# CONDUIT FILL REPORT

Compliance with NEC Chapter 9-2023, IEEE STD 525, IEEE STD 1185

Simply-Substations
November 16, 2026

## PROJECT INFORMATION

| | |
|---|---|
| **Project Name:** | Simply Substations |
| **Client Name:** | Mitchel Valentine |
| **Prepared By:** | Donovan Frye |

## SCOPE

*This report presents a concise evaluation of conduit fill and jamming ratio parameters critical to the design and installation of electrical cable systems, referencing guidelines from IEEE Std 525, IEEE Std 1185 and the National Electrical Code (NEC). Conduit Fill refers to the percentage of the conduit's internal cross-sectional area occupied by conductors. NEC Chapter 9, Table 1, specifies maximum fill limits to ensure safe heat dissipation and ease of cable installation. Criteria for maximum allowed conduit percentage fill:*

- *1 conductor: 53% fill.*
- *2 conductors: 31% fill.*
- *3 or more conductors: 40% fill.*

*Jamming Ratio is a dimensionless value used to assess the risk of cable jamming when pulling three unbound cables through a conduit bend. IEEE 525 and supporting studies indicate that jamming probability, when:*

- *D/d < 2.8 : Jamming is not likely.*
- *D/d < 3.0 : Jamming cannot occur.*
- *2.8 ≤ D/d ≤ 3.0 : Probability of jamming.*

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## INPUT DATA

### CONDUIT INFORMATION

| | |
|---|---|
| **Conduit Type** | PVC SCH 40 |
| **Conduit Trade Size** | 4.000 inch |
| **Conduit Internal Diameter (D)** | 3.998 inch |



## CABLE INFORMATION

| Cable | Outer Diameter of Cable ( inch) | Number of Cables (N) |
|---|---|---|
| A | 0.715 | 7 |
| B | 0.270 | 3 |

# CALCULATIONS

### 1. CONDUIT AREA (AD)

**AD = π/4 × D²**

**AD = 3.14/4 × 3.998 inch²**

**Ad = 12.554 inch²**

### 3. FILL PERCENTAGE

**% Fill = (Σ Ad / AD) × 100%**

**% Fill = 23.760%**

### 2. CABLE AREA

**A1 = N × π/4 × d1²** **... for (A) cable**

**A1 = 7 × 3.14/4 × 0.715²**

**A1 = 2.811 inch²**

**A2 = N × π/4 × d2²** **... for (B) cable**

**A2 = 3 × 3.14/4 × 0.270²**

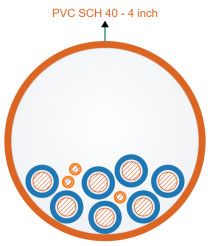
**A2 = 0.172 inch²**

**Ad = 2.982 inch²**

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# RESULTS

## CONDUIT FILL STATUS







The image shown is for visualization purposes only. The actual cable laying within the conduit may follow a different configuration, depending on site conditions or as determined by the installer.

**Status:** Safe

Fill ratio 23.760% is within the limit (40%).

**Suggestions:** If the conduit fill percentage is exact as shown in the above table or near the threshold (e.g., for 2 cables, % fill is near 31%), it is highly recommended to use one size bigger conduit or reduce the number of cables to guarantee clearance for future installations and safe pulling tensions.

## JAM RATIO STATUS

Jamming refers to the condition where cables are so tightly packed inside the conduit that they become difficult or impossible to pull through or install properly. This can lead to damage to cable insulation, increased friction, and safety hazards during installation and operation.

*As per NEC Chapter 9, Information Note No. 2 / IEEE Std 525 Annex J: - For mixed cable sizes, the conductor geometry does not produce the same "locking" behavior, making jam ratio calculation meaningless. - IEEE standards and cable installation guides advise that, for multiple cables of different diameters, the jamming risk is inherently lower, and no standard jam ratio applies. Instead, focus should be placed on maintaining proper conduit fill percentage and applying good cable pulling practices.

# CONCLUSION

*The conduit fill and jamming calculations confirm whether the selected conduit size is suitable for the cables intended to be installed, ensuring compliance with NEC, IEEE STD 525 & IEEE STD 1185 guidelines. The calculated fill percentage and jam ratio are within acceptable limits, indicating that cables will fit comfortably without risk of damage or pulling difficulties. If either fill or jamming thresholds are exceeded, it is recommended to increase conduit size or reduce cable quantity to maintain system safety, ease of installation, and long-term reliability.*

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