



®

enercon  
INDUSTRIES CORPORATION

# Surface Treating Handbook

APPLICATIONS | MAINTENANCE | PARTS



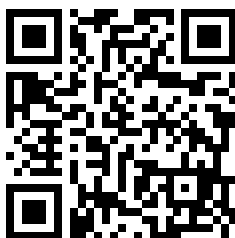
# Our experts are here to help you find an answer.

**Enercon's team of application & technical support engineers are ready to answer your questions.**

Have an issue and need to talk with someone immediately? Enercon offers 24/7 support to our customers. Please be prepared with your system's serial number and call us at +1.262.255.6070 and one of our support engineers will assist you.

Visit our support site for help or create a support case.

<https://enerconindustries.my.site.com/helpcenter/s/>



## **Enercon Manufactures Several Types of Electrodes!**

Before you replace the electrodes in your Enercon corona treater make sure you have the correct style. Installing any electrode other than the one specifically designed and manufactured by Enercon for your system can lead to improper treatment and/or system damage! Contact Enercon Customer Service if you have any questions.

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# Ordering / Returning Parts

The information on this page is provided to answer some of the more frequent questions we receive when our customers contact us for replacements parts or to return parts or equipment.

Use the breakdown diagrams in this Handbook, as well as the diagrams in your Enercon equipment manuals to determine the names and part numbers of the components you need to replace.

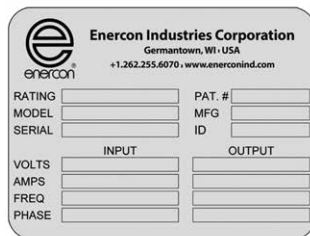
The model number and serial number of your equipment will help us determine if the part numbers you find here are accurate for your equipment, or if an older / newer part number is required.

To order replacement parts, call (262) 250-3140. For your convenience, Fax Order Forms are also available upon request.

For technical assistance or troubleshooting tips call (262) 255-6070.

## When ordering parts, please specify the following:

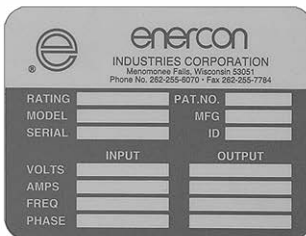
1. The model number of the equipment as shown on the rating plate.
2. The serial number of the equipment as shown on the rating plate.
3. The part number as shown in the parts breakdown drawings and tables and the quantity needed.



**Enercon Industries Corporation**  
Germantown, WI - USA  
+1.262.255.6070 - www.enerconind.com

|        |  |        |        |  |
|--------|--|--------|--------|--|
| RATING |  |        | PAT. # |  |
| MODEL  |  |        | MFG    |  |
| SERIAL |  |        | ID     |  |
| INPUT  |  | OUTPUT |        |  |
| VOLTS  |  |        |        |  |
| AMPS   |  |        |        |  |
| FREQ   |  |        |        |  |
| PHASE  |  |        |        |  |

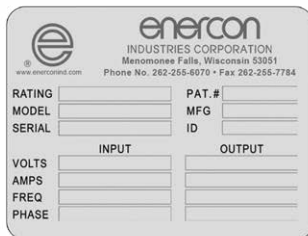
Current Enercon Rating Plates



**enercon**  
INDUSTRIES CORPORATION  
Menomonie Falls, Wisconsin 53051  
Phone No. 262-255-6070 • Fax 262-255-7784

|        |  |        |          |  |
|--------|--|--------|----------|--|
| RATING |  |        | PAT. NO. |  |
| MODEL  |  |        | MFG      |  |
| SERIAL |  |        | ID       |  |
| INPUT  |  | OUTPUT |          |  |
| VOLTS  |  |        |          |  |
| AMPS   |  |        |          |  |
| FREQ   |  |        |          |  |
| PHASE  |  |        |          |  |

Original Enercon Rating Plates



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Menomonie Falls, Wisconsin 53051  
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|        |  |        |        |  |
|--------|--|--------|--------|--|
| RATING |  |        | PAT. # |  |
| MODEL  |  |        | MFG    |  |
| SERIAL |  |        | ID     |  |
| INPUT  |  | OUTPUT |        |  |
| VOLTS  |  |        |        |  |
| AMPS   |  |        |        |  |
| FREQ   |  |        |        |  |
| PHASE  |  |        |        |  |

## When returning parts, please do the following:

1. Ensure you request and receive a **Return Material Authorization (RMA)** for parts or equipment being returned for repair or credit.
2. Write the **RMA** CLEARLY on the outside of all packaging and all associated paperwork.

## Enercon Customer Service Department

### Phone Numbers:

**Parts** - (262) 250-3140

**Technical Assistance** - (262) 255-6070

**Fax Number:** (262) 255-7784

**Parts E-mail:** parts@enerconmail.com

**Service E-Mail:** service@enerconmail.com

**Website:** www.enerconind.com

**24hr Customer Service is available**

# Service Options

## Start Up Made Easy

Enercon has in place a discounted Start Up service for our customers with brand new equipment who are unfamiliar with the installation and operation of surface treating equipment.

As part of the service, an experienced Enercon Field Service Engineer will review your treater installation, making sure that everything has been done correctly. Or, if you prefer, the Field Service Engineer can supervise your installation of the surface treating system.

Once your surface treating system is up and running, the Service Engineer will provide hands on training for your operators, as well as routine care and trouble shooting for your maintenance personnel.

## Preventive Maintenance

Routine Preventive Maintenance is at the heart of every successful manufacturing operation. Over the years, our experience has shown that an aggressive preventive maintenance program is the best insurance against downtime and scrap. Solid periodic maintenance will also prolong the life of your equipment. We have in place a preventive maintenance program, our PMV service, which is designed to give you that insurance.

For customers who have signed up for this service, we will supply, at a discounted rate, a Field Service Engineer who will review all of your Enercon equipment. In addition to insuring that your Enercon surface treating systems are tuned up and performing correctly, our Engineer will provide hands-on training for your operators and maintenance personnel. He will also identify critical spare parts, which should be a part of your maintenance inventory, and help you refine your ongoing maintenance program.

## Field Service

In conjunction with our Start Up and PMV services, Enercon also provides emergency field service that gets consistently high ratings from our customers in the converting and extruding industries. When a problem cannot be resolved by your maintenance department, we will provide a Field Service Engineer to come to your plant and properly diagnose your equipment.

With extensive hands-on experience and direct access to our Engineering Department, our Engineer will be able to ensure that the problem you are experiencing is resolved. They will also be able to determine if anything else in the system may require repair.

## Contacting Customer Service

In addition to the Start Up, Preventive Maintenance and Field Service options, Enercon also provides outstanding phone support to answer your questions on the application and troubleshooting of your equipment. For any of these services, you can contact Enercon's Service Team either by phone at (262) 255-6070, or e-mail at [service@enerconmail.com](mailto:service@enerconmail.com), 24 hours/day.

## NOTE:

When contacting customer service, please specify the equipment model number and serial number as displayed on the equipment rating plate(s). Refer to Ordering / Returning Parts for rating plate details.



# Safety Inspection

| Safety Checks                                       | Requirements                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Safety Labels                                       | Verify that all Enercon safety labels are in place and readable. If customer has installed their own covers anywhere in the system ensure they are labeled with an appropriate Safety Label.                                                                                                                                                                                            |
| High Voltage Covers                                 | Verify that all High Voltage covers were securely in place upon arrival and that each removable cover has a High Voltage Danger label in place. If removed for inspection / testing ensure they are reinstalled properly.                                                                                                                                                               |
| Remote High Voltage Transformer HV Wireways         | Verify that the wireways from remotely mounted High Voltage Transformers are secure and meet the requirements specified in the system manuals and drawing lists. Verify customer has installed appropriate Safety Labels on all covers and access points.                                                                                                                               |
| Remote & Local High Voltage Transformer(s) Grounded | Verify that all High Voltage transformers have an Earth ground wire securely attached to the ground stud on the transformer body. All Remote HV Transformer grounds must be at the same ground potential as the station and power supply grounds.                                                                                                                                       |
| High Voltage Wiring                                 | Verify that all high voltage wiring within the station plenum, or remote high voltage transformers, has a minimum physical clearance of 1" (25mm) from all other wiring and conductive surfaces within Enercon enclosures, or 2" within Non-Enercon enclosures.                                                                                                                         |
| System Grounds and Ground Brushes                   | Verify that the Station Frame, Power Supply, and all optional equipment have their own Earth ground wires securely attached to appropriate ground points, and that the station Ground Brush is making good contact with the end of the roll or the roll shaft. System grounds must all be at the same ground potential with each other and any remote high voltage transformer grounds. |
| Interconnection Wiring                              | Verify that all interconnection wiring is the correct wire type and gauge as noted in the system's connection diagram. Also verify that high frequency output wiring is routed as noted in the system's connection diagram.                                                                                                                                                             |
| Electrode Assy Shroud                               | Inspect electrode shroud for severe damage or missing components. Verify that the outer edges of the shroud are no greater than the factory default settings from the roll face.                                                                                                                                                                                                        |
| Electrode Position Interlock(s)                     | The electrode position interlock(s) stops the power supply when any electrode assembly is rotated out of the treat position. With all other interlocks satisfied, open each assembly, one at a time, and verify that the power supply does not start.                                                                                                                                   |
| Zero Speed Interlock(s)                             | The zero speed interlock(s) stops the power supply when the ground roll slows or stops. With the ground roll idle, or only one roll turning on a two roll system, verify that the power supply does not start. Repeat this test with the 2nd roll when required.                                                                                                                        |
| Air Flow Interlock(s)                               | The air flow interlock(s) stops the power supply when the blower is turned off. With the blower off, or only one running on a 2 blower system, verify that the power supply does not start. Repeat this test with the 2nd blower when required.                                                                                                                                         |
| Optional Equipment Interlock(s)                     | Some system options, such as High Voltage Switching, include interlocks that are connected to your power supply. Refer to the Optional Equipment Section of your power supply manual and perform the interlock tests called out for any options that are included with your system.                                                                                                     |
| Customer Installed Interlock(s)                     | If installed, test all customer interlocks to verify that they stop the power supply, or prevent it from starting when the interlock condition is not satisfied. If not installed, remove the jumper to test the interlock circuit.                                                                                                                                                     |

# Maintenance

## Production Information

| Material | Gap | kW Out | Prod. Speed | Min/Max. Speed | WD | Prop Speed/Power |
|----------|-----|--------|-------------|----------------|----|------------------|
|          |     |        |             |                |    |                  |
|          |     |        |             |                |    |                  |
|          |     |        |             |                |    |                  |
|          |     |        |             |                |    |                  |
|          |     |        |             |                |    |                  |

## Maintenance List

### Station

#### Weekly Checks

Electrode Assembly Gap  
Ground Roll / Bearings / Ground Brush Inspection  
Test Pneumatics (If Applicable)  
Check / Adjust Electrode Air Gap

#### Monthly Checks

Check Station and Optional Interlocks  
Inspect / Lubricate Roll Bearings

#### Quarterly Checks

Inspect Internal Conditions in Station Plenums

### Power Supply

#### Weekly Checks

Power Supply Cabinet / Cooling Fans  
External and Internal connections

#### Monthly Checks

Check Power Supply and Optional Interlocks  
Test Options and Inventory Spare Parts

#### Quarterly Checks

Inspect Internal Conditions of Power Supply Cabinet

**Note:** Ensure that all maintenance is performed in accordance with the appropriate manuals and recorded in the manual's Maintenance Record tables.



# Why do I need corona treating and how does it work?

Corona treating increases the surface energy of plastic films, foils and paper to improve wettability and adhesion of inks, coatings and adhesives. Treating works best when a substrate is treated at the time of extrusion and in-line prior to converting. Corona treating increases quality and productivity through improved print quality, faster press speeds and less scrap.

## Why do I need it?

Polymer films have chemically inert and non-porous surfaces with low surface tensions causing them to be non-receptive to bonding with substrates, printing inks, coatings, and adhesives.

Pretreated films, that is films that have been surface treated at the time they were produced, exhibit a higher surface energy that is crucial to producing quality printed, coated or laminated products.

Film that is not treated at the time of production will not accept printing, coating or lamination well. The opposite is not always true. Even if film is treated at the time of production, it will not always guarantee that printing, coating or laminating will be easily accomplished at any future time.

Each film type has an inherent surface energy (dyne level) that can be increased through corona treatment at the time of production. This level of treatment diminishes over time. So, film that can be easily printed and coated immediately after production can, within a few days or weeks, lose sufficient surface energy to become unprintable and uncoatable.

Since it's nearly impossible to guarantee that the film you receive will be converted within the required time limit, retreating in-line is often a necessity. It's important to note that treating in-line cannot replace primary treatment at the time of production. In fact many films, especially polyolefins (Polyethylene and Polypropylene) are almost untreatable when they set after production.

To ensure consistent quality, use films that have been treated at the time of production and retreat in-line. In order to make a product that is of acceptable quality to the converter and to the end customer, the substrate must be corona treated twice: at the time of production & prior to converting.

## How does it work?

A corona treating system is designed to increase the surface energy of plastic films, foils and paper in order to allow improved wettability and adhesion of inks, coatings and adhesives. As a result, the materials treated will demonstrate improved printing and coating quality, and stronger lamination strength.

A corona treating system consists of two major components: the power supply and the treater station.

The power supply accepts standard 50/60 Hz utility electrical power and converts it into single phase, higher frequency (nominally 10 to 30 kHz) power that is supplied to the treater station.

The treater station applies this power to the surface of the material, through an air gap, via a pair of electrodes at high potential and roll at ground potential which supports the material. Only the side of the material facing the high potential electrode should show an increase in surface tension. (If treatment is applied to the other side of the material it is referred to as backside treatment.)

A corona treating system in its simplest form can be portrayed as a capacitor. Voltage is applied to the top plate which, in the case of a corona treating system, would be the electrode. The dielectric portion of the capacitor would be made up of some type of roll covering, air, and substrate in the corona treater.

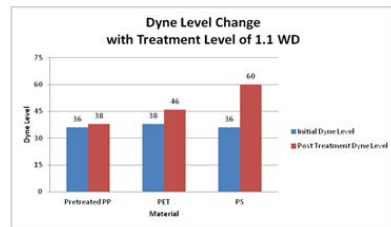
The final component, or bottom plate, takes the form of an electrically grounded roll. In the corona treating system, the voltage buildup ionizes the air in the air gap, creating a corona, which will increase the surface tension of the substrate passing over the electrically grounded roll.

# Why All Films Don't Treat the Same

To understand why all films don't treat the same we must first understand what a corona treater actually does. Although it has the capacity to make films wettable for converting, it is not an all powerful black box that magically transforms all film types equally.

A corona treater is essentially a capacitor that creates a field of ionized air without regard for the type of film that is passing through it. Corona does a number of things to a surface. It forms low molecular weight material on the film surface, it oxidizes the film surface, and forms positive and negative sites by adding and deleting electrons. It also rids the film of organic and inorganic contaminants that can interfere with adhesion. We also know from ESM imaging techniques that corona treatment can microscopically change and increase the surface area of films which increases the chances for successful adhesion.

The most common way to measure the effectiveness of treatment is to take a dyne level reading which measures the surface energy of the film. Generally speaking higher dyne levels are better for adhesion, and higher levels of corona treatment produce higher dyne levels. However, all films start out at a different dyne level, have an inherent responsiveness to corona treatment, and often have a multitude of additives that migrate to its surface which impedes adhesion. An example of these variations are shown in the graph to the right.



## Document your treating recipes

To manage these variations in film it is up to your operation to establish and document how incremental levels of treatment affect the ultimate success of your adhesion goals. For surface treating think in terms of the following: material specification (material supplier, age of film, storage conditions of film etc...) line speed, watt density or kW setting, air gap, web width, initial dyne level, & post treatment dyne level. Additionally, look at your recipe for success with your post treatment converting operation.

| <b>Corona Treater Profile</b>                                                                 |              |
|-----------------------------------------------------------------------------------------------|--------------|
| <b>Date:</b>                                                                                  | <b>Line:</b> |
| <b>Job #:</b>                                                                                 |              |
| <b>Application &amp; Treater Information</b>                                                  |              |
| <i>Record specific information about the treater and line being used in this application.</i> |              |
| <b>Manufacturer Serial Number:</b>                                                            |              |
| <b>Treat Width:</b>                                                                           |              |
| <b>Line Speed:</b>                                                                            |              |
| <b>Kilowatt Setting:</b>                                                                      |              |
| <b>Watt Density:</b>                                                                          |              |
| <b>Measured Input Voltage:</b>                                                                |              |
| <b>Treating 1 or 2 sides:</b>                                                                 |              |
| <b>Material &amp; Supplier:</b>                                                               |              |
| <b>Application:</b>                                                                           |              |
| <b>Measure of Treatment Effectiveness:</b>                                                    |              |
| <b>Electrode &amp; Roll Cleaning Schedule:</b><br>(i.e. once a week, once a month...)         |              |



# Watt Density

Enercon's Surface Treating Systems are available with Watt Density Control either as a standard or optional mode of operation. Below is information on how to calculate and verify the Watt Density for your system.

## Calculating Watt Density

The Watt Density setpoint represents the watts per square foot required to treat a specific product, and is calculated using the following formulas:

### Imperial Units:

$$\text{WD} = \frac{\text{Watts}}{[\text{Treat width (Feet)} \times \text{Line Speed (FPM)} \times \text{Number of Sides Treated}]}$$

### Metric Units:

$$\text{WD} = \frac{\text{Watts}}{[\text{Treat width (Meters)} \times \text{Line Speed (MPM)} \times \text{Number of Sides Treated}]}$$

This number normally ranges from 1 to 3 in English Units, or 10 to 30 in Metric Units, but it may be higher at times for some difficult films or special customer request.

## Watt Density Verification

Under certain conditions, the calculated Watt Density number may not give you the treatment results you are expecting. Keep in mind that the calculated Watt Density number is a starting point when determining your watt density requirements and could require adjustment up or down.

Before you begin to make adjustments to the WD Setpoint, you should verify if the system is interpreting the Watt Density number correctly. Using the currently entered Watt Density number, the output power level can be calculated by using the following formulas:

### Imperial Units:

$$\text{Power} = [\text{Watt Density Number} \times \text{Treat Width (Feet)} \times \text{Current Line Speed (FPM)} \times \text{Number of Sides Treated}]$$

### Metric Units:

$$\text{Power} = [\text{Watt Density Number} \times \text{Treat Width (Meters)} \times \text{Current Line Speed (MPM)} \times \text{Number of Sides Treated}]$$

If the Actual KW does not match the calculated output power level ensure that the units of measure and system parameters are entered properly.

If the Actual KW is correct then you may need to increase or decrease the WD Setpoint in small increments until you achieve the treatment results you are expecting for your product.

### **NOTE:**

Your system may include variables, such as adjustable treat width electrodes or non standard materials, which will need to be taken into consideration when calculating the Watt Density. Please contact Customer Service if you are unfamiliar with the use of Watt Density Control.

# Proportional Speed & Power

Enercon's Surface Treating Systems are available with Proportional Speed Control either as a standard or optional mode of operation. Proportional Speed Control produces a control signal that will increase or decrease the output of the power supply proportional to your line speed. The ratio between line speed and output power is fixed by the Proportional Speed Mode settings. Below is a generic description of how to program Proportional Speed for your system.

In Proportional Speed Mode you will need to enter the line speed and proportional output power level that best fits your production requirements. These values are then used to determine the speed/power ratio used by the system.

**Example:**

In this example we will assume that you have a 5kW power supply and a maximum line speed of 500 fpm. We will also assume that your typical production line speed is 250 fpm, and that you get the best treatment results with an output power level of 2.5kW at that speed.

In this scenario, you would use 250 fpm as the speed setting, and 2.5kW as the power setting.

When you are running production, the system monitors the actual line speed being sent from the station encoder or speed sensor, and then using the speed/power ratio the power supply automatically adjusts the output power level to stay proportional to the actual line speed.

If your line speed is below 250 fpm, the output power level will be below 2.5kW.

If your line speed is at 250 fpm, the output power level will be 2.5kW.

If your line speed is above 250 fpm, the output power level will be above 2.5kW.

**NOTES:**

Regardless of your proportional speed and power settings the maximum output power level will still be limited to the maximum output power rating of your power supply.

Proportional speed and proportional power are only available together on the Compak™ 2000 Deluxe and Touchscreen power supplies, and the Compak™ 9000 Touchscreen power supplies.



# Testing Methods For Surface Tension

Non-porous substrates need to have their surface energies increased for use in a number of packaging applications. There are two commonly accepted methods for determining the surface tension level of a treated substrate. These methods are dyne solution testing and contact angle testing. The following is a brief description of each of these methods.

## Dyne Solution Testing

The generally accepted solution to verify dyne levels or surface energy is a mixture of Ethyl Cellosolve and Formamide (Dyne Solution). This solution contains a dye to make it easier to see. When using these wetting tension solutions, all safety precautions as listed on the labels should be observed. These solutions also have a shelf life of only around six months, so they should be properly dated at time of initial use and replaced when the expiration date has been reached. If this isn't done, false dyne information could result, along with a rejection of treated material by the customer.

There are three methods that are generally used to check the surface energy of a substrate using Ethyl Cellosolve and Formamide (Dyne Solution). They are the cotton-swab applicator method, the dyne-pen method, and the draw-down test method. All three of these methods can be performed at the production line, allowing a real time measurement of surface tensions.

## Contact Angle Testing

This is a method of measuring the surface tension of a non-porous substrate using a contact angle tester (Kruss Device) and a drop of water. In this test a drop of water is placed on the substrate and measured by projecting the drop onto a background chart and measuring the angle on the chart. Due to the variety of manufacturers of contact angle testing equipment, each manufacturer's testing procedure should be followed on their equipment. Due to the equipment involved, this test is usually performed in a lab environment. Peel tests may be conducted to measure peel strength.

Both of these testing methods are accurate, but they do not translate to each other directly. In other words, a specific contact angle does not equal a specific dyne level. These tests should each be performed as a stand alone test and not as a comparison against each other.



**Enercon Dyne Pens are available for purchase on-line.**

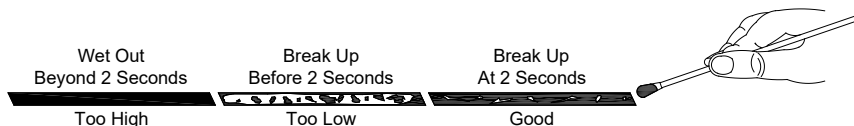


# Application Methods For Dyne Solutions

For all of the application methods listed below Dyne Solutions of various levels are placed on the substrate until a solution is found that wets out properly.

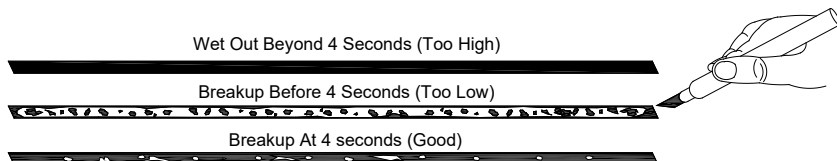
## The Cotton Applicator Method:

Place a few drops of a calibrated Dyne Solution onto the tip of a clean cotton applicator, or lightly immerse the applicator tip into the Dyne Solution container. Be aware that if a clean applicator is not used contamination of the solution may result. The solution is spread lightly over approximately one square inch of the test material. Compare your results with the results shown below. Repeat the procedure until a solution is found that breaks up properly on the surface of the material. This method has been a standard for years but is still somewhat subjective and inconsistent because of the variables involved in the application of the fluid to the substrate.



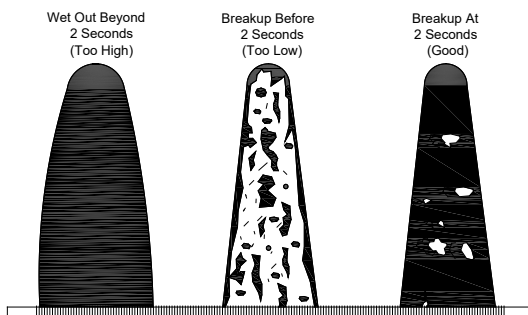
## The Dyne-Pen Method:

This method is typically used by the operator as a quick check of the treat level of a substrate. The Pens, resembling felt-tip markers, are pulled across the entire web in a straight line. Compare your results with the results shown below. Repeat the procedure until a solution is found that breaks up properly on the surface of the material. This method can also quickly determine which side is treated or if there is any back-side treatment. This method can be somewhat subjective and inconsistent mainly due to the possible contamination of the pen tip with incorrect use.



## The Draw-Down Test Method:

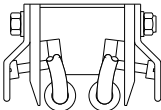
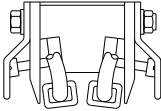
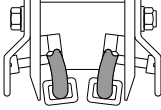
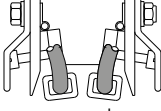
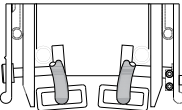
This is the most accurate of the surface-energy measurement tests. Cut a substrate sample, approximately 8 ½ x 11 inches, and clamp it to a clipboard. Horizontally across the top of the sample place single drops of three different level dyne solutions that bracket the desired treat level. A wire wound metering rod is placed just above the drops and pulled down. The tester will look for the proper breakup results of all 3 as described previously. This test tends to be more accurate because the metering rod lays the solutions down at the same relative thickness. The rod must be thoroughly cleaned after each use to ensure accuracy of this application method.



# Enercon Ceramic Electrodes Best Practices

Enercon ceramic electrodes are configured as part of an integrated system including your power supply, ground roll and exhaust system. Operating the corona treater without the correct type, size and length of electrodes properly installed and active in each electrode assembly will lead to improper treatment and prematurely failed electrodes.

Use the chart below to verify the type of electrode included with your system.

| Power Capacity<br>low to high | Electrode Shape<br>Not to scale                                                                          | Wire Color<br>Look for the name for<br>genuine Enercon electrodes                               | Shroud                                                                                        |
|-------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Round                         | <br>tabbed              | AWG <br>white  |              |
| V                             | <br>tabbed              | AWG <br>white  |              |
| PV                            | <br>tabbed              | AWG <br>purple |              |
| EV                            | <br>continuous backbone | AWG <br>purple | <br>reversed |
| E <sup>2</sup>                | <br>continuous backbone | AWG <br>purple |             |

## Use only genuine Enercon electrodes.

### White wire

AWM STYLE 3239 150C 40KVDC VW-1 ROWE IND 16 AWG 

Standard Electrodes - Standard Applications

### Purple wire

AWM STYLE 3239 150C 40KVDC VW-1 ROWE IND 16 AWG 

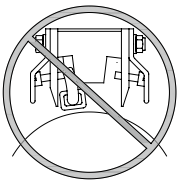
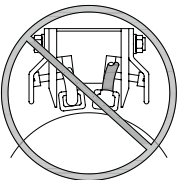
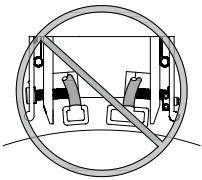
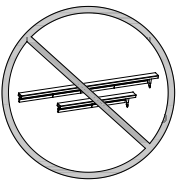
"PV" Electrodes - High Power Applications

Enercon electrodes manufactured prior to 2010 appear as above without the Enercon logo.

V, PV  
tabbed

EV, E<sup>2</sup>  
continuous  
backbone

# Problems Associated with Improper Ceramic Electrode Usage

| Unauthorized                                                                       | Scenario                                                                    | Result                                                                             | Reason                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | Damaged electrode removed to continue operation.                            | Premature failure and stress on the remaining electrodes.                          | <p>Overpower - Power rating of remaining electrode is exceeded.</p> <p>Overheat - Proper exhaust cooling air pattern is disrupted.</p>                                                                                           |
|    | Electrodes with different power ratings, are mixed into a treater station.  | Premature failure of either style of electrode.                                    | <p>Overpower - Power rating of either electrode can be exceeded due to a power imbalance.</p> <p>PV electrodes designed to handle high power levels.</p> <p>V electrodes, or 3rd party electrodes have a lower power rating.</p> |
|   | Enercon with different shapes (or styles) are mixed into a treater station. | Premature failure of either style of electrode.                                    | <p>Overpower - Power rating of either electrode can be exceeded due to a power imbalance.</p> <p>Overheat - Proper exhaust cooling air pattern is disrupted.</p>                                                                 |
|  | Shorter electrodes are mixed into a treater station.                        | Premature failure of existing proper length electrode, or shorter length electrode | <p>Overpower - Power rating of either electrode can be exceeded due to a power imbalance.</p> <p>Overpower - Power rating of remaining electrodes is exceeded.</p>                                                               |

## **WARNING!**

Enercon never recommends replacing our electrodes with a 3<sup>rd</sup> party product due to inconsistencies in design, manufacturing techniques, and materials used. Enercon uses only the highest quality components and consistent, repeatable manufacturing techniques in the design and production of our electrodes.

