron oxides. Used to improve adhesion and corrosion resistance.

-L-

Laddering: See Hash Marks

Live Entry: The first Electrode is placed close to the LPI point, such that the ware is painted more quickly.

Lockout: Method used by a person to place their own lock on the DC rectifier to keep the unit from being turned back on until the lock is removed.

Glossary of Terms

Lug (connector): A clamping device used to hold cable leads to the Bus Bar providing an electrical connection.

-M-

Membrane: Porous synthetic made with differing pore sizes that acts as a highly efficient filter. Allows the passage of ions, water, and other solvents and very small molecules, but almost impermeable to macromolecules.

Membrane Guard: Protective shield around the membrane.

Membrane Monitor™: Monitoring device to measure the voltage drop across the Cell/Electrode.

Membrane Shell: Outer housing of the Cell that contains the membrane.

MEQ (Milliequivalents): Concentration of ED solubilizer in the bath, usually expressed as MEQ/100 grams of paint solids, or MEQ/liter for liquids.

Meter: Unit of distance in SI units.

Milliamp: Unit of distance in SI units.

Millivolt: 1E-3 Amps.

Micron: Micrometer, or 1×10 to the 6th power of a meter, usually shown as the symbol, μ , or mu.

MicroMho: 1×10 to the 6th power of a Siemens, a measure of conductivity.

Mil: Unit of measuring film thickness. 1 mil equals one thousandth of an inch (0.0001 inch).

-N-

Neck: The top most portion of the TECTRON Cell/Electrode.

Neutralizer: The ingredient in the EDP Paint which makes the paint water dispersible. In anodic systems this is an amine while in cathodic systems it is an acid.

Nipple: Commonly used term to describe a pipe with male threads on each end.

No-coat: A part that receives little or no ED paint film. Can be caused by a lack of electrical contact; no applied power (voltage); or rectifier malfunction.

Non-volatile (NV): Compounds that do not evaporate.

Glossary of Terms

-O-

Ohm: Standard unit of electrical resistance.

Ohm's Law: Relationship between voltage, current and resistance for a DC circuit.

Ohmmeter: Measures electrical resistance.

Orange Peel: Rough and uneven cured paint finish usually caused by high levels of iron contamination of the ED bath.

Overflow Nozzle: Usually a hosebarb adapter that connects the return tubing with the return manifold.

-P-

Painted Throughput: The amount of paintable surface area that passes through the ED system. For a monorail conveyor system it is the amount of surface area, per minute, that passes through the ED bath. For a hoist system, it is usually expressed as the surface area per load (in the ED bath at one time) and the number of loads painted per hour.

Passivity: Lack of chemical activity.

Peak Current: The maximum current flow recorded during the ED process. This usually occurs very quickly after the ED process has started. The forming ED film has inherent resistance that will tend to limit current if the voltage is held constant.

Permeable: Porous to the passage of permeation of fluids.

Permeate: The fluid substance (water, solubilizers, and dissolved material) separated from the paint bath by ultrafiltration.

PLC—Programmable Logic Controller: A computer undertaking a multiple level of tasks, that provides automation for production. The PLC sends, receives, and stores data and commands.

Pre Wet: Lineal distance from the LPI point to location of the first electrode, generally equal to a time of about 10 seconds, or more.

pH: The relative scale to judge the number of H⁺ ions in a solution with a range from 1 to 14. A pH of 7.0 is said to be neutral, a pH less than 7.0 is acidic, and a pH more than 7.0 is basic.

Phosphating: Metal treatment prior to the ED bath where a crystalline layer is applied to enhance the adhesion of the ED film layer.

Pinholing: Tiny round breaks in a paint film giving the appearance of pinholes.

Plugging: Rough film due to excess current.

Glossary of Terms

Plaguing: Rough film due to excess current.

Power on Distance, Monorail Type ED Conveyor Systems: Lineal distance from the location of the leading edge of the first Cell to trailing edge of last Cell.

Purge: Amount of permeate diverted to the waste stream in order to remove contaminants.

-Q-

Quick Electrical Current: Electrical connection that can be connected or disconnected without tools.

-R-

Rectifier: Device to convert AC power to DC power.

Relay: Electrical device where a low voltage signal can control higher voltage operation.

Replenishment: High solids paint concentrate added to the paint bath to maintain a proper balance of solids, MEQ, solvent, color, etc.

Resistance: Opposition to flow of current, expressed in ohms.

Resistor: Electrical device with a known resistance value.

Resistivity Specific: A property of a substance or mixture, usually expressed as Ohm-cm for a 1 cm x 1 cm x 1 cm cube. The symbol is ρ , or rho.

Return Tubing: Generally a clear PVC tubing used to connect the overflow nozzle to the return manifold.

Ripple: The superimposition of alternating voltage on a DC output of a rectifier.

Roof Cell: Cell positioned along the roof of the auto body or top section of the ED tank.

Rub Rail: Usually PVC or fiberglass pipes positioned between the side walls of the ED tank and the ware. Used to protect the side walls from damage by a swinging ware.

Rupture: Bursting of the ED paint film caused by the very rapid generation of gas at the surface of the part being painted. Usually due to excessive voltage.

-S-

Glossary of Terms

Shunt: High quality resistor used in combination with a shunt-rated DC ammeter.

Shutdown: Ability of the wet ED paint to restrict the deposition of additional thickness once a certain amount of paint has been deposited.

Signal Conditioner: Electrical device used to transform a high voltage signal to more usable low voltage/low current signal.

Siphon Breaker: Device used to stop a siphoning action. Usually used on electrolyte return manifolds to keep the Cells from losing their electrolyte solution.

Solids: Pigment and non-volatile vehicle components of paint.

Solubilizer: Paint stabilizer that aids in maintaining paint solids in solution.

Solvent: Component of a solution that dissolves other components.

Splash Guard: Protective device at the top of the Cell/Electrode used to keep ED paint out of the inside of the Cell/Electrode.

Stainless Steel: Metal alloy resistive to corrosion from most types of common atmospheric contaminants.

Substrate: Material on which the ED film forms.

Super Cell: See Crescent Shaped Cell.

Supply Tubing: Generally clear PVC tubing used to connect the supply manifold to the Cell.

Surface Conductivity: The electrical resistance of a particular surface.

-T-

Tagout: See Lockout

Throw Power: Relative measure of how far an ED paint will be deposited inside a narrow passageway.

Toroid Coil: Metal shaped toroid, wrapped with an insulated copper conductor. Used to detect the AC current through a conductor.

Turbidity: Relative measure of the opaqueness of a fluid stream.

Tubular Cell: Type of Cell where the membrane is a concentric cylinder around a cylindrical electrode.

-U-

Glossary of Terms

UF: See Ultrafilter.

Ultrafilter: Semi-permeable membrane used to separate water and other low molecular weight compounds from the ED paint resins.

UV: Ultraviolet, invisible rays in the spectrum lying outside the violet end of the visible spectrum. Sometimes used to kill certain types of bacteria in a process stream.

-V-

VCO: Variable Current Overload

Voltage: A measure only of the potential difference (force or pressure) in electrical systems; it does not indicate amount of current.

VOC: Volatile Organic Compound

-W-

Ware: Parts to be painted. See substrate.
