



Totally Focused. Totally Independent.

Technical Guide

# Insulation Protection Systems

Guida Tecnica

## Sistemi di protezione degli avvolgimenti



The world's largest independent  
producer of synchronous  
alternators 1 – 5,000kVA



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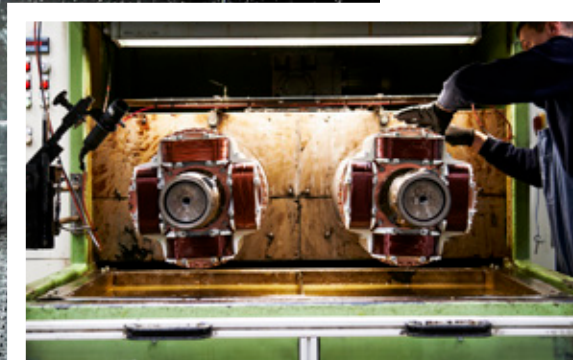
## 1. INTRODUCTION

Mecc Alte is using only premium class H insulation material. Impregnation processes are achieved with the latest impregnation technologies, like Vacuum Pressure Impregnation (VPI) or with the use of dedicated roll and dip or trickle machines. The impregnation process is undertaken twice in the main stator, which assures the best quality for the final customer.

This premium impregnation quality process is perfect for the vast majority of applications, however in order to achieve the same results in insulation reliability when environmental or operating conditions are demanding, it is possible to consider one of the additional protection systems offered by Mecc Alte.

Demanding environmental condition should be considered where:

- There is a high humidity [ $>95\%$ ]
- There is salty atmosphere [marine applications]
- Atmosphere is polluted with some abrasive elements [dust, solid particles]
- Atmosphere is polluted with some chemical aggressive elements [incombustible diesel particles, acids]



Demanding usage applications are those such as:

- Rental
- Automotive/Truck
- Rail
- 24/7 ground or marine
- Power converters reflecting high voltage spikes to the generators

The bigger the size in kVA of the alternator, the bigger the importance of the environmental and the usage conditions with the related protection system on the generator. Please contact a Mecc Alte representative to be guided in the right protection system selection to suit your application.

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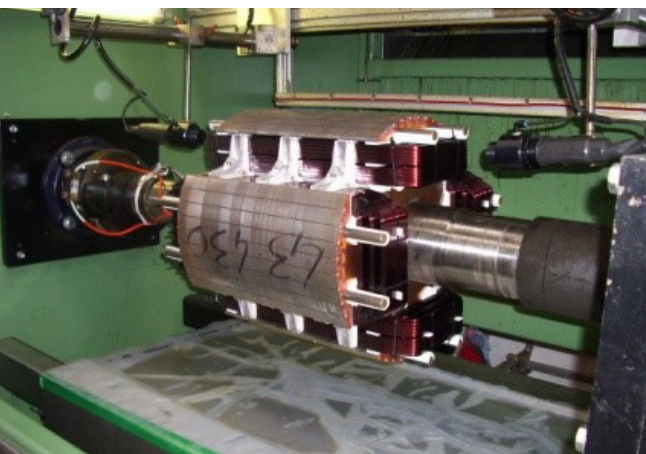
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## 2. INSULATION RESINS AND PROTECTION VARNISHES

Mecc Alte is using the same high quality polyester resin for the impregnation of all the relevant active electrical components. Main stators are impregnated twice. After the impregnation

process is completed, a further protective varnish layer can be applied by dip or by spraying; the two varnishes that can be used are the grey EG43 or the black severe environment protection.



### 2.1 Insulation Resin

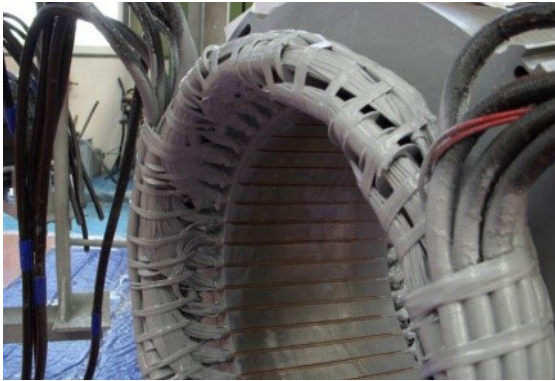
The high quality bi-component insulation resin used from Mecc Alte, is a polyester specially developed to be used in vacuum impregnation or dip/ and trickle machines. It does have superior bond strength characteristics, high chemical and moisture resistance and is suitable for uses up to 212° C.