# Electrode Air Gap Adjustment and Alignment Procedure

## Air Gap Adjustment and Electrode Alignment

1. Lock Out and Tag-Out your system. Wait 2 minutes to allow voltages to discharge before attempting to work on the system.
2. Verify the air gap is even across the entire length of the electrodes by inserting a .060" (1.5mm), or desired thickness, flexible feeler gauge between the electrode and ground roll along the electrode length (**Figure 1**). Do not slide the feeler gauge across the face of the ground roll as this may scratch the roll surface.
3. If the air gap is either too loose or too tight, loosen the end plate bolts on each end of the electrode assembly to adjust the air gap (**Figure 1**).
4. For a loose gap, turn the adjustment bolt CCW until the electrode comes in contact with feeler gauge.
5. For a tight gap, turn the air gap adjustment bolt CW until the gauge fits into the gap. Perform Steps 4 and 5 on both ends of the assembly.
6. Once the gap is set, tighten the end plate bolts on each side of the electrode assembly.
7. If there is an uneven gap between electrodes, adjust the electrode assembly stop bolt to achieve an even air gap between each electrode and the ground roll (**Figure 2**).
8. If necessary, loosen the interlock ring set screws and rotate the ring so that the V-notch aligns with the position switch roller when the assembly is in the treat position (**Figure 3**). Retighten the set screws.

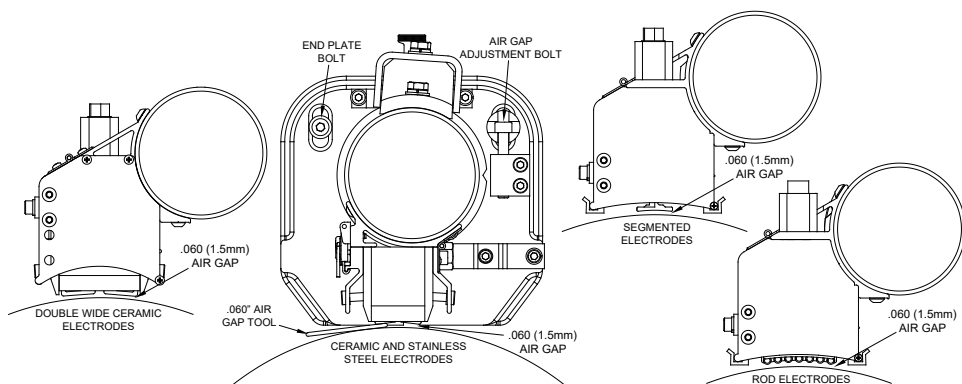


Figure 1

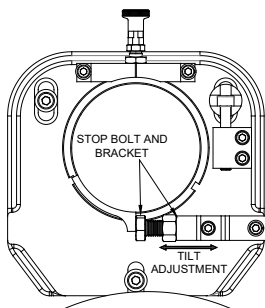


Figure 2

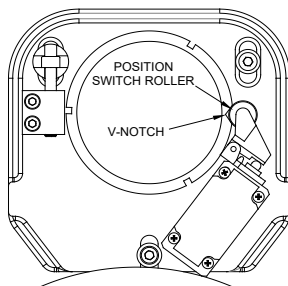


Figure 3

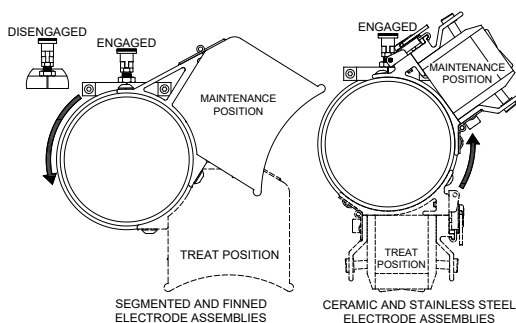


# Electrode Assembly Inspection and Cleaning

Turn off, disconnect, and lock out main input voltage and compressed air to the power supply and station. Wait for 2 minutes to ensure all voltages are safely discharged.

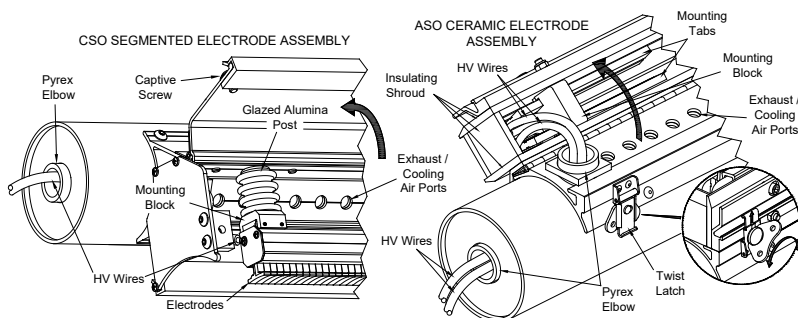
Rotate each electrode assembly into its maintenance position and engage the locking pin to secure the assembly,

**Figure 1.**



**Figure 1**

Open the assembly(s) by releasing the captive screws or twist latches and inspect the cooling air ports, insulating shroud, HV wires and the various electrode mounting components, **Figure 2.**



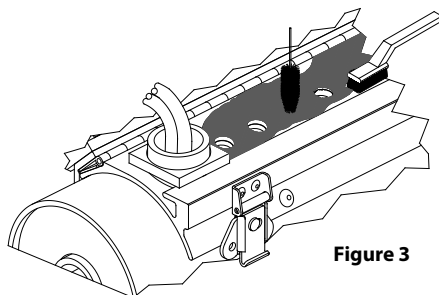
**Figure 2**

**General Cleaning:** Clean the assemblies by blowing them out with compressed air and/or a vacuum. Wipe down the shrouds, Pyrex elbow, mounting blocks, electrodes (including tabs and HV wires) and other surrounding components with isopropyl alcohol and a lint-free cloth.

**Extensive Cleaning:** If your electrode assembly(s) shows signs of air port blockage, excessive dirt buildup, HV arcing, or carbon tracking you will need to perform a more extensive cleaning of the assembly(s). Use a bore style stiff bristled brush to clear the exhaust / cooling air ports. Use a standard stiff bristled brush for any hard to remove contaminants on the exhaust tube surface, **Figure 3.**

Scrub any stubborn buildup from the shrouds, Pyrex elbow, mounting blocks, electrodes (including tabs and HV wires) and other surrounding components with isopropyl alcohol and a Scotch Brite™ pad, then wipe down these components and wipe down the surfaces with isopropyl alcohol and a lint free cloth.

If any severe damage was discovered while cleaning your assembly(s), refer to the Maintenance Section of your station manual for details on cleaning and repairing the components within your assembly(s).



**Figure 3**

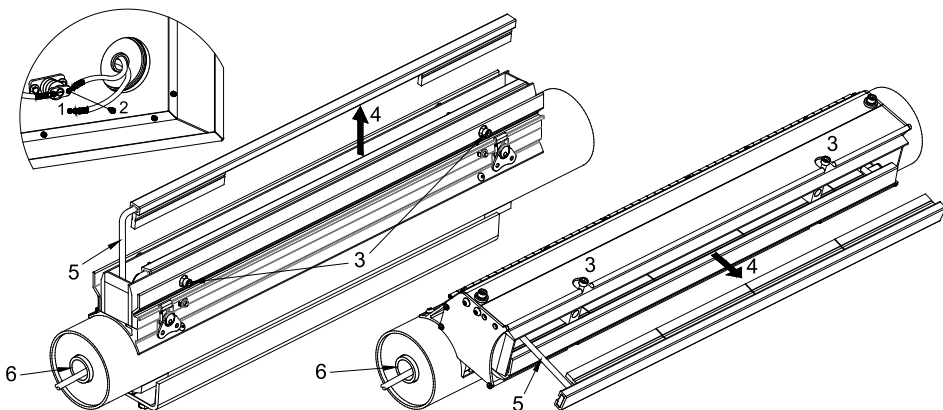
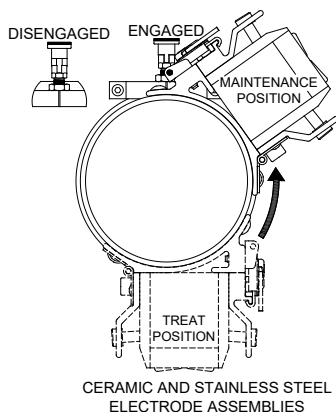


# Ceramic and Stainless Steel Electrode Removal

At some point you may need to remove an electrode(s) for cleaning, repair, or replacement. Use the following steps to remove the electrodes from each assembly.

## Removal Procedure

1. Lock Out and Tag-Out your system. Wait 2 minutes to allow voltages to discharge before attempting to remove and electrode.
2. Rotate the electrode assembly into the Maintenance position and engage the locking pin to lock it in place.
3. Remove the access cover on the High Voltage end of the station to gain access to the HV Terminal Block within the enclosure.
4. Remove the affected electrode's HV wire (1) from the HV terminal block (2).
5. Loosen all of the electrode mounting screws (3) along the full length of your electrode assembly.



6. Carefully lift the electrode up and out (4) of the assembly, taking care to gently pull the HV wire (1) free of the Pyrex tube. If needed, repeat this for the remaining electrode.

## Reinstallation Procedure

1. Ensure the electrode assembly is still in the maintenance position (See Removal Step 2 if needed) and that your system is still Locked Out and Tagged Out.
2. Reinstall the electrode by carefully placing the electrode (5) into the assembly, aligning the electrode mounting tabs into the electrode mounting blocks. Ensure the electrode mounting tabs are fully inserted into the assembly mounting blocks and aligned the electrode within the assembly.
3. Tighten the electrode mounting screws (3) and torque them to 3 in-lbs. (34 N-cm). Ensure that there is no movement of the electrode once it is installed.
4. Carefully feed the HV wire (1) through the Pyrex elbow and into the station enclosure and reconnect the HV wire to the HV terminal block (2). Ensure the screw is tight and that the HV wire does not move on the terminal block.
5. Reinstall the access cover onto the station enclosure. Disengage the locking pin and rotate the electrode assembly back into the treat position. Do Not lock assembly in treat position.



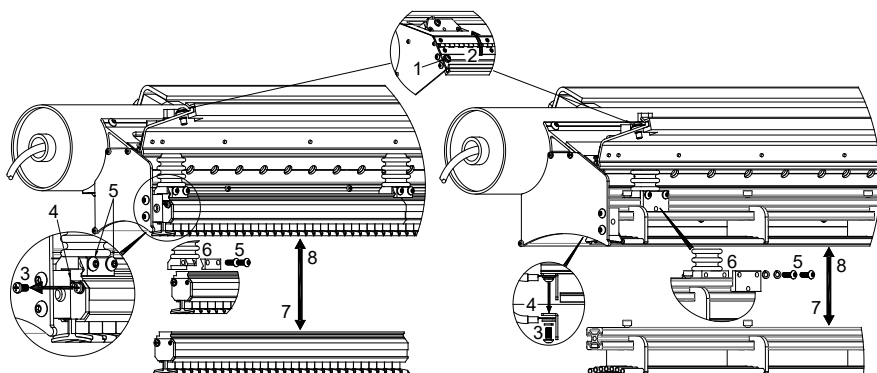
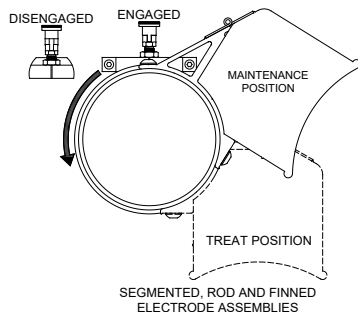
# Segmented, Rod and Finned Electrode Removal

At some point you may need to remove an electrode(s) for cleaning, repair, or replacement. Use the following steps to remove the electrodes from each assembly.

**Note:** Finned Electrode Removal is similar to Rod Electrode Removal, refer to your manual.

## Removal Procedure

1. Lock Out and Tag-Out your system. Wait 2 minutes to allow voltages to discharge before attempting to remove electrode(s).
2. Rotate the electrode assembly into the Maintenance position and engage the locking pin.
3. Disengage the captive screws (1) on both ends of the assembly and lift the shroud out of the way (2).
4. Remove the screw (3) and HV wire (4) from the end of the assembly.
5. For segmented electrodes, firmly support the electrode and loosen the screws (5) and clamp block (6) for the electrode being removed. For rod electrodes, firmly support the full length of the electrode and loosen the screws (5) and clamp block (6) along the full electrode length.



6. Keeping a firm grasp on the electrode, pull the electrode clear of the clamp blocks.
7. Once the electrode is clear of the clamp block, lower it away from the assembly (7) taking care not to allow the electrode to come into contact with the ground roll.

## Reinstallation Procedure

1. Ensure the electrode assembly is still in the maintenance position and that your system is still Locked Out and Tagged Out.
2. Keeping a firm grip on the electrode, lift the electrode (8) into the clamp blocks (6), reassemble the blocks and snug the hardware but do not tighten it at this point (5 & 6).
3. Ensure the electrode extrusion is fully inserted into the assembly mounting blocks and align the electrode within the assembly.
4. Tighten the hardware and ensure that there is no movement of the electrode within the assembly.
5. Reconnect the HV wire (4) using the previously removed screw (3). Ensure the screw is tight and that the HV wire does not move on the block.
6. Close the shroud (2) and reengage the captive screws (1) at both ends.
7. Disengage the locking pin and rotate the electrode assembly back into the treat position. Do Not lock assembly in treat position.





# Proper Termination of High Voltage Wire

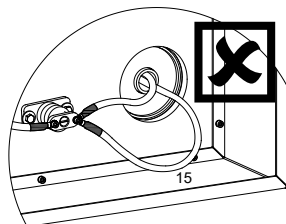
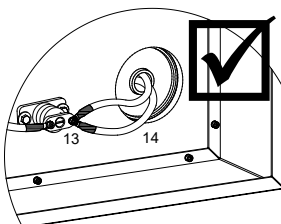
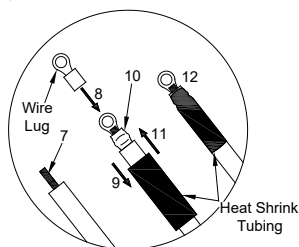
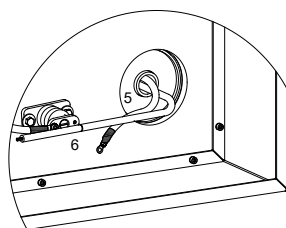
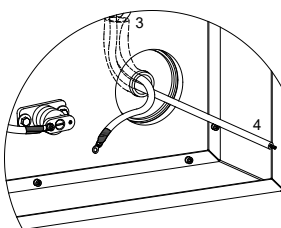
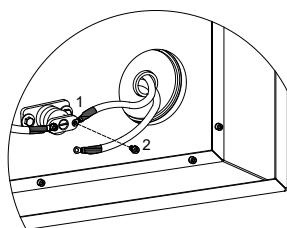
When installing a new electrode, or replacing the HV wire on a segmented or finned electrode assembly, you will need to ensure that the HV wire is the proper length, correctly terminated and connected. In many cases the electrode HV Wire will be cut to the proper length and terminated when it is built. If the HV wire on your electrode was not terminated in this manner, use the following procedure to properly shorten and terminate the HV wire.

1. Lock Out and Tag-Out your system. Wait 2 minutes to allow voltages to discharge before attempting to work on the system.
2. You will need to rotate the assembly into its maintenance position, refer to pages 16 & 17.
3. Disconnect the HV wire (1) of the damaged/old electrode from the HV terminal block (2), and remove the electrode, refer to electrode removal on page 16.
4. Install the new electrode and carefully route the HV wire through the Pyrex elbow (3) ensuring the full length of the HV wire is fed through the elbow (4).
5. For both Ceramic and Stainless Steel electrodes, unlatch and open the electrode shroud to ensure you do not cut the HV wires too short.
6. Route the HV wire to the HV terminal block ensuring the wire run is as short as possible (5) but with enough slack to allow it to be connected properly.

## NOTE:

High voltage wiring must be kept clear of control wiring, surrounding metal and grounded surfaces by a minimum of 1" (25.4mm) within an Enercon enclosure, or 2" (50.8mm) within a 3rd party enclosure.

7. Align the HV wire over the screw hole on the terminal block (6) and cut the wire to this length.
8. Terminate the HV wire using an appropriate sized wire lug (8) and a short length of heat shrink tubing (9) onto the wire. Securely crimp the wire lug (10) and slide the shrink tubing over the lug (11) and shrink it into place using a heat gun (12).
9. Connect the HV wires to the terminal (13) ensuring wire does not move on the terminal block, then close and latch the electrode shroud and check that there is not too much slack in the HV wire (14). If too much slack is left in the HV wire, or if you do not shorten the HV wire (15), the wire will be prone to arcing to the metal in the station and will most likely fail in a short amount of time.



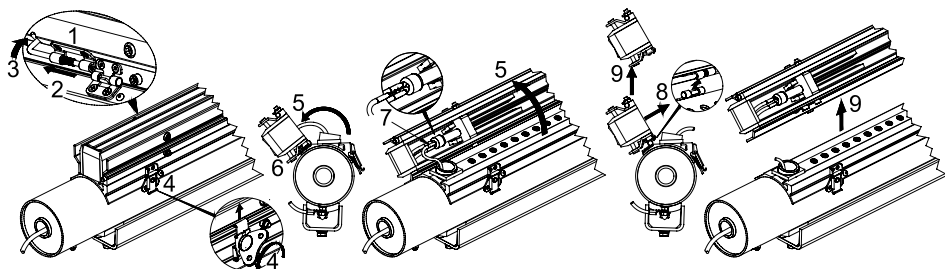
# ASO Quick Disconnect Electrodes and Cartridge Removal

## Cartridge Removal

The Quick Disconnect Cartridge allows for easy removal and replacement of your electrodes, shroud and mounting hardware, reducing equipment down time. Before removing the quick disconnect cartridge, lock, and tag out the system, then rotate and lock the assembly in the maintenance position.

**CAUTION:** Ensure you provide adequate support along the full length when handling the quick disconnect cartridge.

To remove a cartridge, disengage the cartridge stop pins [1] at both ends of the assembly, pulling the pins out [2] and stowing them in the shroud cutouts [3].

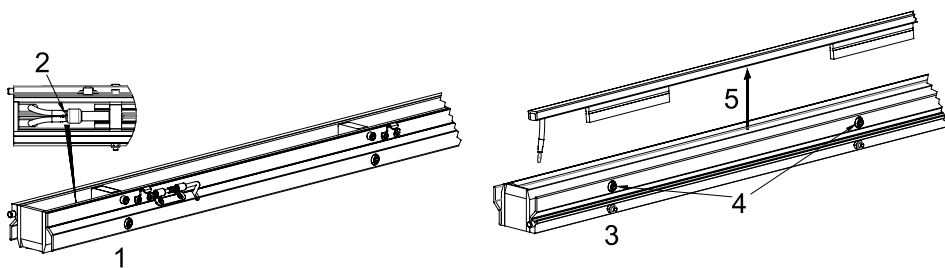


Disengage the twist latches [4] and open the cartridge [5] until it contacts the exhaust tube [6] and disconnect the HV feed wire [7] from the banana jack receiver.

Slide the cartridge to disengage the hinges [8] from the exhaust tube and lift the cartridge free of the assembly [9], placing the loose cartridge on a clean level surface.

## Electrode Removal

To remove the electrodes from the loose cartridge, place the cartridge face down on a clean level surface [1] and disconnect the electrodes HV wire from the banana jack receiver [2]. Rotate the cartridge face up [3] and loosen the electrode mounting screws [4] and lift the electrode(s) out of the cartridge [5].



Installing ASO Quick Disconnect Electrodes and Cartridge on next page.

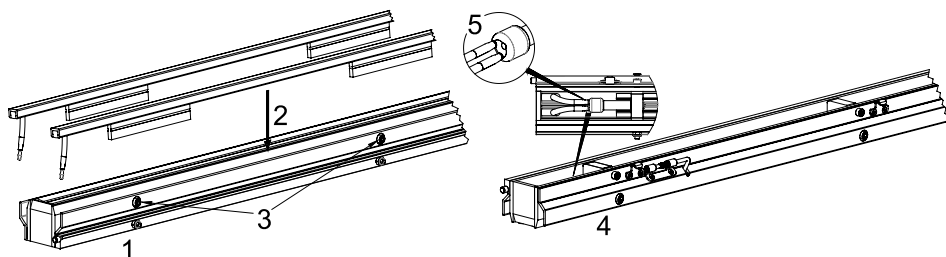
# ASO Quick Disconnect Electrodes and Cartridge Installation

## Installing ASO Quick Disconnect Electrodes and Cartridge

### Electrode Installation

To install cartridge electrodes, place the cartridge face up on a clean level surface [1], refer to 5.812

Removing ASO Quick Disconnect Cartridge and Electrodes if cartridge and electrodes are still installed.



**CAUTION:** Ensure you provide adequate support along the full length when installing the electrodes and cartridge.

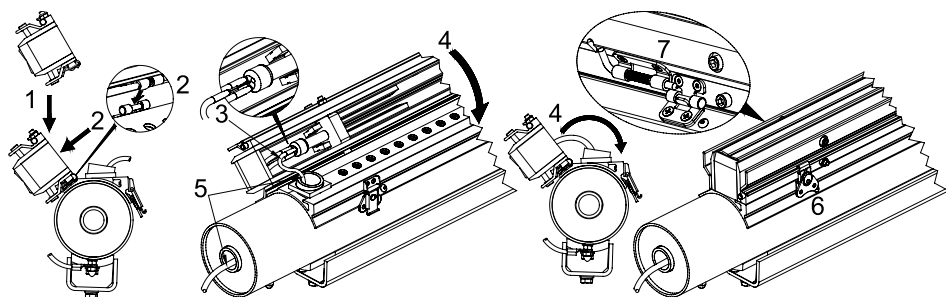
Install the electrodes [2], centering the electrodes within the shroud and placing the mounting tabs into the mounting blocks, and tighten the electrode mounting screws [3] torquing them to 3 in-lbs. (34 N-cm).

Rotate the cartridge face down [4] and connect the HV wires into the banana jack receiver [5].

**NOTICE** Ensure the banana plugs are fully seated, do not use excessive force!

### Cartridge Installation

Install the cartridge by lowering it onto the assembly [1], aligning and reconnect the hinges [2] ensuring they are fully engaged.



Keep the cartridge open and connect the HV feed wire into the banana jack receiver [3].

Close the cartridge onto the assembly tube [4], while guiding the HV feed wire through the Pyrex elbow [5] and reengage the twist latches [6] cartridge stop pins [7] at both ends of the assembly.

**NOTE:** If the Cartridge Electrode Assembly's HV feed wire needs to be repaired, do not attempt to replace the banana plug, refer to 2.3 CONTACT INFORMATION to obtain a replacement HV wire, terminated with an Enercon supplied banana plug.

# Ground Roll Inspection and Cleaning

Enercon produces 3 main types of corona treating stations; Bare Roll – Metal Ground Roll w/Ceramic Electrodes, Universal Roll – Conductive Covered Roll w/Ceramic Electrodes, and Covered Roll – Non-Conductive Covered Ground Roll w/Metal Electrodes. In each of these configurations, the ground roll provides the support for your substrate and completes the circuit for the high voltage on the electrodes that ionizes the air which results in the corona discharge that treats your substrate as it passes over the ground roll and through the corona.

If contaminants are allowed to buildup on the face of your ground roll they can have adverse affects upon the proper treatment of your substrate. The most common issue is backside treatment, resulting in inconsistent treatment across your web, but over time it can also deteriorate the roll face of a covered ground roll, resulting in poor treatment and possibly even failure of the coating.

## Inspection (All Stations)

A weekly visual inspection of your station, in particular the ground roll and its components, is a good practice and will help to identify any build-up of contaminants on the roll and any signs of deterioration of roll coverings. Lock Out and Tag-Out your system. Wait 2 minutes to allow voltages to discharge before attempting to work on the system. Clean the ground roll in accordance with the appropriate instructions listed below.

## Cleaning Of Bare Rolls

### Aluminum

1. General Cleaning – mild soap and water.
2. Removal of Oxidation – Isopropyl alcohol and a Scotch-Brite™ pad.
3. Do not use caustic solutions.

### Electroless Nickel Plating

1. General Cleaning – Any non-caustic cleaner can be used.
2. Remove Oxidation – Any commercial silver cleaner/tarnish remover.

## Cleaning Of Universal Rolls

**Do Not Use:** 1, 1, 1 Trichloroethane, (MEK's) or xylene and similar products.

### Ceramic Roll – General Cleaning

1. For light dust and dirt, use water, a mild soap and a clean cloth.
2. For grease and oil, use Simple Green™ liquid all-purpose cleaner. It is water-based, contains no petroleum, and is non-flammable.
3. For tougher stains, mix a liquid ceramic cleaner and powdered kitchen cleanser (like Comet™) into a paste and scrub with a Scotch-Brite™ pad. Then wipe the surface clean with isopropyl alcohol.

### Electroless Nickel Plating

4. **Do Not Use:** Strong acidic solutions such as HCL acid and sulfuric acid or any cleaning mechanism using metal, conductive material, or power tools of any kind.

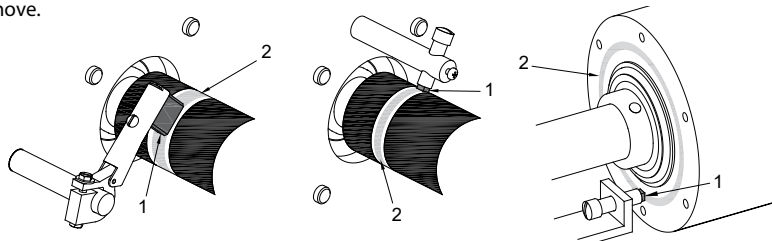
### Hypalon Roll – General cleaning

Use: Soap and water or alcohol (methanol, methyl alcohol).

### Silicone Roll – General Cleaning

Use: Mild soap and water.

Also ensure that the bearings are in good shape and turning freely. Clean and lubricate the bearings as needed. Inspect the ground brush and ensure it is making good contact (1) with the shaft or end of the roll. The carbon ground brush will wear over time and will leave a mark along the path of the brush (2), clean the wear mark using isopropyl alcohol and a lint free cloth, or a Scotch-Brite™ pad if the carbon mark is difficult to remove.

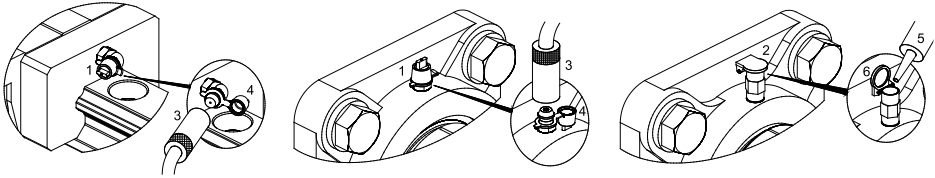


# Bearing Lubrication

All station roll and guide bearings are prelubricated and should not require lubrication prior to initial operation.

**NOTE:** The following information does **not** apply to sealed bearings, or any bearings that do not include a zerk fitting or oil cup.

Zerk fittings [1] include a colored protective cap that indicates the type of lubricant required, but oil cups [2] have no special markings.



## Grease Bearing Lubrication

Due to the location of some fittings, we recommend you use a grease gun with a flexible hose and the appropriately sized nozzle [3]. Open the protective cap [4], connect the nozzle to the fitting and add grease to the bearing.

Clean any excess grease from the zerk fitting and bearing, and close the protective cap on the fitting. Grease bearing lubrication will be identical for both roller and guide bearings that have a zerk fitting.

**NOTE:** An NLGI 2 lubricant may be substituted for an NLGI 3 lubricant as long as the Base Properties match. Do **not** over fill bearings, as excess lubrication may affect a bearings free spinning characteristics.

## Oil Bearing Lubrication

Due to the location and size of most oil cups, we recommend you use a syringe or small plastic bottle [5]. The protective cap on the oil bearings is typically spring loaded, and you will need to hold the cap open [6] while adding oil a few drops at a time.

| Bearing Lubrication Reference |                        |           |                       |
|-------------------------------|------------------------|-----------|-----------------------|
| Fitting                       | Lube Type              | Grade     | Base Properties       |
| Zerk w/Blue Cap               | Standard Grease        | NLGI 3    | Lithium, Mineral      |
| Zerk w/Red Cap                | Lightweight Grease     | NLGI 1    | Lithium Complex       |
| Oil Cup                       | Bearing or Spindle Oil | ISO VG 22 | Mineral               |
| Zerk w/Yellow Cap             | Special                | --        | Reference System Docs |

**Note:** Generally, a temporary rise in operating temperature accompanies lubrication and excess lubricant will be purged at the bearing seals.

