FUSED QUARTZ CATALOG

GENERAL ELECTRIC

WILLOUGHBY QUARTZ PLANT

Euclid Avenue and Campbell Road, Willoughby, Ohio
Telephone No. WHitehall 2-9300

DISTRICT SALES OFFICES

EASTERN
744 Broad Street
Newark 2, New Jersey
Telephone No. MArket 3-3953

NEW ENGLAND
50 Industrial Place
Newton Upper Falls 64, Massachusetts
Telephone No. DEcatur 2-6200

MIDWESTERN
Euclid Avenue and Campbell Road
Willoughby, Ohio
Telephone No. WHitehall 2-9300

WESTERN
2747 South Malt Avenue
Los Angeles 22, California
Telephone No. RAymond 3-2541

Forward

The General Electric Company manufactures two basic types of fused quartz: Clear Fused Quartz, and Translucent Fused Quartz. Clear Fused Quartz is made from high purity silicon dioxide. Translucent Fused Quartz is made from a very pure grade of specially treated silica sand. When silicon dioxide is fused at high temperatures, it is converted from its original crystalline structure into an amorphous or non-crystalline mass, readily permitting its working into various shapes.

Both types of fused quartz have unique properties making it useful for industrial and laboratory applications.

This catalog information, and further informative material to be published, is prepared in the interest of better service to present and prospective customers.

It is designed to show the scope of manufacturing facilities, high standards of quality and diversity of products produced. In addition, expert engineering services are available and should be of value to any manufacturer or laboratory interested in the use of high quality materials in processing or as an essential part of a product. It is also intended as an aid in the selection of various types of fused quartz best suited to your specific applications. Information on additional fused quartz products not listed in this catalog is available on request.

Progress Is Our Most Important Product

GENERAL ELECTRIC

LAMP GLASS DEPARTMENT

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CONDITIONS OF SALE

WARRANTY

The Company warrants to the Purchaser that the products to be delivered hereunder will conform to published specifications and will be of the kind and quality designated or described in the contract. The foregoing warranty is exclusive and in lieu of all other warranties whether written, oral, or implied (including any warranty of merchantability or fitness for purpose). If it appears within 60 days from the date of shipment by the Company that the products delivered hereunder do not meet the warranties specified above and the Purchaser notifies the Company promptly, the Company shall thereupon correct any defect, including non-conformance with the specifications, at its option, either by repairing any defective part or parts or by making available at the Company's plant a repaired or replacement part. The conditions of any tests shall be mutually agreed upon, and the Company shall be notified of, and may be represented at, all tests that may be made. The liability of the Company to the Purchaser (except as to title) arising out of the supplying of the said equipment, or its use, whether on warranty, contract or negligence, shall not in any case exceed the cost of correcting defects in the equipment as herein provided and upon the expiration of said one year, all such liability shall terminate. The foregoing shall constitute the sole remedy of the Purchaser and the sole liability of the Company.

PATENTS

The Company shall defend any suit or proceeding brought against the Purchaser so far as based on a claim that any product, or any part thereof, furnished under this contract constitutes an infringement of any patent of the United States, if notified promptly in writing and given authority, information and assistance (at the Company's expense) for the defense of same, and the Company shall pay all damages and costs awarded therein against the Purchaser. In case said product, or any part thereof, is in such suit held to constitute infringement and the use of said product or part is enjoined, the Company shall, at its own expense and at its option, either procure for the Purchaser the right to continue using said product or part; or replace same with non-infringing products; or modify it so it becomes non-infringing; or remove said product and refund the purchase price and the transportation and installation costs thereof. The foregoing states the entire liability of the Company for patent infringement by said products or any part thereof.

The Purchaser shall hold the Company harmless against any expenses, damages, costs, or losses resulting from any suit or proceeding brought for infringement of patents or trademarks arising from compliance with Purchaser's designs or specifications or instructions.

Sale of products, or any parts thereof, hereunder confers on the Purchaser no license under any patent rights of the Company covering or relating to (a) the structure of any devices to which the products or parts may be applied or (b) a process or machine in connection with which they may be used.

DELIVERY

Shipping dates are approximate and are based upon prompt receipt of all necessary information.

The Company shall not be liable for delays in delivery or failure to manufacture or deliver (1) due to causes beyond its reasonable control, or (2) due to acts of God, acts of the Purchaser, acts of civil or military authorities, priorities, fires, strikes, floods, epidemics, war, riot, delays in transportation or car shortages, or (3) inability due to causes beyond its reasonable control to obtain necessary labor, materials, components or manufacturing facilities. In the event of any such delay, the date of delivery shall be extended for a period equal to the time lost by reason of the delay.

In all cases, risk of loss or damage to goods in transit shall fall upon the Purchaser, whose responsibility it shall be to file claims with the carrier.

PAYMENTS

Each shipment shall be considered a separate and independent transaction, and payment therefor shall be made accordingly. If shipments are delayed by the Purchaser, payments shall become due on the date when the Company is prepared to make shipment. If the work to be performed hereunder is delayed by the Purchaser, payments shall be made based on the purchase price and the percentage of completion.

Products held for the Purchaser shall be at the risk and expense of the Purchaser.