### 2.2 Grey Varnish EG43

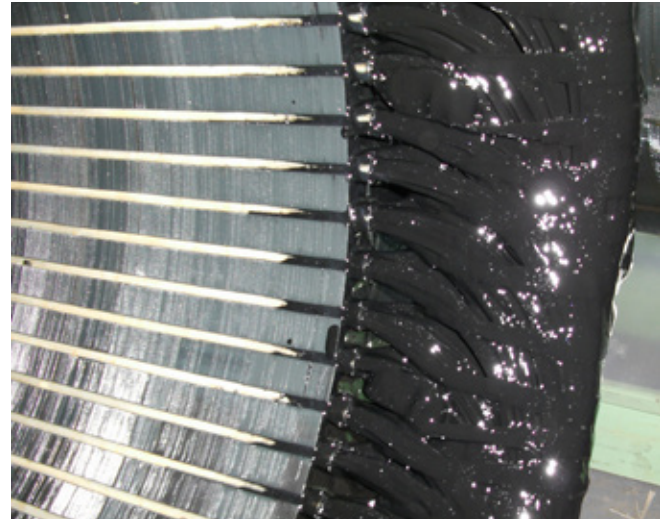
The EG43 grey varnish, is an high temperature insulating enamel that forms a tough and flexible film, with excellent moisture and chemical protection. It is water and oil proof, and also protects windings from abrasion. It is applied

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spraying an over coating layer over the impregnated winding, or dipping the stator in a varnish barrel for superior treatments.



### 2.3 Black Severe Environment Protection.

The black severe environment protection is a system that makes Mecc Alte special. It is the ultimate winding treatment that offers truly superior performances when the environment is severe, or the application very demanding. It is a protection treatment used to replace epoxies and silicones winding encapsulation.

The black protection cures to a tough, resilient, black coating that seals the copper against moisture and

chemical attacks. Due to its encapsulation capability and durability, is also extremely resistant to the particle abrasion as it adsorbs the impacts. Moreover, this leads to a long-trouble less life protection, as the protection layer follows elastically the thermal expansion cycles of the windings from the cold to the hot condition and vice versa without forming any cracks.

## 3. PROTECTION SYSTEMS

### 3.1 Protection level: STANDARD

The Standard protection level is referred to a generator which has the sole impregnation resin applied to all the active parts. It should be noted that this level is standard on the Mecc Alte ECP3 generator series: voltages from turn to turn in this series are never dangerous for the insulation life, resulting in no need to apply any additional protection varnish.

### 3.2 Protection level: STANDARD +

With the Standard + protection system in addition to the usual impregnation resin, the stator exciter is protected with a further layer of grey varnish EG43. Stator exciter is protected because it is the first active part that is cooled from the air cooling flux. The ECP 28, and ECP 32 series are built with this protection level as a standard.



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### 3.3 Protection level: GREY

With the grey protection level, not only the exciter stator is coated with the EG43 but also the main power stator. This protection level, which is available as an option on some families and as a standard on some others, is the standard for the marine and nearly all the most demanding application. Main and exciter stator grey EG43 coating is usually sufficient to protect the windings, as all the rotating machine parts are subjected to much lower voltages and are cleaned centrifugally from the moisture and contaminating particles that could corrode the copper enamel. This level is the Mecc Alte standard for ECP 34, ECO 38, ECO 40, ECO 43 and ECO 46 families



### 3.4 Protection level: GREY+

The Grey+ protection level is available as an option on the whole industrial range. With this protection level, the main stator is coated with the grey EG43 varnish and the exciter stator is upgraded to have the black severe environment protection. This acts as a physical barrier to moisture particles and chemical substances on this part.