For grease lube bearings, refer to the **GREASE BEARING LUBRICATION FREQUENCY TABLE** to determine if your bearings require a modified lubrication schedule.

| Bearing Lubrication Reference |           |          |                             |
|-------------------------------|-----------|----------|-----------------------------|
| Temp °F                       | Clean     | Dirty    | Wash Down / Extremely Dirty |
| Up to 122                     | 12 Months | 6 Months | 3 Months                    |
| 122 to 158                    | 6 Months  | 2 Months | 1 Month                     |
| 158 to 212                    | 3 Months  | 2 Weeks  | 1 Week                      |
| 212 to 248                    | 6 Weeks   | 1 Week   | 3 Days                      |
| 248 to 302                    | 2 Weeks   | 3 Days   | Daily                       |

| Lubricant Examples    |                                        |
|-----------------------|----------------------------------------|
| NLGI 3                | Shell Gadus S2 V100 3                  |
| NLGI 1                | Phillips 66 Multiplex Red              |
| Bearing / Spindle Oil | Mobile Velocite 10<br>Shell Morlina 22 |

Oil lube bearings require more frequent monitoring and the requirements vary depending on your environment. Monitor bearing temperature regularly (180° F max) to establish the re-lube intervals specific to your operating environment.

**NOTE:** The supplied oil cup can be replaced with a drop feed oiler to provide regular re-lubrication as required.

# Exhaust Duct Sizing Requirements

The table of recommended exhaust duct sizes is based on the following:

- Total length of duct run does not exceed specified distance (including distance from blower exit to building exit).
- Maximum number of elbows or 45° fittings indicated.
- Use of smooth wall rigid duct (non-flexible) is ideal.
- Adhering to the guidelines listed below.

| Exhaust Air Flow<br>CFM (CMM) | Minimum Pipe Diameter vs. Length of Exhaust Duct Run |                              |                              |                             |
|-------------------------------|------------------------------------------------------|------------------------------|------------------------------|-----------------------------|
|                               | <100' (30m)<br>(< 6 Elbows)                          | <100' (30m)<br>(6-10 Elbows) | <150' (45m)<br>(< 10 Elbows) | <200' (60m)<br>(<10 Elbows) |
| 1 - 199<br>(.1 - 5.6)         | 4"<br>(100mm)                                        | 5"<br>(125mm)                | 6"<br>(150mm)                | 6"<br>(150mm)               |
| 200 - 299<br>(5.7 - 8.5)      | 5"<br>(125mm)                                        | 6"<br>(150mm)                | 6"<br>(150mm)                | 8"<br>(200mm)               |
| 300 - 499<br>(8.5 - 14.1)     | 6"<br>(150mm)                                        | 8"<br>(200mm)                | 8"<br>(200mm)                | 8"<br>(200mm)               |
| 500 - 899<br>(14.2 - 25.5)    | 8"<br>(200mm)                                        | 10"<br>(250mm)               | 10"<br>(250mm)               | 10"<br>(250mm)              |
| 900 - 1599<br>(25.5 - 45.3)   | 10"<br>(250mm)                                       | 12"<br>(300mm)               | 12"<br>(300mm)               | 14"<br>(350mm)              |
| 1600 - 2499<br>(45.3 - 70.8)  | 12"<br>(300mm)                                       | 14"<br>(350mm)               | 14"<br>(350mm)               | 16"<br>(400mm)              |
| 2500 - 3000<br>(70.8 - 85.0)  | 14"<br>(350mm)                                       | 16"<br>(400mm)               | 16"<br>(400mm)               | 16"<br>(400mm)              |

**NOTE:** The above chart is a guideline only. Refer to qualified HVAC contractor for specific sizing and design recommendations. Customer is responsible for final duct design and installation to meet treater station exhaust requirements.

## OZONE EMISSIONS AND EXHAUST

### Estimating Your Systems Ozone Emissions

To estimate the ozone emissions in pounds per hour, the following formula can be referenced:

*Power Supply kW x 0.073 = Ozone in lbs./hr\*.*

#### **\*NOTE:**

The above formula is for estimation purposes only. Since actual ozone emissions are dependent on several other site-specific variables, field ozone measurements are REQUIRED for accurate numbers. Enercon makes no representations or warranties regarding any of the emissions characteristics for any of its products, including emissions levels of ozone or other chemicals, temperature, or moisture. Consult an environmental professional to determine how OSHA, Clean Air Act, or other legal requirements may apply to your situation.

### Discharge Height Over Ground Level:

We have no specific recommendation. However, we do recommend exhausting be done through the roof.

**Caution:** Insure that the system exhaust discharge outlet is not located in a position where its output could be recirculated into the plant by HVAC equipment.

### Maximum & Minimum Airflow:

We only specify minimum airflow (See specific airflow and water column pressure in the instructional data delivered with the specific system).

### Exhaust Temperature:

Our equipment under normal operation will raise the temperature of the air taken in approximately 30° C (86° F) over ambient. Actual temperature will vary based on site-specific conditions.

### Moisture Content:

Our equipment typically does not affect the moisture content of input air, therefore, the moisture content will typically be that of the plant ambient air and no more.

### Exhaust Pipe Materials:

The exhaust pipes should be constructed of stainless steel, aluminum, or PVC. Do not use galvanized steel as the ozone will attack it and cause leaks within a short time.

### Exhaust Duct Run:

The exhaust duct run from your treater station must remain independent of all other duct runs for its entire length.

# Ozone Decomposers Eliminate Ozone

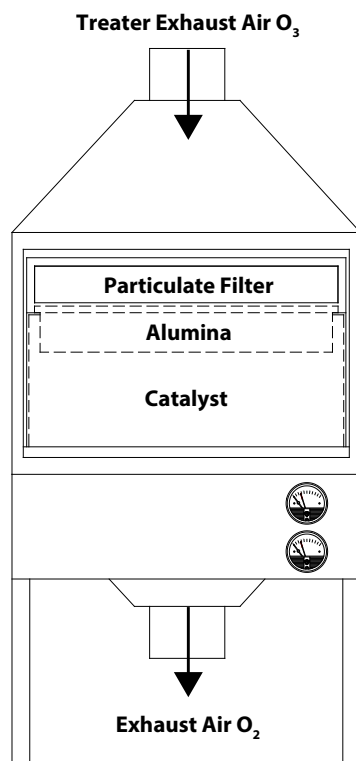
All corona treaters produce ozone as a natural byproduct of the treatment process. Enercon corona treaters safely remove ozone from the work environment through the system's exhaust ducting. To ensure ozone is not released from the exhaust stream into the atmosphere, Enercon has designed Ozone Decomposers for extrusion and converting operations.

Enercon Ozone Decomposers integrate into the exhaust stream after the corona treater and before the exhaust is released into the atmosphere. The decomposer converts the captured ozone into oxygen. These systems work with all corona treater exhaust streams and are available in sizes for any application.

- Destroys ozone created from ozone generation processes
- Ensures compliance with OSHA and EPA Clean Air Act
- Permits direct release of exhaust stream to the atmosphere
- Easy integration with OEM lines

## How the Decomposer will benefit your operation

- Enercon's catalytic ozone decomposer converts ozone (O<sub>3</sub>) into Oxygen (O<sub>2</sub>).
- A particle filter, pre filtered material, and metal oxide catalyst bed reduces an input ozone level of up to 150 PPM to less than the OSHA limit of 0.1 PPM at the designated flow rate.
- Systems allow direct release of the exhaust stream into the atmosphere which is in compliance of the clean air acts and laws related to ozone standards.
- Ensure operator safety by trapping gases through proper exhausting.



## Technical Data:

Ozone contaminated air is input at the top of the unit and flows through the particle filter where matter and dust are removed to ensure they do not contaminate or clog the catalyst bed.

The contaminated air then passes through a pre filtered material prior to the catalyst bed for additional air stream filtration. The ozone contaminated air then moves through the bed of metal oxide pellets which converts the ozone (O<sub>3</sub>) into molecular oxygen (O<sub>2</sub>). If no other contaminant is present, the exhaust can then be vented into the atmosphere.

Ozone and other toxic gas levels must be monitored on a regular basis to confirm that no health hazards exist and to determine when the catalyst should be reactivated.

Pressure gauges indicate when it is time to replace the decomposer's filters.

# Troubleshooting System Faults

This page contains brief explanations of the fault LEDs that you will find on the front panel of the Compak™ 2000 and Compak™ 2000 Deluxe Power Supplies. For more detailed information on the LEDs and what they mean, refer to your power supply manual or contact Enercon Technical Support.

## Compak™ 2000

### STATION INTERLOCK –

**Symptoms:** The **STATION INTERLOCK LED** is lit on the membrane switch and the power supply will not start.

**Possible Causes:** This is typically caused by any system, customer or option interlock that is open on your treater system. Confirm that the ground roll is turning, the exhaust blower is on and the electrode assembly(s) is in the treat position. Also confirm that any customer or option interlocks are closed.

### H.V. TRIP –

**Symptoms:** The **H.V. TRIP** LED is lit on the membrane switch when the **START** pushbutton is pressed. It typically flashes on and off as the power supply cycles, but can be continuously lit. You may also see a bright flash at your station.

**Possible Causes:** This is typically caused by a high voltage arc at the station, often due to a dielectric failure or physical damage to your electrodes or ground roll. It can also be caused by arcing to ground from the high voltage wires, moisture within the station or dirt and moisture buildup within your station.

### TEMP –

**Symptoms:** The **TEMP** LED is lit on the membrane switch and the power supply will not start.

**Possible Causes:** This is typically caused by the inverter temperature exceeding 90° C caused by a dirty heat sink or failed cooling fan. Other causes: damaged sensor wiring, failed sensor or open inverter capacitor.

### INVERTER FAULT –

**Symptoms:** The **INVERTER FAULT** LED is lit on the membrane switch and the power supply will not start.

**Possible Causes:** This is typically caused by the inverter(s) failing, a control board failure, or a wiring problem between the inverter(s) and the control board.

## Compak™ 2000 Deluxe

### STATION INTERLOCK –

**Symptoms:** Only the **STATION INTERLOCK** LED is lit on the front panel as the graphic display scrolls through a list of affected interlocks. The power supply will not start.

**Possible Causes:** This is typically caused by any system, customer or option interlock that is open on your treater system. Confirm that the ground roll is turning, the exhaust blower is on and the electrode assembly(s) is in the treat position. Also confirm that any customer or option interlocks are closed.

### FAULT –

**Symptom #1:** The **FAULT** LED is lit on the membrane switch when the **START** pushbutton is pressed. It typically flashes on and off as the power supply cycles, but will be continuously lit after the power supply cycles several times. You may also see a bright flash at your station.

**Possible Causes:** See the causes listed under Compak™ 2000 H.V. Trip.

**Symptom #2:** The **FAULT** LED is continuously lit.

**Possible Causes:** Record the information listed on the display screen and contact Enercon.

### STATION INTERLOCK – & FAULT –

**Symptoms:** Both the **STATION INTERLOCK** and **FAULT** LEDs are lit.

**Possible Causes:** This is typically caused by an interlock that opens while the power supply is running. Refer to the causes listed under **STATION INTERLOCK**.

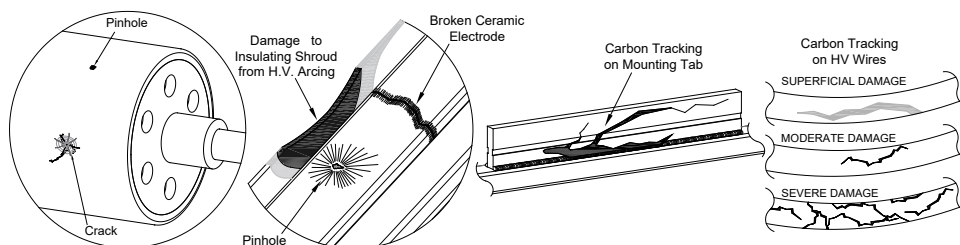


# HV Trip Troubleshooting

If your system is experiencing a H.V. Trip (GEN) the power supply will typically cycle on and off, and the trip indication on your control interface will flash on and off. If the H.V. Trip (GEN) indication is a solid display, contact customer service for troubleshooting assistance to resolve this H.V. Trip issue.

## Perform the following:

1. Reduce the selected output power (kW) setpoint to minimum and attempt to restart the power supply.
  - a. If the H.V. Trip occurs immediately you most likely have a failed electrode or roll covering.
  - b. If the power supply does not trip, slowly raise the output power setpoint until the H.V. trip occurs or the power supply reaches its full output.
    - i. If the H.V. Trip does not reoccur, you may be dealing with a moisture issue within the station that may be resolved by starting and running at minimum for a few minutes.
    - ii. If the H.V. Trip reoccurs you may have a station cleanliness issue or a wiring issue resulting in H.V. arcing once the output power level reaches a level that will allow the H.V. to arc.
2. Locate the arcing within your station.
  - a. Remove the access covers on the station to allow visual inspection of the H.V. plenum. Ensure the H.V. wiring is in good shape and are of the proper length, refer to Page 18.
  - b. With an observer near the station, start the power supply and allow the H.V. Trip to cycle the power supply while the observer looks over the station. Do not place hands or objects within the station frame or plenum while the system is attempting to run!
  - c. Whether you see flashing or not in the station, shut off the power supply and stop your product line. Lock and tag out your treater system to allow safe inspection of the station.
    - i. If a flash was visible within the station or plenum, perform a visual inspection of the station or plenum in the area of the flash to determine what is causing the arc. Look for signs of dirt buildup, carbon tracking on any of the surfaces, broken or pinholed electrodes, and pinholes or cracking of the ground roll surface.
    - ii. If no flash was detected, or if the exact location could not be pinpointed, you will want to do a more thorough inspection of the station frame and plenum which should include opening and inspecting the electrode assemblies.
    - iii. If no evidence of arcing was found during your inspection, contact customer service.



3. Clean, Repair or Replace.
  - a. If the damage from the H.V. arcing is superficial, and is being caused by a buildup of dirt or debris, you will only need to clean the station and ensure that any blackening caused by the arcing is completely removed.
  - b. If the damage is moderate or if the arcing is being caused by wiring that is too long or out of position you should be able to repair most of the assembly components that have moderate damage. The wiring can often be shortened, rerouted or moved back to their original position.
  - c. If the damage is severe you will need to replace the damaged components.

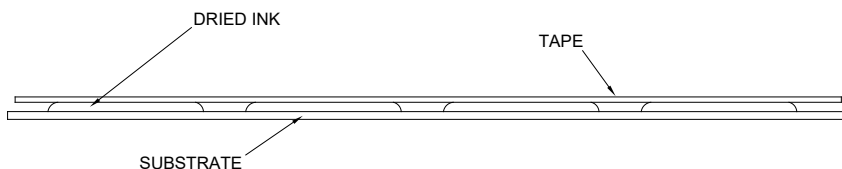


# Backside / Low Treatment Testing

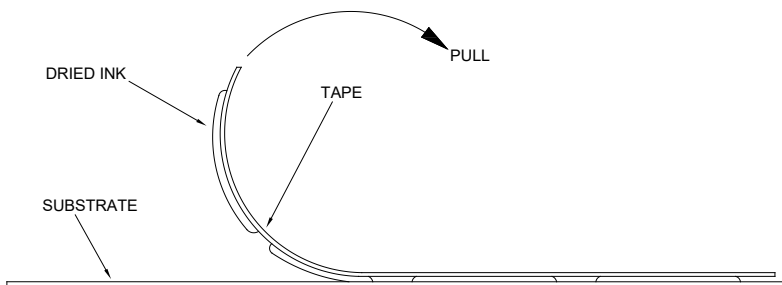
Low treatment levels often cause problems with the adhesion of inks and laminates for the entire length and width of the web. Backside treatment will often cause spotty adhesion problems occurring randomly across the entire length and width of the web.

Laminates often do not adhere to the surfaces or delaminate easily in product testing when the treatment level is low. Backside treatment can cause the final product to look spotty when delamination occurs at the point where backside treatment has occurred, often showing air pockets between the laminated layers. Visual inspection and performing a pull test of the laminated layers is often the best way to test for either of these problems.

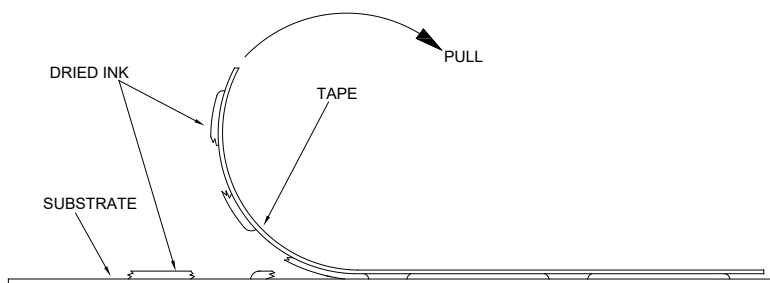
Inks can bead up during the printing process, or will pull away from the substrate after they have dried. Low treatment levels will often cause the ink to bead or pull away across the entire web, but backside treated areas will often only pull away in the spots that have been exposed to backside treatment. A pull test can aid in determining if a product has a low treatment level or has been exposed to backside treatment. This is done by placing tape across the web on top of the dried ink.



Once the tape is firmly attached across the web, pull the tape off of the substrate and observe the results of the test.



**Low Treatment Level**

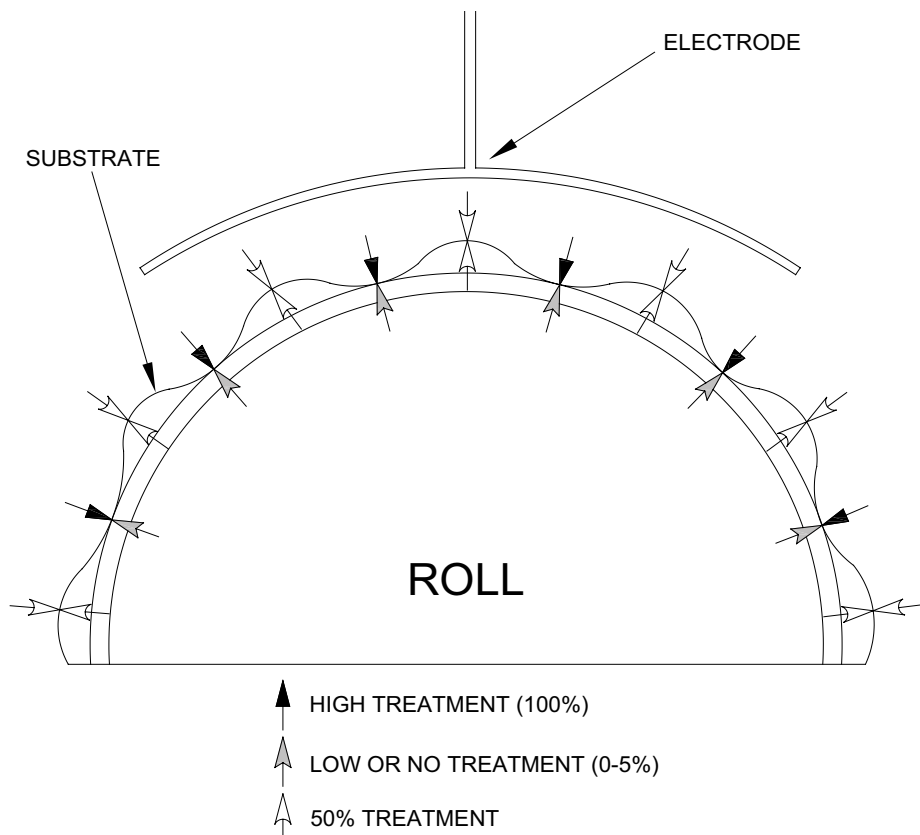


**Backside Treatment**

If you observe low treatment level results, increasing your output appropriately should take care of this problem. If you observe backside treatment results see page 26 for a more detailed explanation of possible causes and how to correct them. If the tape is pulled away clean then the treatment is at a good level.

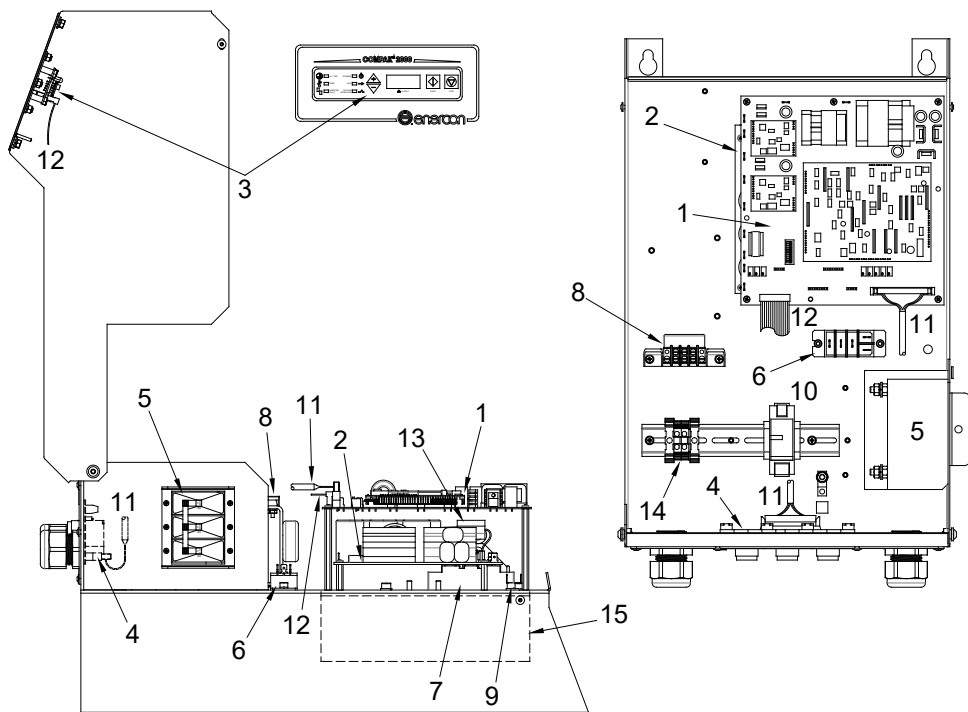
# Backside Treatment Troubleshooting

Backside Treatment occurs when air is trapped between the backside of the web and the ground roll. The air beneath the web is ionized and the backside of the web is corona treated. This condition not only treats the backside of the web, but decreases the treatment to the front side of the web. Several conditions may cause air to be trapped behind the web, see the table below for troubleshooting tips.



| Causes              | Solutions                                                                                                                                                                         |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Wrinkles In Film    | <ol style="list-style-type: none"> <li>1. Nip the web on entry into the ground roll.</li> <li>2. Increase the wrap of web around ground roll.</li> </ol>                          |
| Line Speed Too Fast | <ol style="list-style-type: none"> <li>1. Decrease your line speed.</li> </ol>                                                                                                    |
| Dirty Ground Roll   | <ol style="list-style-type: none"> <li>1. Clean the ground roll.</li> <li>2. Include cleaning of the ground roll on your company's maintenance program.</li> </ol>                |
| Low Web Tension     | <ol style="list-style-type: none"> <li>1. Ensure the web is threaded properly.</li> <li>2. Increase the number of idler rolls in the web path to increase web tension.</li> </ol> |

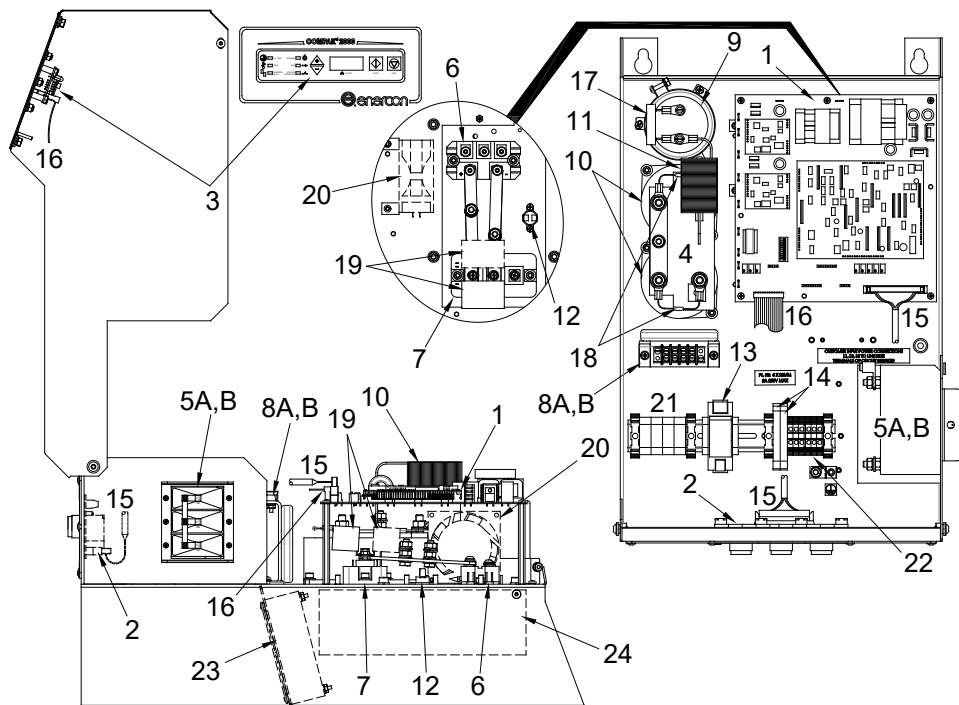
# 1-3 kW Compak™ 2000 Parts



| Item # | Part #    | Description                     | Qty. |
|--------|-----------|---------------------------------|------|
| 1      | LM4027-xx | Control Board                   | 1    |
| 2      | LM3415-xx | Power Board                     | 1    |
| 3      | LM3497-06 | Membrane Assembly               | 1    |
| 4      | LM3958-xx | Modular 2000 Treater I/O Module | 1    |
| 5      | CB0275    | Circuit Breaker                 | 1    |
| 6      | BR0013    | Rectifier                       | 1    |
| 7      | LM3589-02 | Inverter Power Module           | 1    |
| 8      | LM4167-01 | Current Transformer             | 1    |
| 9      | SE0158    | Temperature Sensor Switch, TASI | 1    |
| 10     | EM0256    | 24V DC Power Supply             | 1    |
| 11     | CA1050    | Ribbon Cable (40 Pin)           | 1    |
| 12     | CA1014    | Ribbon Cable (13 Pin)           | 1    |
| 13     | LM4041-01 | Snubber Capacitor Assembly      | 1    |
| 14     | TB0537    | Output Terminal Block           | 2    |
| 15     | FD5373-03 | Power Supply Heat Sink          | 1    |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

