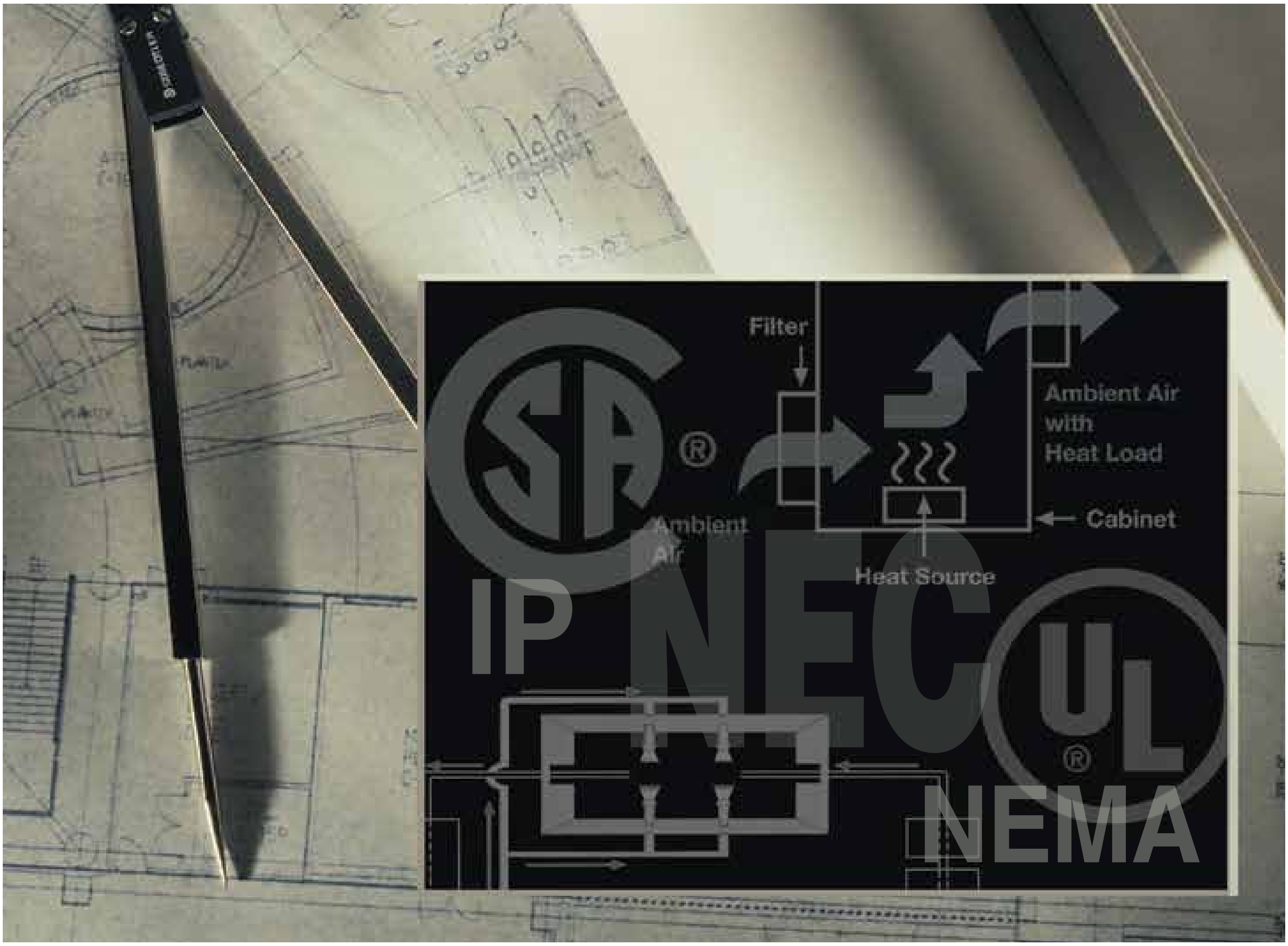
Section N Index

TECHNICAL INFORMATION



Industry Definitions

The National Electrical Manufacturers Association (NEMA) is a US Manufacturers Organization which actively promotes standardized product specifications for electrical apparatus.

While NEMA does not actually test products, it establishes the performance criteria for enclosures intended for specific environments.

NEMA standards describe each type of enclosure in general and functional terms, and specifically omits reference to construction details. In other words NEMA specifies what an enclosure must do, not how to manufacture it. This is also true about the EN 60.529/IEC 529.

NEMA performance criteria and test methods are used by Underwriters Laboratories (UL) and Canadian Standards Association (CSA) as guidelines for investigation and listing of electrical enclosures.

The tested enclosures are then authorized to carry a label by UL or CSA to prove it has passed the required tests and meets the applicable UL and CSA standard.

NEMA CLASSIFICATIONS

Definitions – Non-Hazardous Locations

Type 1

Enclosures are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment. NEMA Standard 1-10-1979.

Type 2

Enclosures are intended for indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt. NEMA Standard 1-10-1979.

Type 3

Enclosures are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet, and external ice formation. NEMA Standard 1-10-1979.

Type 3R

Enclosures are intended for outdoor use primarily to provide a degree of protection against falling rain, sleet, and external ice formation. (May be ventilated). NEMA Standard 1-10-1979.

Type 3S

Enclosure are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet, and to provide for operation of external mechanisms when ice laden. NEMA Standard 1-10-1979.

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. NEMA Standard 1-10-1979.

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. NEMA Standard 1-10-1979.

Type 5

Enclosures are intended for indoor use primarily to provide a degree of protection against settling airborne dust, falling dirt, and dripping non-corrosive liquids. NEMA Standard 5-25-1988.

Type 6

Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against the entry of water during occasional, temporary submersion at a limited depth. NEMA Standard 1-10-1979.

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. NEMA Standard 1-10-1979.

Type 11

Enclosures are intended for indoor use primarily to provide, by oil submersion, a degree of protection to enclosed equipment against the corrosive effects of liquids and gases. NEMA Standard 1-10-1979.

Type 12

Enclosures are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids. NEMA Standard 1-10-1979.

Type 12K

Enclosures with knock-outs are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids other than at knock-outs. NEMA Standard 1-10-1979.

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. NEMA Standard 1-10-1979.

