TYPES 177 AND 180 GLASS TUBING

GENERAL ELECTRIC COMPANY
LAMP COMPONENTS DIVISION
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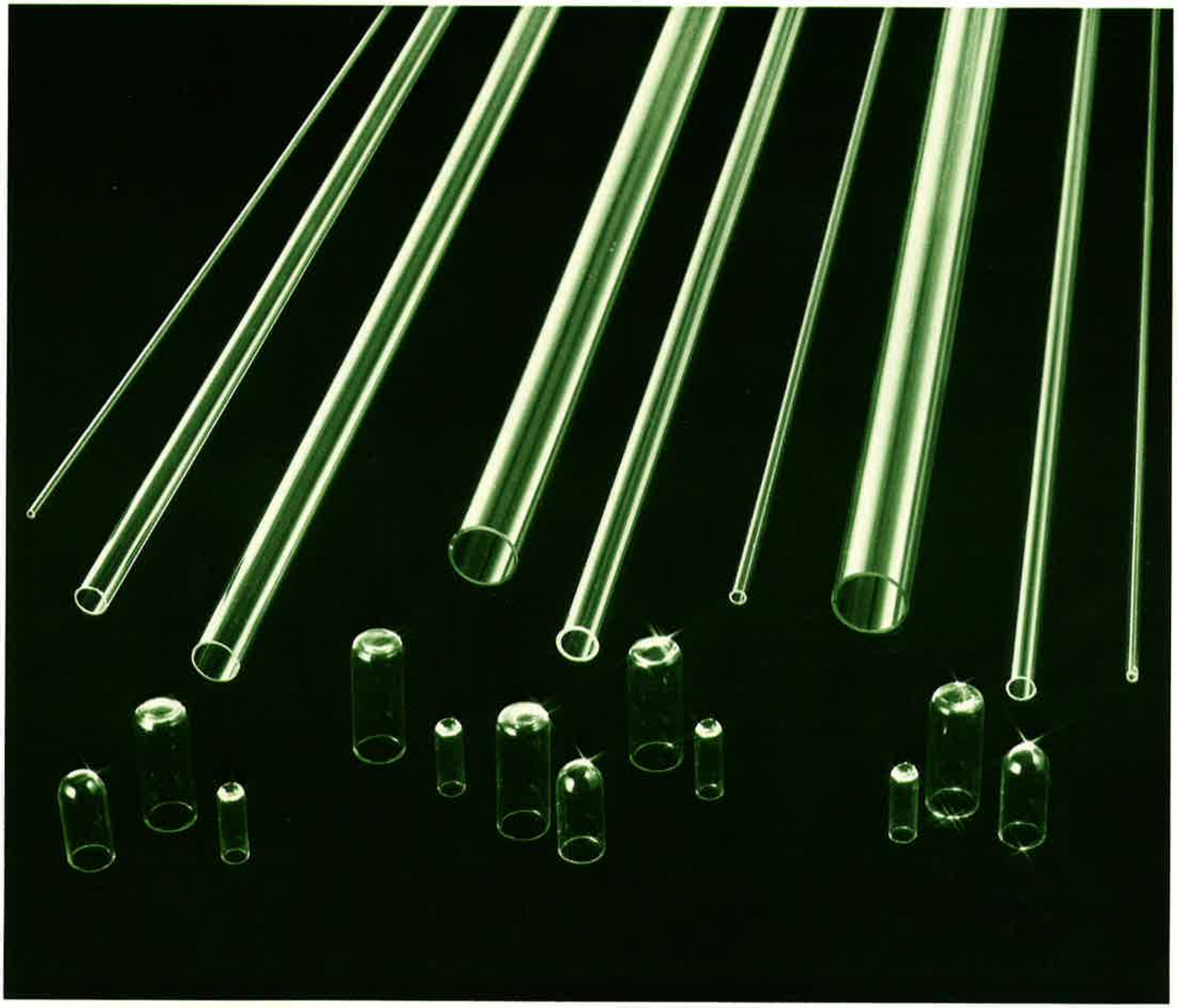

In the manufacture of halogen regenerative cycle lamps, glass used for the envelope must bridge the gap between quartz and common glass, combining desirable qualities of both materials. General Electric Types 177 and 180 Glass Tubing have been designed to meet the demands of this application.

Type 177 was developed for sealing with tungsten leads; 180 for molybdenum leads. Both glasses exhibit desirable purity and strain points (see "Design Considerations"). They have thermal expansion/contraction characteristics and softening points which are suited to the requirements of conventional lampmaking.

Compared to materials now in use for halogen cycle lamps, 177 and 180 are less costly and can offer important advantages in manufacturing.