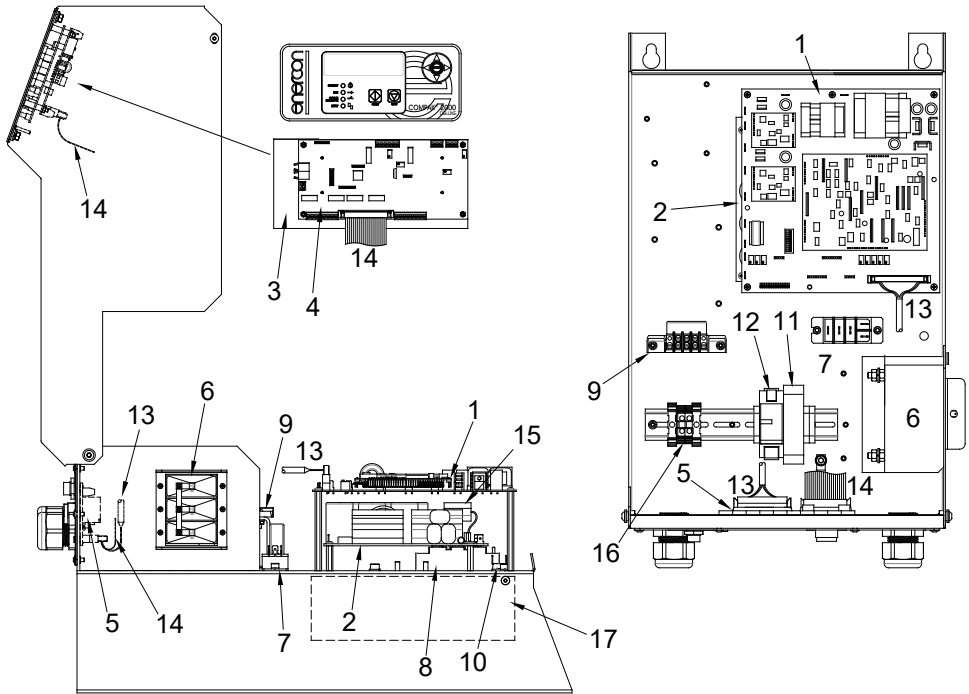
# 4-10 kW Compak™ 2000 Parts



| Item # | Part #    | Description                      | Qty                |
|--------|-----------|----------------------------------|--------------------|
| 1      | LM4027-xx | Control Board                    | 1                  |
| 2      | LM3958-xx | Modular 2000 Treater I/O Module  | 1                  |
| 3      | LM3497-06 | Membrane Switch Assembly         | 1                  |
| 4      | LM5756-01 | Capacitor Trip Board             | 1                  |
| 5A     | CB0278    | Circuit Breaker (4 - 5KW)        | 1                  |
| 5B     | CB0276    | Circuit Breaker (7.5 - 10KW)     | 1                  |
| 6      | BR0015    | Bridge Rectifier                 | 1                  |
| 7      | LM3751-03 | Inverter Power Module            | 1                  |
| 8A     | LM1982-17 | Output CT – Multi-Tap (4-7.5KW)  | 1                  |
| 8B     | LM1982-33 | Output CT – Multi-Tap (10KW)     | 1                  |
| 9      | CP1282    | DC Bus Capacitor                 | 1                  |
| 10     | CP0200    | Capacitor 100uf 800 VDC          | 2                  |
| 11     | FD5339-04 | Inductor Coil                    | 1                  |
| 12     | SE0158    | Temperature Sensor Switch, TASI  | 1                  |
| 13     | EM0256    | 24V DC Power Supply              | 1                  |
| 14     | TB0110    | Fused Terminal Block, 250V 2 Amp | 2                  |
| 15     | CA1050    | Ribbon Cable (40 Pin)            | 1                  |
| 16     | CA1014    | Ribbon Cable (13 Pin)            | 1                  |
| 17     | LM4043-02 | Bleeder Resistor Assembly        | 1                  |
| 18     | RE0735    | Resistor                         | 2                  |
| 19     | CP0070    | Snubber Capacitor                | 1 (4-7.5) / 2 (10) |
| 20     | FA0086    | Cooling Fan (10KW Only)          | 1                  |
| 21     | TB0546    | Output Terminal Blocks           | 4                  |
| 22     | --        | Terminal Blocks                  | Varies             |
| 23     | FA0030    | Cooling Fan                      | 1                  |
| 24     | FD5373-03 | Power Supply Heat Sink           | 1                  |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

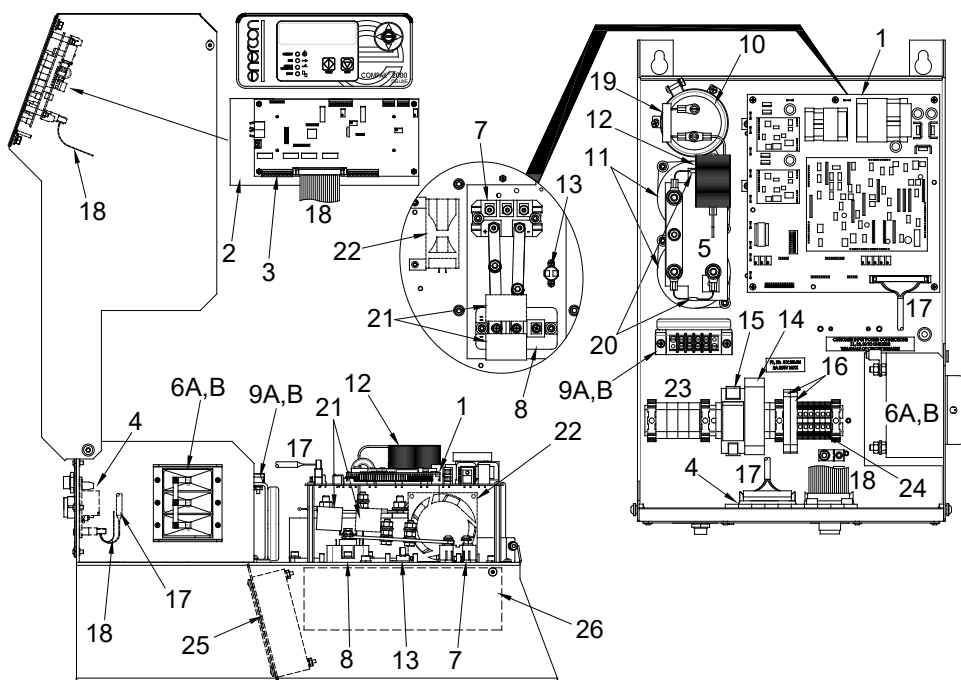
# 1-3 kW Compak™ 2000 Deluxe Parts



| Item # | Part #    | Description                     | Qty. |
|--------|-----------|---------------------------------|------|
| 1      | LM4027-xx | Control Board                   | 1    |
| 2      | LM3415-05 | Power Board                     | 1    |
| 3      | LM4867-01 | Keypad Board                    | 1    |
| 4      | LM4823-xx | HF Display Board                | 1    |
| 5      | LM5095-01 | Deluxe 2000 Treater I/O Module  | 1    |
| 6      | CB0275    | Circuit Breaker                 | 1    |
| 7      | BR0013    | Rectifier                       | 1    |
| 8      | LM3589-02 | Inverter Power Module           | 1    |
| 9      | LM4167-01 | Current Transformer             | 1    |
| 10     | SE0158    | Temperature Sensor Switch, TASI | 1    |
| 11     | EM0054    | 5V DC power Supply              | 1    |
| 12     | EM0256    | 24V DC Power Supply             | 1    |
| 13     | CA1050    | Ribbon Cable (40 Pin)           | 1    |
| 14     | CA1005    | Ribbon Cable (34 Pin)           | 1    |
| 15     | LM4041-01 | Snubber Capacitor Assembly      | 1    |
| 16     | TB0537    | Output Terminal Blocks          | 2    |
| 17     | FD5373-03 | Power Supply Heat Sink          | 1    |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# 4-10 kW Compak™ 2000 Deluxe Parts



| Item # | Part #    | Description                      | Qty                |
|--------|-----------|----------------------------------|--------------------|
| 1      | LM4027-xx | Control Board                    | 1                  |
| 2      | LM4867-01 | Keypad Board                     | 1                  |
| 3      | LM4823-xx | HF Display Board                 | 1                  |
| 4      | LM5095-01 | Deluxe 2000 Treater I/O Module   | 1                  |
| 5      | LM5756-01 | Capacitor Trip Board             | 1                  |
| 6A     | CB0278    | Circuit Breaker (4-7.5KW)        | 1                  |
| 6B     | CB0276    | Circuit Breaker (10KW)           | 1                  |
| 7      | BR0015    | Bridge Rectifier                 | 1                  |
| 8      | LM3751-03 | Inverter Power Module            | 1                  |
| 9A     | LM1982-32 | Output CT – Multi-Tap (4-7.5KW)  | 1                  |
| 9B     | LM1982-33 | Output CT – Multi-Tap (10KW)     | 1                  |
| 10     | CP1282    | DC Bus Capacitor                 | 1                  |
| 11     | CP0200    | Capacitor 100uf 800 VDC          | 2                  |
| 12     | FD5339-04 | Inductor Coil                    | 1                  |
| 13     | SE0158    | Temperature Sensor Switch, TASI  | 1                  |
| 14     | EM0054    | 5V DC power Supply               | 1                  |
| 15     | EM0256    | 24V DC Power Supply              | 1                  |
| 16     | TB0110    | Fused Terminal Block, 250V 2 Amp | 2                  |
| 17     | CA1050    | Ribbon Cable (40 Pin)            | 1                  |
| 18     | CA1005    | Ribbon Cable (34 Pin)            | 1                  |
| 19     | LM4043-02 | Bleeder Resistor Assembly        | 1                  |
| 20     | RE0735    | Resistor                         | 2                  |
| 21     | CP0070    | Snubber Capacitor                | 1 (4-7.5) / 2 (10) |
| 22     | FA0086    | Cooling Fan (10KW Only)          | 1                  |
| 23     | TB0546    | Output Terminal Blocks           | 4                  |
| 24     | --        | Terminal Blocks                  | As Required        |
| 25     | FD5373-03 | Power Supply Heat Sink           | 1                  |
| 26     | FA0030    | Heat Sink Cooling Fan            | 1                  |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.



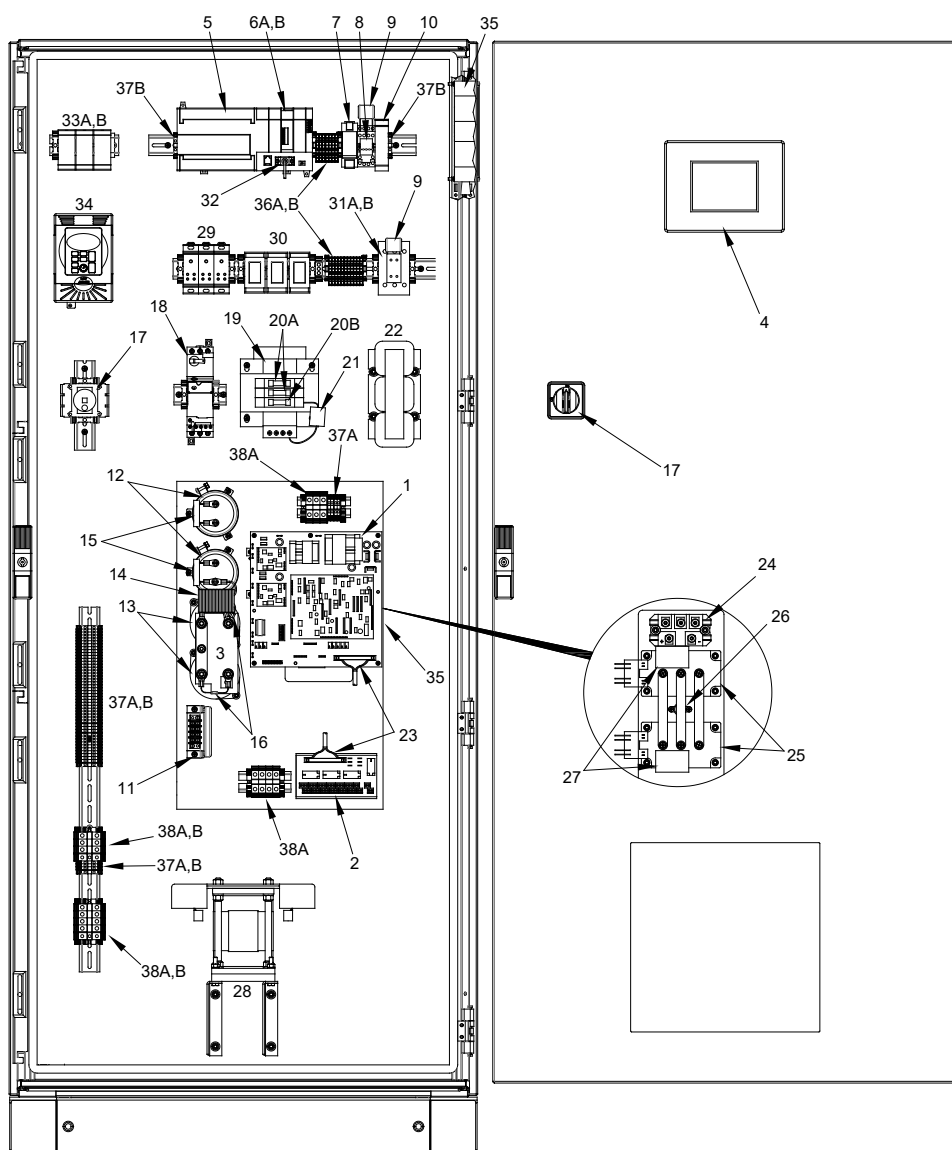


# 12-15 kW Compak™ 2000 Parts

| Index # | Part #           | Description                                         | Qty |
|---------|------------------|-----------------------------------------------------|-----|
| 1       | LM4867-01        | Keypad Board (Deluxe 2000 Only)                     | 1   |
| 2       | LM4823-06        | HF Display Board (Deluxe 2000 Only)                 | 1   |
| 3       | EM0053           | 5V DC power Supply (Deluxe 2000 Only)               | 1   |
| 4       | LM4027-**        | Control Board                                       | 1   |
| 5       | LM3497-06        | Membrane Switch Assembly (Standard 2000 Only)       | 1   |
| 6A      | LM5095-01        | Deluxe 2000 I/O Board                               | 1   |
| 6B      | LM3958-03        | Standard 2000 I/O Board                             | 1   |
| 7       | LM4106-02        | Soft Start Board                                    | 1   |
| 8       | LM3936-**        | Inverter                                            | 1   |
| 9       | BR0015           | Rectifier                                           | 1   |
| 10      | SE0158           | Temperature Sensor                                  | 1   |
| 11      | CP1282           | DC Bus Capacitor                                    | 2   |
| 12      | CP0200           | Output Capacitor                                    | 2   |
| 13      | FD5339-05        | Inductor Coil                                       | 1   |
| 14      | LM4043-02        | Bleeder Resistors                                   | 2   |
| 15      | RE0735           | Resistor                                            | 2   |
| 16      | CP0070           | Snubber Capacitor                                   | 2   |
| 17      | RE4902           | Soft Start Resistors                                | 3   |
| 18      | FU0586           | Fuse 40A, 600V                                      | 3   |
| 19      | FU0361           | Fuse 2A                                             | 2   |
| 20      | FU0360           | Fuse 1.5A                                           | 1   |
| 21      | TF0146           | Control Transformer                                 | 1   |
| 22      | LF0020           | Line Choke                                          | 1   |
| 23      | *Contact Enercon | Contact                                             | 2   |
| 24      | *Contact Enercon | Auxiliary Contact                                   | 2   |
| 25      | LM1982-11        | Output CT                                           | 1   |
| 26      | LM4682-**        | Output Reactor – Not included in all Power Supplies | 1   |
| 27      | CA1050           | Ribbon Cable 40-pin 17" Long                        | 1   |
| 28      | CA1068           | Ribbon Cable 34-pin 48" Long (Deluxe 2000 Only)     | 1   |
| 29      | CA1018           | Ribbon Cable 13-pin 32" Long (Standard 2000 Only)   |     |
| 30      | LM5260-08        | Remote Control Connector (Deluxe 2000 Only)         | 1   |
| 31      | EM0256           | 24V DC Power Supply (Deluxe 2000 Only)              | 1   |
| 32      | RL0065           | Relay module, N.O. Contact (Deluxe 2000 Only)       | 1   |
| 33      | CB0092           | Circuit Breaker                                     | 1   |
| 34      | FA0080           | Cooling Fan                                         | 1   |
| 35      | FA0050           | Cooling Fan                                         | 1   |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# 5-15 kW Compak™ 2000 Touchscreen Parts



# 5-15 kW Compak™ 2000 Touchscreen Parts

| Item # | Part #       | Description                                        | Qty         |
|--------|--------------|----------------------------------------------------|-------------|
| 1      | LM4027-04    | Control Board                                      | 1           |
| 2      | LM3958-03    | I/O Board                                          | 1           |
| 3      | LM5756-01    | Capacitor Trip Board                               | 1           |
| 4      | EM0331       | Touchscreen                                        | 1           |
| 5      | EM0310       | PLC                                                | 1           |
| 6A     | EM0311       | Analog Card 2 IN, 2 OUT, Voltage                   | 1           |
| 6B     | EM0319       | Analog Card 4 IN, 2 OUT, Voltage (used w/AC Drive) | 1           |
| 7      | EM0256       | 24 VDC Power Supply                                | 1           |
| 8      | RL0062       | 120VAC Relay                                       | 1           |
| 9      | RE5101       | Quench Arc                                         | 2           |
| 10     | EM0198       | Safety Relay                                       | 1           |
| 11     | LM1982-xx    | Output CT – Part Numbers Will Vary                 | 1           |
| 12     | CP1282       | DC Bus Capacitors                                  | 2           |
| 13     | CP0200       | Inverter Capacitors                                | 2           |
| 14     | FD5339-06    | HF Inductor                                        | 1           |
| 15     | LM4043-02    | Bleeder Resistors                                  | 2           |
| 16     | RE0735       | 2W 150k Ohm Carbon Resistor (1 hidden)             | 2           |
| 17     | SW0175       | Disconnect Switch Handle and Body                  | 1           |
| 18     | EM0086       | Motor Starter Control                              | 1           |
| 19     | TF0204       | Control Transformer                                | 1           |
| 20A    | FU0366       | Fuse, 3 Amp, Rejection Type                        | 2           |
| 20B    | FU0367       | Fuse, 5 Amp, Non-Rejection Type                    | 1           |
| 21     | LM4044-01    | Snubber Capacitor Assembly                         | 1           |
| 22     | LF0020       | Line Choke                                         | 1           |
| 23     | CA1050       | Ribbon Cable 40-pin 17" Long                       | 1           |
| 24     | BR0016       | Bridge Rectifier                                   | 1           |
| 25     | LM3936-04    | Inverter                                           | 2           |
| 26     | SE0158       | Temperature Sensor                                 | 1           |
| 27     | CP0070       | Snubber Capacitor                                  | 2           |
| 28     | LM4682-04    | Output Reactor (480 VAC Power Supplies)            | 1           |
| 29     | TB0154       | Distribution Block                                 | 3           |
| 30     | – –          | Input Fuses – Fuse Sizes & Part Numbers Will Vary  | 3           |
| 31A    | CN3070       | Contactors 40A                                     | 1           |
| 31B    | CN3071       | Auxiliary Contactor                                | 1           |
| 32     | EM0332A      | PLC To Touchscreen Cable                           | 1           |
| 33A    | FB0211       | AC Drive Fuse Block (Optional)                     | 3           |
| 33B    | FU0526       | AC Drive Fuses 10A, 600V (Optional)                | 3           |
| 34     | MC0006-02    | AC Drive 1HP 380-500V 50/60Hz (Optional)           | 1           |
| 35     | FA0050       | Cooling Fan (Heat Sink Cooling Fan Hidden)         | 2           |
| 36A    | TB7100       | Terminal Block                                     | As Required |
| 36B    | TB7103       | Terminal Block – Ground                            | As Required |
| 37A    | TB7201-020   | Terminal Block, 20 Amp                             | As Required |
| 37B    | TB7201-020-G | Ground Terminal Block, 20 Amp                      | As Required |
| 38A    | TB7201-080   | Terminal Block, 80 Amp                             | As Required |
| 38B    | TB7201-080-G | Ground Terminal Block, 80 Amp                      | As Required |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

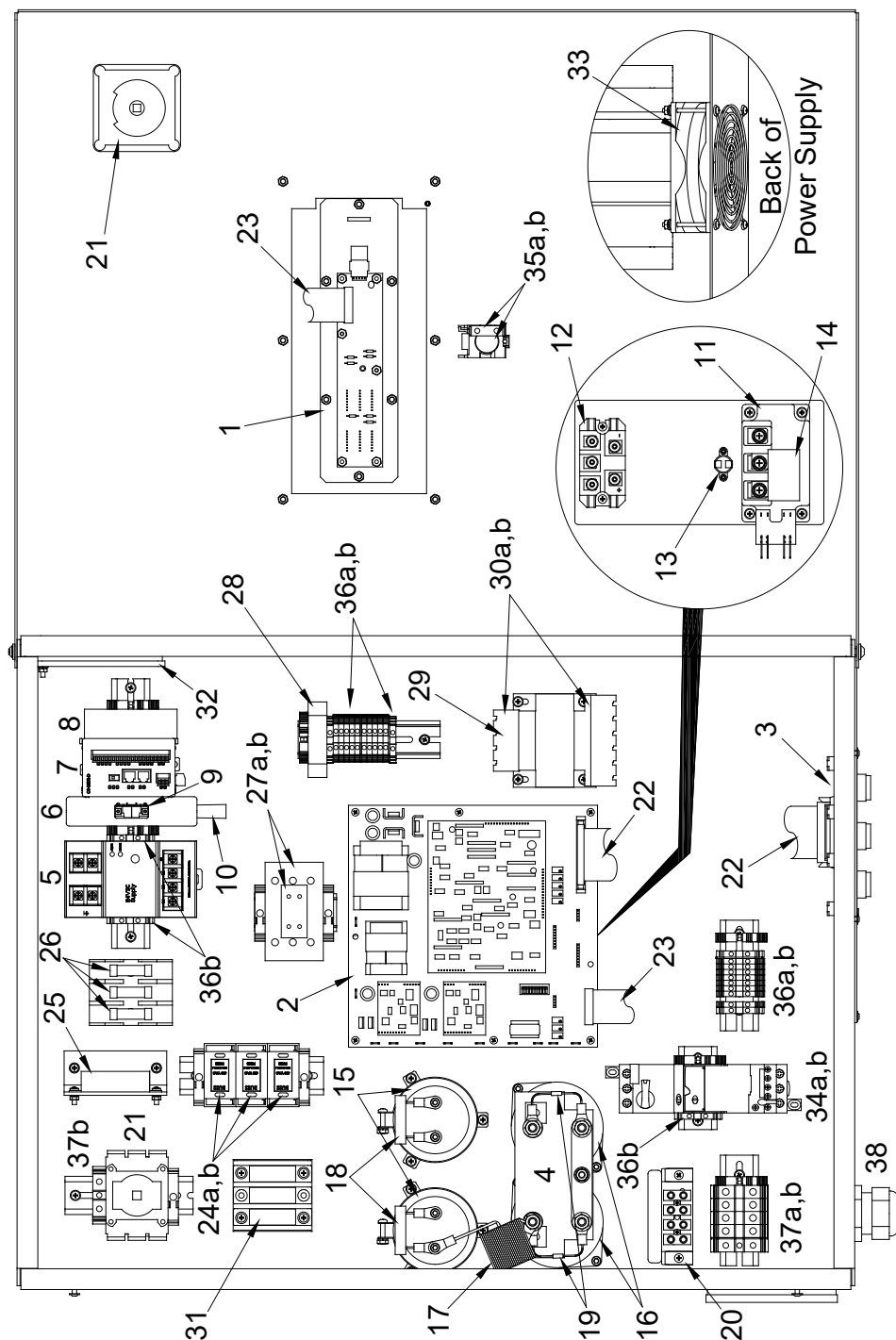


# 4-10 kW Compak™ 2000 Deluxe Parts

| Item # | Part #    | Description                                          | Qty         |
|--------|-----------|------------------------------------------------------|-------------|
| 1      | LM4867-01 | Keypad Board                                         | 1           |
| 2      | LM4823-xx | HF Display Board                                     | 1           |
| 3      | LM4027-04 | Control Board                                        | 1           |
| 4      | LM5756-02 | Capacitor Trip Board                                 | 1           |
| 5      | LM5095-01 | Deluxe 2000 I/O Board                                | 1           |
| 6      | LM3936-04 | Inverter                                             | 1           |
| 7      | BR0015    | Bridge Rectifier                                     | 1           |
| 8      | SE0158    | Temperature Sensor                                   | 1           |
| 9      | CA1071    | Ribbon Cable 34-pin 114" Long                        | 1           |
| 10     | CA1050    | Ribbon Cable 40-pin 17" Long                         | 1           |
| 11     | LM5260-17 | Deluxe Display Communication Cable (Profinet)        | 1           |
| 11A    | LM5260-07 | Remote Control Connection Cable (Remote Control Box) | 1           |
| 12     | LM5260-16 | RS232 Network Communicator Cable (Profinet)          | 1           |
| 13     | LM1982-xx | Output CT                                            | 1           |
| 14     | CP1282    | DC Bus Capacitor                                     | 1           |
| 15     | CP0200    | Inverter Capacitors                                  | 2           |
| 16     | LM4043-02 | Bleeder Resistor                                     | 2           |
| 17     | LM5267-01 | Resistor Assembly                                    | 2           |
| 18     | FD5339-05 | HF Inductor                                          | 1           |
| 19     | CP0070    | Snubber Capacitor                                    | 1           |
| 20     | EM0054    | 5V DC power Supply                                   | 1           |
| 21     | EM0256    | 24V DC Power Supply                                  | 1           |
| 22     | RL0065    | 24V DC N.O. Relay Module                             | 1           |
| 23     | EM0387    | Modbus RTU To Profinet Converter (Optional)          | 1           |
| 24     | EM0395    | Splice Control Micro PLC (Optional)                  | 1           |
| 25     | CN3070    | Contactor                                            | 2           |
| 26     | CN3071    | Auxiliary Contactor                                  | 2           |
| 27     | RE5101    | Quench Arc                                           | 2           |
| 28A    | FB0210    | Fuse Block 60A                                       | 3           |
| 28B    | FU0522    | Fuse 35 Amp                                          | 3           |
| 29     | RE4902    | Bleeder Resistor 50 Ohm                              | 3           |
| 30     | TF0204    | Control Transformer                                  | 1           |
| 31A    | FU0163    | 1.25A, 250V Fuse                                     | 2           |
| 31B    | FU0357    | 3A, 250V Fuse                                        | 1           |
| 32     | LM4106-02 | Soft Start Circuit Board                             | 1           |
| 33     | SW0171    | Disconnect Switch                                    | 1           |
| 34     | FA0050    | Cooling Fan 212 CFM                                  | 1           |
| 35     | TB0158    | 3-Pole Distribution Block                            | 1           |
| 36     | MC0012    | 1HP AC Drive (Optional)                              | 1           |
| 37A    | FB0211    | Fuse Holder 30 Amp (Optional - w/AC Drive)           | 3           |
| 37B    | FU0526    | Fuse 10 Amp (Optional - w/AC Drive)                  | 3           |
| 38     | EM0099    | Motor Starter (Optional)                             | 1           |
| 39     | SW0235    | 2 Position Selector Switches (Optional)              | 1 or 2      |
| 40     | TB0546    | Terminal Blocks                                      | As required |
| 41     | — —       | Terminal Blocks                                      | As required |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# 4-10 kW Compak™ 2000 Flex Parts

