



**Table 1-1—Characteristics of grounding methods**

IEEE Std 142-2007

	Ungrounded	Solid grounding	Reactance grounding		Resonant Grounding Ground-fault neutralizer (Petersen Coil)	Resistance grounding	
			Low value reactor	High value reactor		Low resistance	High resistance
Current for phase-to-ground fault in percent of three-phase fault current	Less than 1%	Varies, may be 100% or greater	Usually designed to produce 25% to 100%	5% to 25%	Nearly zero fault current	20% and downward to 100 A to 1000 A	Less than 1% but not less than system charging current, $3I_{co}$
Transient over-voltages	Very high	Not excessive	Not excessive	Not excessive	Not excessive	Not excessive	Not excessive
Surge arresters	Ungrounded-neutral type	Grounded-neutral type	Grounded-neutral type if current 60% or greater	Ungrounded-neutral type	Ungrounded-neutral type	Ungrounded-neutral type	Ungrounded-neutral type
Remarks	Not recommended due to overvoltages and non-segregation of fault	Generally used on systems (1) 600 V and below and (2) over 15 kV		Not used due to excessive overvoltages	Best suited for application in most medium-voltage industrial and commercial systems that are isolated from their electric utility system by transformers. <sup>2</sup>	Generally used on systems of 2.4 kV to 15 kV particularly where large rotating machines are connected.	Used on systems 600 V and below where service continuity is desired. <sup>2</sup>

<sup>2</sup>Caution should be applied in using this form of grounding with industrial generation (see IEEE Std 367™). Best suited for application in most medium-voltage industrial and commercial systems that are isolated from their electric utility system by transformers. Ideal for use on medium-voltage generators. Also occasionally found on mission-critical 2.4 kV or 4.16 kV industrial or commercial distribution systems.

**Table B6.15** Evaluation of resistance and reactance earthing

Evaluation criterion	Implementation of neutral-point earthing by means of									
	 resistance					 reactance				
	⊖⊖	⊖	0	+	⊕⊕⊕	⊖⊖	⊖	0	+	⊕⊕⊕
Low investment costs for the neutral earthing resistors										
Small space requirement										
Reliable current limitation effect										
High response reliability and selectivity due to undamped starting of the residual current protection										
Strict avoidance of transient earth-fault overvoltages										
Low electrical stress on the circuit-breakers on clearing earth faults										

### $X_0/X_1$ and $R_0/X_0$ Ratios for Low Transient Overvoltage

Grounding Method	Desired $X_0/X_1$ , $R_0/X_0$ Ratio
Ungrounded	<ul style="list-style-type: none"><li>o No ratios available</li><li>o Produces high transient voltages.</li><li>o Systems grounded through potential transformers included here.</li></ul>
Solid Grounding	<ul style="list-style-type: none"><li>o <math>X_0/X_1</math> inherently very low unless wye-wye transformers used.</li></ul>
Reactance Grounded	<ul style="list-style-type: none"><li>o <math>X_0/X_1</math> should be kept less than 3.0</li></ul>
Low Resistance Grounded	<ul style="list-style-type: none"><li>o <math>R_0/X_0</math> should be equal to or greater than 2.0</li><li>o <math>X_0/X_1</math> should be equal to or less than 20.</li></ul>
High Resistance Grounded	<ul style="list-style-type: none"><li>o Resistive current value should be sized <math>\geq</math> to the total three-phase capacitive current to ground under ground fault conditions.</li></ul>