

## Specify the Correct Enclosure for Your Motor Controls

### Type 1

#### General Purpose Surface Mounting

**Type 1 enclosures** are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment in locations where unusual service conditions do not exist. The enclosures are designed to meet the rod entry and rust-resistance design tests. Enclosure is sheet steel, treated to resist corrosion.



### Type 1

#### Flush Mounting

**Type 1 Flush mounting enclosures** for installation in machine frames and plaster wall. These enclosures are for similar applications and are designed to meet the same tests as Type 1 surface mounting.

### Type 3

#### Rainproof Dusttight

**Type 3 enclosures** are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain and sleet; and to be undamaged by the formation of ice on the enclosure. They are designed to meet rain ❶, external icing ❷, dust, and rust-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

### Type 3R

#### Rainproof

**Type 3R enclosures** are intended for outdoor use primarily to provide a degree of protection against falling rain, and to be undamaged by the formation of ice on the enclosure. They are designed to meet rod entry, rain ❸, external icing ❷, and rust-resistance design tests. They are not intended to provide protection against conditions such as dust, internal condensation, or internal icing.

### Type 4

#### Watertight

**Type 4 enclosures** are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, and hose-directed water; and to be undamaged by the formation of ice on the enclosure. They are designed to meet hosedown, dust, and external icing tests ❷. They are not intended to provide protection against conditions such as internal condensation or internal icing.



### Type 4X

#### Non-Metallic, Corrosion-Resistant

**Type 4X enclosures** are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, and hose-directed water; and to be undamaged by the formation of ice on the enclosure. They are designed to meet the hosedown, dust, external icing ❷, and corrosion-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.



### Type 6P

#### For Prolonged Submersion at a Limited Depth

**Type 6P enclosures** are intended for indoor or outdoor use primarily to provide a degree of protection against the entry of water during prolonged submersion at a limited depth; and to be undamaged by the formation of ice on the enclosure. They are designed to meet air pressure, external icing ❶, hosedown and corrosion-resistance design tests. They are not intended to provide protection against conditions such as internal condensation or internal icing.

### Type 7

#### For Hazardous Gas Locations

**Type 7 enclosures** are for indoor use in locations classified as Class I, Groups C or D, as defined in the U.S. National Electrical Code. Type 7 enclosures are designed to be capable of withstanding the pressures resulting from an internal explosion of specified gases, and contain such an explosion sufficiently that an explosive gas-air mixture existing in the atmosphere surrounding the enclosure will not be ignited. Enclosed heat generating devices are designed not to cause external surfaces to reach temperatures capable of igniting explosive gas-air mixtures in the surrounding atmosphere. Enclosures are designed to meet explosion, hydrostatic, and temperature design tests. Finish is a special corrosion-resistant, gray enamel.



### Type 9

#### For Hazardous Dust Locations

**Type 9 enclosures** are intended for indoor use in locations classified as Class II, Groups E, F, or G, as defined in the U.S. National Electrical Code. Type 9 enclosures are designed to be capable of preventing the entrance of dust. Enclosed heat generating devices are designed not to cause external surfaces to reach temperatures capable of igniting or discoloring dust on the enclosure or igniting dust-air mixtures in the surrounding atmosphere. Enclosures are designed to meet dust penetration and temperature design tests, and aging of gaskets. The outside finish is a special corrosion-resistant gray enamel.



### Type 12

#### Dusttight Industrial Use

**Type 12 enclosures** are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids. They are designed to meet drip ❷, dust, and rust-resistance tests. They are not intended to provide protection against conditions such as internal condensation.



### Type 13 Oiltight

**Type 13 enclosures** are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and non corrosive coolant. They are designed to meet oil exclusion and rust-resistance design tests. They are not intended to provide protection against conditions such as internal condensation.

- ❶ Evaluation criteria: No water has entered enclosure during specified test.
- ❷ Evaluation criteria: Undamaged after ice buildup during specified test has melted (Note: Not required to be operable while ice-laden).
- ❸ Evaluation criteria: No water shall have reached live parts, insulation or mechanisms.



## General

# NEMA Enclosures

### ENCLOSURES

Refer to the brief descriptions below for the various types of enclosures offered by Allen-Bradley. See page 1-13 for selection criteria. For definitions, descriptions and test criteria, see National Electrical Manufacturers Association (NEMA) Standards Publication No. 250. Also see individual product listings within the Allen-Bradley catalogue for available enclosure types and for any additional information relating to these descriptions.