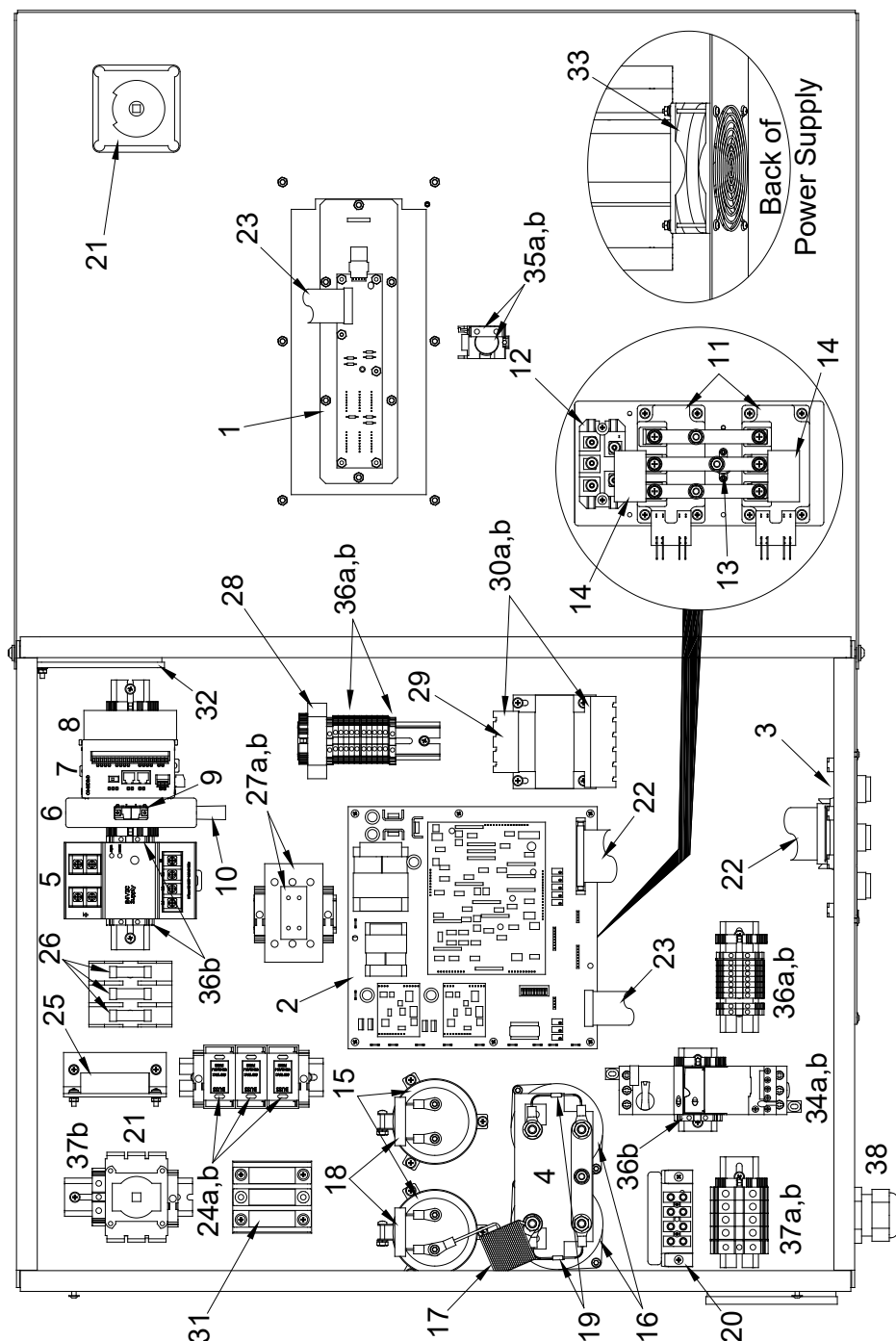


# 4-10 kW Compak™ 2000 Flex Parts

| Item # | Part #       | Description                                       | Qty   |
|--------|--------------|---------------------------------------------------|-------|
| 1      | LM3497-06    | Membrane Switch Assembly                          | 1     |
| 2      | LM4027-xx    | Control Board                                     | 1     |
| 3      | LM3958-xx    | Modular 2000 Treater I/O Module                   | 1     |
| 4      | LM5756-02    | Capacitor Trip Board                              | 1     |
| 5      | EM0640       | 24VDC Power Supply                                | 1     |
| 6      | --           | Network Interface Module (Optional)               | 1     |
| 7      | EM0304       | Micro PLC (Optional)                              | 1     |
| 8      | EM0399       | Expansion Module (Optional)                       | 1     |
| 9      | EM0702       | Female Connector for Field Termination (Optional) | 1     |
| 10     | LM5260-16    | RS232 Network Communicator Cable (Optional)       | 1     |
| 11     | LM3936-xx    | Inverter                                          | 1     |
| 12     | BR0016       | Rectifier                                         | 1     |
| 13     | SE0158       | 90° C Temperature Sensor                          | 1     |
| 14     | CP0070       | 1µf 1000V Inverter Snubber Capacitor              | 1     |
| 15     | CP1282       | DC Bus Capacitor                                  | 2     |
| 16     | CP0200       | Output Capacitor                                  | 2     |
| 17     | FD5339-05    | Inductor Coil                                     | 1     |
| 18     | LM4043-02    | 12W 20k Ω Bleeder Resistor Assembly               | 2     |
| 19     | LM5267-01    | 2W 150k Ω Resistor Assembly                       | 2     |
| 20     | LM1982-xx    | Output CT                                         | 1     |
| 21     | SW0171       | Disconnect Switch                                 | 1     |
| 22     | CA1050       | Ribbon Cable 40-pin 17" Long                      | 1     |
| 23     | CA1018       | Ribbon Cable 13-pin 32" Long                      | 1     |
| 24a    | FB0210       | Fuse Holder - CE Safety J - 60A                   | 3     |
| 24b    | FU0522       | Fuse, 600V, 35A                                   | 3     |
| 25     | RE4902       | 50 Ohm Soft Start Resistor                        | 3     |
| 26     | FU0366       | Fuse, 3A                                          | 3     |
| 27a    | CN3082       | Contact                                           | 1     |
| 27b    | CN3071       | Auxiliary Contact                                 | 1     |
| 28     | RL0114       | Relay, Time-On Delay                              | 1     |
| 29     | TF0207       | Control Transformer                               | 1     |
| 30a    | FU0364       | Fuse 0.25A                                        | 2     |
| 30b    | FU0374       | Fuse 0.5A                                         | 1     |
| 31     | TB0158       | 175A 3 Pole Distribution Block                    | 1     |
| 32     | FA0090       | Cooling Fan                                       | 1     |
| 33     | FA0089       | Cooling Fan                                       | 1     |
| 34a    | --           | Motor Starter Control Unit (Optional)             | 1     |
| 34b    | --           | Motor Starter Power Base (Optional)               | 1     |
| 35a    | PB0329       | Contact Block N.O. Contact                        | 1     |
| 35b    | SW0235       | 2 Position Selector Switch                        | 1     |
| 36a    | TB7201-020   | Terminal Block 20A                                | 18    |
| 36b    | TB7201-020-G | Ground Terminal Block 20 Amp                      | 6 - 7 |
| 37a    | TB7201-080   | Terminal Block 80A                                | 4     |
| 37b    | TB7201-080-G | Ground Terminal Block 80 Amp                      | 2     |
| 38     | CD0525       | Cord Grip                                         | 1     |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# 12-15 kW Compak™ 2000 Flex Parts



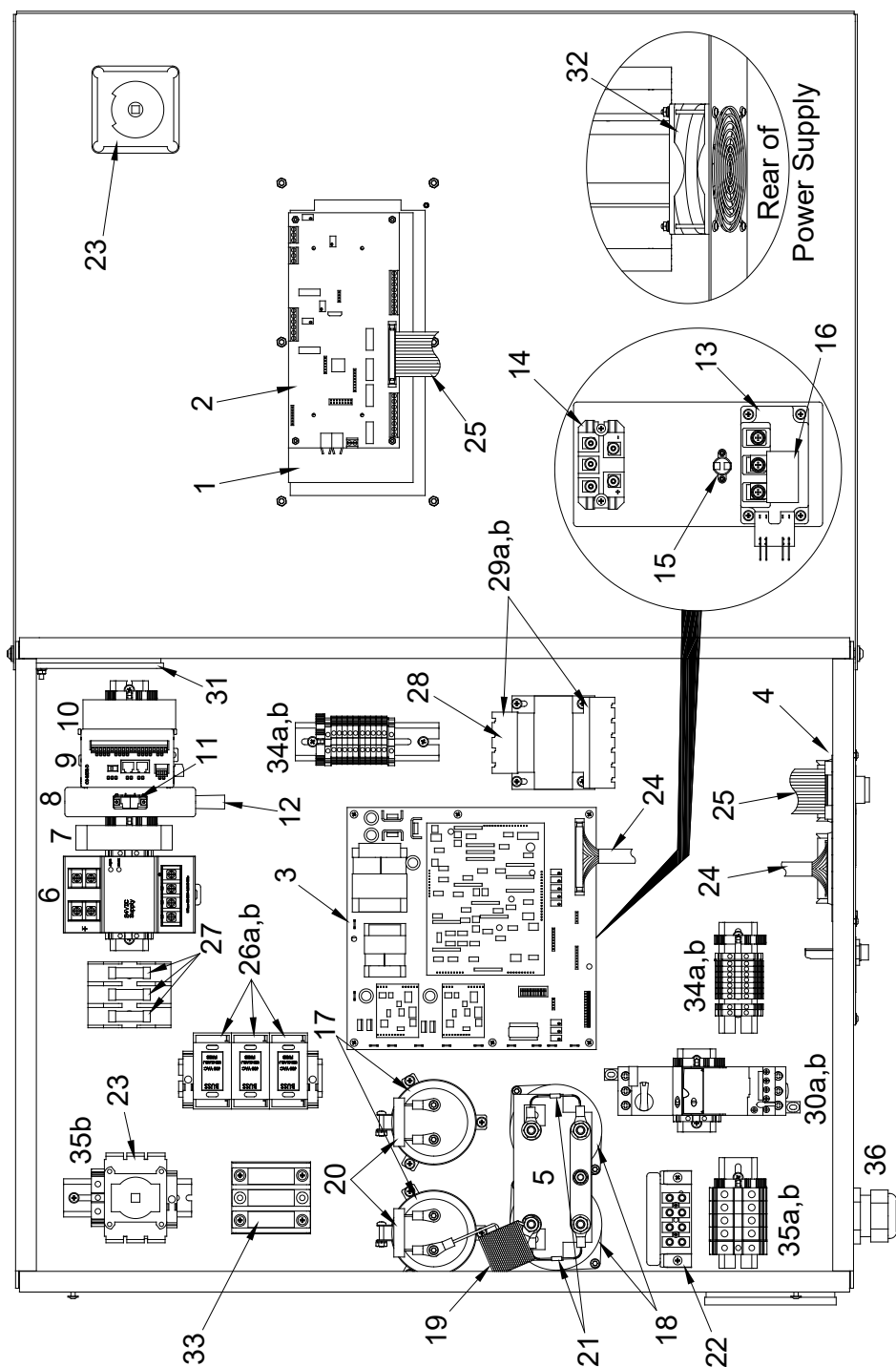


# 12-15 kW Compak™ 2000 Flex Parts

| Item # | Part #       | Description                                       | Qty   |
|--------|--------------|---------------------------------------------------|-------|
| 1      | LM3497-06    | Membrane Switch Assembly                          | 1     |
| 2      | LM4027-xx    | Control Board                                     | 1     |
| 3      | LM3958-xx    | Modular 2000 Treater I/O Module                   | 1     |
| 4      | LM5756-02    | Capacitor Trip Board                              | 1     |
| 5      | EM0640       | 24VDC Power Supply                                | 1     |
| 6      | --           | Network Interface Module (Optional)               | 1     |
| 7      | EM0304       | Micro PLC (Optional)                              | 1     |
| 8      | EM0399       | Expansion Module (Optional)                       | 1     |
| 9      | EM0702       | Female Connector for Field Termination (Optional) | 1     |
| 10     | LM5260-16    | RS232 Network Communicator Cable (Optional)       | 1     |
| 11     | LM3936-xx    | Inverter                                          | 2     |
| 12     | BR0016       | Rectifier                                         | 1     |
| 13     | SE0158       | 90° C Temperature Sensor                          | 1     |
| 14     | CP0070       | 1µf 1000V Inverter Snubber Capacitor              | 2     |
| 15     | CP1282       | DC Bus Capacitor                                  | 2     |
| 16     | CP0200       | Output Capacitor                                  | 2     |
| 17     | FD5339-05    | Inductor Coil                                     | 1     |
| 18     | LM4043-02    | 12W 20k Ω Bleeder Resistor Assembly               | 2     |
| 19     | LM5267-01    | 2W 150k Ω Resistor Assembly                       | 2     |
| 20     | LM1982-xx    | Output CT                                         | 1     |
| 21     | SW0171       | Disconnect Switch                                 | 1     |
| 22     | CA1050       | Ribbon Cable 40-pin 17" Long                      | 1     |
| 23     | CA1018       | Ribbon Cable 13-pin 32" Long                      | 1     |
| 24a    | FB0210       | Fuse Holder - CE Safety J - 60A                   | 3     |
| 24b    | FU0522       | Fuse, 600V, 35A                                   | 3     |
| 25     | RE4902       | 50 Ohm Soft Start Resistor                        | 3     |
| 26     | FU0366       | Fuse, 3A                                          | 3     |
| 27a    | CN3082       | Contact                                           | 1     |
| 27b    | CN3071       | Auxiliary Contactor                               | 1     |
| 28     | RL0114       | Relay, Time-On Delay                              | 1     |
| 29     | TF0207       | Control Transformer                               | 1     |
| 30a    | FU0364       | Fuse 0.25A                                        | 2     |
| 30b    | FU0374       | Fuse 0.5A                                         | 1     |
| 31     | TB0158       | 175A 3 Pole Distribution Block                    | 1     |
| 32     | FA0090       | Cooling Fan                                       | 1     |
| 33     | FA0089       | Cooling Fan                                       | 1     |
| 34a    | --           | Motor Starter Control Unit (Optional)             | 1     |
| 34b    | --           | Motor Starter Power Base (Optional)               | 1     |
| 35a    | PB0329       | Contact Block N.O. Contact                        | 1     |
| 35b    | SW0235       | 2 Position Selector Switch                        | 1     |
| 36a    | TB7201-020   | Terminal Block 20A                                | 18    |
| 36b    | TB7201-020-G | Ground Terminal Block 20 Amp                      | 6 - 7 |
| 37a    | TB7201-080   | Terminal Block 80A                                | 4     |
| 37b    | TB7201-080-G | Ground Terminal Block 80 Amp                      | 2     |
| 38     | CD0525       | Cord Grip                                         | 1     |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# 4-10 kW Compak™ 2000 Flex Deluxe Parts

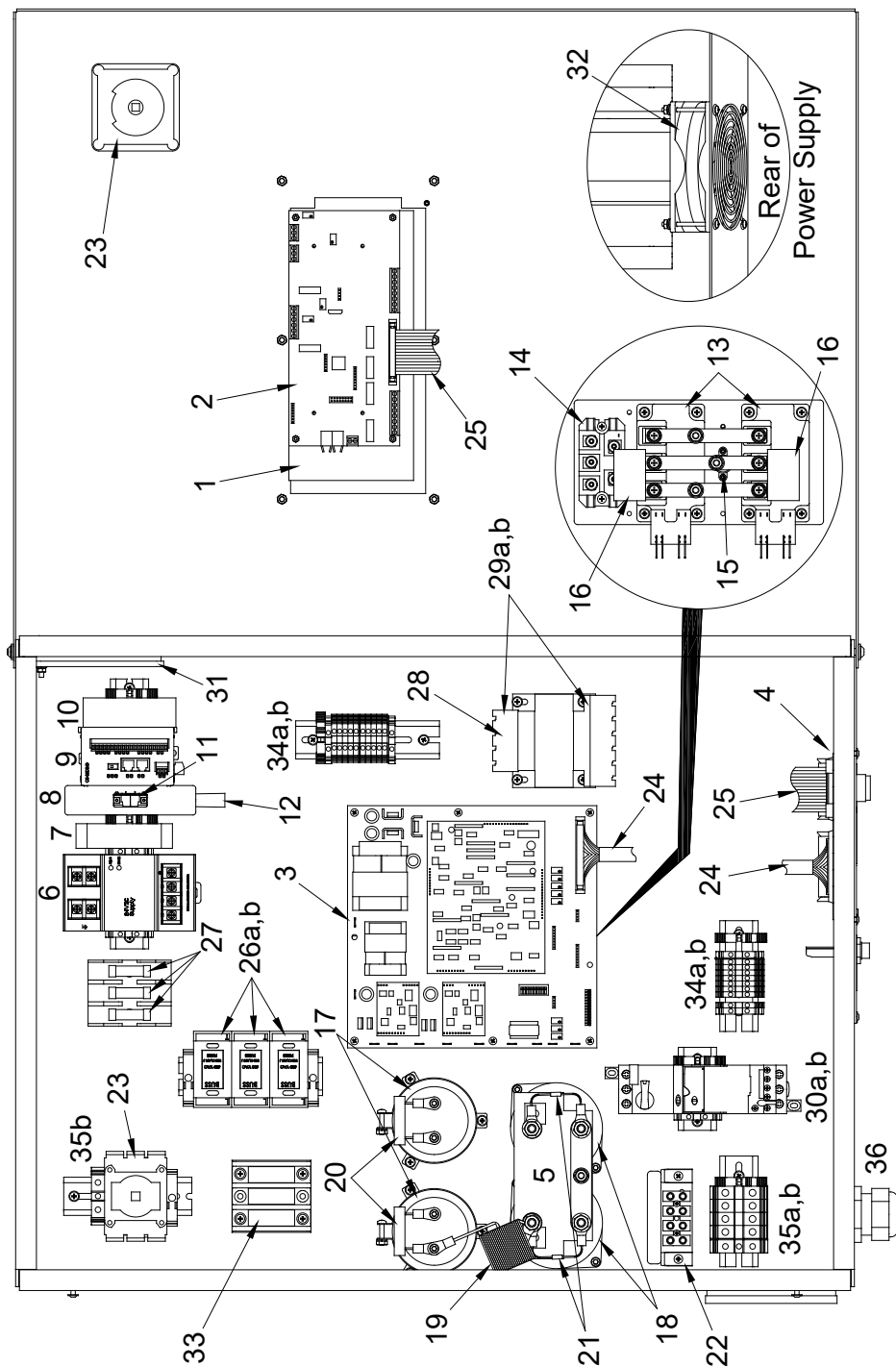


# 4-10 kW Compak™ 2000 Flex Deluxe Parts

| Item # | Part #       | Description                                       | Qty   |
|--------|--------------|---------------------------------------------------|-------|
| 1      | LM4867-01    | Keypad Board                                      | 1     |
| 2      | LM4823-xx    | HF Display Board                                  | 1     |
| 3      | LM4027-xx    | Control Board                                     | 1     |
| 4      | LM5095-01    | Deluxe 2000 I/O Board                             | 1     |
| 5      | LM5756-02    | Capacitor Trip Board                              | 1     |
| 6      | EM0640       | 24VDC Power Supply                                | 1     |
| 7      | EM0054       | 5VDC Power Supply                                 | 1     |
| 8      | — —          | Network Interface Module (Optional)               | 1     |
| 9      | EM0304       | Micro PLC (Optional)                              | 1     |
| 10     | EM0399       | Expansion Module (Optional)                       | 1     |
| 11     | EM0702       | Female Connector for Field Termination (Optional) | 1     |
| 12     | LM5260-16    | RS232 Network Communicator Cable (Optional)       | 1     |
| 13     | LM3936-xx    | Inverter                                          | 1     |
| 14     | BR0016       | Rectifier                                         | 1     |
| 15     | SE0158       | 90° C Temperature Sensor                          | 1     |
| 16     | CP0070       | 1µf 1000V Inverter Snubber Capacitor              | 1     |
| 17     | CP1282       | DC Bus Capacitor                                  | 2     |
| 18     | CP0200       | Output Capacitor                                  | 2     |
| 19     | FD5339-05    | Inductor Coil                                     | 1     |
| 20     | LM4043-02    | 12W 20k Ω Bleeder Resistor Assembly               | 2     |
| 21     | LM5267-01    | 2W 150k Ω Resistor Assembly                       | 2     |
| 22     | LM1982-xx    | Output CT                                         | 1     |
| 23     | SW0171       | Disconnect Switch                                 | 1     |
| 24     | CA1050       | Ribbon Cable 40-pin 17" Long                      | 1     |
| 25     | CA1071       | Ribbon Cable 34-pin 114" Long                     | 1     |
| 26a    | FB0210       | Fuse Holder - CE Safety J - 60A                   | 3     |
| 26b    | FU0522       | Fuse, 600V, 35A                                   | 3     |
| 27     | RE4902       | 50 Ohm Soft Start Resistor                        | 3     |
| 28     | FU0366       | Fuse, 3A                                          | 3     |
| 29a    | CN3082       | Contact                                           | 1     |
| 29b    | CN3071       | Auxiliary Contactor                               | 1     |
| 30     | RL0114       | Relay, Time-On Delay                              | 1     |
| 31     | TF0207       | Control Transformer                               | 1     |
| 32a    | FU0364       | Fuse 0.25A                                        | 2     |
| 32b    | FU0374       | Fuse 0.5A                                         | 1     |
| 33     | TB0158       | 175A 3 Pole Distribution Block                    | 1     |
| 34     | FA0090       | Cooling Fan                                       | 1     |
| 35     | FA0089       | Cooling Fan                                       | 1     |
| 36a    | PB0329       | Contact Block N.O. Contact                        | 1     |
| 36b    | SW0235       | 2 Position Selector Switch                        | 1     |
| 37a    | — —          | Motor Starter Control Unit (Optional)             | 1     |
| 37b    | — —          | Motor Starter Power Base (Optional)               | 1     |
| 38a    | TB7201-020   | Terminal Block – 20 Amp                           | 18    |
| 38b    | TB7201-020-G | Ground Terminal Block                             | 6 - 7 |
| 39a    | TB7201-080   | Terminal Block – 80 Amp                           | 4     |
| 39b    | TB7201-080-G | Ground Terminal Block                             | 2     |
| 40     | CD0525       | Cord Grip                                         | 1     |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# 12-15 kW Compak™ 2000 Flex Deluxe Parts

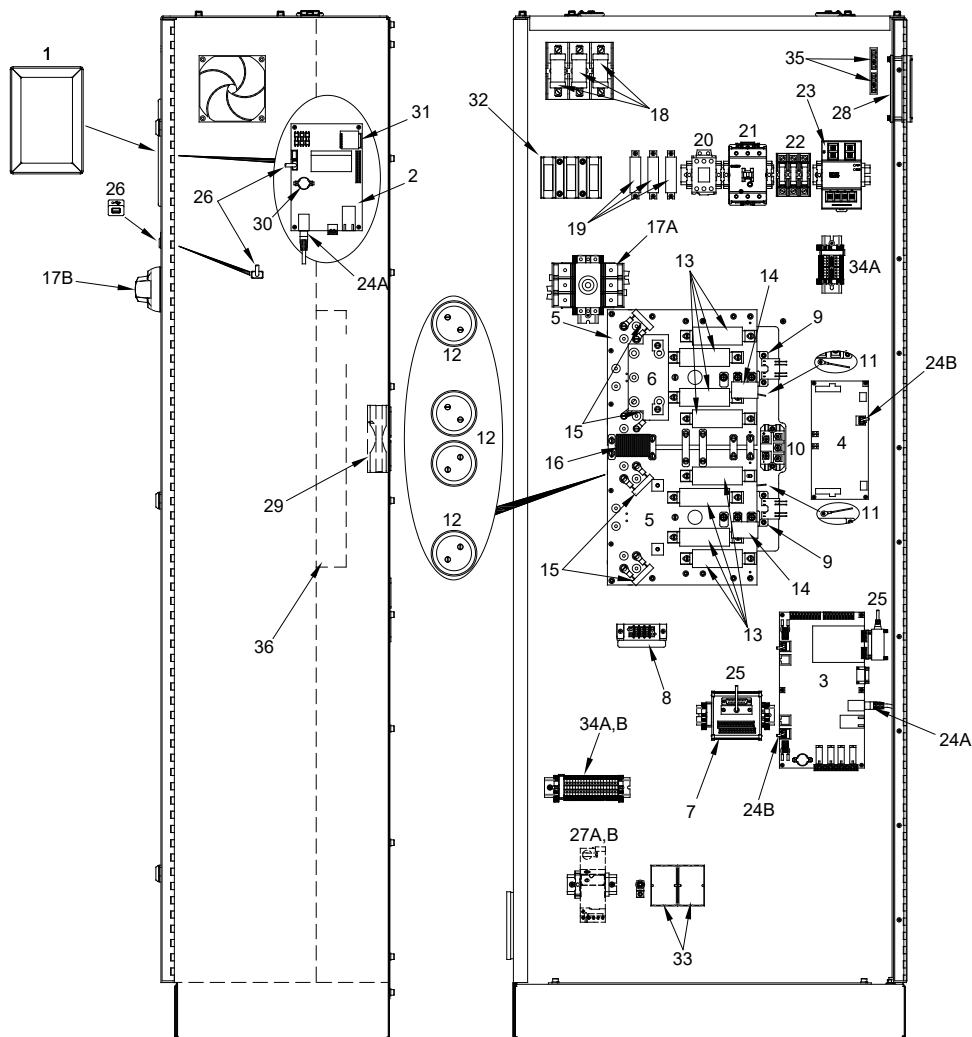


# 12-15 kW Compak™ 2000 Flex Deluxe Parts

| Item # | Part #       | Description                                       | Qty   |
|--------|--------------|---------------------------------------------------|-------|
| 1      | LM4867-01    | Keypad Board                                      | 1     |
| 2      | LM4823-xx    | HF Display Board                                  | 1     |
| 3      | LM4027-xx    | Control Board                                     | 1     |
| 4      | LM5095-01    | Deluxe 2000 I/O Board                             | 1     |
| 5      | LM5756-02    | Capacitor Trip Board                              | 1     |
| 6      | EM0640       | 24VDC Power Supply                                | 1     |
| 7      | EM0054       | 5VDC Power Supply                                 | 1     |
| 8      | — —          | Network Interface Module (Optional)               | 1     |
| 9      | EM0304       | Micro PLC (Optional)                              | 1     |
| 10     | EM0399       | Expansion Module (Optional)                       | 1     |
| 11     | EM0702       | Female Connector for Field Termination (Optional) | 1     |
| 12     | LM5260-16    | RS232 Network Communicator Cable (Optional)       | 1     |
| 13     | LM3936-xx    | Inverter                                          | 2     |
| 14     | BR0016       | Rectifier                                         | 1     |
| 15     | SE0158       | 90° C Temperature Sensor                          | 1     |
| 16     | CP0070       | 1µf 1000V Inverter Snubber Capacitor              | 2     |
| 17     | CP1282       | DC Bus Capacitor                                  | 2     |
| 18     | CP0200       | Output Capacitor                                  | 2     |
| 19     | FD5339-05    | Inductor Coil                                     | 1     |
| 20     | LM4043-02    | 12W 20k Ω Bleeder Resistor Assembly               | 2     |
| 21     | LM5267-01    | 2W 150k Ω Resistor Assembly                       | 2     |
| 22     | LM1982-xx    | Output CT                                         | 1     |
| 23     | SW0171       | Disconnect Switch                                 | 1     |
| 24     | CA1050       | Ribbon Cable 40-pin 17" Long                      | 1     |
| 25     | CA1071       | Ribbon Cable 34-pin 114" Long                     | 1     |
| 26a    | FB0210       | Fuse Holder - CE Safety J - 60A                   | 3     |
| 26b    | FU0522       | Fuse, 600V, 35A                                   | 3     |
| 27     | RE4902       | 50 Ohm Soft Start Resistor                        | 3     |
| 28     | FU0366       | Fuse, 3A                                          | 3     |
| 29a    | CN3082       | Contactors                                        | 1     |
| 29b    | CN3071       | Auxiliary Contactor                               | 1     |
| 30     | RL0114       | Relay, Time-On Delay                              | 1     |
| 31     | TF0207       | Control Transformer                               | 1     |
| 32a    | FU0364       | Fuse 0.25A                                        | 2     |
| 32b    | FU0374       | Fuse 0.5A                                         | 1     |
| 33     | TB0158       | 175A 3 Pole Distribution Block                    | 1     |
| 34     | FA0090       | Cooling Fan                                       | 1     |
| 35     | FA0089       | Cooling Fan                                       | 1     |
| 36a    | PB0329       | Contact Block N.O. Contact                        | 1     |
| 36b    | SW0235       | 2 Position Selector Switch                        | 1     |
| 37a    | — —          | Motor Starter Control Unit (Optional)             | 1     |
| 37b    | — —          | Motor Starter Power Base (Optional)               | 1     |
| 38a    | TB7201-020   | Terminal Block – 20 Amp                           | 18    |
| 38b    | TB7201-020-G | Ground Terminal Block                             | 6 - 7 |
| 39a    | TB7201-080   | Terminal Block – 80 Amp                           | 4     |
| 39b    | TB7201-080-G | Ground Terminal Block                             | 2     |
| 40     | CD0525       | Cord Grip                                         | 1     |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# 10-25 kW ProFlex™ Parts

