NASA TECH BRIEF

Goddard Space Flight Center

Glass Technology Involved in the Manufacture of Magnetometer Components

The problem:

The present glass technology for magnetometer source lamp and absorption cell fabrication requires involved vacuum processing and has problems in sealing procedures.

The solution:

New glass technology has developed quicker and less costly techniques in sealing and vacuum processing which result in improved lamps and bulbs. These, in turn, produce a less costly and more reliable instrument package.

How it's done:

The 1 cm diameter light source bulbs are made from Corning 7740 Pyrex glass. Bulbs of smaller diameter were found to have measurably shorter operating life times; due, probably, to diffusion of the inert gas into the glass. The bulbs are fabricated by splicing a 7 mm o.d. tube to a 3 mm o.d. tube. The tubes are cleaned thoroughly, soaked in a dichromate solution for 12 hours, and rinsed with distilled water. The tube is then set in a precision glassblowing lathe and heated at the 3 mm end to close the tube. A 1 cm bulb is then blown in the sealed end. The bulb is then flame annealed in an oven without forced air, cooled, and rinsed with pure ethyl alcohol.

Fabrication of absorption cells presents the problem of sealing the lens on one end of the cell without distortion. The construction of the cell body and sealing the flat window are standard procedures. In sealing the lens, certain preparations and techniques are required. The lens is standard, but the lens edge is stepped 3 mm in from the inner edge. The mating end of the cell is beveled approximately 45° on the inside diameter to a feather edge to accommodate the lens. The lens and cell are aligned in the lathe and the sealing area preheated to a temperature to allow a very sharp flame to fuse the glass only where the lens and tube join. The configuration results in the molten glass flowing only at the feather edge allowing a permanent bond without endangering the lens surface. The cell is then placed in an annealing oven preheated to 560°C (1040°F). The end plate is normally sealed, and the cell is again oven annealed.

Sealing of the bulbs or cells to the vacuum system is accomplished using a flow of dry nitrogen gas for cleanliness and to prevent moisture from entering the system. A cesium ampule is sealed below the bake-out area and submerged in water to eliminate any metal migration during preliminary processing. The system is then rough pumped and checked for leaks. Next the diffusion pump is activated for the desired vacuum ($2X10^{-7}$ mm Hg). The unit is then baked at 325°C for 24 hours. After cooling, the unit is surrounded by liquid nitrogen. The cesium ampule is broken, and the metal is distilled into the cells or bulb. When the desired amount of metal is collected in the unit, the diffusion pump is closed, and the unit is back filled with the buffer gas. When the required pressures are obtained, the units are tipped off and are ready for testing.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Code 207.1
Greenbelt, Maryland 20771
Reference: TSP72-10132

Patent Status:

This is the invention of a NASA employee and a patent application has been filed. Inquiries concerning license rights may be made directly to the inventor, Mr. George Bergen of Goddard Space Flight Center, Greenbelt, Maryland 20771.

Source: G. Bergen
Goddard Space Flight Center
(GSC-11283)

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