**NOTE: Enclosures do not normally protect devices against conditions such as condensation, icing, corrosion or contamination that may occur within the enclosure or enter via the conduit or unsealed openings. Users must make adequate provisions to safe-guard against such conditions and satisfy themselves that the equipment is properly protected.**

## Selection Criteria

### Enclosures for Non hazardous Locations

For a Degree of Protection Against:	Designed to Meet Tests No. ❶	Type							
		For Indoor Use			Outdoor Use		Indoor or Outdoor		
		1	12	13	3R	3	4	4X	6P
Incidental contact with enclosed equipment	6.2	✓	✓	✓	✓	✓	✓	✓	✓
Falling dirt	6.2	✓	✓	✓	✓	✓	✓	✓	✓
Rust	6.8	✓	✓	✓	✓	✓	✓	✓	✓
Circulating dust, lint, fibres and flyings ❷	6.5.1.2 (2)		✓	✓		✓	✓	✓	✓
Windblown dust	6.5.1.1 (2)					✓	✓	✓	✓
Falling liquids and light splashing	6.3.2.2		✓	✓		✓	✓	✓	✓
Rain (Test evaluated per 6.4.2.1)	6.4.2.1				✓	✓	✓	✓	✓
Rain (Test evaluated per 6.4.2.2)	6.4.2.2					✓	✓	✓	✓
Snow and sleet	6.6.2.2				✓	✓	✓	✓	✓
Hosedown and splashing water	6.7						✓	✓	✓
Occasional prolonged submersion	6.11 (2)								✓
Oil and coolant seepage	6.3.2.2		✓	✓					
Oil or coolant spraying and splashing	6.12			✓					
Corrosive agents	6.9				✓	✓	✓	✓	✓

❶ See page 1-13 for abridged description of NEMA enclosure test requirements. Refer to NEMA Standards Publication No. 250 for complete test specifications.

❷ Non hazardous materials, not Class III ignitable or combustible.

### Enclosures for Hazardous Locations (Division 1 or 2) ❶

For a Degree of Protection Against Atmospheres Typically Containing: ❸	Designed to Meet Tests ❷	Class (National Electrical Code)	7, Class I Group				9, Class II Group		
			A	B	C	D	E	F	G
Acetylene	Explosion Test	I	✓						
Hydrogen, Manufactured Gas	Hydrostatic Test	I	✓	✓					
Diethyl Ether, Ethylene, Hydrogen Sulfide		I			✓				
Acetone, Butane, Gasoline, Propane, Toluene	Temperature Test	I			✓	✓			
Metal dusts and other combustible dusts with resistivity of less than 10 <sup>5</sup> Ω-cm.	Dust Penetration Test Temperature Test with Dust Blanket	II					✓		
Carbon black, charcoal, coal or coke dusts with resistivity between 10 <sup>2</sup> ...10 <sup>8</sup> Ω-cm		II						✓	
Combustible dusts with resistivity of 10 <sup>5</sup> Ω-cm or greater		II							✓
Fibres, flyings	❹	III							✓

❶ For indoor locations only, unless catalogued with additional NEMA Type enclosure number(s) suitable for outdoor use as shown in the table on this page. Some control devices (if so listed in the catalogue) are suitable for Division 2 hazardous location use in enclosures for non-hazardous locations. For explanation of CLASSES, DIVISIONS and GROUPS, refer to the National Electrical Code.

**Note: Classifications of hazardous locations are subject to the approval of the authority having jurisdiction. Refer to the National Electrical Code.**

❷ See abridged description of test requirements on page 1-13. For complete requirements, refer to UL Standard 698, compliance with which is required by NEMA enclosure standards.

❸ For listing of additional materials and information noting the properties of liquids, gases and solids, refer to NFPA 497M-1991, Classification of Gases, Vapours, and Dusts for Electrical Equipment in Hazardous (Classified) Locations.

❹ UL 698 does not include test requirements for Class III. Products that meet Class II, Group G requirements are acceptable for Class III.



**Selection Criteria**

**Abridged Description of NEMA Enclosure Test Requirements**

**6.2 Rod Entry Test** — A 3.18 mm (.125 in.) diameter rod must not be able to enter enclosure except at locations where nearest live part is more than 102 mm (4 in.) from an opening — such opening shall not permit a 13 mm (.5 in.) diameter rod to enter.

**6.3 Drip Test** — Water is dripped onto enclosure for 30 minutes from an overhead pan having uniformly spaced spouts, one every 12,900 mm<sup>2</sup> (20 sq. in.) of pan area, each spout having a drip rate of 20 drops per minute.

Evaluation 6.3.2.2: No water shall have entered enclosure.

**6.4 Rain Test** — Entire top and all exposed sides are sprayed with water at a pressure of 0.35 kg/cm<sup>2</sup> (5 psi) from nozzles for one hour at a rate to cause water to rise 457 mm (18 in.) in a straight-sided pan beneath the enclosure.

Evaluation 6.4.2.1: No water shall have reached live parts, insulation or mechanisms.

Evaluation 6.4.2.2: No water shall have entered enclosure.

**6.5.1.1 (2) Outdoor Dust Test (Alternate Method)** — Enclosure and external mechanisms are subjected to a stream of water at 170.5 litres (45 gallons) per minute from a 25.4 mm (1 in.) diameter nozzle, directed at all joints from all angles from a distance of 3 to 3.7 meters (10 to 12 feet). Test time is 48 seconds times the test length (height + width + depth of enclosure in feet), or a minimum of 5 minutes. No water shall enter enclosure.

