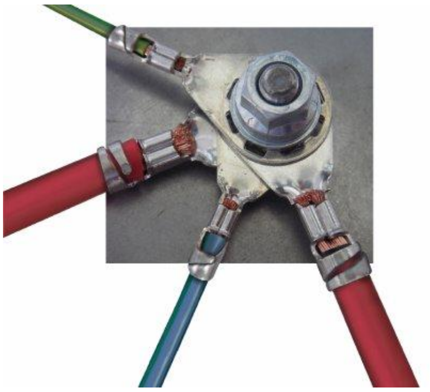
GENERAL INSTALLATION RULES
FOR BURNER CONTROL EQUIPMENTS
SERVICE NOTE 001|10

CONTRIVE S.r.l. I-24040 SUISIO (Bergamo) via Enrico Fermi 18

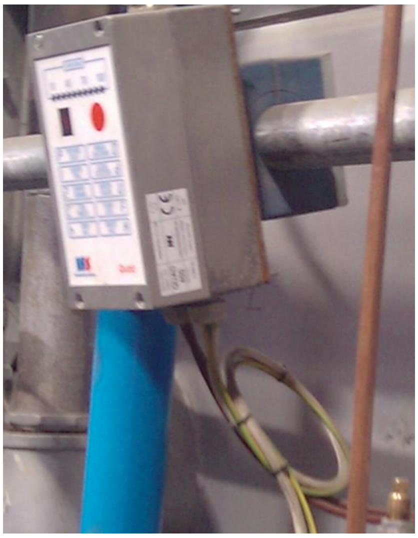
POWER SUPPLY AND GROUNDING

- Any burner control equipment requires a ground system that provides a zero-voltage reference: the voltage measured from Neutral to all unpowered lines should be 0 volts.
- Run the ground wire in the same raceway as the hot and neutral from the main distribution service panel to burner control equipments and insure that all metal parts are connected to ground.
- The power transformer and distribution cables must be sized to handle the inrush currents of the solenoid valves and ignition transformer: the voltage drop at the end of the line in the worst condition must be kept within 15% of nominal voltage.
- Typical 50/60Hz ground system has sufficient low-impedance at nominal frequency to maintain all metal surfaces at the same ground reference. But, this same system could be unable to provide this at higher frequencies because of the increased impedance caused by the SKIN EFFECT. At high frequencies surfaces are working better than solid cables: connect all metal surfaces of the kiln to improve the performance of the ground at high frequencies.
- A common distribution network is better than several independent cables routed to each equipment. The ground wire within multicore cables it's not enough to provide proper grounding.
- All ground wires must be routed to a single ground point (star connection). The same should be made inside the equipment: route all ground wires to the ground screw on the equipment base, then a single ground pigtail should be provided between the ground screw on the equipment base and the equipment terminal board.
- All the equipment must be connected to a single point ground, using different ground connections could present a safety hazard.
- The earth ground wire must be capable of conducting high inrush and short circuit currents: an AWG13/ 2,5mm^2 copper conductor is adequate but AWG11/4mm^2 and wide straps or brackets are preferred.
- The ground path impedance must be less than 1 ohm. For a ground path to be low impedance at RF frequencies, the connection must be made with minimum length conductors having maximum surface areas. Since the ground is the return path for the ignition spark, this rule must be observed for the connection to burners heads (especially when electronic transformers are used).
- All ground connections should be free of non-conducting coatings and protected against rust.
- Utilizing conduit as an exclusive means of providing a ground must be avoided.
- Do not run high voltage ignition transformer wires in the same conduit with other wiring.
- Ensure the frame of the ignition transformer is securely connected to control panel frame and/or the burner frame. It is best to have the equipment, the ignition transformer and the burner on the same metal surface.
- When the ignition transformer is introducing excessive electromagnetic interferences (E/J errors) an additional transient suppressing device and/or filter could be installed from hot and neutral terminals of ignition transformer to ground.
- Periodically, the spark electrode should be inspected for proper gapping and cracked ceramics. Problems at high temperature may arise from electrode bending or ceramic degradation. Electrode cannot be considered reliable flame detector when the temperature is above 1000/1200 °C (1800/2200°F).
- Inspect neatness of wiring in junction boxes and cabinets. It is best to have connections short and direct and also not having wires bunched up and tied off. Also connections should be periodically inspected for tightness and corrosion.
- Care must be taken not to route the control and communication cables in close proximity to any starter motor contactors located in the control panel or across any high voltage ignition wires.
- The use of a small busbar trunking system improves the reliability and simplifies the installation.



