

GROUNDING AND BONDING

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INTRODUCTION

Colorado River Agency Electrical Services recognizes the value of the Industry Uniform Grounding and Bonding requirements. We are pleased to share the following illustrations and data applicable to the requirements.

This information will provide assistance and guidance to person's installing Service Entrance equipment in areas served by CRA-ES with no municipal or county electrical inspection authority.

The methods of Grounding and Bonding of Service Entrance equipment shown in this manual are recommended by CRA-ES to maintain consistency throughout CRA-ES's service territory.

The following drawings and tables will assist in assuring a safe and adequate grounding installation, acceptable under any code.

If the area you are building in has a county or municipal inspection authority, please contact that authority for their regulations.

700.1 GENERAL INFORMATION

1. **Customer wire shall not be run through utility sealed areas. This includes ground electrode conductors as well as any avoidable bond conductors.**
2. **Weatherproof hubs, jam nuts, etc.,** shall be used on any penetrations of equipment at the same height or above energized areas. A good rule of thumb is; that unless the penetration is on the bottom surface of a can, it shall be done with a weatherproof connection. Indoor equipment is an exception to this requirement.
3. **Self-bonding hubs (Meyers or equivalent) shall not be used on multi-centric knockouts, unless the largest knockout is used.**
4. Interior metal water piping systems shall be bonded to the service entrance enclosure with conductors sized to the ampacity of the main bus per NEC. **(See Paragraph 701.0)**
In multiple occupancy buildings where the interior metal water piping system for the individual occupancies is isolated from all other occupancies by the use of non-metallic pipe, each water system may be bonded to the panelboard or switchboard enclosure supplying that occupancy, sized per NEC.
5. Other metal piping systems (E.G. Gas pipe) shall be bonded to the service equipment enclosure with a conductor sized to the largest branch circuit or feeder supplying the facility, sized per NEC **(See Paragraph 701.0)**
6. **Nonconductive paint must be removed at threads, contact points and contact surfaces of any ground/bond lugs, terminal strips, etc., to assure a good electrical connection.**

700.2 GROUNDING

The ground electrode conductor may be either bare or with green insulation. See **Paragraph 701.0** for ground electrode conductor size. Ground electrode conductors not encased in conduit shall be a minimum size of No. 4 copper or larger and must be securely fastened to the building or structure with approved fastening devices. The spacing of such devices shall not exceed 2 feet. If a ground rod is used as an electrode, **at least 8 feet shall be in contact with the soil.**

Ground Electrode conductors smaller than size No. 4 copper shall be solid copper wire, or shall be attached to the ground rod using the exothermic welding process.

700.3 BONDING (Unfused areas)

See **Paragraph 701.0 for bond conductor size.** Bonding is required on all enclosures, equipment, raceways, and fittings which contain unfused service conductors. Nipples and bushings installed with eccentric or concentric lock nuts must be bonded with ground bushings, wedges, or other approved devices. **Bond conductor size shall be determined by the ampere rating of the service entrance equipment.**



MINIMUM SIZE OF BONDING/EQUIPMENT GROUNDING/GROUNDING ELECTRODE CONDUCTORS AND GROUND BUS

TABLE 701.0

MAXIMUM AMPERE RATING	COLUMN 1 LOAD SIDE		COLUMN 2 LINE SIDE		COLUMN 3	
	SIZE OF EQUIPMENT GROUNDING OR BONDING CONDUCTOR MINIMUM (AWG OR MCM) FROM NEC 250.122 SEE NOTE 1		SIZE OF GROUNDING ELECTRODE CONDUCTOR MINIMUM (AWG OR MCM) FROM NEC 250.66 SEE NOTE 2 & 4		SIZE OF MAIN BONDING JUMPER, MINIMUM (AWG OR MCM) FROM NEC 250.66 SEE NOTE 3	
	COPPER	ALUMINUM	COPPER	ALUMINUM	COPPER	ALUMINUM
20	12	10	-	-	-	-
60	10	8	-	-	-	-
90	8	6	-	-	-	-
100	8	6	6	4	6	4
150	6	4	6	4	6	4
200	8	4	4	2	4	2
300	4	2	2	1/0	2	1/0
400	3	1	1/0	3/0	1/0	3/0
500	2	1/0	2/0	4/0	2/0	3/0
600	1	2/0	3/0	4/0	3/0	4/0
800	1/0	3/0	3/0	4/0	3/0	4/0
1000	2/0	4/0	3/0	250	3/0	300
1200	3/0	250	3/0	250	300	400
1600	4/0	350	3/0	250	400	600
2000	250	400	3/0	250	600	700
2500	350	500	3/0	250	700	900
3000	400	600	3/0	250	900	1250
4000	500	800	3/0	250	1250	1500
5000	700	1200	3/0	250	1500	1750
6000	800	1200	3/0	250	1750	2000

NOTES:

1. For sizing bonding conductor for gas line, per NEC. For sizing any bond conductor required on **the load side of fuses or circuit breakers.**
2. For sizing water bonds per NEC.
3. For sizing main bonding jumper from equipment grounding bus to neutral bus, per NEC. For sizing conductor used for bonding unfused nipples and equipment.
4. Grounding electrode conductors need not be larger than #4 (solid or stranded) copper if there is only one connection between the concrete encased electrode or man made electrode (for example – ground rod) & grounded system conductor (neutral conductor), per NEC.