### 3.5 Protection level: TOTAL+

The Total+ protection level is available as an option on the whole industrial range. It is the ultimate solution to be used when the application or the environment is abusing the insulation of the generator. With this protection level, the grey EG43 varnish on main and exciter stator is upgraded to a black severe environment protection. In addition all the active rotating components have an overcoat of the grey varnish EG43. The black protection acts as a physical barrier to moisture particles and chemical substances and is so protective it can limit the main stator capability to dissipate heat: this means that on some specific models a 3% derate is applied on the nominal power. Please refer to the ratings guide in paragraph 10 of this handbook for output adjustments. Before selecting this protection level, please be in contact with a Mecc Alte representative as most likely the Grey or the Grey+ protection levels are going to be adequate for the vast majority of applications.





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### 4. PROTECTION LEVEL SCHEMATICS

The following schematics describes the protection level offered as a standard versus the Mecc Alte generator family.



MODEL	Protection Level: STANDARD	Protection Level: STANDARD +	Protection Level: GREY	Protection Level: GREY+	Protection Level: TOTAL +
BTP/ECP 3	STANDARD	ON REQUEST	ON REQUEST	ON REQUEST	ON REQUEST
LT3			STANDARD		
ECP/ECSP 28		STANDARD	ON REQUEST		
ECP/ECSP 32					
ECP 34					
ECO 38					
ECO 40					
ECO 43					
ECO 46			STANDARD		
HCP 3					
HCP 32					
HCP 34					
HCO 38					

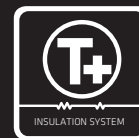
The presence of IP23+, Air Inlet Filters and/or IP43 & IP45 protection available from the Mecc Alte option list, will also influence the protection level necessary for the application requirement or environmental condition.

Please contact a Mecc Alte representative to be guided in the right protection system selection that suits your application.



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## 5. TOTAL+ LEVELS INDUSTRIAL RATINGS

MODEL	50Hz		60Hz	
	125/40 (cl.H)	105/40 (cl.F)	125/40 (cl.H)	105/40 (cl.F)
ECP3-1S/4	6,5	6	7,8	7,2
ECP3-2S/4	8	7,5	9,6	9
ECP3-1L/4	11	10	13,2	12
ECP3-2L/4	13,5	12,5	16,2	15
ECP3-3L/4	15	14	18	16,5
ECP28-1VS/4	7,8	7	9,4	8,5
ECP28-2VS/4	11	10	13,2	12
ECP28-0S/4	13,5	12,5	16,2	15
ECP28-S/4	17	16	20,4	19
ECP28-M/4	20	18,5	24	22
ECP28-2L/4	25	23	30	27,5
ECP28-VL/4	29	25	35	31
ECP32-2S/4	35	33	42	40
ECP32-3S/4	40	37	48	46
ECP32-1M/4	50	48	60	58
ECP32-2M/4	60	57	72	69
ECP32-3L/4	72	64	87	80
ECP32-4L/4	78	69	93	85
ECP34-1S/4	85	77	102	92
ECP34-2S/4	105	95	126	114
ECP34-1L/4	130	118	156	141
ECP34-2L/4	150	136	180	163
ECP34-3L/4	155	141	186	168
ECO38-1S/4	180	170	220	205
ECO38-2S/4	200	185	240	220
ECO38-3S/4	225	207	270	250
ECO38-1L/4	250	230	300	280
ECO38-2L/4	291	267	349	320
ECO38-3L/4	340	310	407	373
ECO40-1S/4	400	370	480	440
ECO40-2S/4	450	410	540	490
ECO40-3S/4	500	450	600	540
ECO40-1L/4	550	500	660	600
ECO40-1.5L/4	601	543	722	652
ECO40-2L/4	660	611	792	733
ECO40-VL/4	698	640	839	776
ECO43-1S/4	800	730	960	870
ECO43-2S/4	930	850	1116	1020
ECO43-1M/4	994	921	1212	1105
ECO43-2M/4	1116	1018	1358	1261
ECO43-2L/4	1261	1164	1513	1397
ECO43-VL/4	1358	1242	1649	1494
ECO46-1S/4	1455	1310	1746	1571
ECO46-1.5S/4	1601	1436	1921	1727
ECO46-2S/4	1746	1552	2095	1862
ECO46-1L/4	2037	1843	2444	2212
ECO46-1.5L/4	2231	1989	2677	2386
ECO46-2L/4	2425	2183	2910	2619
ECO46-VL/4	2716	2425	3308	2958