Definitions – Hazardous Locations

Type 7

Enclosures are for use indoors in locations classified as Class I, Groups A, B, C, or D, as defined in the National Electrical Code. NEMA Standard 1-10-1979.

Type 8

Enclosures are for indoor or outdoor use in locations classified as Class I, Groups A, B, C, or D, as defined in the National Electrical Code. NEMA Standard 1-10-1979.

Type 9

Enclosures are for indoor use in locations classified as Class II, Groups E, F, or G as defined in the National Electrical Code. NEMA Standard 5-19-1986.

Type 10

Enclosures are constructed to meet the applicable requirements of the Mine Safety and Health Administration. NEMA Standard 1-10-1979.

ENCLOSURE TYPES NON-HAZARDOUS LOCATIONS

Type Designation	National Electrical Manufacturers Association (Nema Standard 250) And Electrical And Electronic Mfg. Association Of Canada (Eemac)	Underwriters Laboratories Inc. (Ul 50 And Ul 508)	Canadian Standards Association (Standard C22.2 No. 94)
1	Enclosures are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment or locations where unusual service conditions do not exist.	Indoor use primarily to provide protection against contact with the enclosed equipment and against a limited amount of falling dirt.	General purpose enclosure. Protects against accidental contact with live parts.
2	Enclosures are intended for indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt.	Indoor use to provide a degree of protection against limited amounts of falling water and dirt.	Indoor use to provide a degree of protection against dripping and light splashing of non-corrosive liquids and falling dirt.
3	Enclosures are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, and sleet; undamaged by the formation of ice on the enclosure.	Outdoor use to provide a degree of protection against windblown dust and windblown rain; undamaged by the formation of ice on the enclosure.	Indoor or outdoor use; provides a degree of protection against rain, snow, and windblown dust; undamaged by the external formation of ice on the enclosure.
3R	Enclosures are intended for outdoor use primarily to pro-vide a degree of protection against falling rain and sleet; undamaged by the formation of ice on the enclosure.	Outdoor use to provide a degree of protection against falling rain; undamaged by the formation of ice on the enclosure.	Indoor or outdoor use; provides a degree of protection against rain and snow; undamaged by the external formation of ice on the enclosure.
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; undamaged by the formation of ice on the enclosure.	Either indoor or outdoor use to provide a degree of protection against falling rain, splashing water, and hose-directed water; undamaged by the formation of ice on the enclosure.	Indoor or outdoor use; provides a degree of protection against rain, snow, windblown dust, splashing and hose-directed water; undamaged by the external formation of ice on the enclosure.
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; undamaged by the formation of ice on the enclosure.	Either indoor or outdoor use to provide a degree of protection against falling rain, splashing water, and hose-directed water; undamaged by the formation of ice on the enclosure; resists corrosion.	Indoor or outdoor use; provides a degree of protection against rain, snow, windblown dust, splashing and hose-directed water; undamaged by the external formation of ice on the enclosure; resists corrosion.
6	Enclosures are intended for use indoors or outdoors where occasional submersion is encountered.	Indoor or outdoor use to provide a degree of protec-tion against entry of water during temporary submer-sion at a limited depth; undamaged by the formation of ice on the enclosure.	Indoor or outdoor use; provides a degree of protection against the entry of water during temporary submersion at a limited depth; undamaged by the external formation of ice on the enclosure; resists corrosion.
12	Enclosures are intended for indoor use primarily to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids.	Indoor use to provide a degree of protection against dust, dirt, fiber flyings, dripping water, and external condensation of non-corrosive liquids.	Indoor use; provides a degree of protection against circulating dust, lint, fibers, and flyings; dripping and light splashing of non-corrosive liquids; not provided with knockouts.
13	Enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and non-corrosive coolant.	Indoor use to provide a degree of protection against lint, dust seepage, external condensation and spraying of water, oil, and non-corrosive liquids.	Indoor use; provides a degree of protection against circu-lating dust, lint, fibers, and flyings; seepage and spraying of non-corrosive liquids, including oils and coolants.
	This material is reproduced from NEMA. The pre-ceding descriptions, however, are not intended to be complete representations of National Electrical Manufacturers Association standards for enclosures nor those of the Electrical and Electronic	This material is reproduced from Underwriters Lab-ora-tories Inc. Standard for Safety for Cabinets and Boxes, UL 50, Copyright 1997 and Industrial Control Equipment, UL 508, Copyright 1996 by Underwriters Laboratories Inc. Underwriters Laboratories Inc. (UL) shall not be responsible to anyone for the use of or reliance upon a UL Standard by anyone. UL shall not incur any obli-gation or liability for damages, including consequential damages, arising out of or connection with the use, interpretation of, or reliance upon a UL Standard.	This material is reproduced from the Canadian Standards Association.

COMPARISON OF SPECIFIC NON-HAZARDOUS APPLICATIONS INDOOR LOCATIONS

	Type of Enclosure										
Provides a Degree of Protection Against the Following Environmental Conditions	1*	2*	4	4X	5	6	6P	11	12	12K	13
Incidental contact with the enclosed equipment	•	•	•	•	•	•	•	•	•	•	•
Falling dirt	•	•	•	•	•	•	•	•	•	•	•
Falling liquids and light splashing		•	•	•		•	•	•	•	•	•
Dust, lint, fibers, and flyings†			•	•	•	•	•		•	•	•
Hose down and splashing water			•	•		•	•				
Oil and coolant seepage									•	•	•
Oil or coolant spraying and splashing											•
Corrosive agents				•			•	•			
Occasional temporary submersion						•	•				
Occasional prolonged submersion							•				

**These enclosures may be ventilated. However, Type 1 may not provide protection against small particles of falling dirt when ventilation is provided in the enclosure top.*

†These fibers and flyings are non-hazardous materials and are not considered Class III type ignitable fibers or combustible flyings.For Class III type ignitable fibers or combustible flyings see the National Electrical Code, Section 500-6(a).

In order to protect the sometimes delicate equipment against foreign objects there are protection standards developed which grade the degree of protection level achieved. It is important to know that there are two such standards for the degree of protection by an enclosure.

