Engineered Polymer Housing

1.1 Overview

An engineered polymer transmitter housing allows a wireless devices' antenna to be located inside the transmitter. This material is widely used within the industry and Emerson branded products. It is the same material used for the Emerson wireless antenna which, as of 2015, had over 4 billion hours of operation in the process industry. The technical specifications in this document outline the material properties and testing performed to ensure a high quality design.

1.2 Material composition

Polybutylene terephthalate (PBT) and polycarbonate (PC) blend that is flame retardant and UV-stabilized, specifically designed for outdoor enclosure applications. The polycarbonate provides excellent impact strength and the polybutylene terephthalate provides chemical resistance.

1.3 Impact strength

Impact testing is done on an enclosure to verify mechanical robustness. The polycarbonate in the engineered polymer housing delivers high impact strength. The impact level used by NEMA® to rate electrical enclosures is 6.8 Joules. This is a 1 Kg steel weight dropped from 0.7m (2.2 lbs from 28 inches).

Impact is usually of biggest concern for polymers at cold temperatures. The requirement for hazardous location approvals is 6.8J at -35 °C (-31 °F). Emerson Polymer housings pass 12J at -35 °C (-31 °F) and exceed the requirement for hazardous location approvals.

The polymer enclosure retains its impact strength over time and exposure to the elements. Impact strength is tested before and after weathering and chemical compatibility testing to verify retention of mechanical properties after exposure.

1.4 Ultraviolet (UV) resistance and weatherability

Most weathering damage is caused by light, heat, and moisture. They often work together to cause more degradation than any one factor alone. The polymer for Emerson device enclosures is a UV-stabilized grade specifically designed for outdoor enclosure applications and is F1 rated per UL 746C. To be F1 rated, Underwriters Laboratories (UL) specifies a 1,000 hr accelerated UV plus high temperature water exposure test to qualify polymer enclosures for outdoor industrial use.

UL results for Engineered Polymer housing:

Test	Result
1,000 hrs accelerated Xenon Arc UV exposure	100% retention of tensile strength
1,000 hrs accelerated Xenon Arc UV plus 7 days water at 82 °C (180 °F)	97% retention of tensile strength

Emerson has done testing on the complete molded enclosure. This testing is 1,000 hour accelerated UV at elevated temperature plus cycles of water spray. Cold impact performance was observed to validate retention of mechanical properties.

Emerson results on actual molded enclosure:

Test	Result
1,000 hrs accelerated Xenon Arc UV exposure	Pass 6.8 Joule impact at -40 °C

Longer duration weathering testing has been done by the resin supplier. The polymer retains greater than 80% of impact strength after exposure to 6,000 hrs of accelerated UV weathering testing.

1.5 Chemical resistance

PBT/PC resins are characterized by their excellent resistance to a variety of chemicals, including aliphatic hydrocarbons, petrol, oils and greases, dilute acids and bases, detergents and most aqueous salt solutions at ambient temperatures.

1.5.1 Chemical compatibility testing

A chemical compatibility test was performed to qualify enclosure materials for hazardous industrial environments. It is a solvent vapor exposure for 150 hrs at 22 ± 5 °C (70 ± 9 °F).

To verify retention of mechanical properties after exposure, hardness is tested before and after exposure. A change of less than 15% is required for a passing result.

Results:

Chemical	Average % change in hardness
Acetone	0%
Gasoline	0.3%
Hexane	-1.0%
Methanol	0%
Ethyl Acetate	-1.5%
Acetic Acid	0.8%

1.5.2 Salt spray testing

Salt spray testing is often done on enclosures to ensure a reasonable service life in a marine environment. A standard 1,000 hr salt spray test was conducted on the polymer enclosure. There was no degradation to the polymer enclosure.

Parts were subjected to and passed an impact of 7 Joules at -40 °C after salt spray exposure to verify retention of mechanical properties. 7 Joule impact is a 1 Kg steel weight dropped from 0.7 m (2.2 lb from 28 inches).

1.6 High-temperature performance

UL has a test that gives a polymer a number called a Relative Temperature Index. It is the upper temperature that a polymer can withstand for a long period of time. It is essentially the temperature at which a polymer can withstand for 60,000 hrs and at the end of that exposure retain 50% of the property measured such as tensile strength or impact strength.

Property	Value
Vicat softening temperature	105 °C per ASTM 1525
Relative Temperature Index, mechanical with impact	120 °C per UL 746

The polymer maximum allowable temperature is well in excess of the maximum allowed electronics temperature of 85 °C (185 °F).

1.7 Enclosure rating

The wireless transmitter is rated to enclosure Type 4X and IP66/67/68.

1.8 Hazardous area approval rating

Emerson wireless instruments with engineered polymer have Intrinsically Safe (I.S.) approvals. Since there are no wires, no I.S. barriers are needed and installation is greatly simplified.

1.9 Weight

Polymer is a lighter weight material creating weight savings. This may be very attractive to offshore oil and gas platforms as wireless reduces the needed wiring infrastructure as well as polymer delivering significant weight savings when compared to stainless steel.

Table 1-1. Wired Pressure Transmitter Weights

Wired transmitters	Aluminum	Stainless steel
Coplanar	2.2 kg (4.9 lbs)	3.6 kg (8.0 lbs)
Inline	1.4 kg (3.1 lbs)	3.2 kg (7.0 lbs)

Table 1-2. Wireless Pressure Transmitter Weights

Wireless transmitters	Aluminum	Stainless steel	Polymer
Coplanar	2.9 kg (6.4 lbs)	4.5 kg (9.9 lbs)	1.9 kg (4.2 lbs)
Inline	2.1 kg (4.6 lbs)	3.7 kg (8.1 lbs)	1.1 kg (2.4 lbs)

As Table 1-1 and Table 1-2 show, you can save 4.6 lbs (2.08 kg) per transmitter by using a wireless polymer device rather than a SST wired transmitter. On average the weight savings in cable, conduit trays and other wiring infrastructure has a much bigger impact.

Global Headquarters

Emerson Process Management
6021 Innovation Blvd
Shakopee, MN 55379, USA
+1 800 999 9307 or +1 952 906 8888
+1 952 949 7001
RFQ.RMD-RCC@EmersonProcess.com

North America Regional Office

Emerson Process Management
8200 Market Blvd.
Chanhassen, MN 55317, USA
+1 800 999 9307 or +1 952 906 8888
+1 952 949 7001
RMT-NA.RCCRFQ@Emerson.com

Latin America Regional Office

Emerson Process Management
1300 Concord Terrace, Suite 400
Sunrise, Florida, 33323, USA
+1 954 846 5030
+1 954 846 5121
RFQ.RMD-RCC@EmersonProcess.com

Europe Regional Office

Emerson Process Management Europe GmbH
Neuhofstrasse 19a P.O. Box 1046
CH 6340 Baar
Switzerland
+41 (0) 41 768 6111
+41 (0) 41 768 6300
RFQ.RMD-RCC@EmersonProcess.com

Asia Pacific Regional Office

Emerson Process Management Asia Pacific Pte Ltd
1 Pandan Crescent
Singapore 128461
+65 6777 8211
+65 6777 0947
Enquiries@AP.EmersonProcess.com

Middle East and Africa Regional Office

Emerson Process Management
Emerson FZE P.O. Box 17033,
Jebel Ali Free Zone - South 2
Dubai, United Arab Emirates
+971 4 8118100
+971 4 8865465
RFQ.RMTMEA@Emerson.com

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Process Management