If the financial condition of the Purchaser at any time does not, in the judgment of the Company, justify continuance of the work to be performed by the Company hereunder on the terms of payment as agreed upon, the Company may require full or partial payment in advance or shall be entitled to cancel any order then outstanding and shall receive reimbursement for its reasonable and proper cancellation charges, and in the event of bankruptcy or insolvency of the Purchaser or in the event any proceeding is brought against the Purchaser, voluntarily or involuntarily, under the bankruptcy or any insolvency laws, the Company shall be entitled to cancel any order then outstanding at any time during the period allowed for filing claims ag ainst the estate andshall receive reimbursement for its reasonable and proper cancellation charges.

SALES AND SIMILAR TAXES

Unless otherwise stated herein, the Company's prices do not include sales, use, excise or similar taxes. Consequently, in addition to the price specified herein, the amount of any present or future sales, use, excise or other similar tax applicable to the sale or use of the equipment hereunder shall be paid by the Purchaser, or in lieu thereof the Purchaser shall provide the Company with a tax-exemption certificate acceptable to the taxing authorities.

CANCELLATION

The Purchaser may cancel his order only upon written notice and upon payment to the Company of reasonable and proper cancellation charges.

LIMITATION OF LIABILITY

The Company's liability on any claim of any kind, including negligence, for any loss or damage arising out of, connected with, or resulting from this contract, or from the performance or breach thereof, or from the manufacture, sale, delivery, resale, repair or use of any product covered by or furnished under this contract shall in no case exceed the price allocable to the product or part thereof which gives rise to the claim, except as provided in the paragraph entitled "Patents". In no event shall the Company be liable for special or consequential damages.

SECURITY TITLE

Title and right of possession of the products sold hereunder shall remain with the Company and such products shall remain personal property until all payments hereunder (including deferred payments whether evidenced by notes or otherwise) shall have been made in full in each, and the Purchaser agrees to do all acts necessary to perfect and maintain such right and title in the Company.

VARIATIONS

Unless otherwise specified in writing, any variation in quantities shipped not exceeding 10% of the quantities ordered shall constitute compliance with the order and the unit price will continue to apply.

GENERAL

The Company will comply with all applicable Federal, State, and local laws, and specifically represents that any goods to be delivered hereunder will be produced in compliance with the requirements of the Fair Labor Standards Act of 1938, as amended.

An extra charge will be made for special containers, but refund will be made if returned in good condition to the factory or other point designated by the Company within 90 days from date or original shipment, charges prepaid.

Any assignment of this order, or any rights hereunder, by the Purchaser without written consent of the Company shall be void.

The provisions of any contract resulting from this quotation are for the benefit of the parties thereto and not for any other person.

No waiver, alteration, or modification of any of the provisions hereof shall be binding unless in writing and signed by a duly authorized representative of the Company.

The product sold hereunder was not designed or manufactured for use in or with any atomic installation or activity. If so used the Company disclaims all responsibility of every kind, including negligence, and in addition the Purchaser shall indemnify and hold the Company harmless for any liability or damage whatsoever arising out of the use of the product in such a manner.

PRICES—The list prices in this catalog agree with correct list prices at time of going to press, but are subject to change without notice. All orders will be furnished at prices in effect at time of shipment. A minimum charge of $10.00 per order will be made.

DELIVERY TERMS—All prices are F.O.B. Factory, Willoughby, Ohio. Shipping carrier chosen at General Electric discretion unless specified on order.

TERMS OF PAYMENT—All invoices are due and payable not later than 30 days from date of invoice. For other terms and conditions of sale see standard provisions shown above.

ORDER—Orders should be sent to:
General Electric Company
Willoughby Quartz Plant
Euclid Avenue and Campbell Road
Willoughby, Ohio

Tel. No. WHitehall 2-9300

TABLE OF

PHYSICAL PROPERTIES

OF CLEAR FUSED QUARTZ

Density		2.2 g./c.c.
Hardness		4.9 (Mohs')
Tensile Strength		7,000 p.s.i.
Compressive Strength		> 160,000 p.s.i.
Bulk Modulus	(approx.)	5.3×10^6 p.s.i.
Rigidity Modulus		4.5×10^6 p.s.i.
Young's Modulus		10.4×10^6 p.s.i.
Poisson's Ratio		.16
Coefficient of Thermal Expansion	(av.)	$.55 \times 10^{-6}$ cm./cm./°C. $\begin{cases} 20°C. \\ 320°C. \end{cases}$
Thermal Conductivity		.0033 g. cal./cm.^{2}/sec./°C./cm.
Specific Heat		.18 g. cal./gm.
Fusion Temperature	(approx.)	1800°C.
Softening Point	(approx.)	1670°C.
Annealing Point	(approx.)	1140°C.
Strain Point		1070°C.
Electrical Resistance		9.5 $\log_{10}$ R for cm. ^{3} at 350°C.
Dielectric strength volts/mil.		400-410 (20° C 1MC)
Dielectric Constant		3.75 at 20°C. 1 Mc.
Dielectric Loss Factor		less than .0004 at 20°C. 1 Mc.
Specific Resistivity OHMS/CM^3 MIN		10^{18}
Dissipation Factor		less than .0001 at 20°C. 1 Mc.
Index of Refraction		1.4585
Velocity of Sound—Shear Wave		3.75×10^5 cm./sec.
Velocity of Sound—Compressional Wave		5.90×10^5 cm./sec.
Sonic Attenuation		less than .033 db/ft./mc.