- The European specification: IP-code according to EN 60.529 / IEC 529
- The American specification: TYPE-code according to NEMA 250

The European IP-Code

To help the design engineer identify the degree of protection provided by an enclosure, EN60.529/IEC 529 (International Electrotechnical Commission) was introduced. The latest version was issued 11/89. (Correct at date of printing). Both harmonized standards classify the extent to which an enclosure will resist the ingress of solid bodies and water under designated tests.

After successful testing the enclosure will be allocated a classification code with the letters IP (International Protection) prefixing that code.

Further explanation of the degree of protection provided by an enclosure indicated by the IP-code is detailed below:

IP 55 W

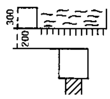
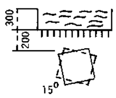
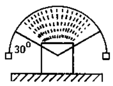
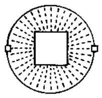
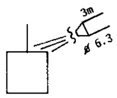
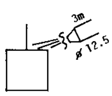
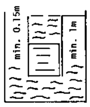
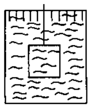
Code letters
(International Protection)

First Characteristic Numeral
(dust protection, numerals 0-6, or letter X)

Second Characteristic Numeral
(water protection, numerals 0-8, or letter X)

Optional Letter for Application in Specified Weather Conditions
(normally agreed between user and manufacturer, example: Rain hood)

THE IP SCALE

1st Numeral: Degree Of Protection With Respect To Persons And Solid Objects		2nd Numeral: Degree Of Protection With Respect To Harmful Ingress Of Water								
		0	1	2	3	4	5	6	7	8
0	Non Protected	Non Protected IP 00	Protected against dripping water Test time 10 mins  IP 01	Protected against dripping water of ±15° angle Test time 10 mins  IP 02 80kN/m	Protected against dripping water of ±60° angle Test time 10 mins  10l./min 80kN/m	Protected against splashing water Test time 10 mins  10l./min 30kN/m	Protected against water jets Test time 1 min/m  12.5l./min 100 kN/m	Protected against heavy Seas Test time 1 min/m  100l./min	Protected against immersion Test time 30 mins 	Protected against submersion Test time 30 mins 
1	Protected against solid objects greater than Dia. 50 mm	IP 10	IP 11	IP 12	IP 13					
2	Protected against solid objects greater than Dia. 12 mm	IP 20	IP 21	IP 22	IP 23					
3	Protected against solid objects greater than Dia. 2.5 mm	IP 30	IP 31	IP 32	IP 33	IP 34				
4	Protected against solid objects greater than Dia. 1.0 mm	IP 40	IP 41	IP 42	IP 43	IP 44	IP 45	IP 46		
5	Dust Protected					IP 54	IP 55	IP 56		
6	Dust Tight						IP 65	IP 66	IP 67	IP 68

NEMA TO IEC – ENCLOSURE RATING CROSS-REFERENCE*

NEMA TYPE	IP23	IP30	IP32	IP55	IP64	IP65	IP66	IP67
1	•		•	•	•	•		
2		•		•	•	•		
3					•	•		
3R			•			•		
4							•	
4X							•	
6								•
12				•	•			
13						•		

**Note:* *This cross-reference table is an approximation of NEMA and IEC classifications for reference only. Please consult the appropriate agency's requirements and test qualifications for complete information.*

ENCLOSURE METAL SPECIFICATIONS
TECHNICAL DATA

N.I.B. GAUGE EQUIVALENTS

Gauge Number	Thickness (Inches)
7 Gauge	.179
8 Gauge	.164
9 Gauge	.150
10 Gauge	.134
11 Gauge	.120
12 Gauge	.105
13 Gauge	.090
14 Gauge	.075
15 Gauge	.067
16 Gauge	.060
17 Gauge	.054
18 Gauge	.048
19 Gauge	.042
20 Gauge	.036
21 Gauge	.033
22 Gauge	.030

Steel Manufacturers' Standard Gauge for Sheet Steel (Hot or Cold Rolled)

NEMA TO IEC – ENCLOSURE RATING CROSS-REFERENCE* DECIMAL & METRIC EQUIVALENTS

4ths	8ths	16ths	32nds	64ths	To 3 Places	To 2 Places	Millimeters
				1/64	.016	.02	0
			1/32		.031	.03	1
				3/64	.047	.05	1
		1/16			.062	.06	2
				5/64	.078	.08	2
			3/32		.094	.09	2
				7/64	.109	.11	3
	1/8				.125	.12	3
				9/64	.141	.14	4
			5/32		.156	.16	4
				11/64	.172	.17	4
		3/16			.188	.19	5
				13/64	.203	.20	5
			7/32		.219	.22	6
				15/64	.234	.23	6
1/4					.250	.25	6
				17/64	.266	.27	7
			9/32		.281	.28	7
				19/64	.297	.30	8

continued on page N7

NEMA TO IEC – ENCLOSURE RATING CROSS-REFERENCE* DECIMAL & METRIC EQUIVALENTS (CONT.)

4ths	8ths	16ths	32nds	64ths	To 3 Places	To 2 Places	Millimeters
		5/16			.312	.31	8
				21/64	.328	.33	8
			11/32		.344	.34	9
				23/64	.359	.36	9
	3/8				.375	.38	10
				25/64	.391	.39	10
			13/32		.406	.41	10
				27/64	.422	.42	11
		7/16			.438	.44	11
				29/64	.453	.45	12
			15/32		.469	.47	12
				31/64	.484	.48	12
1/2					.500	.50	13
				33/64	.516	.52	13
			17/32		.531	.53	13
				35/64	.547	.55	14
		9/16			.562	.56	14
				37/64	.578	.58	15
			19/32		.594	.59	15
				39/64	.609	.61	15
	5/8				.625	.62	16
				41/64	.641	.64	16
			21/32		.656	.66	17
				43/64	.672	.67	17
		11/16			.688	.69	17
				45/64	.703	.70	18
			23/32		.719	.72	18
				47/64	.734	.73	19
3/4					.750	.75	19
				49/64	.766	.77	19
			25/32		.781	.78	20
				51/64	.797	.80	20
		13/16			.812	.81	21
				53/64	.828	.83	21
			27/32		.844	.84	21
				55/64	.859	.86	22
7/8					.875	.88	22
				57/64	.891	.89	23
			29/32		.906	.91	23
				59/64	.922	.92	23
		15/16			.938	.94	24
				61/64	.953	.95	24
			31/32		.969	.97	25
				63/64	.984	.98	25
1 inch					1.000	1.00	25