Typical single point (star) grounding

Correct equipotential (bonding) link between metal parts



Loops on high voltage cables must be avoided

Poor ground connection to the head of the burner

QUAD DIAGNOSTICS

Some dangerous conditions are detected by Quad diagnostics and reported on the local display by means of specific code, some of these failures could be non resettable.

A properly designed ground system meeting all the safety requirements will ensure that any AC voltage quality problems, such as spikes, surges and impulses have a low impedance path to ground. A low impedance path to ground is required to ensure that large currents involved with any surge voltages, including those produced by ignition transformers, will follow the desired path in preference to alternative paths, where extensive damage may occur to equipment.
A bad ground connection to the equipment or to the head of the burner is reported by Quad diagnostics:

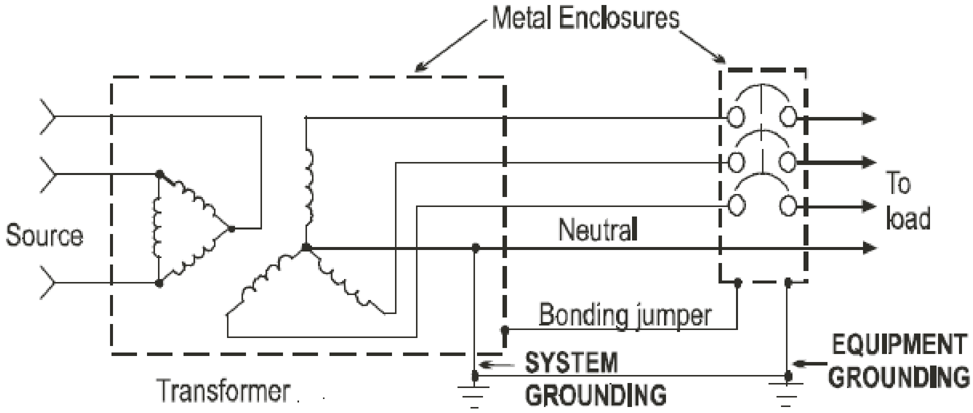
The power transformer and distribution cables must be sized to handle the inrush currents of the solenoid valves and ignition transformer.
When the voltage drop at the end of the line falls below safety limits the Quad diagnostics will report:

What is Grounding?

The term grounding is commonly used in the electrical industry to mean both equipment and system grounding.

EQUIPMEMENT GROUNDING means the connection of a non-current carrying conductive materials such as conduit, cable trays, junction boxes, enclosures and motor frames to earth ground.

SYSTEM GROUNDING means the connection of the neutral points of current carrying conductors such as the neutral point of a circuit, a transformer, rotating machinery, or a system, either solidly or with a current limiting device to earth ground.



The primary function of electrical grounding is to provide safety for equipment and personnel from abnormal electrical conditions. The grounding also provides a path for dissipation of the high-energy electrical discharges caused by lightning and ignition sparks as well as prevents build-up of static charges on equipment and materials.
In addition, the ground establishes an equipotential or zero-voltage (reference) for the electrical system.
A good ground system should be provided to minimize the effects of AC quality problems. A properly designed ground system meeting all the safety requirements will ensure that any AC voltage quality problems, such as spikes, surges and impulses have a low impedance path to ground. A low impedance path to ground is required to ensure that large currents involved with any surge voltages will follow the desired path in preference to alternative paths, where extensive damage may occur to equipment.

The following agencies and organizations all have recommendations and / or standards for grounding, to ensure that personnel safety is being protected. The organizations that provide guidelines/rules for grounding are:

- The International Electrotechnical Commission (IEC)
- European Committee for Electrotechnical Standardization (CENELEC)
- Underwriters Laboratories (UL)
- National Fire Protection Association (NFPA)
- American National Standards Institute (ANSI)
- Mine Safety Health Administration (MSHA)
- Occupational Safety Health Administration (OSHA)
- Telecommunications Industry Standard (TIA)
- and many others.

What is a Grounded System?

Grounded System – a system with at least one conductor or point (usually the middle wire or neutral point of transformer or generator windings) is intentionally grounded, either solidly or through an impedance.

What is the Purpose of System Grounding?

System grounding, or the intentional connection of a phase or neutral conductor to earth, is for the purpose of controlling the voltage to earth, or ground, within predictable limits. It also provides for a flow of current that will allow detection of an unwanted connection between system conductors and ground [a ground fault].
The grounding system serves three primary functions which are listed below.

