## MACHINE INSTALLATION ELECTRICAL GUIDE.

### Introduction

Proper installation will achieve the best results from the production capability of the machine. This can only be accomplished if several important steps are implemented and some precautions are taken. Local codes may suggest different requirements but those given in this section must be satisfied as much as possible.

### Safety

Human safety and equipment safety must be the first considerations when performing the installation procedures.

### Electrical Installation

Safety is the number one concern when performing the electrical connection of equipment; therefore, check every step at least once after it has been taken.

During the installation it is important to minimize the possibility of electrical noise entering critical sensitive circuits. This is best accomplished by following the electrical installation procedures precisely. Considerable attention has been given to noise immunity in the basic design and manufacture of the system. However, it is essential that great care and attention be given during the installation of the machine in your facility.

**NOTE: All motorized driven attachments and accessories for the *Davenport HP* machine require 480 VAC 3 phase power. Any current attachments used within your facility must be capable of 480 VAC to be run on the *Davenport HP* machine. Attempting to run any attachment not wired for 480 VAC could cause serious injury and/or fire. Davenport recommends special attachments be labeled with proper voltage on the attachment and plug/cord. This applies to all motor driven attachments, Rotomist/mist collector, and customer supplied accessories.**

### Power Line Specifications

In order for the ***Davenport HP*** machine to perform properly, it must be supplied with the proper electrical grounding.

A separate earth ground should always be used to ground the ***Davenport HP*** machine. It may consist of a driven rod, driven pipe, buried plate or any other device approved for this purpose. Grounding of this equipment, (ground terminal located in the power distribution panel), is required for two (2) reasons.

1. Prevent hazards to personnel in case of a breakdown between current electrical components and the exposed metal surfaces.

2. To minimize the effects of electrical noise on the control system.

For further information on the grounding system, refer to the section titled, "Power Line Noise Interference".

**Main Electrical Enclosure**

The main electrical enclosure is floor mounted on the right side when viewed from the rear of the machine. Care should be taken when routing electrical power to the enclosure, as not to interfere with the proper movement of the pendant arm. Bring the electrical power line into the cabinet, and connect the lead wires to the terminals of the Main Disconnect Switch. Be sure to refer to the electrical diagrams sent with the machine before making this connection. These diagrams include the electrical supply requirements and other pertinent electrical information. Also, make the connection to the ground terminal as shown.

**CAUTION**

*Only a qualified electrician should be allowed to open and work inside the electrical enclosure.*
*The machine should never be run unless the electrical enclosure door is closed and locked.*
*The electronics inside the main electrical enclosure are sensitive to chips and filings.*
*During the installation of the main power feeder, great care must be given to make sure no metal chips or filings fall onto or into the electrical devices.*

**Typical Causes of Noise Interference**

**Note: Refer to section titled, "Power Line Noise Interference", for additional information on this subject.**

1. The earth cable between the control cabinet and the earth rod may be too small. It must present a very low impedance and be capable of passing all of the current generated as noise from any source. It also serves as a safety means to unload all circulating currents that could cause the control cabinet or the machine to become voltage elevated, which would be dangerous to humans.

2. Loss of continuity between the earth rod and earth. Copper sulfate should be poured down along side the earth rod periodically, at least every three months. This is to minimize the resistance between the copper clad rod and the earth.

3. Star washers missing or loose between cable lugs and connection points.

4. Loose or missing suppressors across solenoids. These are diodes if the coils are DC and RC networks if the coils are AC.

**Preventative Maintenance for Electrical systems**

A good electrical preventive maintenance tool is to have recorded as many wave forms as possible under normal and abnormal conditions. These can be used for subsequent comparison when something doesn't work properly. These tests should be done after the installation has been completed and at other times, such as at night or weekends when the plant electrical bus is not fully loaded. Usually the bus voltage goes very high or sometimes very low and may become more noisy. A Dranetz line analyzer is an excellent tool for monitoring the power lines for all kinds of noise.

## POWER LINE NOISE INTERFERENCE

### Introduction

This section provides basic information that should help achieve a safe, successful and reliable electrical installation. It does not cover all possibilities but does give good basic information and guidance.

Power lines are one of the most troublesome sources of electrical noise, which can affect the operation of digital electrical computer control systems used on the ***Davenport HP*** machine.

The power lines to which the ***Davenport HP*** machine is connected may also supply power to equipment such as arc welders, high current (induction) furnaces, or large horsepower electric motors. Starting or stopping these large consumers of power or changing the load conditions on them may cause transient voltages, which may take the form of voltage surges or dips accompanied by high frequency noise superimposed on the incoming voltage waveform.

This electrical noise may cause a digital electronic control system to count incorrectly, lose stored data, store incorrect data, or lose axis synchronization.