ENCLOSURE METRIC CONVERSION TECHNICAL DATA

LENGTH CONVERSIONS

1mm=0.039 in.	8mm=0.315 in.	60mm=2.362 in.	400mm=15.748 in.
2mm=0.079 in.	9mm=0.354 in.	70mm=2.756 in.	500mm=19.685 in.
3mm=0.118 in.	10mm=0.394 in.	80mm=3.150 in.	600mm=23.622 in.
4mm=0.157 in.	20mm=0.787 in.	90mm=3.543 in.	700mm=27.559 in.
5mm=0.197 in.	30mm=1.181 in.	100mm=3.937 in.	800mm=31.496 in.
6mm=0.236 in.	40mm=1.575 in.	200mm=7.874 in.	900mm=35.433 in.
7mm=0.276 in.	50mm=1.969 in.	300mm=11.811 in.	1000mm=39.370 in.

AREA CONVERSIONS

Imperial To Metric	Metric To Imperial
1 sq. inch=645.16 sq. millimeters	1 sq. millimeter (mm2)=0.00155 sq. inch
1 sq. inch=6.4516 sq. centimeters	1 sq. centimeter (cm2)=0.1550 sq. inch
1 sq. foot=929.03 sq. centimeters	1 sq. meter (m2)=10.7640 sq. feet
1 sq. foot=0.0929 sq. meter	1 sq. meter (m2)=1.196 sq. yards
1 sq. yard=0.836 sq. meter	

CONVERSIONS

3.0 mm=0.118 ins.	10 gauge=0.1345/0.1225 ins.=3.416 / 3.112 mm
2.5 mm=0.098 ins.	12 gauge=0.1046 / 0.0926 ins.=2.657 / 2.352 mm
2.0 mm=0.079 ins.	14 gauge=0.0747 / 0.0667 ins.=1.897 / 1.694 mm
1.5 mm=0.059 ins.	16 gauge=0.0598 / 0.5928 ins.=1.519 / 1.341 mm

Repainting

For best adhesion results, correct surface preparation before repainting is critical. To avoid discoloration of solvent-based high solids baking enamel, do not bake over 360˚ F. Always follow instructions provided by your paint manufacturer. Apply thin finish coats. Allow the paint to cure properly for best adhesion and hardness.

Panel Installation

When installing the interior sub-panel, it may be necessary to bend one or more mounting studs (slightly) to permit the panel to slide in place. If this would happen, simply position the panel on the studs that line up properly, and pry the other stud into position with a screwdriver inserted through the panel hole.

Door Closing Adjustments

(Single Door Wall Mount) If the surface on which the enclosure is mounted is not flat, the door may not open and close properly. If heavy equipment is mounted on the door, the door may sag slightly. If the top of door strikes the lip which extends around the body opening, place metal shims behind the mounting foot which is located at the bottom of the enclosure and closest to the door hinge. Place the shims between the mounting foot and the wall or mounting surface; be sure all mounting bolts are tight!

(Two Door Floor Mounting) The overlapping doors are factory-fitted to meet evenly at the top and bottom. If the floor under the enclosure is not level, the doors will not close evenly. In this case, place metal shims under the corners of the enclosure. The enclosure should be bolted in place with doors closed to prevent tipping when installing shims. Shims under the right front corner will raise the right door. Shims under the left front corner will raise the left door. It is important that the doors meet evenly to insure a proper seal against liquids and dust. Be sure all mounting bolts are tight!

Lifting Enclosures

To lift an enclosure which has eyebolts or mounting feet, be sure to use all the eyebolts or tip mounting feet provided. Arrange your chains and cables with spreader bars, etc., so you are lifting straight up on the eyebolts or top mounting feet.

HUBBELL

Hubbell Wiegmann
Special Quotation Request Form

(1) Agent: _____(2) Contact Person: _____ (3) Date:_______

(4) Distributor: ______ (5) Location / Acct #: _____ (6) Dist Contact:_____

(7) Expired Quote #: ________________ (8) New Quote: ☐ Yes ☐ No

(9) Job Name/End User Info: (Address, Zip Code, Phone #) :________________________________

Detailed Enclosure Information

(10) Total Quantity: _________________ (11) Per Release: __________________

(12) Style Enclosure / Family: ____

(13) Modified Special Size:____

(14) Material: ☐ Carbon Steel ☐ 304SS ☐ 316SS ☐ Galvanized ☐ Aluminum

(15) Nema / UL Listing: ☐ N1 ☐ N12 ☐ N3R ☐ N412 ☐ N4 X N4X

(16) Sub Panel Installed: ☐ Yes ☐ No (17) Sub Panel Quoted Separate: ☐ Yes ☐ No

(18) Standard Finish: ☐ Yes ☐ No (19) Special Paint Color: RAL Number ______________

All Wiegmann colors are powder finish and must be predetermined in RAL format before placing order.
*******We cannot quote an enclosure in two or more colors*******

Detail Punching Information
Reference Quantity and Size of Holes in Each Location

Size/Tap:______ Quantity:______________ Cut-Out: ______________________ Quantity: _____________

Size/Tap:______ Quantity:______________ Cut-Out: ______________________ Quantity: _____________

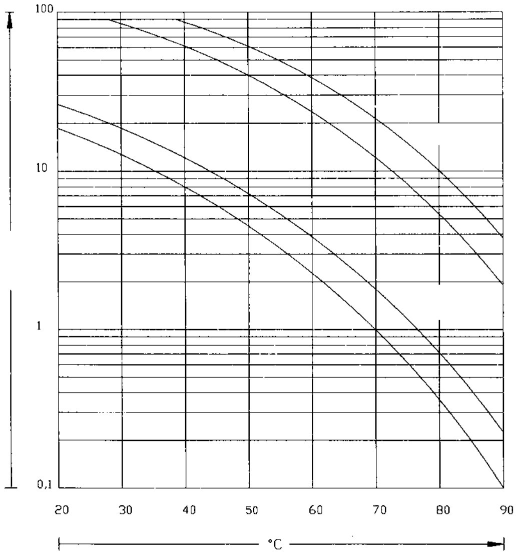
Size/Tap:______ Quantity:______________ Cut-Out: ______________________ Quantity: _____________

List Drawing Number if Available: ____

Accessories / Notes: ____

Ever since components have been made to control electro-technical tasks, heat loss has been a subject to take into consideration. Sometimes more—sometimes less.