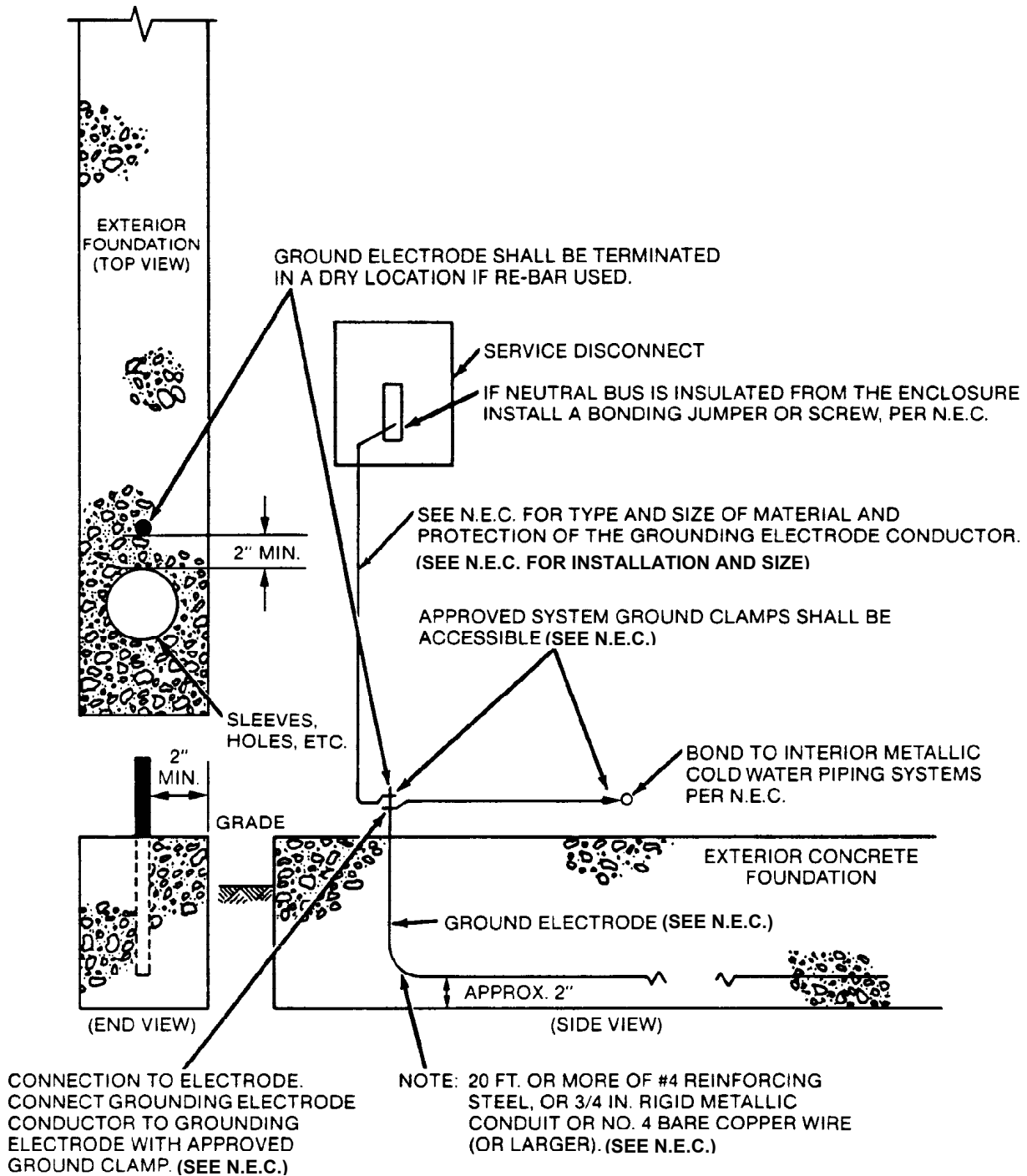
Ground Electrode conductors smaller than size No. 4 copper shall be solid copper wire, or shall be attached to the ground rod using the exothermic welding process.