Personnel Safety

Personnel safety is provided by low impedance grounding and bonding between metallic equipment, chassis, piping, burners and other conductive objects so that currents, due to ignition sparks, faults or lightning, do not result in voltages sufficient to cause a shock hazard. Proper grounding facilitates the operation of the overcurrent protective device protecting the circuit.

Equipment Protection

Equipment protection is provided by low impedance grounding and bonding between electrical services, protective devices, equipment and other conductive objects so that spark currents, faults or lightning currents do not result in hazardous voltages. Also, the proper operation of overcurrent protective devices is frequently dependent upon low impedance fault current paths.

Electrical Noise Reduction

Proper grounding aids in electrical noise reduction and ensures:

1. The impedance between the signal ground points throughout the installation is minimized.
2. The voltage potentials between interconnected equipment are minimized.
3. That the effects of electrical and magnetic field coupling are minimized.

Another function of the grounding system is to provide a reference for circuit conductors to stabilize their voltage to ground during normal operation. The earth itself is not essential to provide a reference function.
Another suitable conductive body may be used instead.

Electrical Shock

In an electrical system, the grounding and bonding system is the primary protection against electrical shock hazards. It provides a low resistance path to ground to protect against electrical faults. The effective ground-fault current path ensures facilitation of overcurrent device operation under ground-fault conditions.
The earth is not to be considered as an effective ground-fault current path. Using proper grounding and bonding techniques, testing and maintaining a good electrical ground and installing protection devices are the best ways to protect people and equipment from electrical shock.

Bonding the Junction Box to the Grounding Conductor

In many wiring circuits, more than one grounding conductor enters an equipment box.
Where more than one grounding conductor enters a box, all such conductors shall be spliced or joined within the box or to the box.
For metal junction boxes, the grounding conductors from each device also needs to be connected to the box with a listed grounding device, or a grounding screw, that is not used for any other purpose.

Maintaining an Effective Grounding Path

A good electrical grounding system involves more than following Code and legal requirements; it must also be an effective grounding system. The path to ground is the system grounded conductor and equipment connection to the earth and serves as a path for stray current. If electricity follows the path of least resistance, then the grounding circuit (path) must have a lower resistance than an individual to protect them.
The rule of thumb for protecting people and equipments is to maintain a ground impedance of less than one ohm. Note the Code has no set value for this resistance other than for the maximum resistance values indicated for rod, pipe, or plate electrodes, which is 25 ohms.

Isolated Grounds and Dedicated Circuits

In some cases, it is easier to isolate sensitive electronic equipment than to re-wire an entire circuit. This can be done by running an isolated ground for the equipment in question, or by running a new dedicated circuit.

An isolated ground protects the equipment from other equipment on the same grounding circuit.

Electronic equipment can create electrical noise on the grounding circuit, which can interfere with the operation of other equipment on the circuit. It is important to note that an isolated ground will not protect equipment from harmonic distortion running through a shared neutral conductor of typical multiwire branch circuits.

In some cases, running a dedicated circuit (individual branch circuit) is necessary to completely isolate a piece of equipment in order to ensure protection.

Conclusion

The hidden dangers associated with branch-circuit wiring are very serious, but fortunately the precautions are straightforward. We can protect ourselves and equipment by using certified devices and testing equipment from reputable manufacturers and by implementing policies on branch-circuit testing. These policies should include verifying proper wiring, testing devices, checking the integrity of the branch circuit, and measuring the integrity of the grounding system.

Installers should always check all devices immediately after installation to verify proper wiring and test devices.

It is generally not the responsibility of the electrical inspector to test installations upon completion.

The installing contractor is generally responsible for this type of testing.

Equipments should be checked to avoid common wiring errors, such as reversed polarity or an open neutral. Checking the voltage level with a voltage tester quickly verifies that the equipments has been correctly wired for either 115 or 230Vac.

Test electrical circuits under load to test the integrity of the branch circuit. The voltage drop test can identify high resistance connections, which can lead to fires, breakdown in insulation, and poor efficiency of the electrical system, which can contribute to erratic equipment operation.

Test the integrity of the grounding system, which includes not only the equipment grounding conductors, but also the ground rod or grounding electrode system. A low-impedance path on both of these systems is essential to protect against electrical shock. The effective ground fault current path ensures that overcurrent devices will operate under ground fault conditions.

In summary branch-circuit testing is an important part of wiring any circuit. It verifies that devices have been wired up correctly and allows you to protect yourself against the hidden defects in an electrical system.