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### 6. PROTECTION MATRIX

The life expectancy of a wound assembly will be heavily affected by its operating temperature and like most alternators the Mecc Alte is designed for Class H 180°C maximum. Operating at these levels continuously would have noticeable dielectric degradation after 20,000 hours. Lower operating temperatures extend life such as Class F (155°C) to 120,000 hours and Class B (120°C) to 640,000 hours (UL advice). Operating security must be considered when deciding which to select.

**After this there are other factors to be considered:**

Vibration related in terms of isolation from external vibration (engine/vehicle/drive train), torsional compatibility (harmful resonances imposed by engine or natural frequencies of the connected environment

Voltage spikes or current surges generated by the connected load. Large spikes may bridge the insulation system and erode the dielectric strength of the insulation system!

Air borne contamination including solid particles, dust, water and any active elements within either i.e. chemical, saline etc. Mecc Alte use the latest technology in both impregnation processes and resins together with ingress protection from IP23, IP23+, IP23 with inlet filters, IP45 to IP54, although some applications may require a more cost effective approach rather than higher IP rating but a protection for the windings once the potentially harmful foreign bodies are already within the machine! The list below discusses the options and applications supplied by Mecc Alte:

		Winding Insulation Coating & other Notes				
		STANDARD	STANDARD+	GREY	GREY+	TOTAL+
		Dew (anti-condensation) heaters recommended where relative humidity is >60%				
For use in / to protect against	Temperature controlled environments / modest levels of humidity	Temperature controlled environments / modest levels of humidity	Marine standard protection for humidity ≤95%		High humidity [>95%]	
	safe/clean environments with zero aggressive elements	Safe/clean environments with zero aggressive elements	In continuous operation, the rotor is okay without added coat, but the stator has EG43 added for light moisture	In continuous operation, the rotor and stator have EG43 added. More suitable where the enclosure / building / site have little protection for the air ingress	Salty atmosphere (coastal or exposed marine) arising corrosion and hygroscopic attraction compromising the insulation	
				Light aggressive content i.e. saline	Other corrosive elements i.e. chemical, methane etc	
			Resistance air borne contaminants potentially causing tracking on live components			
		Possibility of small airborne particles in light volumes	Possibility of small airborne particles in light volumes	Possibility of small airborne particles in light volumes	Airborne solid particles i.e. dust, sand, crushed rock	
	Typical Applications (Non-exhaustive)	Industrial light duty	Industrial light duty	Marine	Marine	Rental
Standby / clean / dry environment		Standby / moderate clean environment	Static canopied genset	Static canopied genset	Vehicle Mounted	
Standby / clean / dry environment		Continuous / moderate clean environment	Continuous / Standby	Continuous / Standby	Continuous / Standby	
					Rail	
					RTCC	
					Coastal location or marine exposed	
				Chemical/corrosive		

**Note** that the installation and application should be such that airborne dust, dirt, debris, water and any other contaminants are prevented from reaching the alternator air inlet. Air ingress to the alternator should NOT be direct and systems incorporated to divert (baffles with multi 90° air turns) air before entry to the alternator - preferably through coalescent filters if practicable. Such systems to have drain facility to eject the vast majority of harmful products. Note that the increase in IP on the alternator can offer this independently with associated derates.

**Note** that the canopy, container or engine room should have sufficient ventilation in static condition to allow passive airflow thus reducing condensation following generator operation.

**Note:** Pooling of water beneath the alternator should be avoided by design as high turbulence within the genset enclosure would allow the water to enter the alternator together with the contaminants such as fuel/oil in the bottom of the enclosure. This gives a sticky tracking path where insulation may already be compromised.

**Note:** For high humidity we recommend the heaters fitted within the alternator. Additionally, after hot runs and shutdown, the enclosure micro-climate will generate humidity. The recommendation is that the enclosure itself has a heater installed - say 2kW set to operate once the genset has stopped - if power is available onsite!

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