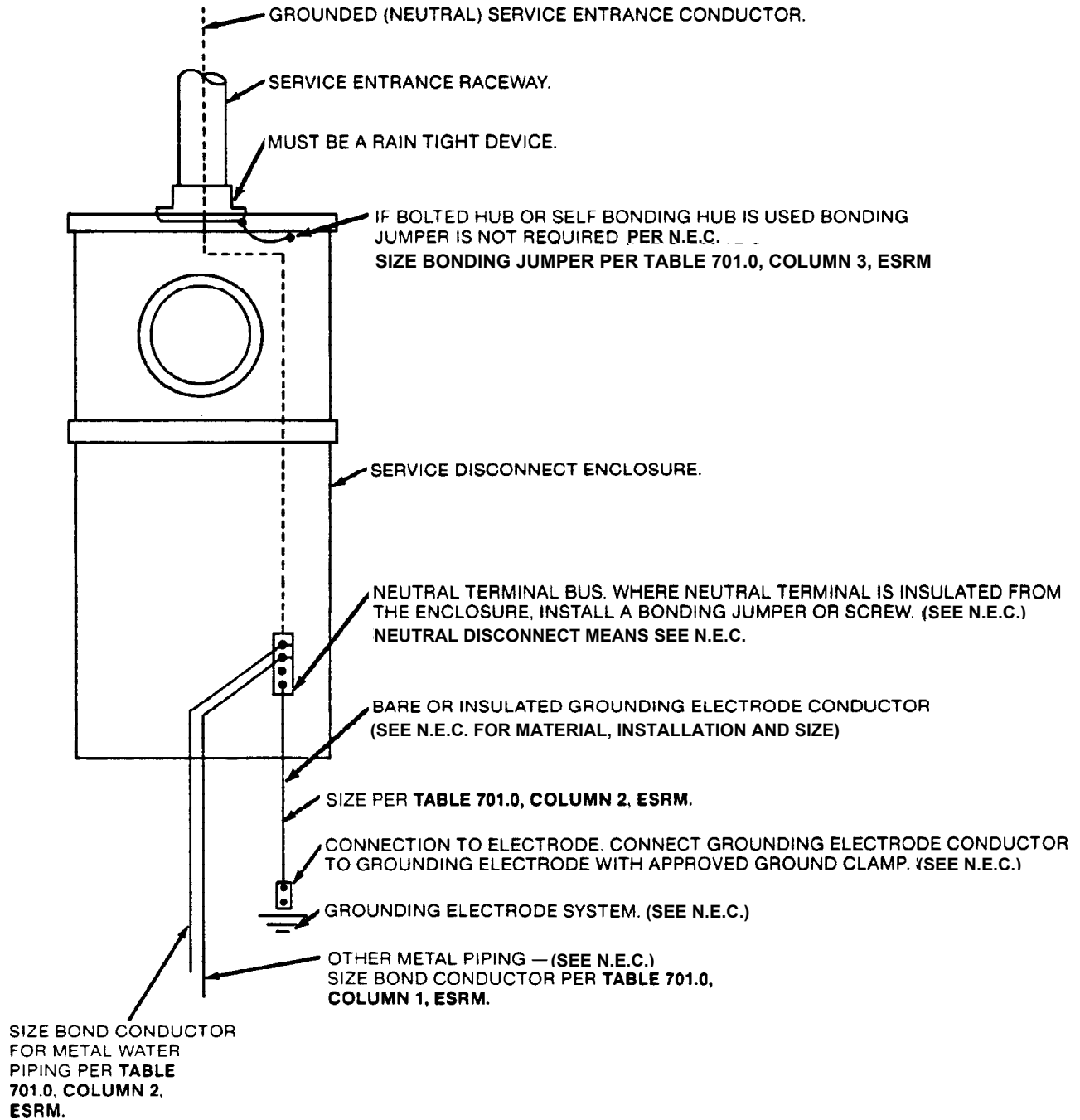
ELECTRIC SERVICE REQUIREMENTS

701.0

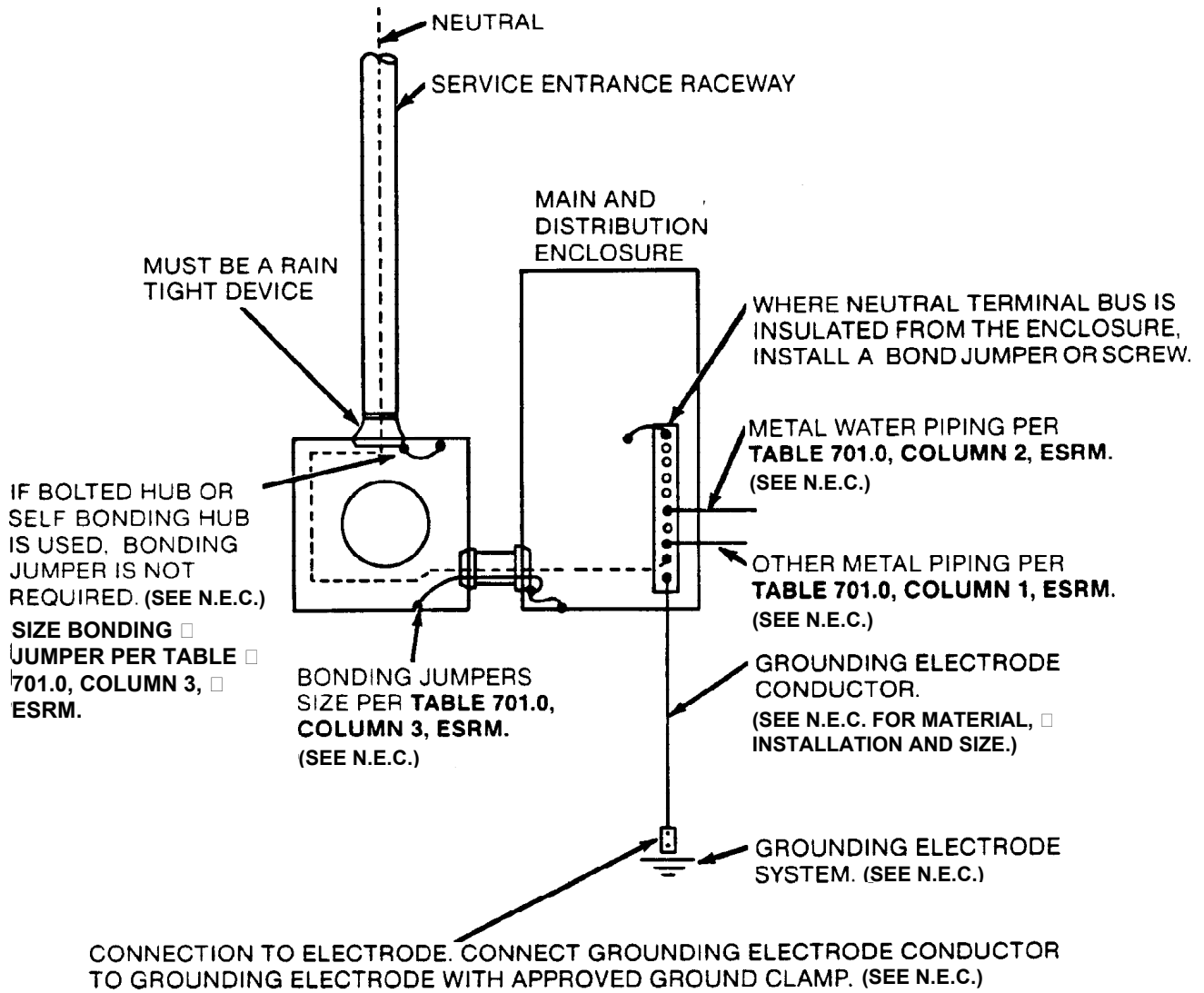
702.0 CONCRETE ENCASED ELECTRODE (UFER GROUND)