Power lines in an ungrounded Delta power system are inherently noisy. This system floats with respect to ground and may also cause excessively high voltages to be applied to equipment connected to it. For these reasons, a grounded Wye power system is preferred for supplying power to a computer controlled machine tool.

To minimize the effects of power line noise on computer controlled machine tools, the power wiring is physically and electrically separated from the logic signal wiring. Also, shielded cables are used for logic signal wiring where appropriate, and an effective common point ground system is provided. Even though these precautions have been taken, power line noise may still be coupled into the logic in extreme cases and cause the control to malfunction as described above.

### Solutions

To eliminate control malfunctions which are caused by excessive power line noise, one or more of the following may be necessary.

1. Reduce existing power line noise or install a separate incoming power line to the machine.

2. If the only available power source is an ungrounded Delta type, install a Delta-to-Wye isolation transformer ahead of the control and ground the neutral of the Wye to improve noise rejection and to better regulate the input voltage to the control.

3. Install a motor alternator set ahead of the control to isolate it from the incoming power line.

**How Good Is Your Earth Grounding System?**

The existing factory earth and power systems of the plant, into which the machine is to be installed, should be checked for at least 24 hours before the machine arrives. This should be done as soon as the location is known to give as much time as possible to make any changes that may be required. A good and reliable system that has been used for this purpose for many years is a Dranetz line analyzer. The power line disturbances should not exceed + or - 15% of the machine specification power requirements. This includes all forms of noise, voltage drop out or voltage spikes. While the machine control system can usually tolerate more deviation than this, it is best to maintain these limits to protect people and the machine performance.

**Machine Grounding**

Grounding may be defined as a continuous low impedance metallic connection to a properly designed ground grid located in the earth. Grounding of the Equipment Ground Stud located in the Power Distribution Panel is required for two reasons.

1. To prevent hazards to personnel in case of a breakdown between current carrying electrical components and the exposed metal surfaces.

2. To minimize the effects of electrical noise on the control system.

**Noise Generation**

Electrical noise from any source, whether it is the power line, an electrical arc generated in an adjacent machine, or crosstalk within the control, is transmitted by conduction, inductive or capacitive coupling, or radiation. It is extremely important to maintain the electrical enclosures and panels, conduits, wiring shields, and machine members at zero potential and to provide a return path to the earth for noise currents so as to effectively shield the sensitive logic from electrical noise.

Connecting the Equipment Ground Terminal inside of the Power Distribution Panel to a low impedance, stable, noise free ground provides this protection, and thereby prevents the control from intermittently counting incorrectly, losing stored data, storing incorrect data, or losing axis synchronization.

**Water Pipes May Not work**

Although a utility ground, such as a cold water pipe or the metal frame of a building, is generally an adequate ground for safety purposes, IT IS NOT usually recommended for minimizing the effects of electrical noise.

**Sources of Noise**

Normally, other electrical equipment is connected to water pipe grounds or building steel and, therefore, carries the transient electrical noise currents associated with all of the attached

equipment. These combined electrical noise currents cause a voltage gradient to be developed within the pipe or structural member because of its inherent resistance and reactance. The voltage from the Power Distribution Panels Star Ground Stud to the Earth Ground Rod, is, therefore, a function of the total noise current flowing at any one instant. Because of this, transient ground shift voltage disturbances are set up which may be coupled into the electronics and cause the control to malfunction.

**What Is An Earth Rod?**

A separate earth ground should always be used to ground a computer controlled machine tool. It may consist of a driven rod, driven pipe, buried plate, or any other device approved for this purpose, and should be installed as close as practical to the Ground Stud in the Power Distribution Panel; however, they should be kept out of any oily areas.

**Maintain Continuity**

It is preferred that Earth Rods are located where saltwater can periodically be poured down the side of the rod. If a parallel water pipe is provided, the rod should be located where it can easily be filled.

This type of ground usually provides the low impedance, stable, noise free ground required for minimizing the effects of electrical noise on the control system and will also provide personnel safeguards.

**One Rod One Machine**

At no time should MORE THAN ONE machine be connected to one ground rod.

**Earth Connecting Cable**

The cable connecting the panels' ground point to the earth rod should be continuous, as short as practical, and of at least the size of the conductors used to connect the electrical power to the machine tool.

**Installation of Earth Ground Rod**

The length and diameter of the ground rod is dependent upon the soil in the area of machine site. A good starting point would be to use a ten foot long by 5/8" diameter rod. The actual length and diameter of the earth ground rod should be determined by the length, and hence the diameter, required to reach the water, or moisture table in the subsoil. However, the local grounding conditions should be well known by the plant electrical engineers and local electric company or electrical authority engineers, so we recommend consulting with them. It is best to weld a steel spike or cone to the end of the rod to help it penetrate the soil.