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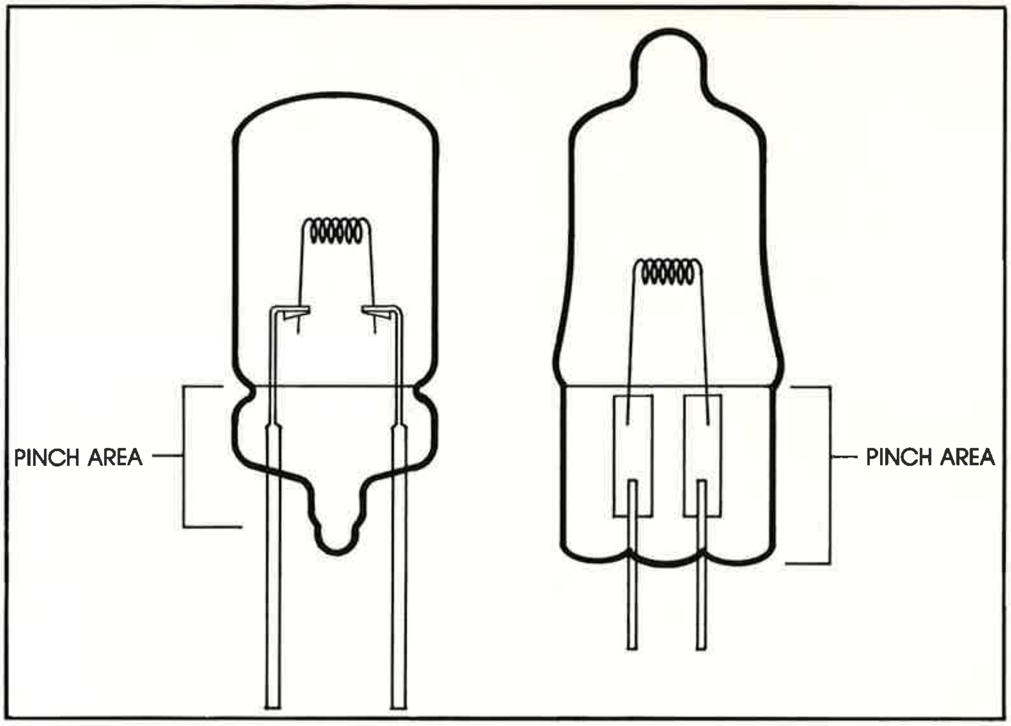


This illustration of the two types of typical halogen cycle lamps, the one on the left employing General Electric aluminosilicate glass and the one on the right using fused quartz or 96% silica glass, can be used to compare the merits of the two materials. With these GE aluminosilicate glasses, lead wires can be single lengths or two part round leads with one weld per lead, rather than assemblies of wire and foil necessitating two welds per lead. The pinch area is also much smaller with the new GE glasses, and the exhaust seal can be located at the bottom instead of at the top or side of the lamp. Use of foil leads and the high temperatures required with quartz or 96% silica glass make location of the exhaust seal at the bottom difficult if not impossible.

GLASS FOR HALOGEN CYCLE LAMPS

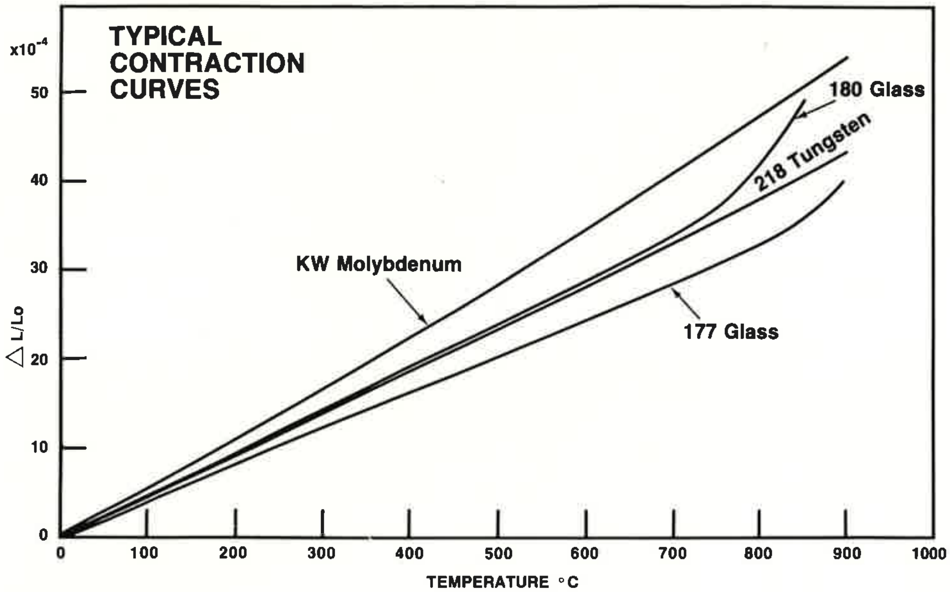
In an ordinary incandescent lamp, the tungsten "boils" off the filament and deposits on the relatively cold wall of the glass bulb. This puts a limit on the filament temperature and/or the life of the lamp and leads to gradual degradation of the light output through darkening of the glass bulb. Introduction of a halogen gas into the lamp atmosphere implements the so-called regenerative cycle whereby the evaporated tungsten combines with the halogen and is returned to the hot filament where the tungsten is redeposited and the halogen is released for repetition of the cycle. This regeneration makes possible lamp designs with higher efficiency or longer life, or a combination of both these desirable characteristics. It also virtually eliminates bulb wall darkening.