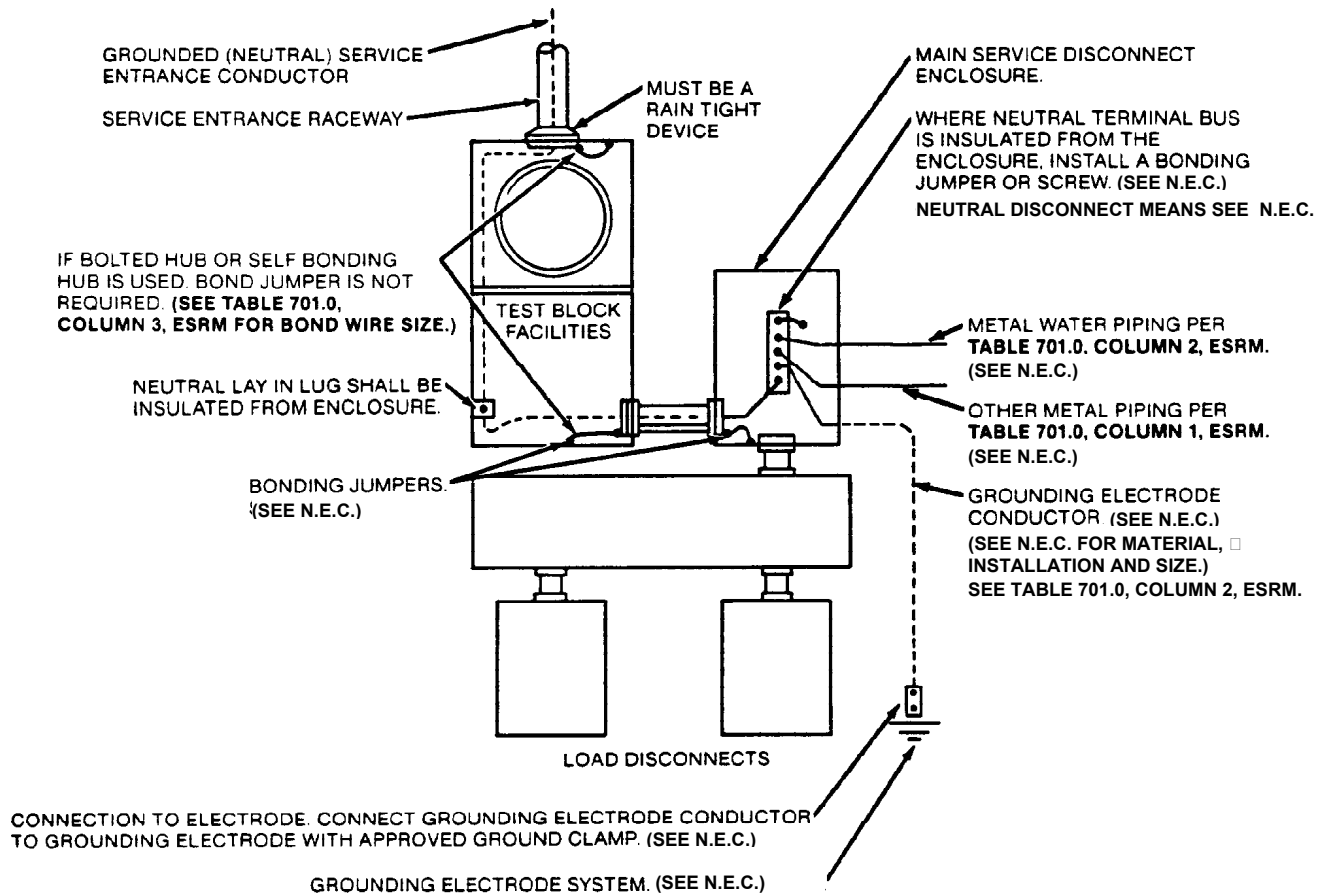
**703.1 TYPICAL RESIDENTIAL OVERHEAD SERVICE—ALL IN ONE (SINGLE FAMILY)
MAX 200 AMP—SINGLE PHASE**