Major problems with heat caused excessive dust accumulation in switchgear equipment because the doors were left open during the summer to allow the equipment to cool down. This can result in fluctuations in temperature. These lead to stress situations that can considerably reduce the service life of electronic components (see chart).



This chart demonstrates the relationship between temperature and service life.

THREE BASIC COOLING METHODS

When selecting a cooling method there are three types to consider:

1. **Natural Convection** — If there is only a minimal heat gain in your circumstance, use of louvers or grilles with filters can be effective. This method, however, usually provides less cooling effect than is necessary with today's components (Fig. 1, pg. L15).
2. **Forced Convection Air Cooling** — If the installation will be in a clean, non-hazardous environment with an acceptable ambient (outside the enclosure) temperature range, a simple forced-air cooling system utilizing outside air is usually adequate. Combined with an air filter, such devices generally meet the heat removal needs of typical electronic equipment and many electrical applications (Fig. 2a & 2b, pg. L16). Examples of forced convection air cooling are Filterfans™ and Box Fans.
3. **Closed-Loop Cooling** — In harsh environments involving high temperatures, wash-down requirements, heavy particulate matter or the presence of chemicals capable of damaging components (NEMA 4 or 12 environments), ambient air must be kept out of the enclosure. Closed-loop cooling consists of two separate circulation systems. One system seals out the ambient air, cooling and recirculating clean, cool air throughout the enclosure. The second system uses ambient air or water to remove and discharge the heat (Fig. 3, pg. L18). Examples of closed-loop cooling equipment employed with electronics and process controls are air conditioners and heat exchangers.

Heat Abduction by Natural Convection

If the ambient temperature is lower than the temperature inside the switch cabinet, the dissipated heat escapes into the atmosphere through the surface of the switch cabinet. The following simple equation is used to calculate the level of heat radiated from a switch cabinet:

PR[W} = c x A x DT

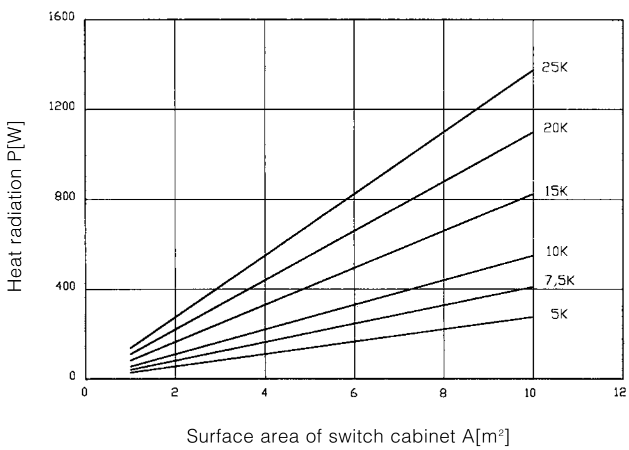
P_R[Watt]: **Radiation Power**
Thermal power radiated from the surface area of the switch cabinet into the ambience or radiated from the ambience into the switch cabinet.

C[W/m²K]: **Coefficient of heat transmission**
Radiation power per 1m2 surface area and 1K difference in temperature. This constant is determined by the material:

Sheet steel	-5.5 W/m2K
Stainless steel	-3.7 W/m2K
Aluminum	-12.0 W/m2K
Plastic	-0.2 W/m2K

A[m²]: **Surface area of switch cabinet**
Effective surface area of a switch cabinet measured according to the specifications of VDE0660, Part 506.

ΔT[K]: **Difference in temperature between the ambience and inside the switch cabinet**



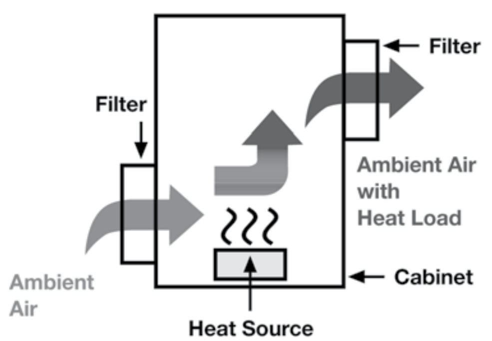


Figure 1

Heat Abduction with Filterfans™

Follow the simple equation for calculating the required air flow volume:

$$V = \frac{3.1(Pd)}{\Delta T}\ [m_3/h]$$

V[m3/h]: **Flow volume for a filter fan**

Pd[Watt]: **Dissipation loss**
Thermal power generated inside a switch cabinet by dissipation loss from components.

A[m2]: **Difference in temperature between the ambience and inside the switch cabinet**

In the course of development, absolute priority was given to the use of high-quality components (plastic material, fan, filter mat) and comprehensive transparent technical data. For this purpose we measured every Filterfan™ and exhaust filter in a test laboratory.

When considering the use of Filterfans™:

- Always use the Filterfan™ to propel the cool ambient air into the switch cabinet. This ensures that slight positive pressure builds up inside the switch cabinet in comparison to the ambience and that only air filtered by the Filterfan™ flows into the switch cabinet. The air propelled into the cabinet displaces the warm air which exits through the exhaust filter. If, however, the air is drawn out of the switch cabinet by suction power, unfiltered air can also enter through gaps and components
- If you install a combination of Filterfan™/exhaust filter, fit the Filterfan™ in the lower third of the switch cabinet if possible. The exhaust filter must be installed as near to the top as possible to prevent heat pockets in the upper part of the cabinet
- In switch cabinets consisting of several compartments, the cool air capacity required should be divided among two or more Filterfans™/exhaust fans. This measure helps to ensure a more acceptable distribution of temperature throughout the cabinet
- If you combine a Filterfan™ with two exhaust filters, the cool air divides into “Y” shape. In this way, with just one additional exhaust filter you can considerably improve the circulation inside the switch cabinet
- Install a thermostat that only trips the Filterfan™ when the temperature is too high. This can quite substantially increase the service life of your filter mat