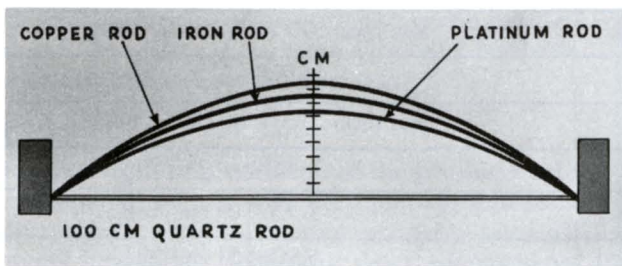
CHEMICAL CONSTITUTION AND REACTIVITY

Fused quartz or fused silica is made by heating high purity, naturally occurring quartz crystals to a sufficiently high temperature to produce an amorphous condition. The clear varieties can nominally have a purity of 99.97 to 99.98% SiO_2. Alumina (Al_2O_3) is the major impurity usually accounting for about two-thirds of the total impurity. The remaining impurity content is composed of Na_2O, Fe_2O_3, CaO, TiO_2, K_2O and Li_2O. No fused or vitreous silica is known to be boron free, although the quantities of boron, phosphorus, arsenic and antimony are not detectable by ordinary analytical procedures. The translucent variety of fused quartz, made from sand, can have a purity of about 99.9 to 99.93% SiO_2. Again, alumina represents about two-thirds of the total impurity. The Fe_2O_3 and TiO_2 contents are higher than in the clear materials. Remaining impurities consist of CaO, Na_2O, K_2O, MgO and Li_2O.

Most acids, metals, chlorine and bromine are unreactive with fused silica at ordinary temperatures. It is slightly attacked by alkaline solutions, the reaction rate increasing with temperature and concentration of solution. Phosphoric acid will attack fused silica at temperatures above about 150°C. Hydrofluoric acid alone will attack it at all temperatures. Carbon and some metals will reduce fused silica and basic oxides, carbonates, sulfates, etc., will react with it at elevated temperatures. For general use it can be concluded that fused silica is quite unreactive. However, it should be cautioned that the surface of fused silica will undergo subtle changes when influenced by many substances. One of the manifestations of these subtle changes is in the rate of devitrification.

PHYSICAL CHANGES DUE TO TEMPERATURE

Fused silica has an extremely low coefficient of thermal expansion, 0.55 x 10^{-6} cm/cm./°C. (0-300°C.). For example, its coefficient is 1/34th that of copper, 1/17th of platinum, 1/9th of tungsten and 1/7th of borosilicate glass. The low expansion imparts a high thermal shock resistance. This makes it possible to



subject fused silica to extremely great temperature gradients and heating rates. It can be heated rapidly

to above 1500°C. and then plunged into water without cracking. Another application would be lenses for projectors using a carbon arc light source.

Aside from the temperature tolerance, other items in the optical field requiring extreme precision can best be made from fused silica. For example, optical flats have been made which do not depart more than 4 ten-millionths of an inch from a true plane.

The diffusion of helium, hydrogen, deuterium and neon through fused quartz is accelerated with increasing temperature. According to General Electric Research Laboratory, the permeability constants for these gases through fused silica at 700°C. are estimated to be:

Helium	2.1 x 10^{-8} cc./sec./cm.^{2}/mm./cm. Hg.
Hydrogen	2.1 x 10^{-9}
Deuetrium	1.7 x 10^{-9}
Neon	4.2 x 10^{-10}

The softening point of fused silica has been variously reported from 1500°C. to 1670°C. There is good reason for this large range of temperature. First, the softening point determination is based on a definition; and the conditions of the determination are not easily attained. Secondly, the softening point will vary, depending on the method of fusion. Materials having a low softening point usually contain appreciable quantities of water as hydroxyl groups. The higher softening points occur with materials which are essentially water-free.

The annealing and strain points of fused silica have been determined as 1140°C. and 1070°C., respectively. The effect of water content of the fused silica

is not as pronounced on these points as it is on the softening point.

Devitrification of fused silica is probably the biggest disadvantage in its use at high temperatures. Generally 1000°C. is the temperature boundary below which continuous use is not hampered by devitrification. Above 1000°C., the fused silica will devitrify at an increasing rate as temperature increases. At 1450°C., appreciable devitrification can occur in a relatively short time.

Materials fused by different methods do, under similar conditions, exhibit different devitrifying rates. The rate differences, however, are usually insufficiently large to make this a selection criteria except in some special cases. The presence of structurally combined water has no established effect on the devitrification.