**The Way to Make an Earth System**

One method uses a copper pipe in parallel with the ground rod to facilitate periodic regeneration of the electrical continuity. The end of the pipe should be closed off (flatten like a wedge) also the pipe should have 1/4" holes drilled into one side at 3" intervals to allow the salt water to leach toward the rod.

**CAUTION**
**DO NOT MAKE ANY ELECTRICAL CONNECTION TO THIS PIPE!!!**

**How to Regenerate a Rod**

Regenerating should be done by pouring salt water down the side of the rod or into the tube, if so installed. This should be done approximately two or three times a year depending on soil conditions.

**Required Impedance**

If a good ground of less than 10 ohms with respect to a master round reference cannot be obtained, then multiple rods should be sunk to obtain the desired results. The rods should be approximately 10 feet apart or whatever is required to get a good earth condition.

**Periodic Testing Of the Rod**

To test a ground rod, it is necessary to have a known good ground reference.

A master ground reference is often difficult to obtain. The simplest method is to sink three earth rods in a delta or triangle pattern about 10 feet apart. All three should then be connected to each other in a Y form. The resistance reference should be taken from the point where the three wires meet at the center of the Y.

**Testing Earth Ground Rods**

Periodically all power of all machines connected to the grounding system should be shut off. Then all cables connected to each rod should be disconnected (one at a time) and a measurement of the resistance from the rod to all other rods should be made. The interconnecting (daisy chain) cable should remain connected to all other rods during this test. The impedance from each disconnected rod to the remaining cluster of interconnected rods should be compared and recorded for future reference. If one is found to be high, then salt water should be poured along side it, or into the leach tube; then, after about an hour repeat the test of that rod. If the rod does not recover, a new rod may have to be driven.

## POWER LINE SPECIFICATIONS

In order for the ***Davenport HP*** machine machines to perform their tasks properly, they must be supplied with the proper electrical power, and they must have proper electrical grounding.

Grounding is covered in the section titled “Power Line Noise Interference”.

The power supplied to the machine tools conform to the following specifications:

**Spikes:**
(Measured line to neutral), not to exceed 1000 V
Peak-to-Peak, conditions being:
pulse width, <+1 µs
polarity, + or -

**Impulse:**
200% peak voltage up to 1 ms duration with a rise time of 500 ns to 500 µs.

**Phase Coordination:**
Phases to maintain 120º relationship, ±4º.

**Voltage Between Phases:**
Should be balanced within ±3% of the highest value.

**Frequency:**
Maintain 1± Hz from nominal 50/60 Hz.

**Harmonic Distortion:**
Up to 10% of total RMS sum of the 2nd through 5th harmonics. Up to an additional 2% RMS sum of the 6th through 30th harmonics.

**Radio Frequency Voltages:**
Up to 2% RMS above 10 KHz.

**Voltage:**
Maintain within ±3% IEC of the nominal voltage specified for the machine.

**Average Power:**
The duty cycle of the AC waveform must be 50%, ±5%.

**Power Distribution:**
We recommend fuseable disconnects for power distribution and disconnecting means to the machine from the main power distribution in the facility. Circuit breakers can be used but must meet the interrupt and trip curves equal to or higher than the main disconnect of the machine.

**Fusing:**
Bussman type FRS or equivalent should be used. It is not recommended to use circuit breakers feeding the machine unless they have interrupt capacities and trip curves equal to or higher than the main disconnect of the machine.

**Dropout:**

Sags, or dropouts, must not exceed 1/2 of a half-wave, or 60º, or about 3 ms on a 60 Hz line. Successive interruptions should not occur more often than once per second. If the power at any machine installation site does not conform to these specifications, consideration must be given to providing the machine with a power conditioner. Three types of power conditioners are (1) motor-generator sets, (2) battery-backed Uninterruptible Power Supplies (UPS), and (3) power line conditioners sold by companies such as Oneac.

In areas where local commercial power is often not in conformance with the specification listed above, customers should consider installing an uninterruptible power supply in front of the machine. Most UPS systems will eliminate spikes and dropouts. Some, however, will not protect against surges caused by lightning. Protection should be added ahead of the UPS. If a UPS is used, a contact from the UPS should be wired into the ***Davenport HP*** machine control to signal that the commercial power has failed, and that the machine should initiate an orderly abort sequence in order to protect the machine, the part, and the cutting system.

Davenport can provide a quotation for a power line conditioner and/or UPS equipment for a specific customer's application. The customer should contact their Davenport representative for more specific information. These components are also available from good electrical equipment suppliers.