**703.2 TYPICAL RESIDENTIAL OVERHEAD SERVICE—SEPARATE METER AND DISTRIBUTION CAN.
MAX 200 AMP. (SINGLE FAMILY)**

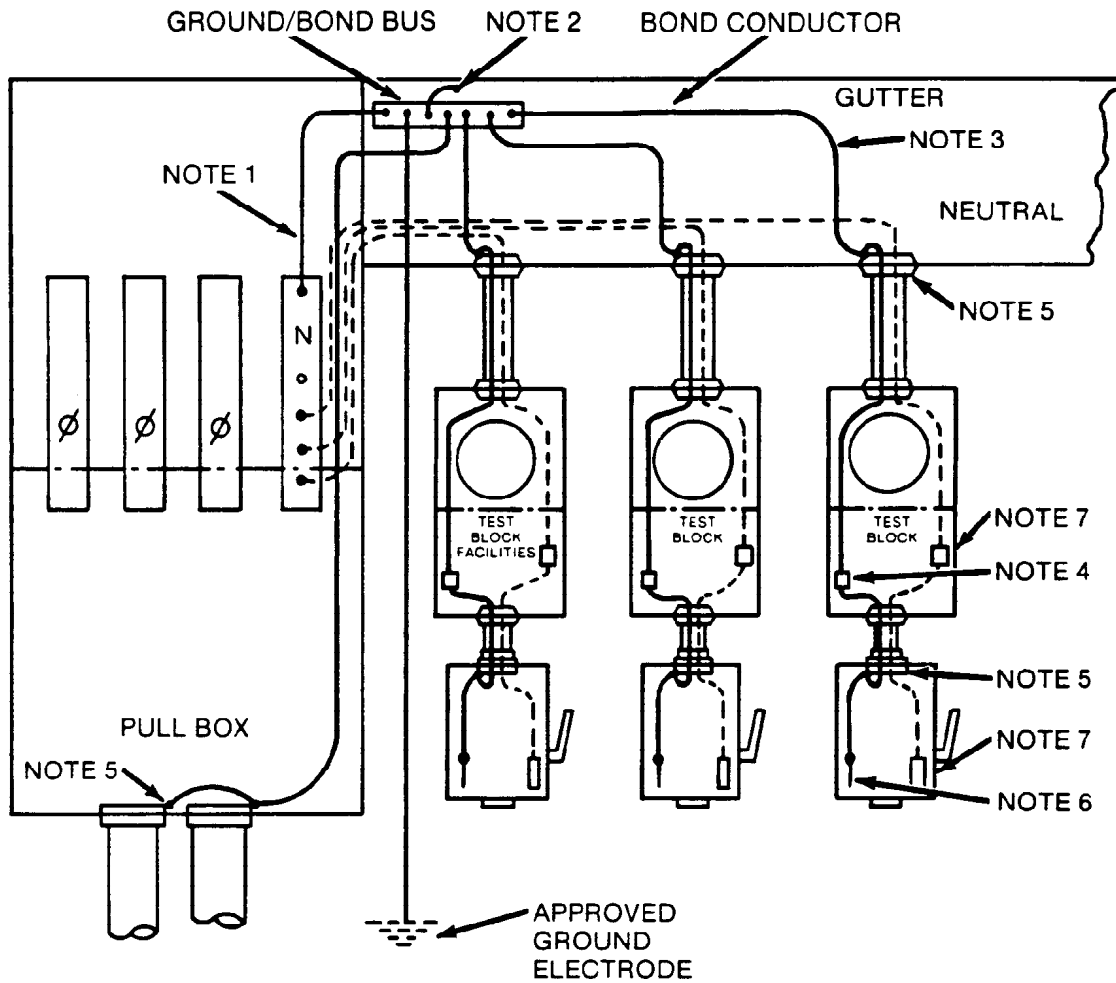


705.1 TYPICAL NON-RESIDENTIAL OVERHEAD SERVICE (SINGLE METER) SINGLE OR THREE PHASE. 200 AMP MINIMUM.



705.2

ILLUSTRATION FOR 400 AMP OR LARGER SERVICE ENTRANCE EQUIPMENT (UNDERGROUND) NON-RESIDENTIAL

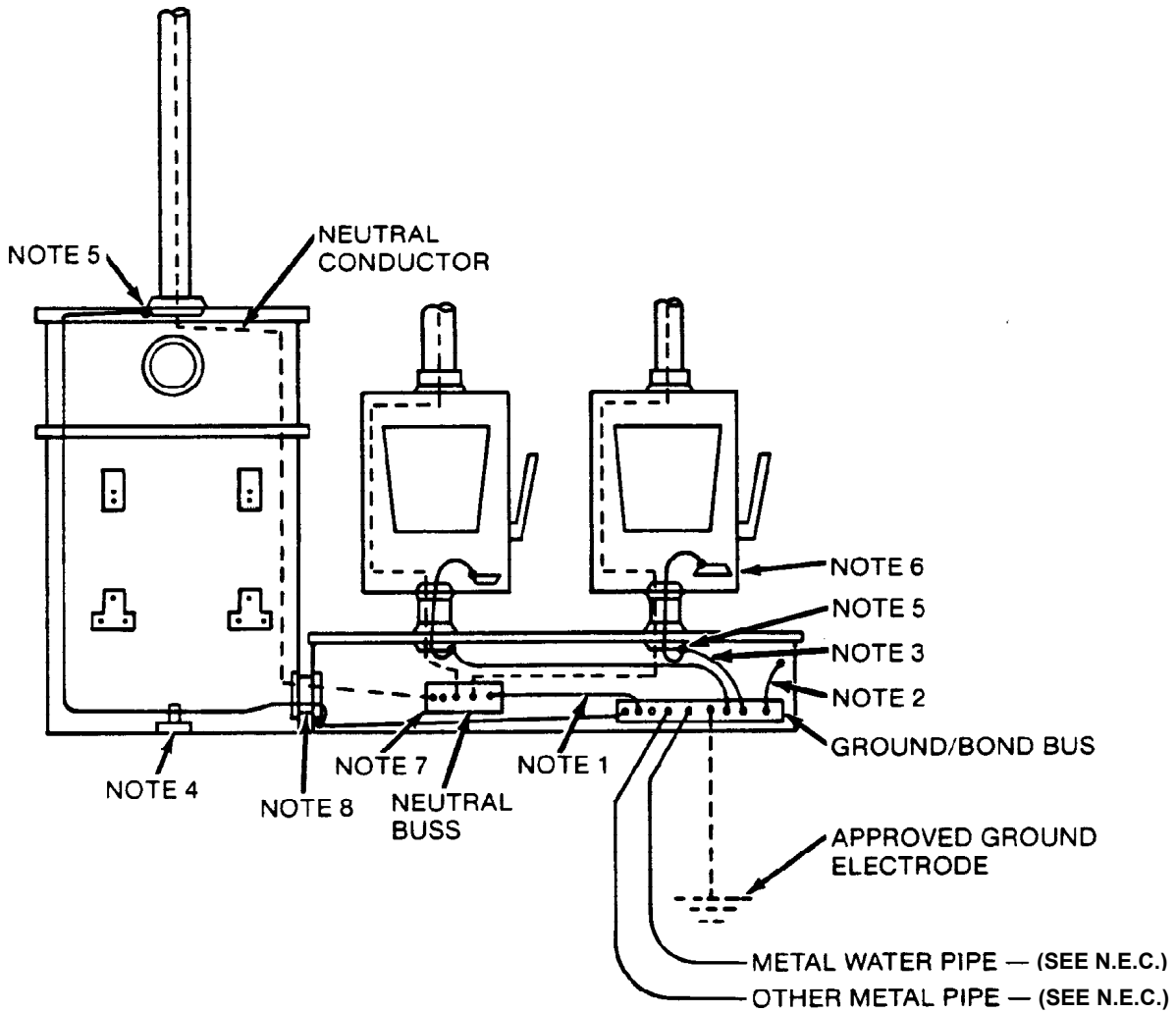


NOTES:

1. Main bonding jumper sized per **Table 701.0 Column 3** (per NEC)
2. Ground bond bus to be tied to metal gutter. Per **Table 701.0 Column 3** (per NEC)
3. Insulated bond conductor sized per NEC. Size per **Table 701.0 Column 3 ESRM**.
4. Insulated bond conductor to be tied to metal enclosure.
5. All unfused nipples to be bonde per NEC. Size per **Table 701.0 Column 3 ESRM**.
6. Bond terminal bar to be tied to metal enclosure.
7. Neutral terminal shall be insulated from metal enclosure.