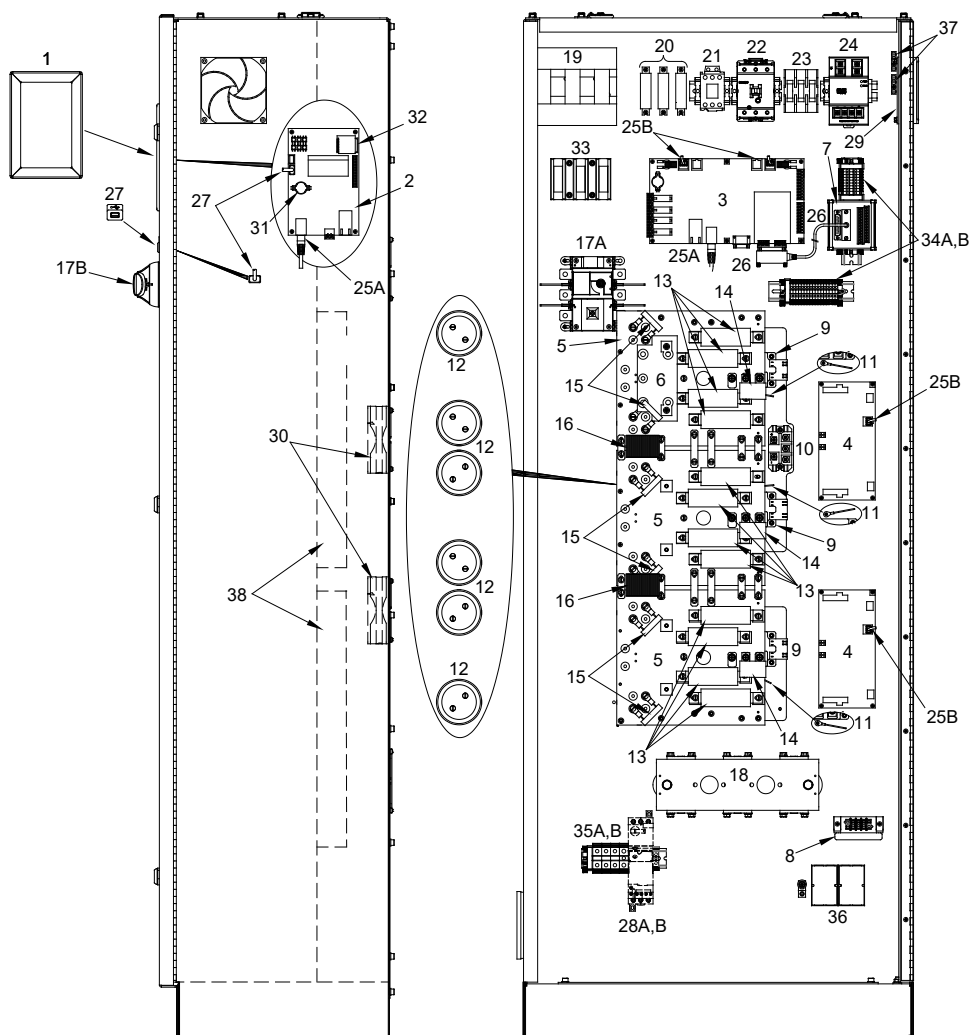


# 10-25 kW ProFlex™ Parts

| Item # | Part #       | Description                                | Qty    |        |        |        |
|--------|--------------|--------------------------------------------|--------|--------|--------|--------|
|        |              |                                            | 10kW   | 15kW   | 20kW   | 25kW   |
| 1      | EM0421       | LCD Touchscreen                            | 1      | 1      | 1      | 1      |
| 2      | LM5697-03    | Touchscreen Display Control Board          | 1      | 1      | 1      | 1      |
| 3      | LM5696-02    | Main Control Board                         | 1      | 1      | 1      | 1      |
| 4      | LM5688-01    | IGBT Driver Board                          | 1      | 1      | 1      | 1      |
| 5      | LM5680-01    | Power Board                                | 1      | 2      | 2      | 2      |
| 6      | LM5756-03    | Open Capacitor Detection Board             | 1      | 1      | 1      | 1      |
| 7      | EM0136       | DB 25 Feed Through Module                  | 1      | 1      | 1      | 1      |
| 8      | LM1982-xx    | Output CT (Part Number Varies by Size)     | 1      | 1      | 1      | 1      |
| 9      | LM3936-xx    | Inverter Module                            | 1      | 2      | 2      | 2      |
| 10     | BR0015       | Bridge Rectifier                           | 1      | 1      | 1      | 1      |
| 11     | SE0241       | Thermistor                                 | 1      | 2      | 2      | 2      |
| 12     | CP1282       | Capacitor, Electrolytic 400V, 3300 uF      | 2      | 4      | 4      | 4      |
| 13     | CP1800       | Capacitor, 15uF 800 VDC                    | 4      | 6      | 8      | 10     |
| 14     | CP0070       | 1 uF, 1000V, Snubber Cap                   | 1      | 2      | 2      | 2      |
| 15     | LM4043-02    | Bleeder Resistor Assembly                  | 2      | 4      | 4      | 4      |
| 16     | FD5339-03    | Inductor Coil                              | 1      | 1      | 1      | 2      |
| 17A    | SW0350-060   | Disconnect Switch                          | 1      | 1      | 1      | 1      |
| 17B    | SW0352-BB    | Disconnect Switch Handle                   | 1      | 1      | 1      | 1      |
| 18     | --           | Input Fuse (Part Number Varies by Size)    | 3      | 3      | 3      | 3      |
| 19     | RE4902       | 50 OHM Soft Start Resistor                 | 3      | 3      | 3      | 3      |
| 20     | CN3074       | Contact 9A 24VDC                           | 1      | 1      | 1      | 1      |
| 21     | CN3082       | Contact 50A 480V, 24VDC Coil               | 1      | 1      | 1      | 1      |
| 22     | FU0366       | Fuse 3A                                    | 3      | 3      | 3      | 3      |
| 23     | EM0640-02    | 24VDC Power Supply                         | 1      | 1      | 1      | 1      |
| 24A    | CA0756-SH-RA | Ethernet Cable                             | 1      | 1      | 1      | 1      |
| 24B    | CA0753-SH-RA | Ethernet Cable                             | 1      | 1      | 1      | 1      |
| 25     | CA0531       | DB-25 Cable                                | 1      | 1      | 1      | 1      |
| 26     | CA1200       | USB Panel Mount Cable Assembly             | 1      | 1      | 1      | 1      |
| 27A    | EM0099       | Motor Starter Control 12 Amp (Optional)    | 0 to 1 | 0 to 1 | 0 to 1 | 0 to 1 |
| 27B    | SR0025       | Motor Starter Power Base 12 Amp (Optional) | 0 to 1 | 0 to 1 | 0 to 1 | 0 to 1 |
| 28     | FA0090       | Fan, 24VDC, 100 CFM                        | 1      | 1      | 1      | 1      |
| 29     | FA0089       | Fan, 24VDC, 243 CFM                        | 1      | 1      | 1      | 1      |
| 30     | EM0346       | Lithium Ion Battery                        | 1      | 1      | 1      | 1      |
| 31     | EM0347       | SD Card – 128MB                            | 1      | 1      | 1      | 1      |
| 32     | TB0258       | 175A 3 Pole Distribution Block 1 IN/4 OUT  | 1      | 1      | 1      | 1      |
| 33     | TB0142       | Output Terminal Block                      | 1      | 2      | 2      | 2      |
| 34A    | TB7201-020   | Terminal Block                             | 26     | 26     | 26     | 26     |
| 34B    | TB7201-020-G | Ground Terminal Block                      | 1      | 1      | 1      | 1      |
| 35     | SW0025       | Grounding Kit                              | 2      | 2      | 2      | 2      |
| 36     | FD4302-16    | Heat Sink                                  | 1      | 1      | 1      | 1      |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# 30 kW ProFlex™ Parts



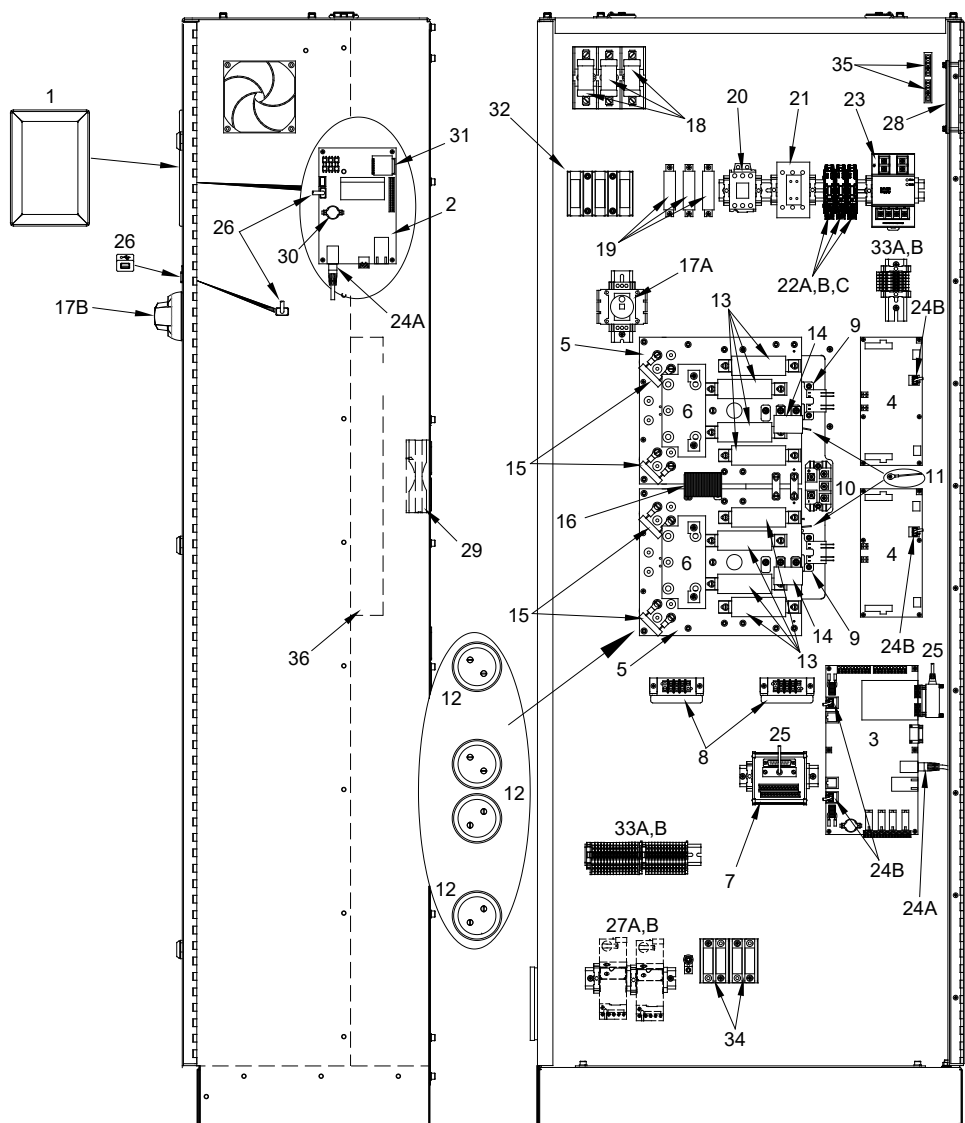


# 30 kW ProFlex™ Parts

| Item # | Part #       | Description                                | Qty    |
|--------|--------------|--------------------------------------------|--------|
| 1      | EM0421       | LCD Touchscreen                            | 1      |
| 2      | LM5697-03    | Touchscreen Display Control Board          | 1      |
| 3      | LM5696-02    | Main Control Board                         | 1      |
| 4      | LM5688-01    | IGBT Driver Board                          | 2      |
| 5      | LM5680-01    | Power Board                                | 3      |
| 6      | LM5756-03    | Open Capacitor Detection Board             | 1      |
| 7      | EM0136       | DB 25 Feed Through Module                  | 1      |
| 8      | LM1982-42    | Output CT                                  | 1      |
| 9      | LM3936-05    | Inverter Module                            | 3      |
| 10     | BR0015       | Bridge Rectifier                           | 1      |
| 11     | SE0241       | Thermistor                                 | 3      |
| 12     | CP1282       | Capacitor, Electrolytic 400V, 3300 uF      | 6      |
| 13     | CP1800       | Capacitor, 15uF 800 VDC                    | 12     |
| 14     | CP0070       | 1 uF, 1000V, Snubber Cap                   | 3      |
| 15     | LM4043-02    | Bleeder Resistor Assembly                  | 6      |
| 16     | FD5339-03    | Inductor Coil                              | 2      |
| 17A    | SW0360-100   | Disconnect Switch                          | 1      |
| 17B    | SW0362-BB    | Disconnect Switch Handle                   | 1      |
| 18     | LM4837-03    | Sharing Transformer                        | 1      |
| 19     | FU0162       | Fuse, 600V, 70A                            | 3      |
| 20     | RE4902       | 50 OHM Soft Start Resistor                 | 3      |
| 21     | CN3074       | Contactors 9A 24VDC                        | 1      |
| 22     | CN3089       | Contactors 80A 480V, 24VDC Coil            | 1      |
| 23     | FU0366       | Fuse 3A                                    | 3      |
| 24     | EM0640-02    | 24VDC Power Supply                         | 1      |
| 25A    | CA0756-SH-RA | Ethernet Cable                             | 1      |
| 25B    | CA0753-SH-RA | Ethernet Cable                             | 2      |
| 26     | CA0531       | DB-25 Cable                                | 1      |
| 27     | CA1200       | USB Panel Mount Cable Assembly             | 1      |
| 28A    | EM0099       | Motor Starter Control 12 Amp (Optional)    | 0 to 1 |
| 28B    | SR0025       | Motor Starter Power Base 12 Amp (Optional) | 0 to 1 |
| 29     | FA0090       | Fan, 24VDC, 100 CFM                        | 1      |
| 30     | FA0089       | Fan, 24VDC, 243 CFM                        | 2      |
| 31     | EM0346       | Lithium Ion Battery                        | 1      |
| 32     | EM0347       | SD Card – 128MB                            | 1      |
| 33     | TB0258       | 175A 3 Pole Distribution Block 1 IN/4 OUT  | 1      |
| 34A    | TB7201-020   | Terminal Block                             | 24     |
| 34B    | TB7201-020-G | Terminal Block                             | 2      |
| 35A    | TB7201-115   | Terminal Block                             | 3      |
| 35B    | TB7201-115-G | Terminal Block                             | 1      |
| 36     | TB0153       | 175A 2 Pole Distribution Block 1 IN/4 OUT  | 2      |
| 37     | SW0025       | Grounding Kit                              | 2      |
| 38     | FD4302-16    | Heat Sink                                  | 2      |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# 5-12 kW Twin ProFlex™ Parts

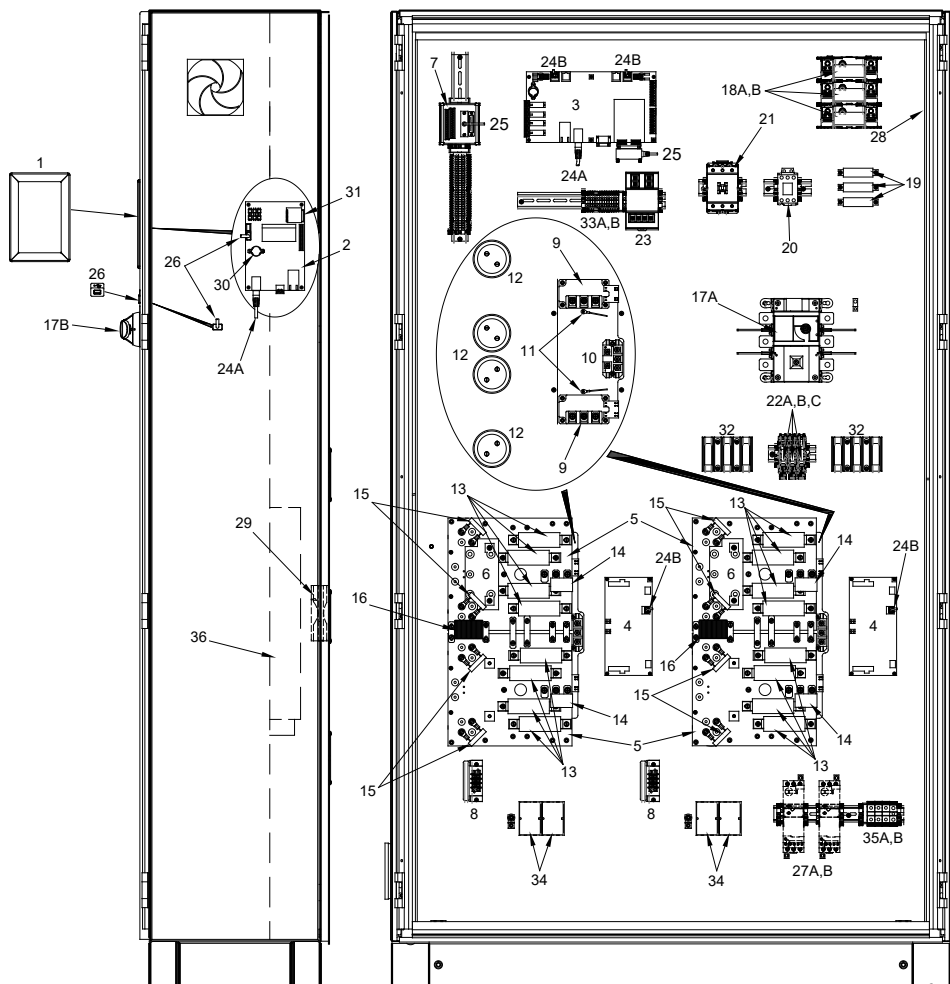


# 5-12 kW Twin ProFlex™ Parts

| Item # | Part #       | Description                                | Qty    |        |        |        |
|--------|--------------|--------------------------------------------|--------|--------|--------|--------|
|        |              |                                            | 5 kW   | 7.5 kW | 10 kW  | 12 kW  |
| 1      | EM0421       | LCD Touchscreen                            | 1      | 1      | 1      | 1      |
| 2      | LM5697-03    | Touchscreen Display Control Board          | 1      | 1      | 1      | 1      |
| 3      | LM5696-02    | Main Control Board                         | 1      | 1      | 1      | 1      |
| 4      | LM5688-01    | IGBT Driver Board                          | 2      | 2      | 2      | 2      |
| 5      | LM5680-01    | Power Board                                | 2      | 2      | 2      | 2      |
| 6      | LM5756-03    | Open Capacitor Detection Board             | 2      | 2      | 2      | 2      |
| 7      | EM0136       | DB 25 Feed Through Module                  | 1      | 1      | 1      | 1      |
| 8      | LM1982-xx    | Output CT                                  | 2      | 2      | 2      | 2      |
| 9      | LM3936-xx    | Inverter Module                            | 2      | 2      | 2      | 2      |
| 10     | BR0015       | Bridge Rectifier                           | 1      | 1      | 1      | 1      |
| 11     | SE0241       | Thermistor                                 | 2      | 2      | 2      | 2      |
| 12     | CP1282       | Capacitor, Electrolytic 400V, 3300 uF      | 4      | 4      | 4      | 4      |
| 13     | CP1800       | Capacitor, 15uF 800 VDC                    | 4      | 6      | 8      | 10     |
| 14     | CP0070       | 1 uF, 1000V, Snubber Cap                   | 2      | 2      | 2      | 2      |
| 15     | LM4043-02    | Bleeder Resistor Assembly                  | 4      | 4      | 4      | 4      |
| 16     | FD5339-03    | Inductor Coil                              | 1      | 1      | 1      | 1      |
| 17A    | SW0350-060   | Disconnect Switch                          | 1      | 1      | 1      | 1      |
| 17B    | SW0352-BB    | Disconnect Switch Handle                   | 1      | 1      | 1      | 1      |
| 18     | --           | Input Fuse                                 | 3      | 3      | 3      | 3      |
| 19     | RE4902       | 50 OHM Soft Start Resistor                 | 3      | 3      | 3      | 3      |
| 20     | CN3074       | Contacto 9A 24VDC                          | 1      | 1      | 1      | 1      |
| 21     | CN3082       | Contacto 50A 480V, 24VDC Coil              | 1      | 1      | 1      | 1      |
| 22A    | FB0148       | Fuse Block, 3 Pole, 600 VAC, 30A           | 3      | 3      | 3      | 3      |
| 23B    | FB0149       | Fuse Block Cover, 3 Pole                   | 3      | 3      | 3      | 3      |
| 23C    | FU0366       | Fuse 3A                                    | 3      | 3      | 3      | 3      |
| 23     | EM0640-02    | 24VDC Power Supply                         | 1      | 1      | 1      | 1      |
| 24A    | CA0756-SH-RA | Ethernet Cable                             | 1      | 1      | 1      | 1      |
| 24B    | CA0753-SH-RA | Ethernet Cable                             | 2      | 2      | 2      | 2      |
| 25     | CA0531       | DB-25 Cable                                | 1      | 1      | 1      | 1      |
| 26     | CA1200       | USB Panel Mount Cable Assembly             | 1      | 1      | 1      | 1      |
| 27A    | EM0099       | Motor Starter Control 12 Amp (Optional)    | 0 to 2 | 0 to 2 | 0 to 2 | 0 to 2 |
| 27B    | SR0025       | Motor Starter Power Base 12 Amp (Optional) | 0 to 2 | 0 to 2 | 0 to 2 | 0 to 2 |
| 28     | FA0090       | Fan, 24VDC, 100 CFM                        | 1      | 1      | 1      | 1      |
| 29     | FA0089       | Fan, 24VDC, 243 CFM                        | 1      | 1      | 1      | 1      |
| 30     | EM0346       | Lithium Ion Battery                        | 1      | 1      | 1      | 1      |
| 31     | EM0347       | SD Card – 128MB                            | 1      | 1      | 1      | 1      |
| 32     | TB0258       | 175A 3 Pole Distribution Block 1 IN/4 OUT  | 1      | 1      | 1      | 1      |
| 33A    | TB7201-020   | Terminal Block                             | Varies | Varies | Varies | Varies |
| 33B    | TB7201-020-G | Ground Terminal Block                      | Varies | Varies | Varies | Varies |
| 34     | TB0142       | Output Terminal Block                      | 2      | 2      | 2      | 2      |
| 35     | SW0025       | Grounding Kit                              | 2      | 2      | 2      | 2      |
| 36     | FD4302-16    | Heat Sink                                  | 1      | 1      | 1      | 1      |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# 15-25 kW Twin ProFlex™ Parts



# 15-25 kW Twin ProFlex™ Parts

| Item # | Part #       | Description                                | Qty    |        |        |
|--------|--------------|--------------------------------------------|--------|--------|--------|
|        |              |                                            | 15kW   | 20kW   | 25kW   |
| 1      | EM0421       | Touchscreen Display Assembly               | 1      | 1      | 1      |
| 2      | LM5697-03    | Touchscreen Display Control Board          | 1      | 1      | 1      |
| 3      | LM5696-02    | Main Control Board                         | 1      | 1      | 1      |
| 4      | LM5688-01    | IGBT Driver Board                          | 2      | 2      | 2      |
| 5      | LM5680-01    | Power Board                                | 4      | 4      | 4      |
| 6      | LM5756-03    | Open Capacitor Detection Board             | 2      | 2      | 2      |
| 7      | EM0136       | DB 25 Feed Through Module                  | 1      | 1      | 1      |
| 8      | LM1982-xx    | Output CT                                  | 2      | 2      | 2      |
| 9      | LM3936-xx    | Inverter Module                            | 4      | 4      | 4      |
| 10     | BR0015       | Bridge Rectifier                           | 1      | 1      | 1      |
| 11     | SE0241       | Thermistor                                 | 2      | 2      | 2      |
| 12     | CP1282       | Capacitor, Electrolytic 400V, 3300 uF      | 8      | 8      | 8      |
| 13     | CP1800       | Capacitor, 15uF 800 VDC                    | 12     | 16     | 20     |
| 14     | CP0070       | 1 uF, 1000V, Snubber Cap                   | 4      | 4      | 4      |
| 15     | LM4043-02    | Bleeder Resistor Assembly                  | 8      | 8      | 8      |
| 16     | FD5339-03    | Inductor Coil                              | 2      | 2      | 4      |
| 17A    | SW0360-100   | Disconnect Switch                          | 1      | 1      | 1      |
| 17B    | SW0362-BB    | Disconnect Switch Handle                   | 1      | 1      | 1      |
| 18A    | FB0160       | Fuse Holder                                | 1      | 1      | 1      |
| 18B    | FU0162       | Input Fuse                                 | 3      | 3      | 3      |
| 19     | RE4902       | 50 OHM Soft Start Resistor                 | 3      | 3      | 3      |
| 20     | CN3074       | Contacto 9A 24VDC                          | 1      | 1      | 1      |
| 21     | CN3086       | Contacto 80A 480V, 24VDC Coil              | 1      | 1      | 1      |
| 22A    | FB0148       | Fuse Block, 3 Pole, 600 VAC, 30A           | 1      | 1      | 1      |
| 22B    | FB0149       | Fuse Block Cover, 3 Pole                   | 1      | 1      | 1      |
| 22C    | FU0366       | Fuse 3A                                    | 3      | 3      | 3      |
| 23     | EM0640-02    | 24VDC Power Supply                         | 1      | 1      | 1      |
| 24A    | CA0756-SH    | RJ45 Cable                                 | 4      | 4      | 3      |
| 24B    | CA0753       | RJ45 Cable                                 | 1      | 1      | 1      |
| 25     | CA0531       | DB-25 Cable                                | 1      | 1      | 1      |
| 26     | CA1200       | USB Panel Mount Cable Assembly             | 1      | 1      | 1      |
| 27A    | EM0099       | Motor Starter Control 12 Amp (Optional)    | 0 to 2 | 0 to 2 | 0 to 2 |
| 27B    | SR0025       | Motor Starter Power Base 12 Amp (Optional) | 0 to 2 | 0 to 2 | 0 to 2 |
| 28     | FA0090       | Fan, 24VDC, 100 CFM                        | 1      | 1      | 1      |
| 29     | FA0089       | Fan, 24VDC, 243 CFM                        | 2      | 2      | 2      |
| 30     | EM0346       | Lithium Ion Battery                        | 1      | 1      | 1      |
| 31     | EM0347       | SD Card – 128MB                            | 1      | 1      | 1      |
| 32     | TB0258       | 175A 3 Pole Distribution Block             | 2      | 2      | 2      |
| 33A    | TB7201-020   | Terminal Block, 20 AMP, 26-12 AWG          | Varies | Varies | Varies |
| 33B    | TB7201-020-G | Ground Terminal Block, 26-12 AWG           | Varies | Varies | Varies |
| 34     | TB0153       | 175A 2 Pole Distribution Block             | 4      | 4      | 4      |
| 35A    | TB7201-115   | Terminal Block, 115 Amp, 12-2 AWG          | 3      | 3      | 3      |
| 35B    | TB7201-115-G | Ground Terminal Block, 12-2 AWG            | 1      | 1      | 1      |
| 36     | FD4302-16    | Heat Sink                                  | 2      | 2      | 2      |

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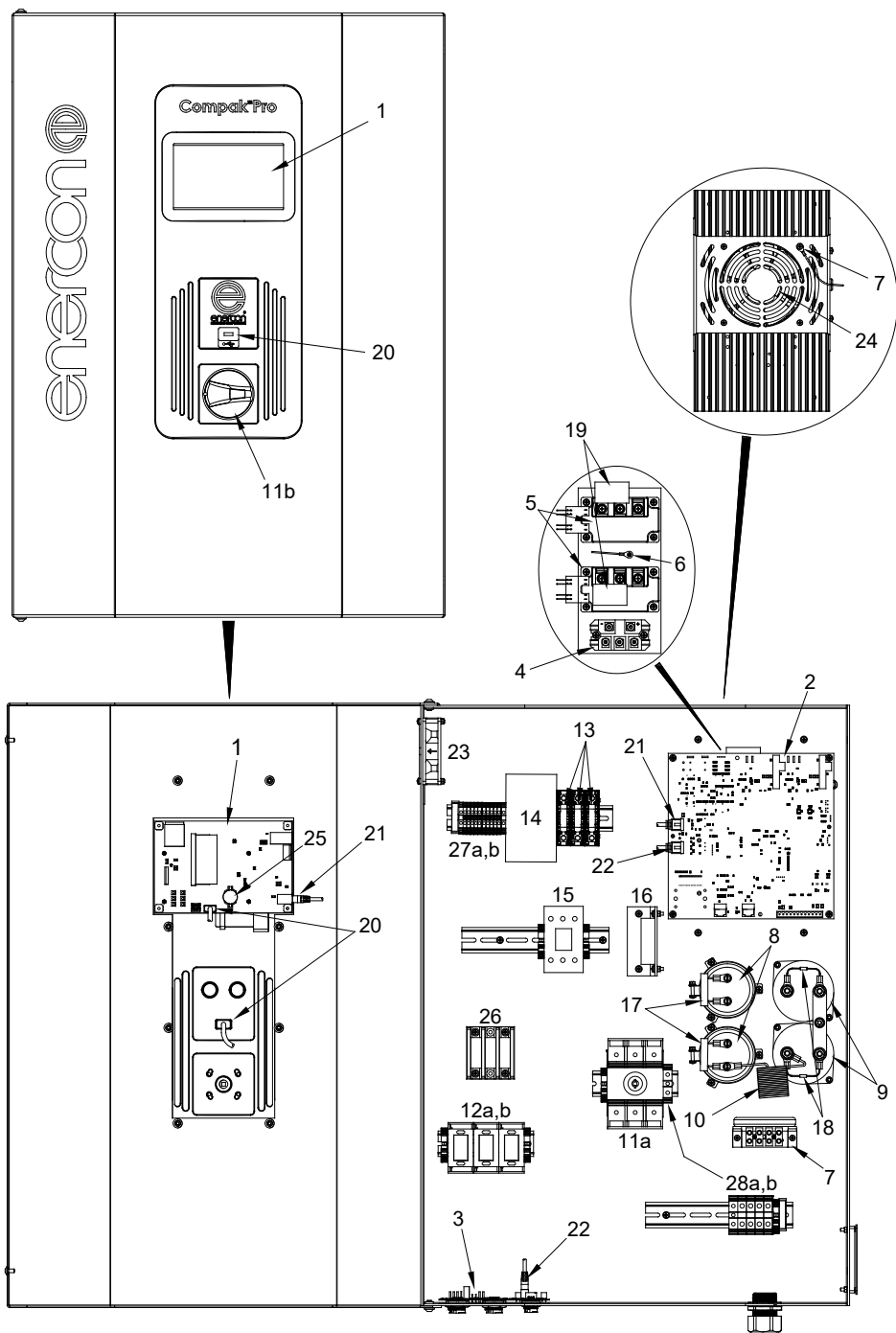