In the past, fused quartz or 96% silica glass have been used for this application. Both have temperature tolerance far in excess of that required to maintain the halogen cycle.

However, both fused quartz and 96% silica glass have shortcomings which adversely affect both cost and design flexibility of the lamp. These include their relatively high cost; their very low thermal expansion, which requires the use of special foil lead-in wires; and their high working temperatures, which require very high bulb-forming and sealing temperatures.

Types 177 and 180 aluminosilicate glasses were developed to overcome these shortcomings. Both glasses have operating temperatures which are high enough to support the tungsten-halogen cycle, and are virtually free of impurities which might interfere with the cycle. They exhibit forming temperatures which are desirable in the lampmaking process, and they have thermal contraction characteristics suitable for sealing with lead wires, either tungsten or molybdenum, commonly used in regenerative cycle lamps.

The relationship of contraction curves (see chart) permits the use of conventional glass sealing methods and presents four definite advantages in lamp manufacture. First, the lower cost of the wire lead-in compared to foil; second, the well established method for glass sealing with round wire; third, the better mount control contributed by the rigidity of a wire lead compared to foil; and fourth, elimination of the two extra welds per lamp which are required when sealing with foil leads.



Glass expansion coefficients are normally given for the temperature range 0-300°C. However, understanding of stresses in glass-to-metal seals requires knowledge of the contraction coefficients of the materials from the setpoint of the glass to room temperatures.

MOLYBDENUM SEALING TYPE 180 GLASS

Type 180 glass has a strain point that approaches that of 96% silica glass. Its softening point, however, is approximately 510°C below that of 96% silica glass, suggesting sizeable economies in lamp manufacture.

TUNGSTEN SEALING TYPE 177 GLASS

Type 177 glass is a higher temperature glass than Type 180. It offers a design advantage in that smaller, more compact lamps with tungsten leads can be manufactured. Because of its lower thermal expansion, this glass is also more heat-shock resistant. However, it does require somewhat higher temperatures in lampmaking than Type 180, but still about 400°C lower then 96% silica glass.

COMPARATIVE DATA

The properties of Types 177 and 180 aluminosilicate glass tubing compared to other materials currently used or being contemplated for use in halogen cycle lamps:

	GE TYPE 177**	GE TYPE 180**	FUSED QUARTZ***	96% SILICA GLASS***	GE TYPE 174**	GE TYPE 172**
Softening Point °C	1130	1020	1670	1530	940	915
Anneal Point °C	865	805	1140	1020	710	715
Strain Point °C	805	755	1070	890	670	670
Expansion (0-300°C) cm x 10^{-7}/cm/°C	38	43	5.5	7.5	43	42
Density (gms/cc)	2.70	2.68	2.20	2.18	2.65	2.53
Electrical Resistivity (Log_{10} ohm x cm @ 250°C	12.2	12.7	11.8	9.7	12.4	10.8
@ 350°C)	10.5	11.1	10.2	8.1	10.8	9.8
Reboil Rating*	9	8	10	10	5	2

*On a scale 1-poor to 10-excellent
**Published values, subject to normal manufacturing variations.
***Typical values

TABLE OF SIZES

Listed below are some typical sizes with indicated tolerances on diameter and wall thickness. Other sizes are available on request.

TYPICAL SIZES

Tubing Designation	Metric (mm) O.D.		Metric (mm) Wall	Nominal Meters Per Kilogram
1.9	1.78- 2.03	×	.30- .41	215
2.5	2.41- 2.67	×	.36- .46	135
3.7	3.56- 3.81	×	.51- .66	65
4.1	3.94- 4.19	×	.71- .86	45
4.5	4.42- 4.65	×	.38- .49	65
6.1	5.99- 6.25	×	.56- .71	35
7.0	6.81- 7.16	×	.91-1.12	20
7.25	7.06- 7.44	×	.53- .69	28
8.8	8.64- 8.99	×	.91-1.12	15
9.0	8.81- 9.17	×	.61- .76	20
10.0	9.83-10.19	×	.91-1.12	13
10.3	10.11-10.46	×	.61- .76	18
14.0	13.82-14.18	×	.78-1.02	10

DESIGN CONSIDERATIONS

Although 177 and 180 possess many of the desired properties, it does not follow that they can always be substituted directly in halogen lamps that have been designed for either quartz or 96% silica glass. Minor or possibly major redesign may be required to utilize these glasses to the fullest advantage. It is also possible that operating requirements and/or environment of some halogen cycle applications will not permit the use of these glasses.

However, because they combine lower initial cost with superior manufacturing characteristics, 177 and 180 should stimulate greater design activity in regenerative cycle lamps, extending the technology in areas that were formerly not practical nor economically feasible.

For application engineering assistance on these two product offerings, contact Lamp Glass Products Department, Marketing Section (see "Ordering").

ORDERING

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General Electric's Lamp Components Division is the source for tungsten, molybdenum, glass, fused quartz, Lucalox®, phosphors, chemicals, Dumet and Cumet Wire, leads, bases and other components used by the lamp, electronic and cemented carbide industries. Technical and engineering assistance is available on all products. For information contact:

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