When fused silica devitrifies, the original product is β or high cristobalite. Nucleation occurs only on the surface or at an interface between the fused silica and some other material, such as a metal. Provided that the fused silica surface is originally clean and that heating is carried on in a clean atmosphere, the devitrification product will remain as β cristobalite at the elevated temperature. The growth will usually be restricted to only a slight depth into the fused silica. A devitrified surface while still hot will appear clear, just as it appeared prior to heating. On cooling, one can observe a hazy film develop on the surface. This haze develops as the surface cools below about 250°C. and is caused by a maze of very fine cracks. The temperature is that where the β cristobalite inverts to χ (low) cristobalite accompanied by a drastic volume change of the devitrified layer. If the devitrified layer is thick enough, this volume change can cause the devitrified layer to spall away from the remaining vitreous mass. When it is desired to use fused silica for prolonged times at temperatures in excess of 1000°C., it is advisable to maintain the devitrified fused silica at an elevated temperature to suppress the surface cracking as long as possible.

Elsewhere it has been mentioned that contamination of the fused silica surface will affect the devitrification, almost universally in the direction of higher rates. Contamination can be in just about any form. Alkaline solutions, salts or vapors are particularly bad. Handling of fused silica with the bare hands deposits sufficient alkali from perspiration to leave clearly defined fingerprints upon devitrification. Also, drops of water allowed to stand on the surface will collect enough contamination from the air to promote divitrified spots and water marks. Surface contamination affects devitrification in two ways. First, the contaminant promotes nucleation of the cristobalite; and, secondly, it acts as a flux to alter the cristobalite to β_2 (high) tridymite. Under some conditions, the tridymite devitrification will grow deeply and rapidly into the interior of the fused silica.

It is desirable in some uses to clean the surface of fused silica. Many cleaning procedures have been examined for their ability to inhibit devitrification. The most widely used procedure involves washing the fused silica in a 10% hydrofluoric acid solution at room temperature for 3 to 5 minutes. This is then followed by several rinses in preferably distilled or deionized water, removal of the excess water and drying as rapidly as possible.

Heating of fused silica to temperatures above about 1350°C. causes the SiO_2 to undergo dissociation (or sublimation). This is generally considered to be:

$$SiO_2 \xrightarrow[\Delta]{1350°C.} SiO + 1/2\ O_2.$$

Consequently, when flame-working fused silica, one observes a band of haze (or smoke) forming just outside of the intensely heated region. This haze or smoke forms presumably by the process of the SiO recombining with oxygen from the air (and perhaps water) and condensing as extremely small particles of amorphous SiO_2. The haze (or smoke) can be removed from the surface by a gentle heating in the oxy-hydrogen flame. The dissociation is greatly enhanced when the heating of silica is carried out in reducing conditions. For example, the proximity or contact with graphite during heating will cause rapid dissociation of the SiO_2.

OPTICAL TRANSMISSION PROPERTIES

Fused silica (clear) is one of the best known transmitters of ultraviolet radiation commercially available. The cutoff for fused silicas in the ultraviolet region range from about 155 to 175 $m\mu$ and is dependent on the fusion procedure used to make the material. Some materials will also have an absorption band in the 240 $m\mu$ region.

The transmission of the visible wave lengths is generally high.

In the infrared region, some fused silicas will have an absorption band at 2720 $m\mu$. This band is attributed to the presence of water (hydroxyls) in the fused silica. The magnitude of the absorption is dependent on the quantity of water present. The infrared cutoff is in the region of 5500 to 6000 $m\mu$.

Irradiation of fused silicas by high energy radiations (such as X-rays, gamma rays or neutrons) will induce certain absorption bands in some materials. Generally three absorption bands occur; these are at about 215, 303 and 540 $m\mu$. When absorptions are induced, they can be bleached by heating to about 500°C. or by exposure to ultraviolet radiation. Irradiated fused silicas on heat bleaching will exhibit thermoluminescence.

Excitation by 253.7 $m\mu$ radiation, or what is known as "black light", will cause some fused silicas to fluoresce. Most fused silicas have a bluish-purple fluorescence while other varieties will fluoresce a yellowish-green, and a few others will have no fluorescence. It is known that some impurities in silica (amorphous) will cause fluorescence; however, it appears that impurities are not necessary for fluorescence to occur.

General Electric fused quartz has a wide range of useful applications. This range can be extended, or the service life improved, by consideration of certain basic data concerning the fused silica.

MECHANICAL STRENGTH

Fused quartz has good mechanical strength. Its compressive strength is better than 160,000 p.s.i., and its tensile strength is generally better than 7,000 p.s.i.

The modulus of elasticity is approximately 10 million p.s.i., and fused quartz is one of the most perfectly elastic materials known. Fibers of this material used as galvanometer suspensions sustain large angles of deflection (twist) and yet return the instrument reading to zero after the deflection.

On the Mohs' scale, hardness of fused silica is 4.9.

ELECTRICAL PROPERTIES

Fused quartz has excellent electrical properties which are quite stable with temperature.

Its high resistivity, on the order of 10^{17} ohms/cc. at 25°C. is still on the order of 10^{7} ohms/cc. at 1000C°.

One of the unique properties is the extremely low dielectric loss factor (less than .0004 at 20°C., 1 Mc.) which remains quite constant with frequency and temperature.