# 1-8 kW Compak™ Pro 200 Series Parts

| Item # | Part #       | Description                                     | Qty   |     |     |     |
|--------|--------------|-------------------------------------------------|-------|-----|-----|-----|
|        |              |                                                 | 1-3kW | 4kW | 5kW | 8kW |
| 1      | LM5704-05    | Touchscreen Assembly                            | 1     | 1   | 1   | 1   |
| 2      | LM5999-01    | Control Board                                   | 1     | 1   | 1   | 1   |
| 3      | LM5992-01    | I/O Board                                       | 1     | 1   | 1   | 1   |
| 4      | BR0015       | Bridge Rectifier                                | 1     | 1   | 1   | 1   |
| 5      | LM3751-03    | Inverter                                        | 1     | 1   | 1   | 1   |
| 6      | LM5781-01    | Thermistor                                      | 2     | 2   | 2   | 2   |
| 7      | LM1982-xx    | Output CT                                       | 1     | 1   | 1   | 1   |
| 8      | CP1282       | 3300uf Electrolytic Capacitor, 400V             | 1     | 1   | 1   | 1   |
| 9      | CP0200       | 100uf Capacitor, 800VDC, 90A RMS                | 2     | 2   | 2   | 2   |
| 10     | FD5339-xx    | Inductor                                        | 1     | 1   | 1   | 1   |
| 11a    | SW0350-xxx   | Disconnect Switch                               | 1     | 1   | 1   | 1   |
| 11b    | SW0352-BB    | Disconnect Switch Handle                        | 1     | 1   | 1   | 1   |
| 12a    | FB0210       | Fuse Holder                                     | 3     | 3   | 3   | 3   |
| 12b    | FU0522       | Fuse, Class J 600V, 35A                         | 3     | 3   | 3   | 3   |
| 13a    | TB7201-F06   | Fused Terminal Block                            | 2     | 2   | 2   | 2   |
| 13b    | FU0124       | Fuse 2A                                         | 2     | 2   | 2   | 2   |
| 14     | EM0256       | 24VDC Power Supply                              | 1     | 1   | 1   | 1   |
| 15     | LM4043-02    | Bleeder Resistor Assembly                       | 1     | 1   | 1   | 1   |
| 16     | LM5267-01    | Resistor Assembly                               | 2     | 2   | 2   | 2   |
| 17     | CP0070       | IGBT Snubber Cap                                | 1     | 1   | 1   | 1   |
| 18     | CA1200       | USB Panel Mount Cable Assembly                  | 1     | 1   | 1   | 1   |
| 19     | CA0755-SH-RA | Straight Cable RJ45 to RJ45 – 5 ft. Right Angle | 1     | 1   | 1   | 1   |
| 20     | CA0753-SH-LA | Straight Cable RJ45 to RJ45 – 3 ft. Left Angle  | 1     | 1   | 1   | 1   |
| 21     | FA0089       | Heat Sink Cooling Fan                           | 1     | 1   | 1   | 1   |
| 22     | EM0346       | Battery 3V                                      | 1     | 1   | 1   | 1   |
| 23a    | TB7201-020   | Terminal Block – 20 Amp                         | 6     | 6   | 6   | 6   |
| 23b    | TB7201-020-G | Ground Terminal Block – 20 Amp                  | 2     | 2   | 2   | 2   |
| 24a    | TB7201-050   | Terminal Block – 50 Amp                         | 3     | 3   | 3   | 3   |
| 24b    | TB7201-050-G | Ground Terminal Block – 50 Amp                  | 1     | 1   | 1   | 1   |
| 25a    | TB7201-080   | Terminal Block – 80 Amp                         | 4     | 4   | 4   | 4   |
| 25b    | TB7201-080-G | Ground Terminal Block – 80 Amp                  | 2     | 2   | 2   | 2   |
| 26a    | CD0241       | 8 AWG, 4 Conductor Tray Cable                   | 1     | 1   | 1   | 1   |
| 26b    | CD0514       | Cord Grip – 1" NPT                              | 2     | 2   | 2   | 2   |

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# 1-16 kW Compak™ Pro 400 Series Parts

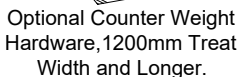




# 1-16 kW Compak™ Pro 400 Series Parts

| Item # | Part #       | Description                                     | Qty   |       |      |      |
|--------|--------------|-------------------------------------------------|-------|-------|------|------|
|        |              |                                                 | 1-8kW | 10kW  | 12kW | 16kW |
| 1      | LM5704-05    | Touchscreen Assembly                            | 1     | 1     | 1    | 1    |
| 2      | LM5999-01    | Control Board                                   | 1     | 1     | 1    | 1    |
| 3      | LM5992-01    | I/O Board                                       | 1     | 1     | 1    | 1    |
| 4      | BR0016       | Bridge Rectifier                                | 1     | 1     | 1    | 1    |
| 5      | LM3936-04    | Inverter                                        | 1     | 1 – 2 | 2    | 2    |
| 6      | LM5781-01    | Thermistor (Hidden Beneath Fan on Heat Sink)    | 2     | 2     | 2    | 2    |
| 7      | LM1982-xx    | Output CT                                       | 1     | 1     | 1    | 1    |
| 8      | CP1282       | 3300uf Electrolytic Capacitor, 400V             | 2     | 2     | 2    | 2    |
| 9      | CP0200       | 100uf Capacitor, 800VDC, 90A RMS                | 2     | 2     | 2    | 2    |
| 10     | FD5339-05    | Inductor                                        | 1     | 1     | 1    | 1    |
| 11a    | SW0350-xxx   | Disconnect Switch                               | 1     | 1     | 1    | 1    |
| 11b    | SW0352-BB    | Disconnect Switch Handle                        | 1     | 1     | 1    | 1    |
| 12a    | FB0210       | Fuse Holder                                     | 3     | 3     | 3    | 3    |
| 12b    | FU0522       | Fuse, Class J 600V, 35A                         | 3     | 3     | 3    | 3    |
| 13     | FU0366       | Fuse 3A                                         | 3     | 3     | 3    | 3    |
| 14     | EM0640-02    | 24VDC Power Supply                              | 1     | 1     | 1    | 1    |
| 15     | CN3082       | Contactors                                      | 1     | 1     | 1    | 1    |
| 16     | RE4902       | Resistor 50 Ohm                                 | 3     | 3     | 3    | 3    |
| 17     | LM4043-02    | Bleeder Resistor Assembly                       | 2     | 2     | 2    | 2    |
| 18     | LM5267-01    | Resistor Assembly                               | 2     | 2     | 2    | 2    |
| 19     | CP0070       | IGBT Snubber Cap                                | 1     | 1 – 2 | 2    | 2    |
| 20     | CA1200       | USB Panel Mount Cable Assembly                  | 1     | 1     | 1    | 1    |
| 21     | CA0753-SH-LA | Straight Cable RJ45 to RJ45 – 3 ft. Left Angle  | 1     | 1     | 1    | 1    |
| 22     | CA0755-SH-RA | Straight Cable RJ45 to RJ45 – 5 ft. Right Angle | 1     | 1     | 1    | 1    |
| 23     | FA0096       | Cabinet Cooling Fan                             | 1     | 1     | 1    | 1    |
| 24     | FA0089       | Heat Sink Cooling Fan                           | 1     | 1     | 1    | 1    |
| 25     | EM0346       | Battery 3V                                      | 1     | 1     | 1    | 1    |
| 26     | TB0158       | 175A, 3 Pole Distribution Block – 1 IN / 4 OUT  | 1     | 1     | 1    | 1    |
| 27a    | TB7201-020   | Terminal Block – 20 Amp                         | 10    | 10    | 10   | 10   |
| 27b    | TB7201-020-G | Ground Terminal Block – 20 Amp                  | 2     | 2     | 2    | 2    |
| 28a    | TB7201-080   | Terminal Block – 80 Amp                         | 4     | 4     | 4    | 4    |
| 28b    | TB7201-080-G | Ground Terminal Block – 80 Amp                  | 2     | 2     | 2    | 2    |

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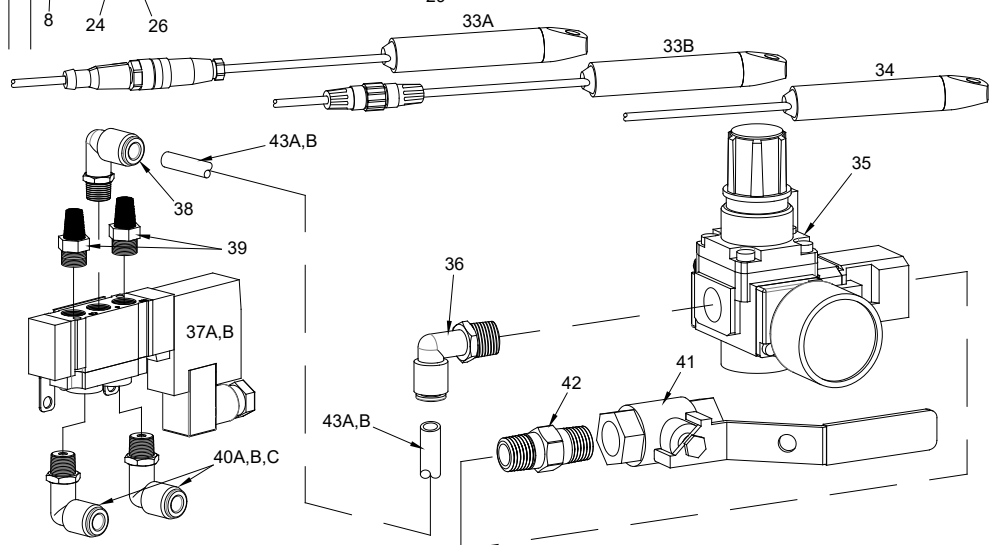
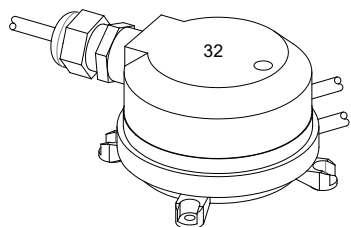
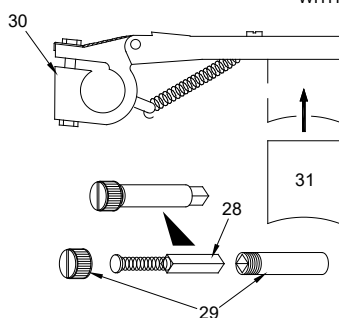
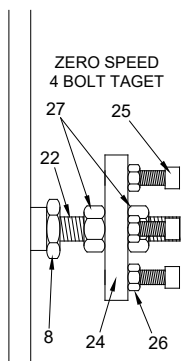
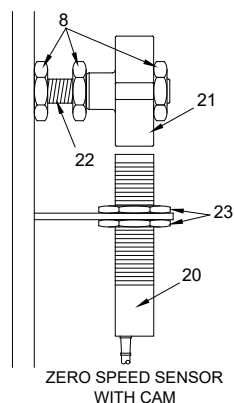
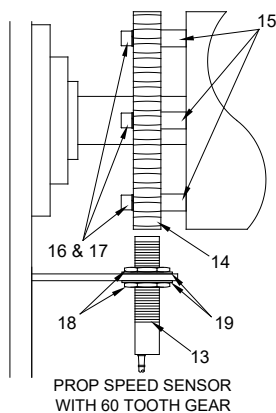
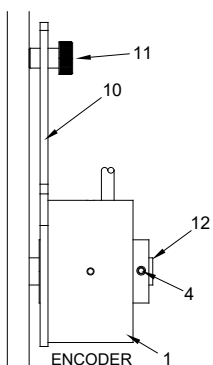
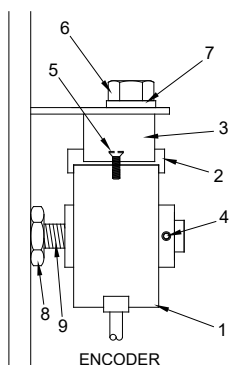


# Electrode Assembly Common Parts

| Item # | Part #           | Description                                                                   | Qty     |
|--------|------------------|-------------------------------------------------------------------------------|---------|
| 1a     | LM4728-04        | Plastic Bearing Replacement Kit                                               | 2       |
| 1b     | LM4791-03        | Plastic Bearing Retrofit Kit (Includes item 1a and item 5)                    | --      |
| 2a     | FD3914-01        | Aluminum Ring With Notch                                                      | 2       |
| 2b     | LM5693-01        | Aluminum Ring Assembly (Includes 1 of item 2a & 3 of item 3)                  | --      |
| 3      | MS7420           | Socket Head Set Screw                                                         | 6       |
| 4      | SP0052           | Spring Pin 1/8 x 3/4"                                                         | 1       |
| 5      | FD5975-01        | Bushing Ring                                                                  | 2       |
| 6      | FD4109-04        | Adjustment Block                                                              | 2       |
| 7      | FD4110-04        | Adjustment Stud                                                               | 2       |
| 8      | FD4027-01        | Bearing Housing Spacer                                                        | 4       |
| 9      | MM080-125S050S-0 | Socket Head Screw M8 x 1.25P x 50                                             | 2       |
| 10     | MM060-100S025S-0 | Socket Head Screw M6 x 1.0P x 25 (Standard – Optional Qty)                    | 6 – 8   |
| 11     | NU2001           | Hex Nut M8 x 1.25P (Standard – Optional Qty)                                  | 4 – 6   |
| 12     | FD6389-xxxx      | Counter Weight (Lengths Vary)                                                 | 1       |
| 13     | FD5611-06        | Counterweight Adjustment Block                                                | 2       |
| 14     | NU7379           | Rivet Nut M8 x 1.25P (Standard – Optional Qty)                                | 2 – 3   |
| 15     | MM080-125H025S-0 | Hex Head Screw M8 x 1.25P x 25                                                | 4       |
| 16     | WA1600           | Lock Washer                                                                   | 5       |
| 17     | WA4056           | Flat Washer (Standard Qty – Optional Qty)                                     | 10 – 12 |
| 18     | MM080-125H060S-0 | Hex Head Cap Screw M8 x 1.25P x 60 (Optional)                                 | 1       |
| 19     | SW7010           | Interlock Switch                                                              | 1       |
| 20     | MM040-070P040S-0 | Fillister Screw M4 x 0.7P x 40                                                | 4       |
| 21     | LM3772-01        | Ground Strap                                                                  | 1       |
| 22     | FD4027-02        | Bearing Housing Spacer                                                        | 2       |
| 23     | NU0030           | Acorn Nut M6 x 1.0P                                                           | 1       |
| 24     | WA1555           | Lock Washer (Standard – Optional Qty)                                         | 8 – 12  |
| 25     | NU2000           | Hex Nut M6 x 1.0P (Standard – Optional Qty)                                   | 3 – 5   |
| 26     | MM060-100S020S-0 | Socket Head Screw M6 x 1.0P x 20                                              | 3       |
| 27     | MM080-125S025S-0 | Socket Head Screw M8 x 1.25P x 25                                             | 2       |
| 28     | MM080-125S040S-0 | Socket Head Screw M8 x 1.25P x 40                                             | 1       |
| 29     | HW7090           | Locking Pin Indexing Plunger                                                  | 1       |
| 30     | FD4761-01        | Locking Pin Holder                                                            | 1       |
| 31     | HW7092           | Indexing Plunger Jam Nut M10 x 1.0P                                           | 1       |
| 32     | FD4108-26        | Electrode Assembly Stop Bracket (Frame)                                       | 1       |
| 33     | MM120-175H040S-0 | Hex Head Cap Screw, M12 x 1.75P x 40                                          | 1       |
| 34     | NU7321           | Hex Nut M12 x 1.75P                                                           | 1       |
| 35     | MM060-100S030S-0 | Socket Head Screw M6 x 1.0P x 30mm                                            | 1       |
| 36     | MM060-100S040S-0 | Socket Head Screw M6 x 1.0P x 40mm                                            | 1       |
| 37     | MM100-150H065S-0 | Hex Head Cap Screw, M10 x 1.5P, 65mm (With Reverse Stop Only)                 | 1       |
| 38     | NU2020           | Hex Nut M10 x 1.5P (With Reverse Stop Only)                                   | 1       |
| 39     | FD4107-01        | Electrode Assembly Stop Bracket (Tube [Standard – Reverse Stop])              | 1 – 2   |
| 40     | MM060-100F018S-0 | Flat Socket Head Cap Screw M6 x 1.0P (Standard / Reverse Stop / Optional Qty) | 2 – 6   |
| 41a    | PN7027           | Air Cylinder – 90° Option (Pneumatics Option - Shown)                         | 1       |
| 41b    | PN7016           | Air Cylinder – Standard (Pneumatics Option - Not Shown)                       | 1       |
| 42a    | FD3984-xx        | Mounting Bracket – 90° Option (Pneumatics Option - Shown)                     | 1       |
| 42b    | FD3984-xx        | Mounting Bracket – Standard (Pneumatics Option - Not Shown)                   | 1       |
| 43     | PN1500           | Flow Control 1/8 NPT TO 1/4" (Pneumatics Option Only)                         | 2       |
| 44a    | LM5465-02        | Rod Fitting – 90° Option (Pneumatics Option - Shown)                          | 1       |
| 44b    | FD3590-01        | Rod Fitting – Standard (Pneumatics Option - Not Shown)                        | 1       |
| 45     | NU7022           | Jam Nut 5/16 x 24 (Pneumatics Option)                                         | 1       |
| 46     | NU0141           | Low Profile Nut 5/8 x 18 (Pneumatics Option)                                  | 1       |
| 47a    | FD4283-xx        | Lift Bracket – 90° Option (Pneumatics Option - Shown)                         | 1       |
| 47b    | FD4213-xx        | Lift Bracket – Standard (Pneumatics Option - Not Shown)                       | 1       |

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# Miscellaneous Station Parts

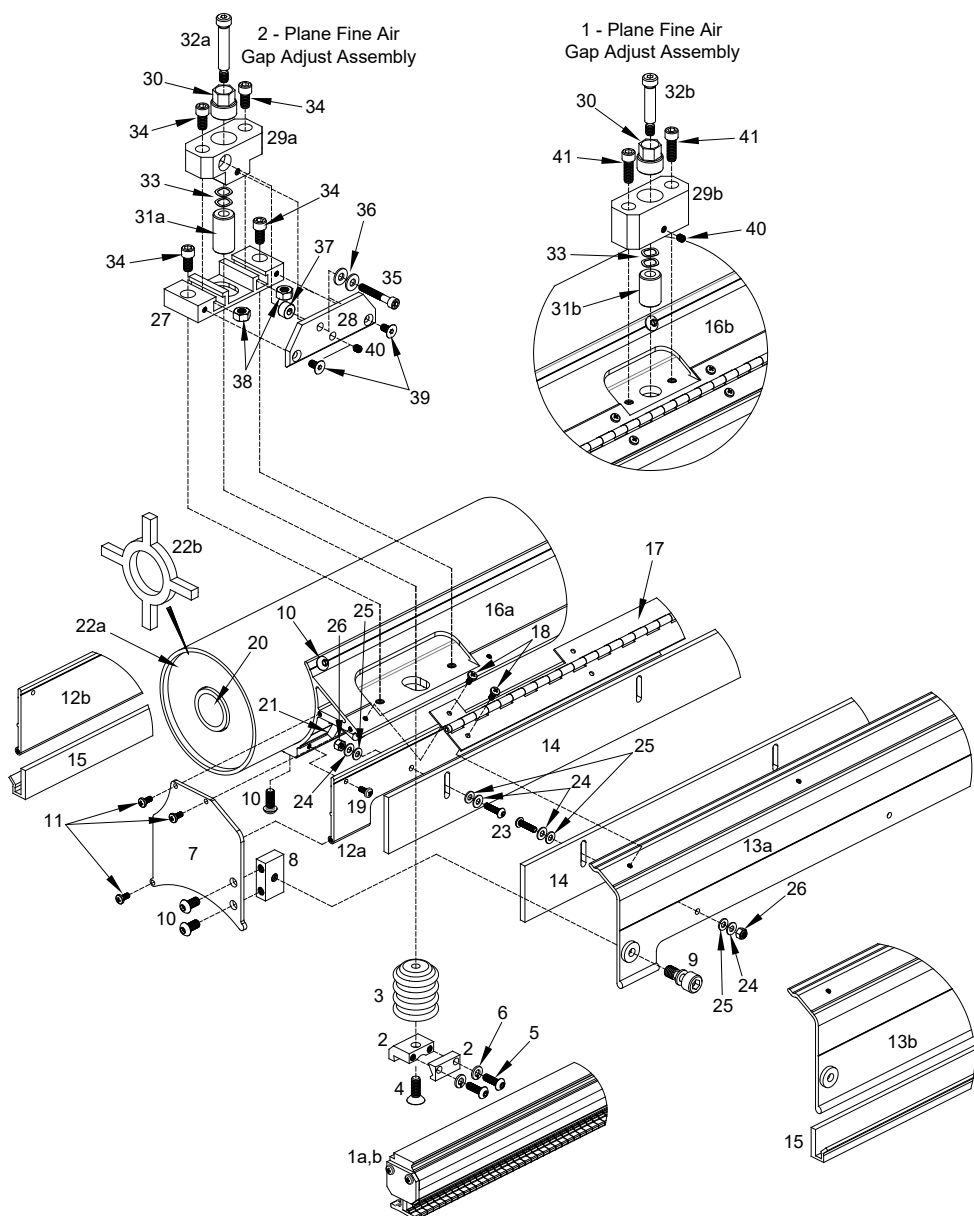


# Miscellaneous Station Parts

| Item # | Part #           | Description                                            | Qty.        |
|--------|------------------|--------------------------------------------------------|-------------|
| 1      | SE7011           | Encoder                                                | 1           |
| 2      | FD5260-02        | Mounting Yoke                                          | 1           |
| 3      | FD5260-04        | Mounting Yoke                                          | 1           |
| 4      | --               | 6 – 32 Set Screw – Supplied with Item #1               | 1           |
| 5      | MS004-40F04385-0 | 4 – 40 x 7/16" Flat head Machine Screw                 | 1           |
| 6      | MS044-14H07505-0 | 7/16 – 14 x 3/4" Hex Head Cap Screw                    | 1           |
| 7      | WA1611           | 7/16" Lock Washer                                      | 1           |
| 8      | NU7020           | M10 Jam Nut                                            | As Required |
| 9      | FD5259-01        | Shaft Adapter                                          | 1           |
| 10     | FD3526-21        | Encoder Mounting Arm                                   | 1           |
| 11     | MS7725           | Shoulder Bolt, M6 x 1.0P x 8mm                         | 1           |
| 12     | FD5259-22        | Shaft Adapter                                          | 1           |
| 13     | SE7021           | Proportional Speed Sensor                              | 1           |
| 14     | FD4344-xx        | 60 Tooth Gear                                          | 1           |
| 15     | FD4027-02        | Aluminum Spacers                                       | 4           |
| 16     | MS025-20S20005-0 | 1/4 – 20 x 2" LG Socket Head Cap Screw                 | 4           |
| 17     | WA1555           | 1/4" Lock Washer                                       | 4           |
| 18     | WA7070           | 3/8" Nylon Washer                                      | 2           |
| 19     | --               | Supplied with Item #13                                 | 2           |
| 20     | SE7022           | Zero Speed Sensor                                      | 1           |
| 21     | FD4217-01        | Zero Speed Cam                                         | 1           |
| 22     | RD6001           | M10 Threaded Rod                                       | 1           |
| 23     | --               | Supplied with Item #20                                 | 2           |
| 24     | FD3314-01        | Ground Disc                                            | 1           |
| 25     | MM060-100S025S-0 | M6 Socket Head Cap Screw                               | 4           |
| 26     | NU2000           | M6 Hex Nut                                             | 4           |
| 27     | NU7270           | M10 Hex Nut                                            | 2           |
| 28     | BH7000           | Ground Brush                                           | 1           |
| 29     | BH7390           | Ground Brush Holder                                    | 1           |
| 30     | BH7001           | Ground Brush Holder                                    | 1           |
| 31     | BH7002           | Ground Brush                                           | 1           |
| 32     | SWxxxx           | Differential Pressure Switch (Size Requirement Varies) | As Required |
| 33A    | LM3921-xx        | Station Mounted Air Flow Sensor                        | As Required |
| 33B    |                  | Remote Mounted Air Flow Sensor                         | As Required |
| 34     | SE7027           | Air Flow Sensor                                        | As Required |
| 35     | PN7055           | Regulator w/Gauge, Bracket and Port Adapter            | 1           |
| 36     | FT3051           | Elbow 1/4" NPT to 1/4" Tube                            | 1           |
| 37A    | PN7120-01        | 120V Solenoid Valve                                    | 1           |
| 37B    | PN7120-02        | 24V Solenoid Valve                                     | 1           |
| 38     | FT3050           | Elbow, 1/8" NPT to 1/4" Tube                           | 1           |
| 39     | PN0051           | Exhaust Silencer, 1/8" NPT                             | 2           |
| 40A    | FT3050           | 11V Station: Elbow, 1/8" NPT to 1/4" Tube              | 2           |
| 40B    | FT3100           | 21V Station: Male Run Tee, 1/8" NPT to 1/4" Tube       | 2           |
| 40C    | FT7390           | 31V or Greater Station: Manifold                       | 2           |
|        | FT3050           | Elbow, 1/8" NPT to 1/4" Tube                           | 2           |
| 41     | PN7002           | Lockout Valve                                          | 1           |
| 42     | FT0025           | Hex Nipple, 1/4" NPT                                   | 1           |
| 43A    | TU7090           | Black Polyethylene Tube, 1/4"                          | As Required |
| 43B    | TU7094           | White Polyethylene Tube, 1/4"                          | As Required |

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# CSO Segmented Electrode Assembly Parts

