

This American Gas Association fact sheet provides an overview of the requirements for the electrical bonding of fuel gas piping systems to the electrical grounding system based on ANSI Z223.1/NFPA 54, National Fuel Gas Code - 2015 (NFGC). The bonding requirements in previous code editions, in local jurisdictions or in specific situations, may differ.

This fact sheet is not intended to replace knowledge of applicable local and national codes or address specific situations. The user should consult a competent professional and be thoroughly familiar with all applicable local codes, specific manufacturer's installation instructions and the National Electrical Code (NEC®)¹ before attempting to bond any fuel-gas installation.

WHAT IS AN ELECTRICAL BOND

An electrical bond is an intentionally installed electrically conductive and continuous path from the gas piping to the grounding electrode system.

WHY BOND GAS PIPING?

Bonding is provided primarily to prevent a possible electric shock hazard for persons coming into contact with the gas piping and other metal objects that are connected to the grounding system, but which may be energized at a different level of electrical potential. Gas piping can become energized by an electrical fault in the branch circuit of a gas appliance connected to the piping system. Nearby lightning strikes can also result in an unbalanced voltage build-up and a resulting high electrical potential difference. That potential can cause an electrical arc between the gas piping and another nearby metallic system such as the copper water piping or electric wiring or structural steel. The arc may cause damage to certain gas tubing systems.

NFGC REQUIREMENTS²

The NFGC requires bonding to help reduce possible electric shock hazard and potential tubing damage. The specific requirements in the 2015 NFGC are contained in Section 7.13 as follows:

7.13 Electrical Bonding and Grounding.³

7.13.1 Pipe and Tubing other than CSST. Each aboveground portion of a gas piping system other than CSST that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping other than CSST shall be considered to be bonded when it is connected to

appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.

7.13.2 * CSST. CSST gas piping systems and gas piping systems containing one or more segments of CSST, shall be bonded to the electrical service grounding electrode system or where provided, lightning protection grounding electrode system.

7.13.2.1 The bonding jumper shall connect to a metallic pipe, pipe fitting, or CSST fitting.

7.13.2.2 The bonding jumper shall not be smaller than 6 AWG copper wire or equivalent.

7.13.2.3 The length of the jumper between the connection to the gas piping system and the grounding electrode system shall not exceed 75 ft (22 m). Any additional electrodes shall be bonded to the electrical service grounding electrode system or where provided, lightning protection grounding electrode system.

7.13.2.4 Bonding connections shall be in accordance with NFPA 70, *National Electrical Code*®.

7.13.2.5 Devices used for the bonding connection shall be listed for the application in accordance with UL 467, *Grounding and Bonding Equipment*.

7.13.3* Prohibited Use. Gas piping shall not be used as a grounding conductor or electrode.

7.13.4* Lighting Protection System. Where a lightning protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2008.

GAS PIPING BONDING METHODS

The NFGC bonding methods can utilize the appliance grounding conductor (the third or grounding wire) of any connected appliance, or it can be made using a direct bond. A direct bond consists of a listed grounding clamp and separate conductor run from the gas piping to the grounding electrode system. The 2015 NFGC requires a direct bond whenever Corrugated Stainless Steel Tubing (CSST) gas piping is installed.

Appliance Grounding Conductor for Other Than CSST: NFGC section 7.13.1 specifies when and how the bonding of gas piping other than CSST is to be undertaken. When a gas appliance has an electrical connection, that appliance may energize the gas piping system, and a bond is required. The NFGC does not require gas piping other than CSST to be bonded where there are no electrically connected appliances on the system.

The appliance grounding conductor for the circuit that is likely to energize the piping is considered sufficient to meet the bonding requirement for gas piping other than CSST. This type of bond provides an effective, low-impedance, electrically conductive current path to the over-current protective device (typically the circuit breaker), and is designed to protect people from ground faults within the

¹ NEC and National Electrical Code are registered trademarks of the National Fire Protection Association.

² The 2015 Editions of the International Fuel Gas Code contain extracts of the same bonding requirements.

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electrical system. The bonding conductor is sized based on the electrical power requirements of the appliance branch circuit. The NFGC and the appliance manufacturer's instructions require that the appliance's grounding conductor be installed and sized in accordance with the National Electric Code and Table 250.122.