CONVERSION FACTORS

DECIMAL EQUIVALENTS • Millimeters to Inches

MM	=	INCHES	MM	=	INCHES	MM	=	INCHES	MM	=	INCHES	MM	=	INCHES
1	=	0.0394	21	=	0.8268	41	=	1.6142	61	=	2.4016	81	=	3.1890
2	=	0.0787	22	=	0.8661	42	=	1.6535	62	=	2.4409	82	=	3.2283
3	=	0.1181	23	=	0.9055	43	=	1.6929	63	=	2.4803	83	=	3.2677
4	=	0.1575	24	=	0.9449	44	=	1.7323	64	=	2.5197	84	=	3.3071
5	=	0.1969	25	=	0.9843	45	=	1.7717	65	=	2.5591	85	=	3.3465
6	=	0.2362	26	=	1.0236	46	=	1.8110	66	=	2.5984	86	=	3.3858
7	=	0.2756	27	=	1.0630	47	=	1.8504	67	=	2.6378	87	=	3.4252
8	=	0.3150	28	=	1.1024	48	=	1.8898	68	=	2.6772	88	=	3.4646
9	=	0.3543	29	=	1.1417	49	=	1.9291	69	=	2.7165	89	=	3.5039
10	=	0.3937	30	=	1.1811	50	=	1.9685	70	=	2.7559	90	=	3.5433
11	=	0.4331	31	=	1.2205	51	=	2.0079	71	=	2.7953	91	=	3.5827
12	=	0.4724	32	=	1.2598	52	=	2.0472	72	=	2.8346	92	=	3.6220
13	=	0.5118	33	=	1.2992	53	=	2.0866	73	=	2.8740	93	=	3.6614
14	=	0.5512	34	=	1.3386	54	=	2.1260	74	=	2.9134	94	=	3.7008
15	=	0.5906	35	=	1.3780	55	=	2.1654	75	=	2.9528	95	=	3.7402
16	=	0.6299	36	=	1.4173	56	=	2.2047	76	=	2.9921	96	=	3.7795
17	=	0.6693	37	=	1.4567	57	=	2.2441	77	=	3.0315	97	=	3.8189
18	=	0.7087	38	=	1.4961	58	=	2.2835	78	=	3.0709	98	=	3.8583
19	=	0.7480	39	=	1.5354	59	=	2.3228	79	=	3.1102	99	=	3.8976
20	=	0.7874	40	=	1.5748	60	=	2.3622	80	=	3.1496	100	=	3.9370

DECIMAL EQUIVALENTS • Fractional Inch to Decimals to Millimeters

INCH	INCH	MM	INCH	INCH	MM	INCH	INCH	MM	INCH	INCH	MM
1/64	.015625	.3969	17/64	.265625	6.7469	33/64	.515625	13.0969	49/64	.765625	19.4470
1/32	.03125	.7938	9/32	.28125	7.1438	17/32	.53125	13.4938	25/32	.78125	19.8438
3/64	.046875	1.1906	19/64	.296875	7.5407	35/64	.546875	13.8907	51/64	.796875	20.2407
1/16	.0625	1.5875	5/16	.3125	7.9375	9/16	.5625	14.2876	13/16	.8125	20.6376
5/64	.078125	1.9844	21/64	.328125	8.3344	37/64	.578125	14.6844	53/64	.828125	21.0345
3/32	.09375	2.3813	11/32	.34375	8.7313	19/32	.59375	15.0813	27/32	.84375	20.4313
7/64	.109375	2.7781	23/64	.359375	9.1282	39/64	.609375	15.4782	55/64	.859375	21.8282
1/8	.125	3.1750	3/8	.375	9.5250	5/8	.625	15.8751	7/8	.875	22.2251
9/64	.140625	3.5719	25/64	.390625	9.9219	41/64	.640625	16.2719	57/64	.890625	22.6620
5/32	.15625	3.9688	13/32	.40625	10.3188	21/32	.65625	16.6688	29/32	.90625	23.0188
11/64	.171875	4.3656	27/64	.421875	10.7157	43/64	.671875	17.0657	59/64	.921875	23.4157
3/16	.1875	4.7625	7/16	.4375	11.1125	11/16	.6875	17.4626	15/16	.9375	23.8126
13/64	.203125	5.1594	29/64	.453125	11.5094	45/64	.703125	17.8594	61/64	.953125	24.2095
7/32	.21875	5.5563	15/32	.46875	11.9063	23/32	.71875	18.2563	31/32	.96875	24.6063
15/64	.234375	5.9531	31/64	.484375	12.3032	47/64	.734375	18.6532	63/64	.984375	25.0032
1/4	.25	6.3500	1/2	.5	12.7001	3/4	.75	19.0501	1	1.00	25.4001

TUBING
ROD

CLEAR FUSED QUARTZ

INGOTS
PLATES AND DISCS

Clear fused quartz consists of pure silicon dioxide (SiO_2) called silica. The unrestricted use of "Fused Quartz" and "Fused Silica" has caused some confusion, although from a strict terminology standpoint they are identical. Over the years "Fused Quartz" has come to be associated with the transparent variety while "Fused Silica" is commonly associated with the translucent type produced from high grade silica sand.

Clear Fused Quartz produced from rock crystal contains over 99.8% silicon dioxide. After fusion, the tubing and rod is non-crystalline in structure, water white, and can readily be manufactured in a wide range of sizes and fabricated shapes. The coefficient of expansion of fused quartz is lower than that of any commonly known material over a wide temperature range.