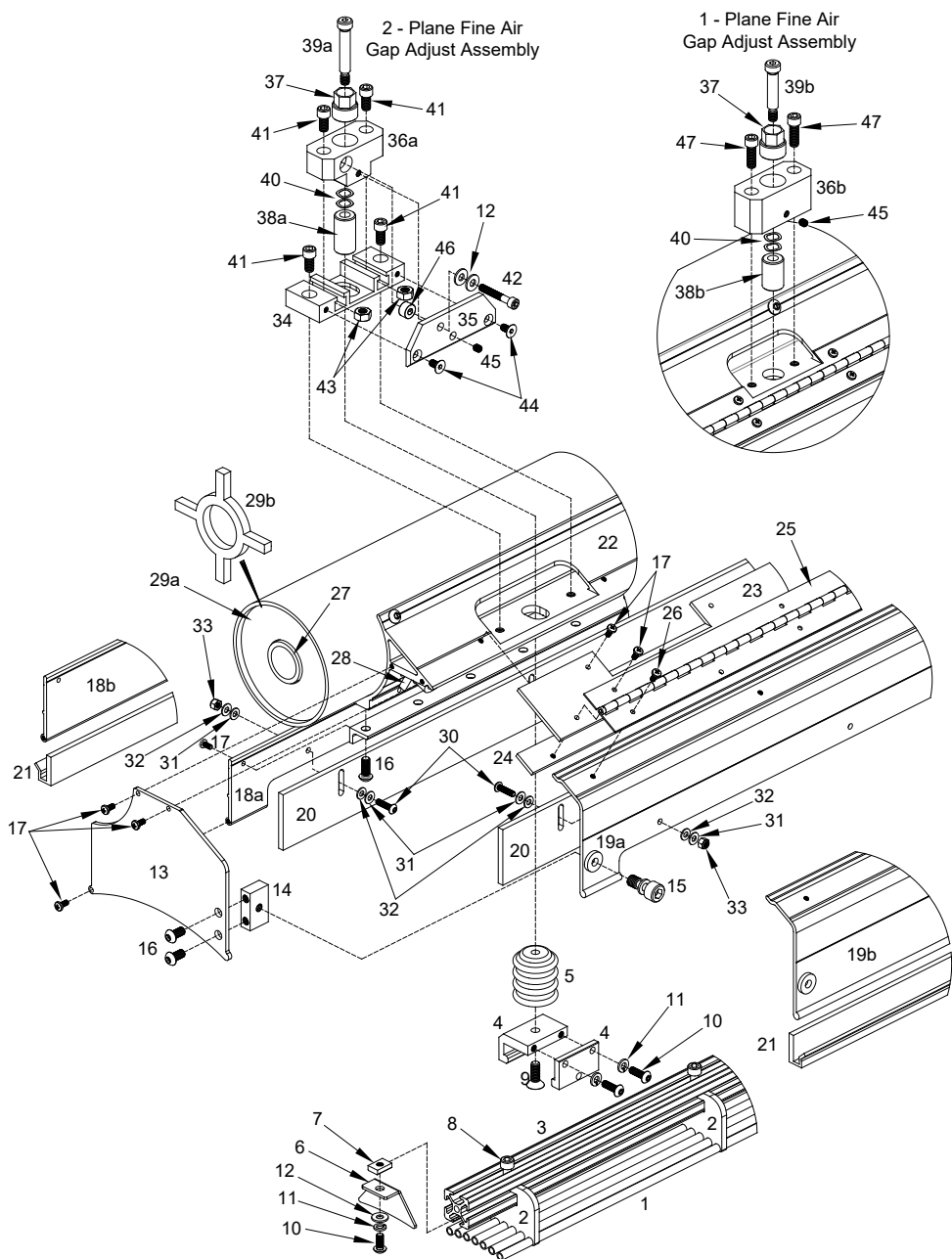


# CSO Segmented Electrode Assembly Parts

| Item # | Part #             | Description                                                                 | Qty.       |
|--------|--------------------|-----------------------------------------------------------------------------|------------|
| 1A     | LM4096-xxx         | Electrode Sub Assembly – 1/4" Segments                                      | Varies     |
| 1B     | LM4164-xxx         | Electrode Sub Assembly – 1/2" Segments                                      | Varies     |
| 2      | LM6007-01          | CSO Clamp Block Assembly (Includes Items 5 & 6)                             | Varies     |
| 3      | IN0012-02          | Glazed Alumina Post                                                         | Varies     |
| 4      | MS025-20F0625S-0   | Flat Head Cap Screw, 1/4"–20 x 5/8"                                         | Varies     |
| 5      | MM050-080B016S-0   | SS Button Head Screw M5 x 0.8P x 16                                         | Varies     |
| 6      | WA1550             | SS Lock Washer                                                              | Varies     |
| 7      | FD5212-01          | Side Plate, Offset Shroud                                                   | 2          |
| 8      | FD5263-01          | Shroud Clamp Block                                                          | 2          |
| 9      | HW7036             | Captive Panel Screw Assembly                                                | 2          |
| 10     | MS025-20B0500S-0   | Button Head Cap Screw, 1/4"–20 x 1/2"                                       | Varies     |
| 11     | MS006-32P0313S-0   | Pan Head Machine Screw, #6–32 x 5/16"                                       | 6          |
| 12a    | FD5556-xxxx        | Aluminum Shroud, Offset Leg, Short – Modified for Shroud Ext.               | 1          |
| 12b    | AL7146-03          | Aluminum Shroud, Offset Leg, Short                                          | 1          |
| 13a    | FD5555-xxxx        | Aluminum Shroud, Offset Leg, Long – Modified for Shroud Ext.                | 1          |
| 13b    | AL7146-02          | Aluminum Shroud, Offset Leg, Long                                           | 1          |
| 14     | FD5299-138-2122-02 | Adjustable Shroud Extension (Supplied w/Items 12a & 13a)                    | 2          |
| 15     | IN0059             | Wear Strip (Supplied w/Items 12b & 13b)                                     | 2          |
| 16a    | FD6210-xxx         | Offset Shroud Base, 2-Plane Fine Air Gap Adjust Assy                        | 1          |
| 16b    | FD5534-xxx         | Offset Shroud Base, 1-Plane Fine Air Gap Adjust Assy                        | 1          |
| 17     | HW7000             | Piano Hinge                                                                 | Varies     |
| 18     | MS006-32P0188S-0   | Pan Head Machine Screw, #6–32 x 3/16"                                       | Varies     |
| 19     | MS006-32P0250S-0   | Pan Head Machine Screw #6–32 x 1/4"                                         | Varies     |
| 20     | FD4997-04          | Pyrex Elbow                                                                 | 1          |
| 21     | FD5700-01          | Pyrex Elbow Insulator                                                       | 1          |
| 22a    | IN7210-03          | Round Insulator for Pyrex Tube                                              | 1          |
| 22b    | IN7140-03          | Star Insulator for Pyrex Tube                                               | 1          |
| 23     | MM040-070B016S-0   | SS Button Head Screw, M4 x 0.7P x 16mm                                      | Varies     |
| 24     | WA4045             | SS Flat Washer SAE .171" x .375" x .031"                                    | Varies     |
| 25     | WA0069             | M4 PTFE Flat Washer, 4.3mm ID x 9.0mm OD x 0.8mm THK                        | Varies     |
| 26     | NU2056             | SS Lock Nut, M4 x 0.7P w/Nylon Insert                                       | Varies     |
| 27     | FD5658-04          | Adjustment Mount Block (2-Plane Fine Air Gap Adjust Assy)                   | 1 per Assy |
| 28     | FD5658-05          | Adjustment Plate (2-Plane Fine Air Gap Adjust Assy)                         | 1 per Assy |
| 29a    | FD5658-06          | Adjustment Block (2-Plane Fine Air Gap Adjust Assy)                         | 1 per Assy |
| 29b    | FD5658-01          | Adjustment Block (1-Plane Fine Air Gap Adjust Assy)                         | 1 per Assy |
| 30     | FD5658-02          | Fine Adjust Screw (Both Fine Air Gap Adjust Assy)                           | 1 per Assy |
| 31a    | FD5658-07          | Fine Adjust Spacer (2-Plane Fine Air Gap Adjust Assy)                       | 1 per Assy |
| 31b    | FD5658-03          | Fine Adjust Spacer (1-Plane Fine Air Gap Adjust Assy)                       | 1 per Assy |
| 32a    | MS2802             | SS Socket Head Shoulder Bolt 1/4-20, 5/16 OD x 1-1/2 (2-Plane)              | 1 per Assy |
| 32b    | MS0099             | SS Socket Head Shoulder Bolt 1/4-20, 5/16 OD x 1-1/4 (1-Plane)              | 1 per Assy |
| 33     | WA0027             | Wave Washer (Both Fine Air Gap Adjust Assy)                                 | 2 per Assy |
| 34     | MS025-20S0500S-0   | SS Socket Head Screw 1/4-20 x 1/2 (2-Plane Fine Air Gap Adjust Assy)        | 4 per Assy |
| 35     | MS010-32S1250S-0   | SS Socket Head Screw #10-32 x 1-1/4 (2-Plane Fine Air Gap Adjust Assy)      | 1 per Assy |
| 36     | WA4050             | SS Flat Washer (2-Plane Fine Air Gap Adjust Assy)                           | 2 per Assy |
| 37     | HW0186             | 3/16" ID Shaft Clamp (2-Plane Fine Air Gap Adjust Assy)                     | 1 per Assy |
| 38     | NU2050             | Nut 1/4-20 Hex SS (2-Plane Fine Air Gap Adjust Assy)                        | 2 per Assy |
| 39     | MS010-32F0375S-0   | 18-8 SS Flat Head Cap Screw #10-32 x 3/8 (2-Plane Fine Air Gap Adjust Assy) | 2 per Assy |
| 40     | MS0101             | Set Screw w/Nylon Tip #10-32 x 3/16                                         | 1 per Assy |
| 41     | MS025-20S0750S-0   | SS Socket Head Screw 1/4-20 x 3/4 (1-Plane Fine Air Gap Adjust Assy)        | 2 per Assy |

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# CSO Rod Electrode Assembly Parts



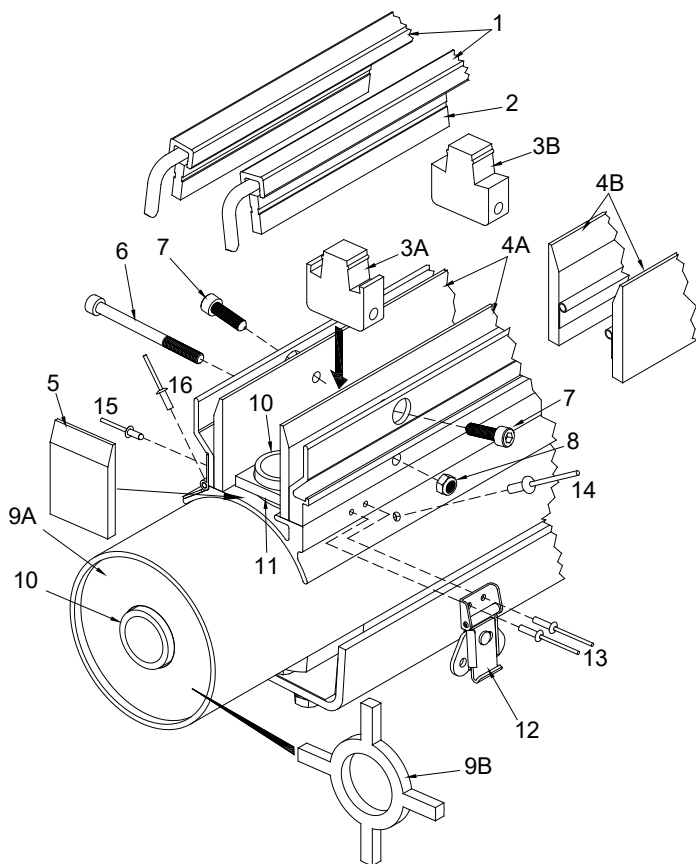


# CSO Rod Electrode Assembly Parts

| Item # | Part #             | Description                                                                 | Qty.       |
|--------|--------------------|-----------------------------------------------------------------------------|------------|
| 1      | FD5745-xxxx        | SS Electrode Tube                                                           | 7 - 9      |
| 2      | FD6287-xxx         | SS Electrode Tube Holder                                                    | Varies     |
| 3      | FD6696-xxxx        | 1.0" Square Aluminum Extrusion Electrode Support                            | 1          |
| 4      | LM6007-02          | CSO Clamp Block Assembly (Includes Items 10 & 11)                           | Varies     |
| 5      | IN0012-02          | Glazed Alumina Post                                                         | Varies     |
| 6      | FD3265-1066        | Tube Stop                                                                   | 2          |
| 7      | FD6719-01          | SS M5 T-Nut                                                                 | 2          |
| 8      | MM060-100S020S-0   | SS Socket Head Screw, M6 x 1.0P x 20mm                                      | Varies     |
| 9      | MS0025-20F0625S-0  | SS Flat Head Cap Screw, 1/4"-20 x 5/8"                                      | Varies     |
| 10     | MM050-080B016S-0   | SS Button Head Screw, M5 x 0.8P x 16                                        | Varies.    |
| 11     | WA1550             | SS Lock Washer                                                              | Varies     |
| 12     | WA4050             | SS Flat Washer                                                              | Varies     |
| 13     | FD5212-04          | Side Plate, Offset Shroud                                                   | 2          |
| 14     | FD5263-01          | Shroud Clamp Block                                                          | 2          |
| 15     | HW7207             | Captive Panel Screw Assembly                                                | 2          |
| 16     | MM060-100B012S-0   | SS Button Head Screw, M6 x 1.0P x 12mm                                      | Varies     |
| 17     | MM035-060P008S-0   | SS Phillips Head Screw, M3.5 x 0.6P x 8mm                                   | Varies     |
| 18a    | FD5556-xxxx        | Aluminum Shroud, Offset Leg, Short – Modified for Shroud Ext.               | 1          |
| 18b    | AL7146-03          | Aluminum Shroud, Offset Leg, Short                                          | 1          |
| 19a    | FD5555-xxxx        | Aluminum Shroud, Offset Leg, Long – Modified for Shroud Ext.                | 1          |
| 19b    | AL7146-02          | Aluminum Shroud, Offset Leg, Long                                           | 1          |
| 20     | FD5299-138-2122-02 | Adjustable Shroud Extension (Supplied w/Items 18a & 19a)                    | 2          |
| 21     | IN0059             | Wear Strip (Supplied w/Items 18b & 19b)                                     | 2          |
| 22     | FD6186-2032-03     | Aluminum Shroud Offset Base                                                 | 1          |
| 23     | AL0035-xxxx        | 2 x 1/8" Aluminum Rectangle                                                 | 1          |
| 24     | AL7007-xxxx        | 3/4 x 1/8" Aluminum Rectangle                                               | 1          |
| 25     | HW7000-xxxx        | Piano Hinge                                                                 | 1          |
| 26     | MM035-060P005S-0   | SS Phillips Head Screw, M3.5 x 0.6P x 5mm                                   | Varies     |
| 27     | FD4997-xxx-xxx     | Pyrex Elbow                                                                 | 1          |
| 28     | FD5700-01          | Pyrex Elbow Insulator                                                       | 1          |
| 29a    | IN7210-03          | Round Insulator for Pyrex Tube                                              | 1          |
| 29b    | IN7140-03          | Star Insulator for Pyrex Tube                                               | 1          |
| 30     | MM040-070B016S-0   | SS Button Head Screw, M4 x 0.7P x 16mm                                      | Varies     |
| 31     | WA4045             | SS Flat Washer SAE .171" x .375" x .031"                                    | Varies     |
| 32     | WA0069             | M4 PTFE Flat Washer, 4.3mm ID x 9.0mm OD x 0.8mm THK                        | Varies     |
| 33     | NU2056             | SS Lock Nut, M4 x 0.7P w/Nylon Insert                                       | Varies     |
| 34     | FD5658-04          | Adjustment Mount Block (2-Plane Fine Air Gap Adjust Assy)                   | 1 per Assy |
| 35     | FD5658-05          | Adjustment Plate (2-Plane Fine Air Gap Adjust Assy)                         | 1 per Assy |
| 36a    | FD5658-06          | Adjustment Block (2-Plane Fine Air Gap Adjust Assy)                         | 1 per Assy |
| 36b    | FD5658-01          | Adjustment Block (1-Plane Fine Air Gap Adjust Assy)                         | 1 per Assy |
| 37     | FD5658-02          | Fine Adjust Screw (Both Fine Air Gap Adjust Assy)                           | 1 per Assy |
| 38a    | FD5658-07          | Fine Adjust Spacer (2-Plane Fine Air Gap Adjust Assy)                       | 1 per Assy |
| 38b    | FD5658-03          | Fine Adjust Spacer (1-Plane Fine Air Gap Adjust Assy)                       | 1 per Assy |
| 39a    | MS2802             | SS Socket Head Shoulder Bolt 1/4-20, 5/16 OD x 1-1/2 (2-Plane)              | 1 per Assy |
| 39b    | MS0099             | SS Socket Head Shoulder Bolt 1/4-20, 5/16 OD x 1-1/4 (1-Plane)              | 1 per Assy |
| 40     | WA0027             | Wave Washer (Both Fine Air Gap Adjust Assy)                                 | 2 per Assy |
| 41     | MS025-20S0500S-0   | SS Socket Head Screw 1/4-20 x 1/2 (2-Plane Fine Air Gap Adjust Assy)        | 4 per Assy |
| 42     | MS010-32S1250S-0   | SS Socket Head Screw #10-32 x 1-1/4 (2-Plane Fine Air Gap Adjust Assy)      | 1 per Assy |
| 43     | WA4050             | SS Flat Washer (2-Plane Fine Air Gap Adjust Assy)                           | 2 per Assy |
| 44     | HW0186             | 3/16" ID Shaft Clamp (2-Plane Fine Air Gap Adjust Assy)                     | 1 per Assy |
| 45     | NU2050             | Nut 1/4-20 Hex SS (2-Plane Fine Air Gap Adjust Assy)                        | 2 per Assy |
| 46     | MS010-32F0375S-0   | 18-8 SS Flat Head Cap Screw #10-32 x 3/8 (2-Plane Fine Air Gap Adjust Assy) | 2 per Assy |
| 47     | MS0101             | Set Screw w/Nylon Tip #10-32 x 3/16                                         | 1 per Assy |

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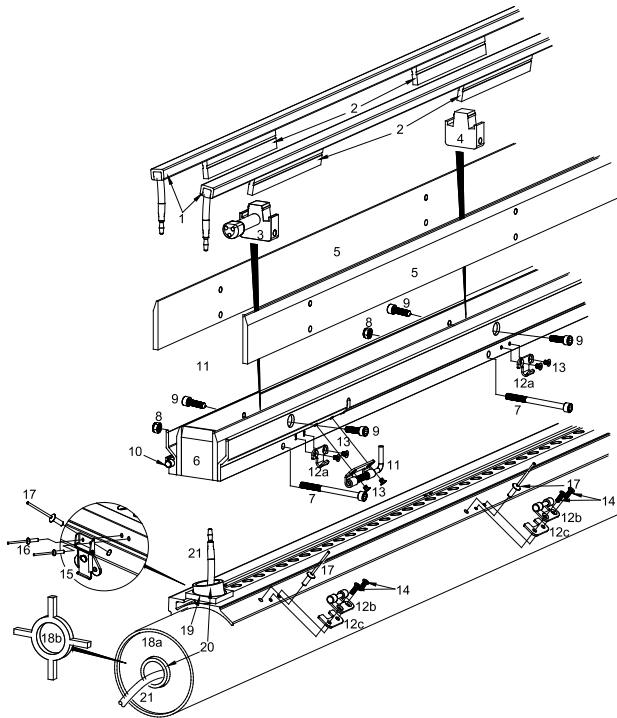
# ASO / ESO Ceramic Electrode Assembly Parts



| Item # | Part #           | Description                                                              | Qty     |
|--------|------------------|--------------------------------------------------------------------------|---------|
| 1      | --               | Electrode (Electrodes will be either V, PV or EV Style only - No Mixing) | 2       |
| 2      | FD4150-01        | Electrode Mounting Tab (Included with Electrode)                         | As Req. |
| 3A     | FD4104-01        | ASO Assembly Electrode Mounting Block                                    | As Req. |
| 3B     | FD4104-06        | ESO Assembly Electrode Mounting Block                                    | As Req. |
| 4A     | --               | ASO Assembly Insulating Shroud                                           | 2       |
| 4B     | --               | ESO Assembly Insulating Shroud                                           | 2       |
| 5      | FD5376-0040      | Insulating Shroud End Piece (One at each end)                            | 2       |
| 6      | MM060-100S075S-0 | M6 Hex. Head. Cap Screw                                                  | As Req. |
| 7      | MS7900           | Electrode Mounting Screw                                                 | As Req. |
| 8      | NU2054           | M6 Locknut w/Nylon Insert                                                | As Req. |
| 9A     | IN7210-03        | Round Insulator for Pyrex Tube                                           | 1       |
| 9B     | IN7140-03        | Star Insulator for Pyrex Tube                                            | 1       |
| 10     | FD4997-xx        | Pyrex Elbow                                                              | 1       |
| 11     | FD5700-01        | Pyrex Elbow Insulator                                                    | 1       |
| 12     | HW7060           | Twist Latch                                                              | As Req. |
| 13     | RV0125-376-500   | Blind Rivet, 1/8, .376-.500 Grip, Closed End                             | As Req. |
| 14     | RV0188-126-250   | Blind Rivet, 3/16, .126-.250 Grip, Closed End                            | As Req. |
| 15     | RV0125-032-062   | Blind Rivet, 1/8, .032-.062 Grip                                         | As Req. |
| 16     | RV0125-126-187   | Blind Rivet, 1/8, .126-.187 Grip, Closed End                             | As Req. |

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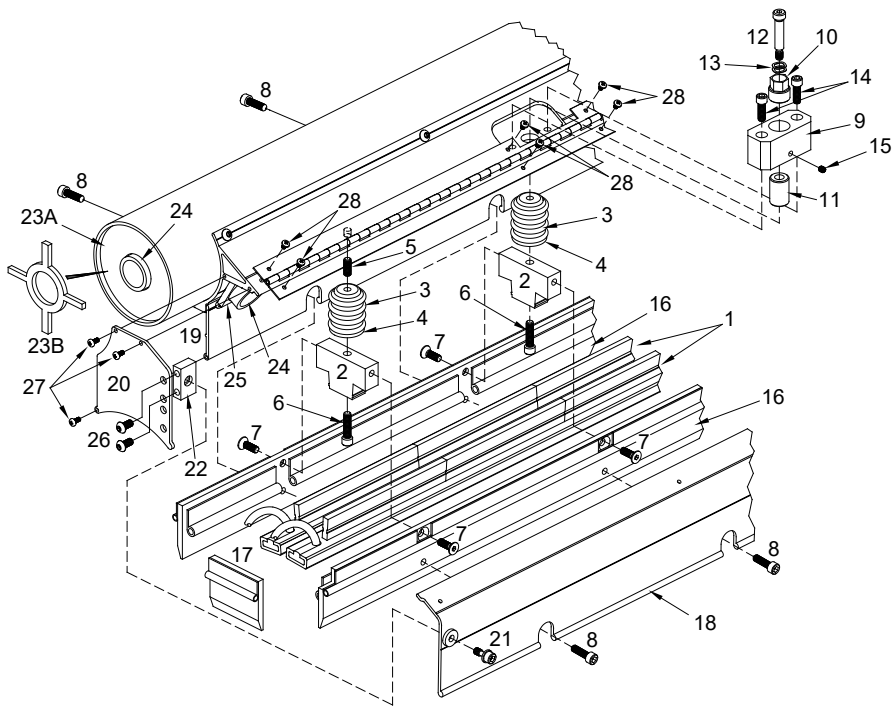
# ASO Quick Disconnect Cartridge Electrode Assembly Parts



| Item # | Part #               | Description                                                      | Qty.    |
|--------|----------------------|------------------------------------------------------------------|---------|
| 1      | LM6164-xxxx          | Electrode                                                        | 2       |
| 2      | FD4150-01            | Electrode Mounting Tab (Included with Electrode)                 | As Req. |
| 3      | LM6166-003           | 3 Port Banana Jack Receiver                                      | 1       |
| 4      | FD4104-14            | Electrode Mounting Block                                         | As Req. |
| 5      | FD4151-01-xxxx       | Insulating Shroud                                                | 2       |
| 6      | FD5376-0040          | Insulating Shroud End Piece (One at each end of assembly)        | 2       |
| 7      | MM060-100S075S-0     | Stainless Steel Socket Head Screw M6 x 1.0P x 75                 | As Req. |
| 8      | NU2054               | M6 Locknut w/Nylon Insert                                        | As Req. |
| 9      | MS7900               | Electrode Mounting Screw                                         | As Req. |
| 10     | SE7115               | Magnetic Sensor Target                                           | 1       |
| 11     | HW0418               | Pull Release Quick Disconnect Hinge                              | 2       |
| 12a    | HW0416               | Lift Off Hinge, Clip Half                                        | As Req. |
| 12b    | HW0415               | Lift Off Hinge, Pin Half                                         | As Req. |
| 12c    | HW0417               | Shim, Hinge Pin Half                                             | As Req. |
| 13     | MM040-070F005S-0     | Stainless Steel Flat Head Screw M4 x 0.7P x 5                    | As Req. |
| 14     | MM040-070P012S-0     | Stainless Steel Pan Head Screw M4 x 0.7P x 12                    | As Req. |
| 15     | HW7060               | Twist Latch                                                      | As Req. |
| 16     | RV0125-376-500-SS-02 | Stainless Steel Blind Rivet, 1/8", .376-.500 Grip                | As Req. |
| 17     | RV0188-126-250-SS    | Stainless Steel Blind Rivet, 3/16", .126-.250 Grip, Closed End   | As Req. |
| 18a    | IN7210-07            | Round Insulator for Pyrex Tube                                   | 1       |
| 18b    | IN7140-03            | Star Insulator for Pyrex Tube                                    | 1       |
| 19     | FD5700-01            | Pyrex Elbow Insulator                                            | 1       |
| 20     | FD4997-xx            | Pyrex Elbow                                                      | 1       |
| 21     | LM6167-002           | High Voltage Wire w/Banana Plug (Lengths Vary)                   | 1       |
| 22     | LM6163-xxxxx         | Quick Disconnect Cartridge (Fully Assembled Cartridge Not Shown) | - -     |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# ESO E<sup>2</sup> Ceramic Electrode Assembly Parts



| Item # | Part #           | Description                                        | Qty.    |
|--------|------------------|----------------------------------------------------|---------|
| 1      | LM5405-xx        | E <sup>2</sup> Electrode                           | 2       |
| 2      | FD4105-06        | Electrode Mounting Block                           | As Req. |
| 3      | IN0012-02        | Glazed Alumina Post                                | As Req. |
| 4      | FD5255-11        | Electrode Mounting Spacer                          | As Req. |
| 5      | FD1127-63        | Threaded Rod, Brass                                | As Req. |
| 6      | MS025-20S0875S-0 | SS Socket Head Cap Screw 1/4-20 x 7/8              | As Req. |
| 7      | MM060-100F018S-0 | SS Flat Socket Head Cap Screw M6 x 1P              | As Req. |
| 8      | MS0079           | Electrode Mounting Screw                           | As Req. |
| 9      | FD5658-01        | Fine Adjustment Mount Block                        | As Req. |
| 10     | FD5658-02        | Fine Adjustment Screw                              | As Req. |
| 11     | FD5658-03        | Fine Adjustment Spacer                             | As Req. |
| 12     | MS0099           | SS Socket Head Shoulder Bolt 1/4-20 x 5/16 x 1-1/4 | As Req. |
| 13     | WA0027           | Wave Washer                                        | As Req. |
| 14     | MS025-20S0750S-0 | SS Socket Head Screw 1/4-20 x 3/4                  | As Req. |
| 15     | MS0101           | SS Set Screw Flat Point Nylon Tip 10-32 x 3/16     | As Req. |
| 16     | FD5376-xx        | Insulating Shroud                                  | 2       |
| 17     | FD5376-xx        | Insulating Shroud End                              | 2       |
| 18     | AL7146-02-xx     | Alum Shroud Offset Leg, Long                       | 1       |
| 19     | AL7146-03-xx     | Alum Shroud Offset Leg, Short                      | 1       |
| 20     | FD5212-06        | Side Plate Offset Shroud                           | 2       |
| 21     | FD5263-03        | Shroud Clamp Block                                 | 2       |
| 22     | HW7207           | Captive Panel Screw Assy                           | 2       |
| 23A    | IN7210-xx        | Round Insulator Pyrex Elbow                        | 2       |
| 23B    | IN7140-xx        | Star Insulator Pyrex Elbow                         | 1       |
| 24     | FD4997-xx        | Pyrex Elbow                                        | 1       |
| 25     | FD5700-01        | Insulator For Pyrex Elbow                          | 1       |
| 26     | MM060-100B012S-0 | SS Button Head Screw M6 x 1.0P x 12                | 4       |
| 27     | MM035-060P008S-0 | SS Pan Head Screw M3.5 x 0.6P x 8                  | 6       |
| 28     | MM035-060P005S-0 | SS Pan Head Screw M3.5 x 0.6P x 5                  | As Req. |

**NOTE:** To insure the correct parts are supplied please have the model and serial number of the system available.

# Enercon Global Manufacturing Operations



**Enercon Industries Corporation United States**



**Enercon Industries Ltd.  
United Kingdom**



**Enercon Asia Pacific  
India**

## Major Enercon Operating Centers

### USA

**Enercon Industries Corporation**  
N120 W19349 Freistadt Rd.  
Germantown, WI 53022  
tel + 1 262 255 6070

### EUROPE

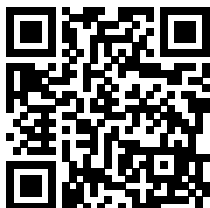
**Enercon Industries, Ltd./UK**  
64 Edison Road  
Aylesbury  
BUCKINGHAMSHIRE  
HP19 8UX  
tel + 44 1296 330542  
info@enerconind.co.uk

### INDIA

**Enercon Asia Pacific**  
#23/10, Elluvapalli, Nallur (P.O),  
Bagalur Road - Hosur - Pin 635103  
tel +91 9629 000358  
info@enerconasiapacific.com

### CHINA

**Enercon/Wealthy Printing**  
tel + 86 22 345 0710



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N120 W19349 Freistadt Rd.,  
Germantown, WI 53022

+1 (262) 255-6070

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