Base Materials

FOR OXIDE-COATED CATHODES

Cathodes are classified as unipotential and filamentary types. Unipotential cathodes are of the coated type, as are most filamentary cathodes. The coating is a layer of oxide, generally a combination of barium and strontium oxides. Proper conditioning of the coating to obtain satisfactory electron emission depends to a large extent upon the composition of the base metal.

Coated cathodes are operated in a temperature range of 700-850° C; their electron emission and life are functions of the operating temperature. Barium is obtained through reduction of BaO by an active reducing agent in the base metal. Reduction proceeds continuously during operation of the tube through contact of reducing agent and oxide layer.

Manufacturing processes and operating conditions are adjusted to produce a barium surface that is maintained throughout tube life. Too much or too little barium is undesirable. Initial production of barium occurs in the later stages of tube manufacture and then continues for the life of the tube.

While barium is being released, various compounds are being formed; these compounds accumulate at the interface between coating and base metal if the latter is the source of the active reducing agent. This accumulation of inactive compounds affects electron emission. Consequently, to insure good emission and long life, it is important that the composition and treatment of the base metal be so chosen that the reaction between the base metal and the BaO is adequately controlled.

Base materials for unipotential cathodes fall into active, normal, or passive classes; each class derives its properties from the amount of reducing agent which it contains. RCA has developed several base metals which are designed to release barium at the proper rate for each class of application.

For general application, the active grade is preferred. The passive grade is used in tubes which operate with relatively hot grids and in which grid emission might otherwise be appreciable. The normal grade with intermediate activity is applicable to certain in-between types. The less active base metals are more difficult to process for good initial emission.

Each grade of activity thus has its own field of application, and to some extent one grade can be replaced by another; however, replacement usually requires an adjustment of exhaust or aging schedules.

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RCA selects reducing agents with great care to insure that adequate emission is obtained easily and quickly after manufacture without production of excess barium to cause possible grid emission or electrical leakage. To assure continued emission during tube life, RCA uses one or more activating agents that diffuse slowly to the surface and renew the barium by chemical reduction of the BaO as the barium is lost or consumed. Accordingly, a proper balance of activating materials is important.

Filamentary-type cathodes for low-drain battery application involve the same considerations as unipotential-type cathodes in the production and control of emission. In addition, it is necessary to control electrical resistance and hot tensile or creep strength. It is essential that the hot strength have a high value to allow appreciable hook tension and make possible a construction which is less likely to be microphonic.

Certain ribbon types of filaments must have high resistivity to meet specified tube parameters and to achieve high hot strength. To realize these objectives, additional elements are used which do not interfere with electron emission, but which give the filament considerable hot strength.

Grades, compositions, and designations of RCA base materials for oxide-coated cathodes are listed in the following left-hand table:

FOR UNIPOTENTIAL CATHODES				
Form	RCA Designation			
	Active	Normal		Passive
Seamless Lock Seam	N19 N34	N18 N109		N81
Form	FOR FILAMENTARY CATHODES RCA Designation Application			
	General	Vac. Rect.	Hg Rect.	Miniature
Ribbon Wire	N9	N91	N97	N100

COMPARISON OF FILAMENTARY CATHODES OF OTHER MANUFACTURERS	
Other Manufacturer's Designation	Similar RCA Designation*
Sigmund Cohn No. 210	N9
Konel	N97
Cobanic	N97
Hilo	N97
Modified Hilo	N97
Tensite	N100
Sigmund Cohn No.213,225	N100

* Slight modification of filament weight may be necessary because of differences in physical properties of filament compositions.

As shown in the left-hand table above, RCA manufactures four types of filament wire, designated as N9, N91, N97, and N100.

N9 is a Grade-A nickel modified to obtain high electron emission. It is used in general applications which require low-resistivity filaments.

N91 has greater hot strength and resistivity than N9; it is used in vacuum rectifiers, and is particularly resistant to peeling of coating in the finished tube.

N97 has still greater hot strength and resistivity than N91 and finds its most extensive application in large rectifiers, especially in mercury rectifiers using crimped or edge-wound filaments.

N100 has high hot strength and is used for fine round filaments in miniature types.

The right-hand table on the previous page gives some useful information on RCA filament material in comparison with the materials of other manufacturers.

RCA materials for oxide-coated cathodes have been engineered for optimum performance. Manufacturers will receive prompt and courteous assistance in choosing the proper materials for their requirements.

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