Objectives

- Describe why the cable should be bonded
- Describe bonding and grounding procedures
- Define Bonding and Grounding
- Explain Safety Benefits and intent of bonding and grounding a cable drop system.
Ground Versus Bond

Ground:

- “a conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.”
  NEC Article 100

- Grounding is the establishment of an effective electrical ground to earth.
- Accomplished by connecting wires and hardware to an appropriate ground
- In most cases, this ground is accomplished by driving an 8 foot copper or copper/steel rod (grounding electrode) into the earth—Usually placed by power utility company
Ground Versus Bond

- **Bonding:** “the permanent joining of metallic parts to form an electrically conductive path, that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.” NEC, Article 100

- In the drop system, installers will usually bond the drop. Very rarely do they ground a drop.

- Bonding is the way all conductive cables and equipment are continuously connected.
Once the utility power ground rod is properly placed, all connections to it are considered bonded to a common ground.

However, it is not necessary to bond strictly to the ground rod—it can be done to any portion of an electrical system that is already properly bonded to an effective ground.

In the situation below, the metal conduits are grounded because they connect to the metal cabinet which is connected to the power grounding conductor which is bonded to the ground rod.
Electrical Code Requirements

- The NEC is recommended practices, but not actual law
- Communities must adopt—and then it is enforceable by law
Safety Benefits

- Grounding provides a termination point for currents that might be present, or in the event that metallic surfaces are inadvertently energized.
  
  - Metallic surfaces include:
    - Faulty equipment-TVs, Set top terminals,
    - Direct contact with high voltage wires and equipment
    - Induced voltages from high voltage in close proximity, static and lightning
    - Any electrical device can become faulty and produce electrical voltages
Safety Benefits

- Bonding equalizes and limits the differences in potential between conductors.
  - Electrons take the path of least resistance.
  - If an individual simultaneously touches two separate wiring systems (power, cable or telephone) that have different ground potentials---Unwanted current will flow though that individual to the second system.
  - The individual becomes the conducting path---potential deadly.
  - For this reason separate wiring systems in a house are bonded to a common ground.

Broadband, power and telephone bonded to same ground
Difference of Potential
Safety Benefits

- Primary reason for bonding and grounding is to protect human life
  - Technician as well as home owner
- Secondary reason is protection of equipment
  - Electronic Equipment can be damaged
  - Shorted electrical circuits and electrical fires can result from improper bonding and grounding
Bonding Location

- Choose where to bond the security box for the bonding block or bonded splitter:

- Considerations:
  - Proximity of the premises power ground or utility cabinets
  - Available authorized bonding hardware
  - Cable TV outlet locations
  - Customer preferences
Locating Security Box
As close to power as possible
Approved Bonding Hardware

A. Meter Pan Bonding Connector
B. Bonding strap
C. Bonding Connector
D. Water Pipe Bonding Clamp
E. Ground Rod Clamp
F. Meter Pan Bonding Connector
G. Vise-Type Clamp
H. Split Bolt Clamp
I. Ground Rod Clamp
Examining Bonding Options

Bonding the broadband drop to the Utility Power Grounding Conductor

To grounding rod

Examples of hardware for bonding to grounding conductor
Bonding to Utility Ground Rod

**A**
- Drop System Bonding Wire to Bonding Block
- Utility Power Ground Rod Clamp
- No. 6 Copper Power Grounding Conductor
- Separate Ground Rod Clamp for Drop Bond

**B**
- Ground Rod Clamp that installs over end of ground rod
- Two-Piece Ground Clamp that installs directly to ground rod

**Bonding to utility grounding electrode (rod)**

**Examples of clamps for bonding to ground rod**
Bonding to Electrical Meter Cabinet

- Utility Power Mast
- Drop System Bonding Wire to Bonding Block
- Wire Attachment Screw
- Meter Pan Lip
- Clamp Attaching Screws
- Meter Pan Bonding Connector
Bonding to Electrical Meter Cabinet

- Bonding to electric meter cabinet using panel lid bonding connector
Bonding to Electrical Meter Cabinet

Bonding to electric cabinet with meter box bar clamp
Unacceptable Bonding practices

- Natural Gas piping systems
- Telephone grounding rod, clamp, wire or equipment
- Outdated cable TV ground rod
- Sharing the power company’s grounding clamp
- Outdated cable TV ground rod, usually ½ inch in diameter and 3 feet in length.
What’s wrong with this picture?
Good Ground?
Green Tax says: “DO NOT REMOVE GROUNDING WIRE CALL CABLE TV”
Grounds can be:

- **Intentional**
  - Of low impedance that has enough current carrying capacity to prevent buildup of voltage.

- **Accidental**
  - Usually referred to as short or short circuit. A path with little or no resistance to ground created between circuit and ground.
  - ESD, example

Intentional Grounds protect equipment, Accidental grounds destroy equipment
Bonding; Equipment Failure

- CATV and electrical wiring systems are frequently hit by
  - high amplitude, short duration currents from power surges, lightning, and downed power poles

- These voltage potentials can destroy equipment.

- If all equipment shares a common ground it can help bleed off these voltages.