Direct Bonding: NFGC Section 7.13.2 requires all CSST to be directly bonded using a properly sized conductor. A direct bond may also be used for gas piping other than CSST. The conductor is to be connected to the grounding electrode system, options include:

- Electrical service enclosure, or
- Grounded conductor at the electrical service, or
- Grounding electrode conductor, or
- Any installed grounding electrode.

The bond is achieved by attaching a conductor from a segment of rigid gas pipe or CSST fitting to any one of the options listed. The conductor length is limited to a maximum of 75 ft. A clamp listed to UL 467 is required and can be installed anywhere on the gas piping system. For CSST systems, this bond is intended to provide a means to minimize the difference in voltage level between the CSST and other metallic systems in close proximity caused by a line surge or imposed by an indirect lightning strike. NEC® Table 250.66 contains the minimum size for the bonding conductor which may be larger than the NFGC's minimum requirement of 6 AWG. The NEC's specified bonding conductor size should be installed; however, the conductor may not be smaller than a 6 AWG copper wire. NEC® Section 250.70 describes the various methods for making this connection.

The option of bonding to any installed electrode is contingent on the additional electrodes being bonded to the electrical service grounding electrode system or where provided, lightning protection grounding electrode system.

Where a lightning protection system is installed the bonding of gas piping must be in accordance with NFPA 780.

The direct bonding of CSST systems is required regardless of the type of appliances connected and is in addition to the bonding that results from the use of the appliance grounding conductor on electrically powered gas appliances.

OTHER BONDING CONSIDERATIONS

Regardless of the bonding method selected, the gas piping system must be electrically continuous in order to bond an entire piping system from a single point. Metal pipe and tubing joints that are threaded (including those using joint compounds), flanged, welded and brazed are considered to provide an electrically continuous connection and do not require bonding jumpers to maintain this continuity. When appliances are connected to the gas piping system using a flexible metal gas appliance connector, the connector has been found to provide an adequate electrical connection between the appliance and the gas piping, and are considered sufficient to meet the NEC® requirements for bonding

connectivity. Additionally, the dielectric isolation fitting between the underground utility service line and the above ground customer-owned piping must not be bypassed with a bonding jumper. The isolation fitting is necessitated by the NFGC/NEC® requirement that prohibits using the underground metallic gas piping as a grounding electrode, and also prevents stray currents from energizing the piping in the premise.

Under no circumstances is any underground metallic gas service (utility) piping to be used as a grounding electrode because grounding electrodes are intended to carry large currents. This can expose the piping to the possibility of sparking that can create a hazardous condition if the service piping is undergoing any type of maintenance.

NEC® REQUIREMENTS

The NFPA 70, National Electrical Code requires all above ground metallic piping (water, gas, electrical conduits, etc.) be bonded. Article 250 in the NEC® contains extensive coverage for the grounding and bonding of electrical and other metallic systems. The specific types of grounding electrodes and acceptable methods of bonding gas piping systems to them are found in Sections 250.52, 250.70 and 250.104(B). The NEC® requires that all separate grounding electrode systems (including lightning protection systems) be bonded together to establish an equal potential state between these systems.

NEC® Section 250.104 (B) requires that any metal piping including gas piping that is likely to become energized be bonded to the grounding electrode system. The NEC® also states that bonding of metallic systems, as a general practice, will provide additional safety.

DEFINITIONS

The following terms and definitions are commonly used to describe technical requirements:

Bonded (Bonding): Connected to establish electrical continuity and conductivity.

Bonding Jumper: A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected.

Grounded (Grounding): Connected (connecting) to ground or to a conductive body that extends the ground connection.

Grounding Electrode Conductor: A conductor used to connect the system grounded conductor or the appliance to a grounding electrode or to a point on the grounding electrode system.

Grounding Electrode System: The NEC® describes the grounding electrode system and its installation in Sections 250.50 to 250.53. Electrodes can be a metal rod/pipe/plate driven into the ground; the metal frame of a building; buried metal water piping; a ground ring of copper wire; or a concrete encased foundation electrode. Buried metal water piping can not be used as the sole grounding electrode, but must be bonded to a second grounding electrode such as a driven rod (250.53).