Due to this extremely low expansion (0.55×10^{-6}) General Electric fused quartz can withstand extreme thermal shock. Tubing and rod can be subjected to red heat and immediately quenched or cooled in cold liquid or air without harm.

All General Electric clear fused quartz is made from high purity silicon dioxide. High standards of production and exacting requirements produce essentially boron free quartz.

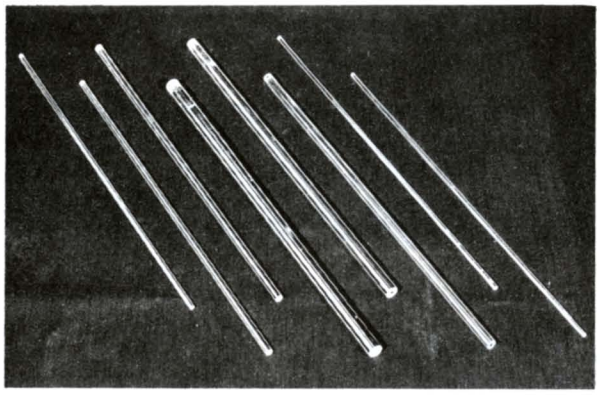
Where fused quartz material is to be used at elevated temperatures, particularly in the neighborhood of 1000°C. and above, it is extremely important that the surface of the material be free of any contamination if accelerated devitrification is to be prevented. Quartz will devitrify at these temperatures, over a period of time in any case. However, contamination of almost any kind will accelerate this condition.

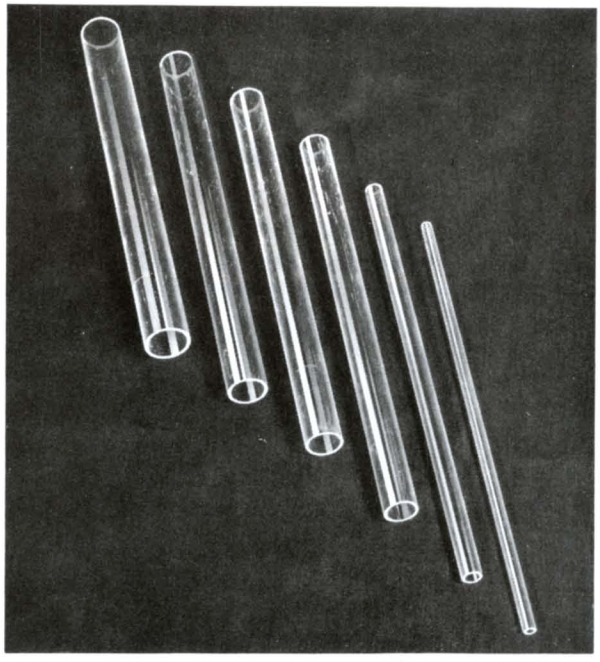
Generally a solution of hydrofluoric acid of approximately 10% concentration at room temperature is used to clean the material. This acid is used primarily because it is one of the few solvents for silica. Water is used to rinse. Five minutes in acid is usually sufficient time to clean the surface of the material and is a short enough time to prevent etching. It is important that the tube be free of fingerprints, oils, etc., before it is acid washed.

To eliminate surface contamination, all fused quartz should be handled with cotton gloves.

This same material can be fabricated into various shapes to your specifications. A variety of standard quartzware is available for silicon and germanium crystal growing for semi-conductor transistors, such as crucibles, test tubes, boats and special apparatus. See section on fabricated quartzware.

CLEAR FUSED QUARTZ TUBING TYPE 204





DESCRIPTION

Type 204 tubing is used for most applications and is produced in large volume with a complete range of sizes carried in stock at all times. This type is of high quality, having closer tolerances than all other tubing produced. Clear fused quartz is a remarkably transparent material. It has the highest transmission of the ultraviolet and visible radiation of all commercially available materials except crystal quartz and fluorite, which materials do not lend themselves to commercial fabrication in functional shapes. The high transmission of ultraviolet and its thermal properties makes fused quartz particularly adaptable in the manufacture of special light sources for therapeutic and photochemical applications.

Chemical analysis Type 204 Tubing.
MAXIMUM CONSTITUENTS

	PPM	%
Al_2O_3	180	.018
FE_2O_3	15	.0015
TiO_2	8	.0008
CaO	25	.0025
MgO	trace	
K_2O	10	.001
Na_2O	15	.0015
Li_2O	12	.0012
B	.90	.00009
ZnO_2	0	
P, As_8	.08	.000008

PRICE SCHEDULE TYPE 204 Effective October 28, 1960

Prices for straight, random lengths are listed below:

O.D. Tolerance	Bore in m.m.	O.D. in m.m.	Theo. Feet Per Lb.	Small Volume Price Per Foot	Large Volume Minimum Ft. To Be Ordered	Large Volume Price Per Foot
± 12%	.5	1.5	430.10	$ .15	1300	$ .10
	1	2	286.73	.20	860	.15
	1	3	107.53	.35	320	.30
	1	6	24.58	4.50	75	3.50
	2	3	172.04	.25	520	.20
	2	4	71.68	.50	220	.40
	2	6	26.88	2.25	80	1.85
	2	8	14.34	4.00	45	3.50
	2	10	8.96	7.00	25	6.00
	2.35	3.8	96.46	.40	300	.33
± 10%	3	4	122.88	.30	375	.25
	3	5	53.76	.60	160	.55
	4	6	43.01	.80	130	.75