- The VCR cable input can be smoked by voltage spikes when grounding is inadequate.
Bonding Customer Premises

- Select Bonding Block/Splitter

F-81 connector mounted to a medal block
Inside Security Box

Bonded wire attached to Bonding Block

Unbonded Splitter for multiple outlets
Inside Security Box

7/16\textsuperscript{th} wrench used to connect input and output cables to splitter
Bonding Wire

NEC Handbook articles 820 & 830 require bonding wire to be:
1. Insulated,
2. Solid copper,
3. Not smaller than No. 14 gauge with current carrying capacity approximately equal to that of the outer conductor of the coaxial drop cable

No. 14 wire is the minimum size required for Series 56 and Series 6 drop cables
For larger coax No. 12 or 10 AWG (American Wire Gauge) will be required to comply with NEC

<table>
<thead>
<tr>
<th>Conductor gauge</th>
<th>Amps at 40°C</th>
<th>Amps at 20°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 14</td>
<td>20.5</td>
<td>27.0</td>
</tr>
<tr>
<td>No. 12</td>
<td>24.6</td>
<td>32.4</td>
</tr>
<tr>
<td>No. 10</td>
<td>32.8</td>
<td>43.2</td>
</tr>
<tr>
<td>No. 08</td>
<td>49.2</td>
<td>64.8</td>
</tr>
<tr>
<td>No. 06</td>
<td>65.6</td>
<td>86.4</td>
</tr>
</tbody>
</table>

Select bonding wire with current carrying capacity approximately equal to that of drop cable needed (per NEC Handbook)
Coaxial Cable Current Carrying Capacities

The size of the drop wire and its current carrying capacity are directly related.

The current carrying capacity of the drop cable must directly correlate to the bonding wire capacity.

Note that Series 11 quad-shield cable can carry current from 35-42 amps. To properly bond this cable, No 10 wire is required.

<table>
<thead>
<tr>
<th>Cable</th>
<th>Amps at 40°C</th>
<th>Amps at 20°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series 6 90% braid</td>
<td>25.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Series 6 trishield 60%</td>
<td>18.5</td>
<td>22.5</td>
</tr>
<tr>
<td>Series 6 quadshield 60%/42%</td>
<td>26.0</td>
<td>31.0</td>
</tr>
<tr>
<td>Series 11 60% braid</td>
<td>27.0</td>
<td>32.5</td>
</tr>
<tr>
<td>Series 11 quadshield 50%/40%</td>
<td>35.0</td>
<td>42.5</td>
</tr>
<tr>
<td>Series 59 95% braid</td>
<td>23.5</td>
<td>28.5</td>
</tr>
<tr>
<td>Series 59 trishield 67%</td>
<td>17.5</td>
<td>21.5</td>
</tr>
<tr>
<td>Series 59 quadshield 53%/55%</td>
<td>22.5</td>
<td>27.5</td>
</tr>
</tbody>
</table>
A bonding block or grounding block is pictured here:

- One side connects to the Tap cable
- The other side connects to customer drop
- The hole is for insertion of the bonding wire
- This device is usually attached to the outside of the house
- F-81 connector with attachment for ground.
Bonding Wire

- Attach the bonding wire to the drop cable by the use of a bonding block or splitter.

- Insulated with rubber or other insulation and made of copper or other corrosion-resistant conductive material.

- Identify it with a tag: “This bond is not to be removed.”
Bonding Wire (cont)

- Keep it as short and straight as practical.
- Be sure it is at least #14 wire (#12 wire when bonding to the frame of a mobile home) and has a current-carrying capacity equal to or greater that that of the outer conductor of the coaxial cable.

Wire gauge table

http://www.reade.com/Conversion/wire_gauge.html
Bonding Options

- Check with your supervisor (or company policy) for the bonding specifications of the system you maintain.

- Bonding Options:
  - Customer’s electrical service grounding electrode or grounding conductor.
  - Metallic conduit on the load side of the power meter.
  - Metallic conduit between and weather head and meter pan.
  - Electrically conductive cold water pipe.
  - 5/8 inch, 8 foot ground rod made of copper-clad or galvanized steel.

Details pg 9.14

http://www.lipower.org/residential/safety/powersupply.html
House Electrical

A - Service Drop
B - Weatherhead
C - Service Mast / Conduit
D - Electric Meter
E - Main Panel
F - 120 Volt Lighting Circuit
G - 120 Volt Outlet Circuit
H - 240 Volt Oven Circuit
I - 120 Volt Outlet Circuit
J - Sub-Panel
K - "GFCI" Protected Outlet
L - 240 Volt Water Heater Circuit
Only acceptable if paint and rust are removed from Metallic Conduit. Many power companies are now using plastic conduit which is unacceptable for bonding.
Not all cable companies will allow this type of bond.
Should be zero volts and less than 25 ohms of resistance.

If a water faucet is to be used as a ground, it should be verified with a VOM. There should be no voltage and a max of 25 ohms of resistance. Notice the spool of wire since the faucet and power meter panel are likely far apart. This will rule out the use of PVC in the water system.
Professional Preferences

- Always choose to run a large quantity of coaxial cable around the house instead of a large quantity of bonding wire.

- When two or more buildings have a common service but each one has its own building electrode system, bond each building independently.

- When only one power branch circuit is supplied and the power service is grounded at the main building (for example a house and a garage), a separate bond at each building is not needed.
Conclusion

- Bonding and grounding is often the final step in the exterior work of an install, but one you have to plan for at the beginning of each install.

- To do it well, you need to follow procedures, use accepted practices, and be sure your workmanship is excellent.
Links

- Wire gauge table
- Grounding Electrode
- Documenting Cable Wiring Violations
  - Kramer.Firm's Cable Television System Photos – Home