705.3 ILLUSTRATION FOR 400 AMP OR LARGER SERVICE ENTRANCE EQUIPMENT (OVERHEAD)

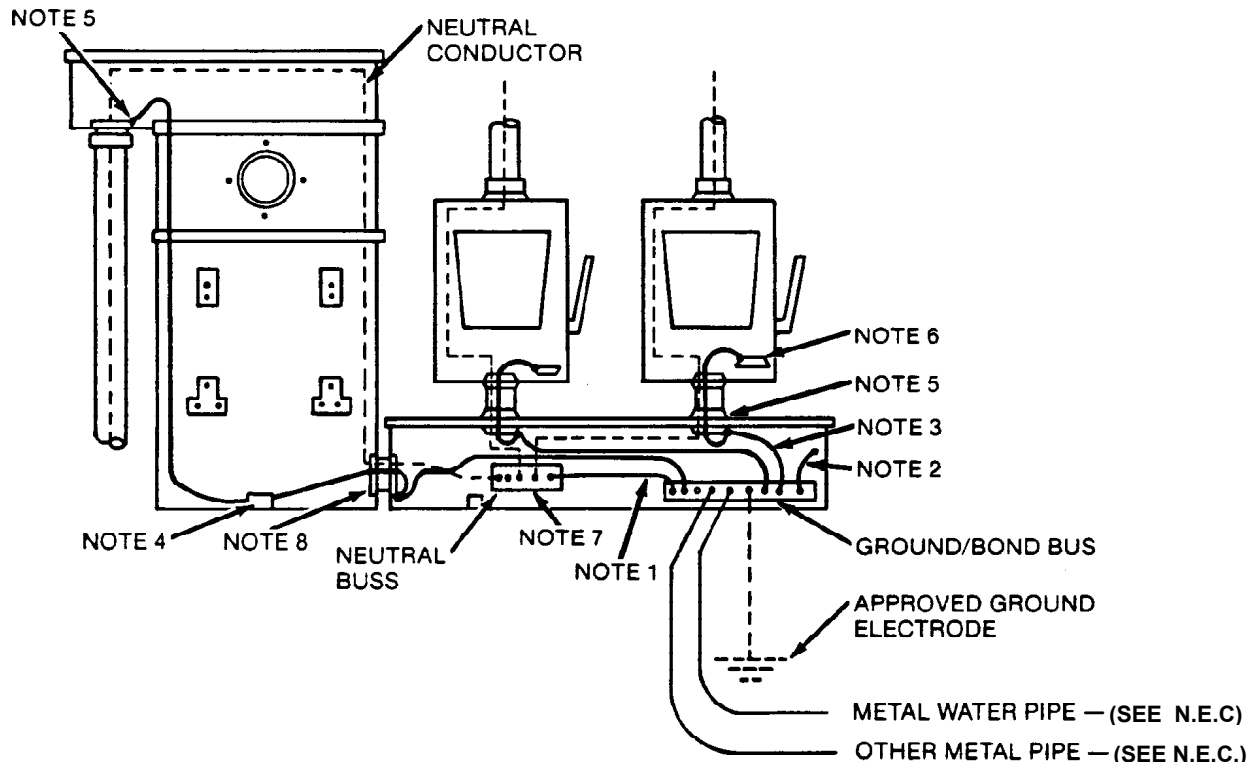


NOTES:

1. Main bonding jumper sized per NEC. Size per **Table 701.0 Column 3, ESRM.**
2. Ground bond bus to be tied to metal gutter.
3. Bond conductor sized per NEC. Size per **Table 701.0 Column 3, ESRM.**
4. Bond conductor to be tied to metal enclosure.
5. All unfused nipples to be bonded. Size per **Table 701.0 Column 3, ESRM.**
6. Bond terminal bar to be tied to metal enclosure.
7. Neutral terminal shall be insulated from metal enclosure.
8. If parallel conductors run from the can into the gutter a bond wire must be installed in each conduit (per NEC). See section 300 page 60 for parallel requirements.



705.4 ILLUSTRATION FOR 400 AMP OR LARGER SERVICE ENTRANCE EQUIPMENT (UNDERGROUND)

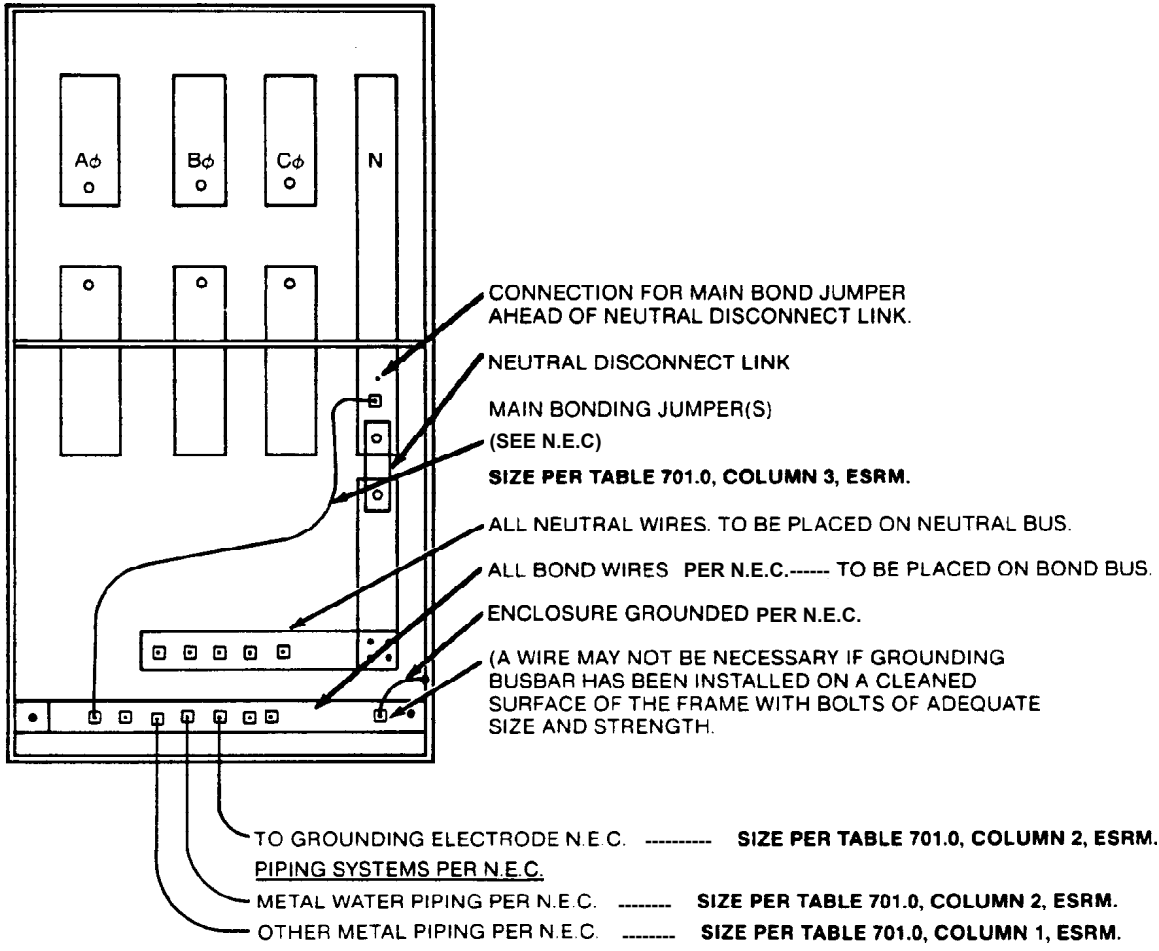


NOTES:

1. Main bonding jumper sized per NEC. Size per **Table 701.0 Column 3, ESRM.**
2. Ground bond bus to be tied to metal gutter.
3. Bond conductor sized per NEC. Size per **Table 701.0 Column 3, ESRM.**
4. Bond conductor to be tied to metal enclosure.
5. All unfused nipples to be bonded. Size per **Table 701.0 Column 3, ESRM.**
6. Bond terminal bar to be tied to metal enclosure.
7. Neutral terminal shall be insulated from metal enclosure.
8. If parallel conductors run from the can into the gutter a bond wire must be installed in each conduit (per NEC). See section 300 page 60 for parallel requirements.

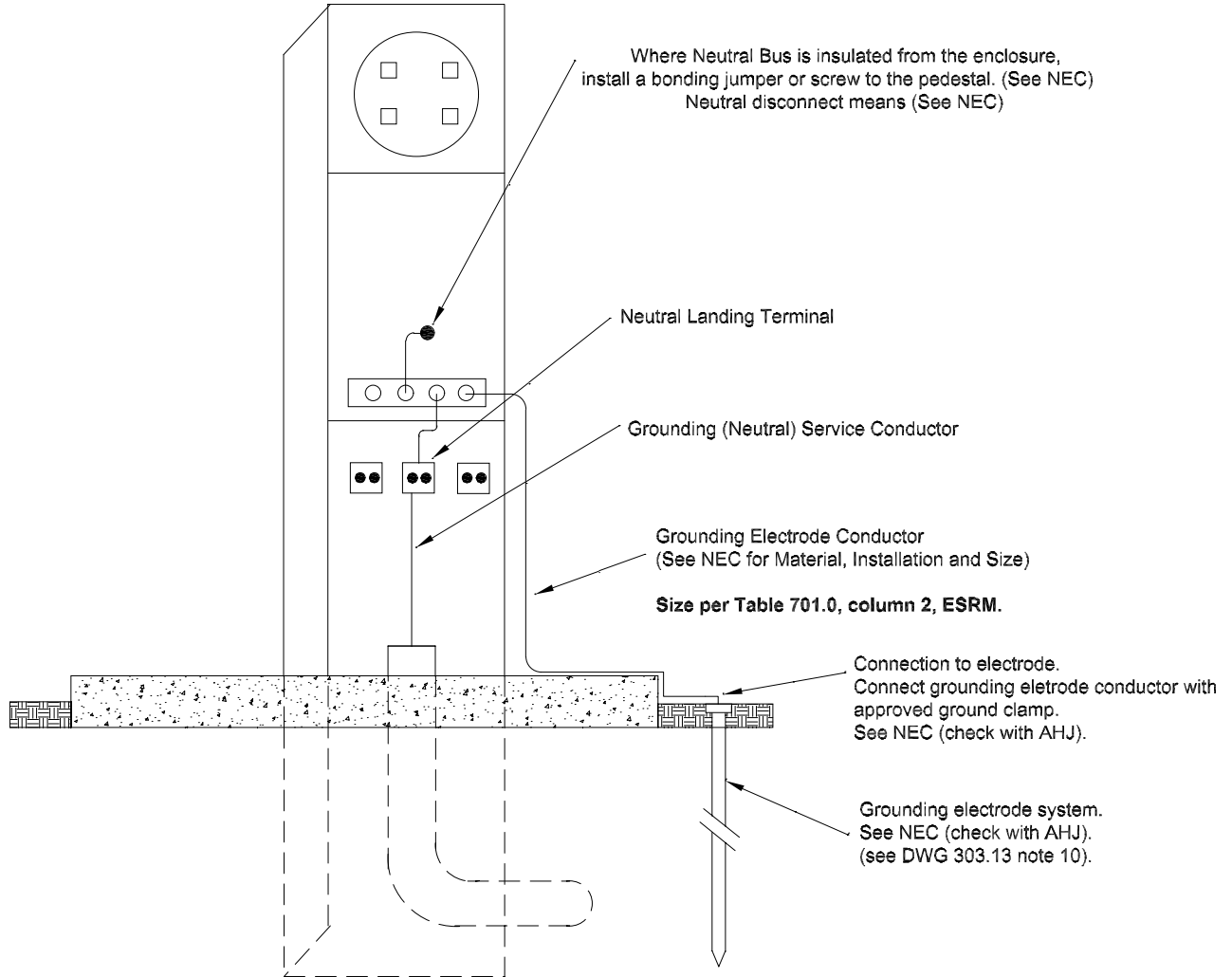


705.6 PROPER BONDING AND GROUNDING



Electric Service Requirements 705.6





ELECTRIC SERVICE REQUIREMENTS