O.D. Tolerance	Bore in m.m.	O.D. in m.m.	Theo. Feet Per Lb.	Small Volume Price Per Foot	Large Volume Minimum Ft. To Be Ordered	Large Volume Price Per Foot
± 6%	5	7	35.84	$ .90	360	$ .65
	5	7.4	28.90	1.15	290	.80
	6	8	30.72	1.05	310	.75
	6.5	8.5	28.67	1.15	290	.80
	7	9	26.88	1.25	270	.85
	7	9.6	19.93	1.60	200	1.15
	7.75	9.75	24.58	1.35	245	.95
	8	10	23.89	1.40	240	.95
	8	12	10.75	3.05	110	2.15
	9	11	21.51	1.55	215	1.05
	9	11.8	14.77	2.25	150	1.55
	10	12	19.55	1.65	200	1.15
	11	13	17.92	1.85	180	1.30
± 4%	12	14	16.54	2.00	165	1.40
	12	15.2	9.88	3.30	100	2.35
	12.7	19	4.31	7.70	40	5.35
	13	15	15.36	2.15	155	1.50
	13	16.2	9.21	3.60	90	2.55
	14	16	14.34	2.30	145	1.60
	15	17	13.44	2.45	135	1.70
	15	18	8.69	3.80	85	2.70
	16	18	12.65	2.60	125	1.80
	17	19	11.95	2.75	120	1.90
	18	20	11.32	2.90	115	2.00
	18	21.6	6.03	5.40	60	3.85
	18.3	20.6	9.61	3.50	95	2.40
	20	22	10.24	3.25	100	2.25
	20	23.6	5.48	6.10	55	4.25
	22	24	9.25	3.55	95	2.45
	22	25	6.10	5.50	60	3.80
	22	25.8	4.74	6.90	50	4.90
	24	26	8.60	3.80	85	2.70
	25	27	8.27	4.00	80	2.80
	25	28	5.41	6.10	55	4.25
	25	28.8	4.20	7.85	40	5.50
	25.75	28	7.11	4.60	70	3.25
	26	30	3.84	8.50	35	6.00
	27	30	5.03	6.60	50	4.60
	28	32	3.58	9.45	35	6.65
	30	33	4.55	7.35	45	5.10
	30	34	3.36	10.00	35	7.00
	32	35	4.28	7.85	40	5.50
	32	36	3.16	10.60	30	7.40
	35	38	3.93	8.45	40	5.90
	36	40	2.83	11.80	30	8.20
	37	40	3.72	8.90	35	6.20
	38.1	42.1	2.68	12.35	25	8.60
	40	43	3.45	9.70	35	6.80
	42	45	3.30	10.30	30	7.20
± 3%	45	48	3.08	13.00	30	10.50
	45	49	2.29	17.50	20	14.00
	50	54	2.07	19.60	20	15.50
	50.8	54.3	2.34	17.20	25	13.75
	51	55	2.03	19.75	20	15.75
	51	56	1.61	25.00	15	20.00
	53.8	56.8	2.59	15.40	25	12.50
	55	59	1.89	21.30	20	17.00
	57	61	1.82	22.00	20	17.50
	60	64	1.73	23.00	15	18.50
	63	67	1.65	24.50	15	19.50
	65	69	1.60	25.00	15	20.00
	70	74	1.49	28.00	15	21.50
	75	79	1.40	32.50	15	22.75
	76.2	80.2	1.38	33.00	15	23.00
	80	84	1.31	50.00	10	40.00

Wall Tolerance — Up to and including 20 m.m. bore ± 20%.
Over 20 m.m. bore ± 25%.

Random Lengths — 12" through 72" at catalog price.

Cut Lengths — Up to 12"—Write for prices.
12" through 72"—Catalog price plus 10% for cutting to a specific length.
Over 72" up to and including 144"—Catalog price plus 15% for cutting plus $17.— for crating per crate. (Crates are returnable).
Over 144"—Write for prices.

Length Tolerance — Size

Size	Length	Tolerance
.5 m.m. through 25 m.m. bore	Less than 12"	± .040
	12" through 48"	± 1/16"
	Over 48" through 72"	± 1/8"
Over 25 m.m. bore	Less than 12"	± 1"16"
	12" through 48"	± 1/8"
	Over 48" through 72"	± 1/4"

For prices closer than standard—write for prices.