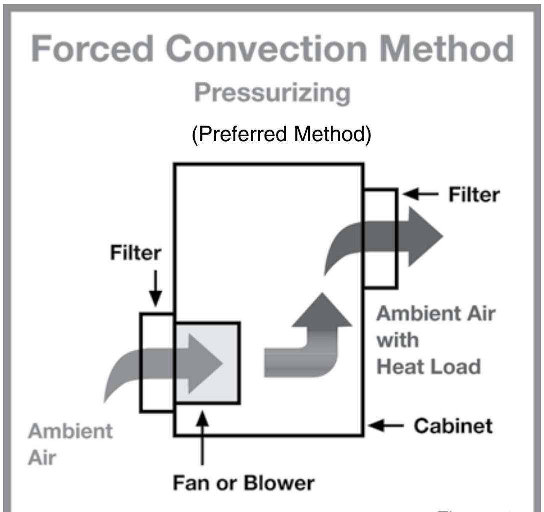


Figure 2a

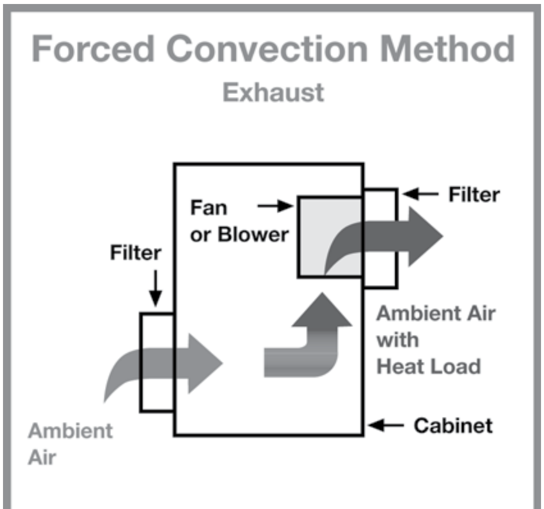


Figure 2b

Heat Abduction with a Cooling Unit

Pfannenberg air/refrigerant cooling units operate on the principle of the Carnot cycle. This means that the cooling unit functions as a heat pump that "pumps" the thermal energy abducted from the switch cabinet (heat dissipated from the components) up to a higher level of temperature (the ambient temperature can reach levels as high as +131˚F). The air inside the switch cabinet is cooled down by the evaporator and is at the same time dehumidified.

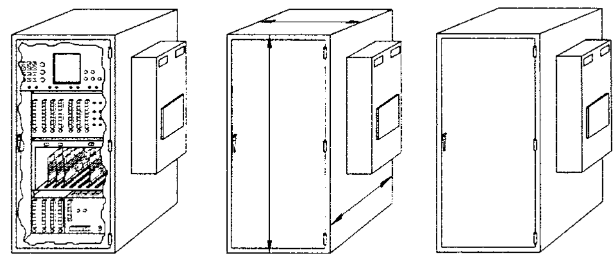
Cooling units are used if:

- The outside air cannot be used for cooling
- The required temperature inside the switch cabinet should be equal to or lower than the required ambient temperature
- The ambient air is extremely oily or rife with conductive dust

Steps for sizing an air conditioner — Proper selection of an air conditioner is determined by the following criteria:

- Required cooling capacity in BTUs/hr (steps 1-4)
- Mounting requirements (top or side mounting options)
- Dimensions of air conditioner and enclosure

Step One **Step Two** **Step Three**



Step One

1 Watt = 3.413 BTU/HR.

Determine the internal heat load in Watts that must be dissipated.

Step Two

1 m^2 = 11.76 ft^2

Calculate the exposed surface area of the enclosure: 2[(h x w) + (h x d) + (w x d)] ÷ 144 = Area (ft^2).

Step Three

1ºC or 1ºKΔT = 1.8ºF T

Determine the temperature differential by subtracting the maximum allowable temperature inside the enclosure (Ti) from the maximum ambient temperature outside the enclosure (To).

To - Ti = ΔT

Step Four

[Watts ÷ ΔT (F˚)] - [0.22 x Area (ft^2)] = Watts/F˚

Capacity Required BTU/HR. Capacity Rating

Selecting cooling units

- Ascertain the total dissipation loss from the components installed in the switch cabinet. Take into account the simultaneity factor, because rarely are all components in operation at the same time
- Also take the heat radiation from the switch cabinet into account. If T, <Ta, this must also be added to the dissipation loss value
- Now select the necessary cooling unit in accordance with the required refrigeration capacity, ensuring that the cooling capacity of the cooling unit is at least equal to the dissipation loss value. Preferable is a figure 10% in excess of that value

Utilizing characteristic curves for proper selection of a cooling unit

Characteristic curves for all cooling units are available for contacting us. These diagrams allow you to determine the corresponding effective (useful) refrigeration capacity for any temperature. All relevant data for our cooling units result from tests in Pfannenberg's own climatic chamber.

Example:

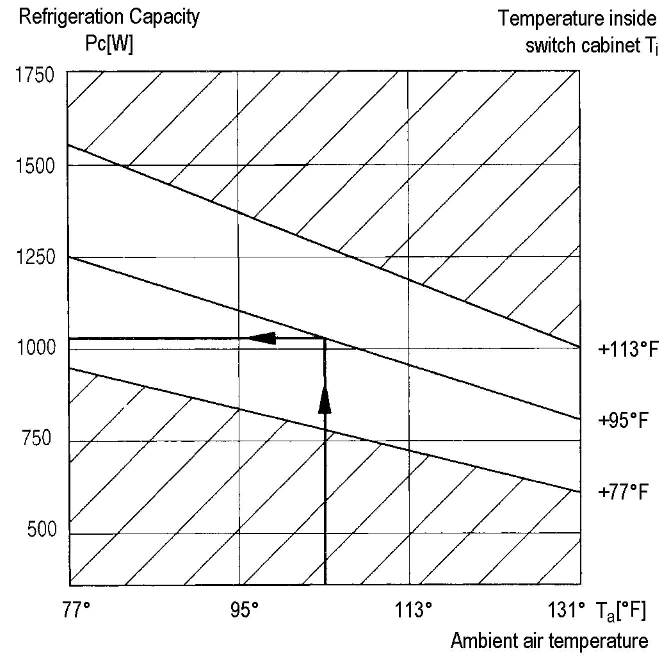
T_a = 104˚F and T_i = 95˚F, where

T_i[ºF]: Maximum admissible temperature inside the switch cabinet. This value reflects the maximum operating temperature of components installed in the switch cabinet. This usually ranges from approx. 95˚F to 113˚F.