**6.5.1.2 (2) Indoor Dust Test (Alternate Method)** — Atomized water at a pressure of 2.11 kg/cm<sup>2</sup> (30 psi) is sprayed on all seams, joints and external operating mechanisms from a distance of 305 to 381mm (12 to 15 in.) at a rate of 11 litres (3 gallons) per hour. No less than 142 gms (5 oz) of water per linear foot of test length (height + length + depth of enclosure) is applied. No water shall enter enclosure.

**6.6 External Icing Test** — Water is sprayed on enclosure for one hour in a cold room +2°C (36°F); then room temperature is lowered to approximately -5°C (-23°F) and water spray is controlled so as to cause ice to build up at a rate of 6.4 mm (.25 in.) per hour until 19 mm (.75 in.) thick ice has formed on top surface of a 25.4 mm (1 in.) diameter metal test bar, then temperature is maintained at -5°C (-23°F) for 3 hours.

Evaluation 6.6.2.2: Equipment shall be undamaged after ice has melted (external mechanisms not required to be operable while ice-laden).

**6.7 Hosedown Test** — Enclosure and external mechanisms are subjected to a stream of water at 246 litres (65 gallons) per minute from a 25.4 mm (1 in.) diameter nozzle, directed at all joints from all angles from a distance of 3 to 3.7 meters (10 to 12 ft). Test time is 48 seconds times the test length [height + width + depth] of enclosure in meters (ft.), or a minimum of 5 seconds. No water shall enter enclosure.

**6.8 Rust Resistance Test (Applicable Only to Enclosures Incorporating External Ferrous Parts)** — Enclosure is subjected to a salt spray (fog) for 24 hours, using water with five parts by weight of salt (NaCl), at 35°C (95°F), then rinsed and dried. There

shall be no rust except where protection is impractical (e.g., machined mating surfaces, sliding surfaces of hinges, shafts, etc.).

**6.9 Corrosion Protection** — Sheet steel enclosures are evaluated per Underwriter's Laboratories (UL) 50, Part 13 (test for equivalent protection as G-90 commercial zinc coated sheet steel). Other materials per Underwriter's Laboratories (UL) 508, 6.9 or 6.10.

**6.11 (2) Air Pressure Test (Alternate Method)** — Enclosure is sub-merged in water at a pressure equal to water depth of 2 meters (6 ft), for 24 hours. No water shall enter enclosure.

**6.12 Oil Exclusion Test** — Enclosure is subjected to a stream of test liquid for 30 minutes from a 9.5 mm (.375 in) diameter nozzle at 7.57 litres (2 gallons) a minute. Water with 0.1% wetting agent is directed from all angles from a distance of 305 to 457 mm (12 to 18 in.), while any externally operated device is operated at 30 operations per minute. No test liquid shall enter the enclosure.

Abridged Description of UL Standard 698 Test Requirements

**Explosion Test** — During a series of tests in which gas-air mixtures of the specific gas, over its range of explosive concentrations, are ignited inside the enclosure, the enclosure shall prevent the passage of flame and sparks capable of igniting a similar gas-air mixture surrounding the enclosure. In addition, there shall be no mechanical damage to enclosed electrical mechanisms or the enclosure.

**Hydrostatic Test** — The enclosure shall withstand for 1 minute a hydrostatic test based on the maximum internal explosion pressure developed during the explosion tests, as follows: cast metal, four times the explosion pressure without rupture or permanent deformation; fabricated steel, twice the explosion pressure without permanent deformation and three times the explosion pressure without rupture. Exception: Hydrostatic tests may be omitted if calculations show safety factor of 5:1 for cast metal and 4:1 for fabricated steel.

**Temperature Test** — The enclosed device is subjected to a temperature test to determine maximum temperature at any point on the external surface. The device must be marked with a temperature code based on the result only if the temperature exceeds +100°C (+212°F).

**Dust Penetration Test** — The device is operated at full rated load until equilibrium temperatures are attained, then allowed to cool to ambient (room) temperature, through six heating and cooling cycles covering at least 30 hours, while continuously exposed to circulating dust of specified properties in a test chamber. No dust shall enter the enclosure.

**Temperature Test with Dust Blanket** — This test is conducted as described for the Dust Penetration test except that the re circulating dust nozzles are positioned so that the dust is not blown directly on the device under test. The device is operated at full rated load (and under abnormal conditions for equipment subject to overloading) until equilibrium temperatures are attained. Dust in contact with the enclosure shall not ignite or discolour from heat, and the exterior temperatures based on +40°C (+104°F) ambient shall not exceed:

Group	Normal Operation	Abnormal Operation
E	+200°C (+392°F)	+200°C (+392°F)
F	+150°C (+302°F)	+200°C (+392°F)
G	+120°C (+248°F)	+165°C (+329°F)

