RCA Cathode Coatings

Emissive coatings are applied to filamentary- and unipotential-type cathodes of electron tubes to provide electron emission at relatively low temperatures and currents. Purity of coating components is of extreme major importance in obtaining uniformity of end results. Not only are RCA coating materials tested daily, but only those lots which measure up to standard are blended for maximum uniformity.

High emission and suitable application characteristics are realized by choosing raw materials with the utmost care, and by crystallizing the appropriate form, size, and composition of the carbonates. The formulation of the spray, including the choice of binder and solvent balance in spray coatings, is highly important.

Prior to 1928, mixed single carbonates of barium and strontium were principally used. In that year, engineers succeeded in co-precipitating a double carbonate of needle-type crystalline structure. This material gave substantially improved emission. Shortly thereafter, a triple carbonate was crystallized in spherulitic form. Since then, extensive research at RCA has made available a wide variety of coatings suitable for numerous applications.

Most emissive coatings comprise carbonates of the alkaline-earth metals, barium, strontium, and calcium. These carbonates are converted to oxides by thermal decomposition during electron tube processing. Following conversion, the cathode is "aged" by gradual heating to induce formation of the free alkaline-earth metal.

The choice of which carbonate to use is dependent upon cathode requirements such as electrode spacing, peak emission, and arc prevention. Crystal structure, composition, and particle size are varied as required to meet the cathode specifications. Durability and mechanical structure of coatings are important factors affecting chipping and peeling. Ease and economy of application must also be taken into consideration.

The drag process and the spray process are the two main methods used to apply carbonates to filamentary or unipotential-type cathodes. The following listings under sections 1 and 2 are representative; for other cathode coating materials, refer to the appended tables.

1. **DRAG PROCESS.** A water suspension of carbonates is used.

RCA Code 14-C22-15 is designed for drag-coating ribbon; its small particle size promotes good adherence to base metal.

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DRAG-PROCESS COATING MATERIALS

RCA No.*	Used for	Coating Finish
33-C-116	Fine Wire Filaments	Med. Heavy Med. Smooth
14-C22-2	Ribbon	Med. Heavy Med. Smooth
14-C22-15	Ribbon	Med. Heavy Med. Smooth

* Water suspension of carbonates.

DRY POWDERS

RCA No.	Type	Crystal Structure	Used in RCA Coating Material
33-C-41	Double precipitated	Needle structure	33-C-80, 14-C22-3, 33-C-125
33-C-130	Triple precipitated	Needle structure	33-C-131, 33-C-132, 33-C-138
33-C-42	Triple precipitated	Spherulitic structure	33-C-118, 33-C-116
33-B-1	$BaCO_3$		14-C22-2, 14-C22-15, 33-C-144
33-S-1	$SrCO_3$		14-C22-2, 14-C22-15, 33-C-144

SPRAY-PROCESS COATING MATERIALS

RCA No.*	Method of Spraying	Density of Coating	Speed of Drying	Rate of Decomposition on Exhaust	Coating Finish
14-C22-3	Hand or Machine	Low	Fast	Fast	Rough
33-C-80	Hand or Machine	Med.-Low	Medium	Med.-Fast	Med.-Smooth
33-C-132	Hand or Machine	Med.-Low	Medium	Medium	Medium
33-C-138	Hand or Machine	Low	Med.-Slow	Med.-Slow	Med. to Med.-Rough
33-C-131	Hand	Medium	Slow	Med.-Slow	Med.-Smooth
33-C-118	Hand	High	Slow	Slow	Smooth
33-C-144	Hand	Very High	Slow	Slow	Very Smooth

* Suspension in organic vehicle.

RCA coatings have been engineered for optimum performance. Manufacturers will receive prompt and courteous assistance in choosing the proper coating materials for their requirements.

2. SPRAY PROCESS. Carbonates are suspended in an organic binder.

a. Fast dry sprays are well adapted to machine spraying, but should not be used for high-density wet applications. This class gives a very fluffy coating from which high emission is easily obtained; they are easy to outgas.

RCA Code 33-C-80 is especially useful on crimped-ribbon filaments used in mercury-vapor rectifier tubes.

b. Medium dry sprays give a medium-low-density coating in which the carbonates decompose readily; they are resistant to poisoning effect. Overall emission is excellent. Effect of room temperature and humidity during spraying is not pronounced.

RCA Code 33-C-132 is a general-purpose spray having small particle size and is well adapted to machine spraying.

RCA Code 33-C-138 is similar to 33-C-132 but contains extra binder to promote adherence where this is an important factor. The coating is very rugged, but requires slightly higher cathode temperature than 33-C-132 to decompose the carbonates.

c. Slow dry sprays give a high-density coat, smooth surface, and are little subject to poisoning. They are particularly suitable for tube types having close electrode spacing. The denser the coating, the slower is the rate of breakdown of the carbonates on exhaust.

RCA Code 33-C-131 is especially suitable for hand-spray, and does not peel under normal receiving tube conditions, even when sprayed wet.

RCA Code 33-C-118 is used where spacing requirements are so stringent that 33-C-131 is not indicated. Less barium is vaporized at high cathode temperatures.

RCA Code 33-C-144 is recommended where prevention of arcing is extremely important, or where vaporization of barium in uhv tubes is troublesome.

Dry powder is also available for mixing with an appropriate binder to obtain spray coatings. Its principal advantage is ease of shipment to large-volume users who have suitable mixing equipment.

RCA Code 33-C-130 is a triple co-precipitated carbonate powder for suspension in one of the following binders:

RCA Code 33-B-109 binder yields the 33-C-131 coating;

RCA Code 33-B-110 binder yields the 33-C-132 coating.

REFERENCES

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