T_a[˚F]: Maximum ambient temperature. Temperature at which the switch cabinet is installed.

P_c[Watt]: Refrigeration capacity of a cooling unit. Only the effective or useful cooling capacity is shown.

Go to the known ambient temperature (T_a = 104˚F) and trace a vertical line up to the intersection with 95˚F line. Then trace a horizontal line left of that intersection until it meets with the ordinate (vertical axis). This point shows the refrigeration capacity required. In this example, the following diagram shows that the value is 1040W.



Important information on the utilization of cooling units

- The refrigeration capacity should exceed the dissipation loss from the installed components by approximately ten percent (10%)
- The switch cabinet must be adequately sealed to prevent the inflow of ambient air
- Use the door contact switch to impede operation with open doors and consequent excessive accumulation of condensation
- Use cooling units with a generous clearance between air inflow and air outflow to prevent poor circulation
- Attach the condensate overflow hose included in the package of accessories supplied with the unit
- Make sure that the air inflow and air outflow in the external circuit of the cooling unit circulates satisfactorily to ensure that the thermal energy is released into the ambience
- When using top-mounted cooling units, make sure that components with their own fans do not expel the air directly into the cooling unit's cool air outflow. This counteraction between the two airflows would otherwise substantially reduce the refrigeration capacity and could cause heat pockets.
- Make sure that the switch cabinet stands up straight. Otherwise the condensation cannot drain properly from the top-mounted unit
- Setting the temperature to the lowest setting is not the optimal solution due to condensation issues. The value we have preset on the cooling unit is a sound compromise between cooling the inside of the switch cabinet and the accumulation of condensation

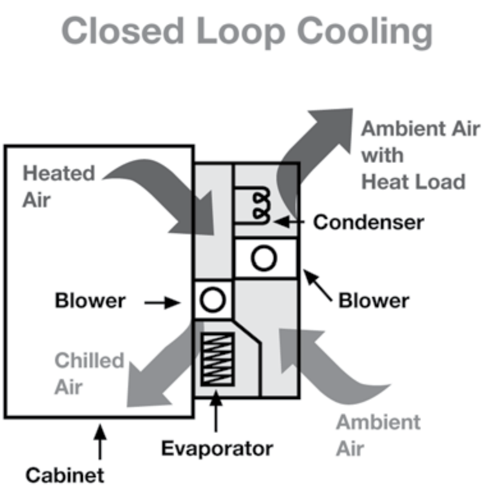


Figure 3

Cooling Control Cabinets

Most electrical & electronic control systems generate substantial amounts of heat during operation. This heat factor intensifies as controls are made more compact, perform more functions, or are placed in more confined areas. Additional problems are encountered when the electronic process control system is located on-site in an industrial setting, as opposed to a clean computer room. For instance, ambient temperatures found in a steel mill can be locally very high. The factory environment can be hostile to the point that performance and effective life of electronic components are materially reduced, or the control system fails completely. Moisture-laden air and airborne particulate matter might be present to adversely affect electronic components, as is true in the paper manufacturing industry or in grain storage facilities.

Our air conditioners are designed to perform reliably under many of these harsh conditions and to provide the cooling and environmental protection required by sensitive electronic production control systems.

Factors affecting model selection

Use this section as a basic outline or checklist of the various conditions to be considered when choosing a cooling unit for a certain application.

The following three factors must be considered when selecting a cooling unit:

1. Internal Heat Load

This is the heat dissipated by electronic controls. It is expressed in watts. One watt equals 3.413 BTU/hr. Thus, to obtain the approximate cooling capacity required to remove a specific heat load, the following formula can be used:

Watts x 3.413 = BTU/hr

For example, a heat load of 800 watts requires an air conditioner capable of removing at least 2,730 BTU/hr

2. Resistance to air flow in the enclosure

Air-flow is measured in cubic feet per minute (CFM). Creating appropriate air flow requires that air pressure be produced by a blower within the air conditioning enclosure. Resistance to blower-produced air flow is created by obstructions within the cabinet's air-flow path. This resistance is called static pressure (SP) and is measured in inches of water column.

The effect of significant resistance in the cabinet's air flow due to static pressure is that it produces a drop in air pressure, or differential, from the air velocity produced by the blower. This reduction in cool air flow will decrease the effective capacity of the cooling unit. So when selecting the proper cooling unit, allowances must be made for static pressure.

3. Heat Load From the Surroundings

Ambient conditions can cause a heat gain in the enclosure. The rated capacity of the cooling unit must be sufficient to handle this heat gain. When evaluating the additional heat load gained from the surroundings, consider the following:

Insulated Cabinet — Normally, well-insulated cabinets will not gain sufficient ambient heat to affect an air conditioner's operation. BTU/hr ratings for our air conditioners have been established at the maximum ambient operating temperature of 125˚F. A substantial improvement in heat removal occurs when operating in ambient temperatures below 125˚F.

Uninsulated Cabinets (most common) — Obviously, this design places more of a burden on the cooling unit. Heat is conducted to the cool side. Thus, high ambient heat will be readily transmitted into the cooler enclosure. To determine the additional capacity required of our air conditioner installed in an uninsulated cabinet, the surface square footage of the enclosure must be calculated to obtain the total effective heat transfer area. For this calculation, use the surface area of the sides, plus the area of the top, and omit the bottom area of the cabinet.

Air movement outside the uninsulated cabinet will increase the heat conducted from the ambient into the enclosure. When there is little or no air circulation outside the cabinet, the layer of air immediately adjacent to the exterior cabinet walls act as an insulating film. Exterior air movement dissipates this insulating layer of air in proportion to the velocity of the air flow. Substantial ambient air circulation will increase the transmitted heat load imposed on the cooling unit. If the cabinet being cooled is not airtight, then high ambient relative humidity will adversely affect the cooling effectiveness of the air conditioner. When humid air infiltrates a poorly sealed enclosure, the air conditioner is required to use up valuable BTU/hr capacity just to condense the moisture from the internal air. Conversely, if the cabinet is well sealed, high ambient relative humidity has very little effect on the heat capacity of the air conditioner.

Why Use a Heater?

Hubbell Wiegmann heater products protect electronic and electrical components from temperature problems that are below acceptable tolerances. There are obvious circumstances when extremely low ambient (outside the enclosure) temperatures would require a heater, but there are also less apparent times that a heater should be considered. For example, a system may run all day having its components generate heat, but once the system shuts down for the night, the quick drop in temperature could cause condensation and possible corrosion — a heater could be used to maintain a safe and constant temperature.

Heater Sizing

Formula for sizing Hubbell Wiegmann enclosure heating products:

$$\mathbf{P_H = (\Delta T \times k \times A) - Pv}$$

Variables:

P_H = Total power required in Watts for application.

ΔT = Difference between the minimum required enclosure interior temperature and the lowest possible exterior temperature, in degrees Kelvin. "DT" can be calculated using the following formula:

$$\frac{(IT) - (ET)}{1.8} = \Delta T \text{ in } {}^{\circ}\text{Kelvin}$$

(IT) – Minimum required enclosure interior temperature [˚F]

(ET) – Lowest possible exterior temperature [˚F]

k = Heat transmission coefficient convection of enclosure material in quiet air.

Painted Steel	0.511 W/(ft^2 ˚K)
Stainless Steel	0.344 W/(ft^2 ˚K)
Aluminum	1.115 W/(ft^2 ˚K)
Plastic (or insulated stainless)	0.325 W/(ft^2 ˚K)

A = Enclosure surface area in ft.^{2} "A" can be calculated by using the following formula (assuming a wall-mounted enclosure):

1((H/12) x (W/12)) + 2((W/12) x (D/12)) + 2((H/12 x (D/12)) = A in ft.^{2}

H = Height of enclosure (in inches)
W = Width of enclosure (in inches)
D = Depth of enclosure (in inches)

Pv = Existing power from installed components (Watts).

Sample with solution:

Required sizing information:

- Wiegmann Painted Steel Enclosure = N12161206 (H = 16", W = 12", D = 6")
- Minimum required enclosure interior temperature in Fahrenheit=50˚F (IT)
- Lowest possible exterior temperature in Fahrenheit = -30˚F (ET)
- Existing components generating 50 Watts (Pv)

$$\Delta \mathbf{T} = \frac{(50) - (-30)}{1.8} = 44.44$$

k = 0.51

A = 2((16/12) x (12/12)) + 2((12/12) x (6/12)) + 2((16/12 x (6/12)) = 4.99

P_H = (44.44 x 0.51 x 4.99) - 50 = **63 Watts** needed to heat the enclosure

Hubbell-Wiegmann cannot assure the safety or effectiveness of any alterations or additions not made by Wiegmann. However, the following information may be helpful. These instructions do not eliminate the need to consult with equipment manufacturers and to observe all regulatory agency procedures and safe practices to assure the proper electrical and mechanical function of Hubbell-Wiegmann products in each particular application.

1 PREPPING CUTOUT AND PUNCHED HOLES

a. All cutouts and punching of holes must be free of burrs and sanded smooth for proper fit of accessories.

b. All holes / bare metal must be painted to prevent rusting of the steel, ensure the U.L. rating of the enclosure, and to maintain the integrity of the enclosure finish.

2 REPAINTING

Contact Hubbell- Wiegmann for the proper replacement, touch up paint.

3 MOUNTING INSTRUCTIONS

a. Wall mounted enclosures have either an internal mounting means or external mounting feet. Proper fasteners must be used in all mounting holes to secure the enclosure to the wall.

b. Floor mounted enclosures have floor stands (legs) which include mounting plates. Proper fasteners must be used in all mounting holes to securely anchor the enclosure to the floor.

4 DOOR CLOSING ADJUSTMENTS

a. Single door (wall mounted)

If the surface on which the enclosure is mounted is not flat, the door may not open and close properly. Also, if heavy equipment is mounted on a large door, the door may sag slightly.

If the top of the door strikes the lip which extends around the body opening, place metal shims behind the mounting foot which is located at the bottom of the enclosure and closest to the door hinge. Place the shims between the mounting foot and the wall or mounting surface. Be sure all mounting screws are tightened securely.

b. Two door (floor mounted)

The overlapping doors are factory-fitted to meet evenly at the top and bottom. If the floor under the enclosure is not level, the doors will not close evenly. In this case, place metal shims under the corners of the enclosure. The enclosure should be bolted in place with the doors closed to prevent tipping when installing shims.

Shims under the right front corner will raise the right door. Shims under the left front corner will raise the left door. It is important that the doors meet evenly to insure a proper seal against liquids and dust. Be sure all mounting bolts are tightened securely.

5 PANEL INSTALLATION

When the interior panel is being installed, it may be necessary to bend one or more mounting studs slightly to permit the panel to fit in place. Simply position the panel on the studs that line up properly and pry the other studs into position with a suitable screwdriver inserted through the panel holes.

4 REMOVING HINGE PINS FROM CONTINUOUS HINGES

This can be a difficult operation requiring one or more people. This procedure is best accomplished by using a small diameter punch to drive the hinge pin toward the bottom of the enclosure. Lay the wall-mounted and floor-mounted or free-standing enclosure on its back side (see note 7 below). When the hinge pin protrudes about two inches below the bottom hinge barrel, bend the end of the pin 1800 so it is shaped like the letter “J”. Use an electric or air powered vibrating hammer fitted with a tool which has a hole in the end to fit over the hinge pin, and drive the hinge pin out while opening and closing the door.

To install the hinge pin, straighten the pin and drive it in with the vibrating hammer while opening and closing the door. Most hinge pins have one end chamfered, so be sure to start the chamfered end first when installing the pin.

7 PRINT POCKET

The print pocket on the door can be mounted in any location or position using the self adhesive strip, or removed entirely.

8 LIFTING ENCLOSURES BY EYEBOLTS

To lift an enclosure which has eyebolts or mounting feet, be sure to use all the eyebolts and top mounting feet provided. Arrange the chains and cables with spreader bars so you are lifting straight up on the eyebolts or top mounting feet.

Eyebolts are used for lifting, shipping, and moving purposes. It is the customers responsibility to ensure that lifting eyes are tightened to maintain proper seal/ NEMA/and UL rating (factory installed rubber washers must be used)