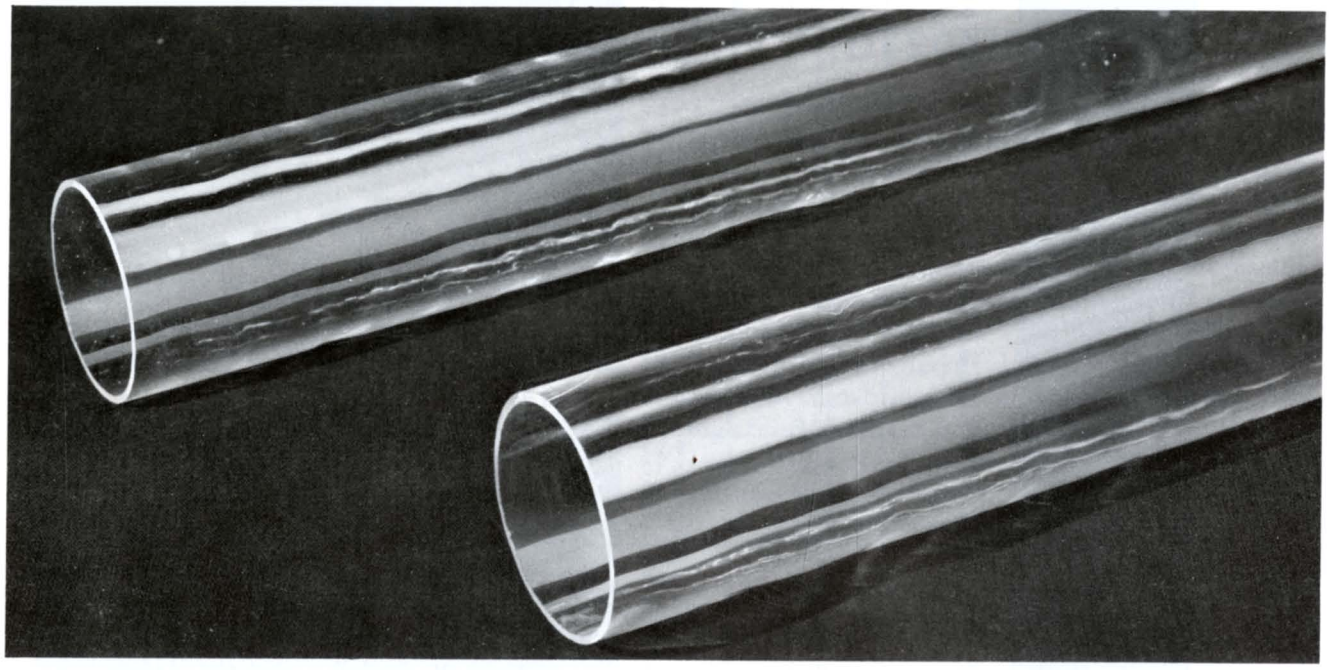
Special Sizes — Available—Write for prices.

To calculate Feet per Pound when O.D. and I.D. are in M.M.

$$\frac{860.2}{(\text{O.D.} + \text{I.D.}) \times (\text{O.D.} - \text{I.D.})}$$

MINIMUM CHARGE — $10.00 per order

CLEAR FUSED QUARTZ TUBING TYPE 208



DESCRIPTION

Type 208 tubing is tubing reworked to secure tubing in large diameters. It is reworked primarily to produce tubing larger than 80mm bore, however, smaller sizes can be manufactured to secure the advantages of this type. Type 208 is free of airlines but contains a minimum quantity of fine bubbles and will have a slightly wavy surface. During the reworking closer tolerances held as shown on the price schedule.

PRICE SCHEDULE TYPE 208 Effective March 16, 1959

*Clear Fused Quartz Tubing

Tolerance Bore & OD	Bore in mm	OD in mm	Price Per Foot
± 2%	45	48	$14.50
	50	54	22.00
	50.8	54.3	19.50
	53.8	56.8	17.50
	55	59	24.00
	60	64	26.00
	63	67	30.00
	65	69	31.00
	70	74	34.00
	76.2	80.2	40.00
	80	84	57.00
	85	89	65.00
	90	94	69.00
	101.6	105.6	85.00

Prices for other sizes up to 180 mm O.D. available on request.

*Reworked tubing—Higher quality tubing containing no airlines and a minimum of fine bubbles. Due to reworking a slightly wavy surface will result.

Cut Lengths—Less than 6″—special pricing

6″ through 72″—Catalog price per foot

Over 72″ and including 120″—Catalog price per foot plus 15% for cutting plus $17.00 for crating per crate.

Tolerances are much closer than tubing that has not been reworked. No additional charge for cut lengths over 6″.

M NIMUM CHARGE—$10 per order.

CLEAR FUSED QUARTZ TUBING TYPE 206

DESCRIPTION

Type 206 tubing is a commercial grade tubing generally used in large volume applications. This variety has the same high purity and transmission in the ultraviolet and infrared as Types 204. Characteristically Type 206 contains many relatively large airseams. It has been used successfully in lampmaking and other applications where visual appearance is not of paramount importance.

SIZE LIMITATIONS

Currently available in a limited number of sizes. Additional sizes beyond those listed on the price sheet are sometimes available. We will be happy to quote assuming volume requirements are met.

PRICE SCHEDULE TYPE 206 Effective March 16, 1959

Prices for straight, random lengths are listed below:

Tolerance on Bore and OD	Bore in mm	OD in mm	Price Per Foot
± 8%	13	15	$ .65
± 4%	20	22	1.00
± 4%	20	22.5	1.25

Write for availability of other sizes.

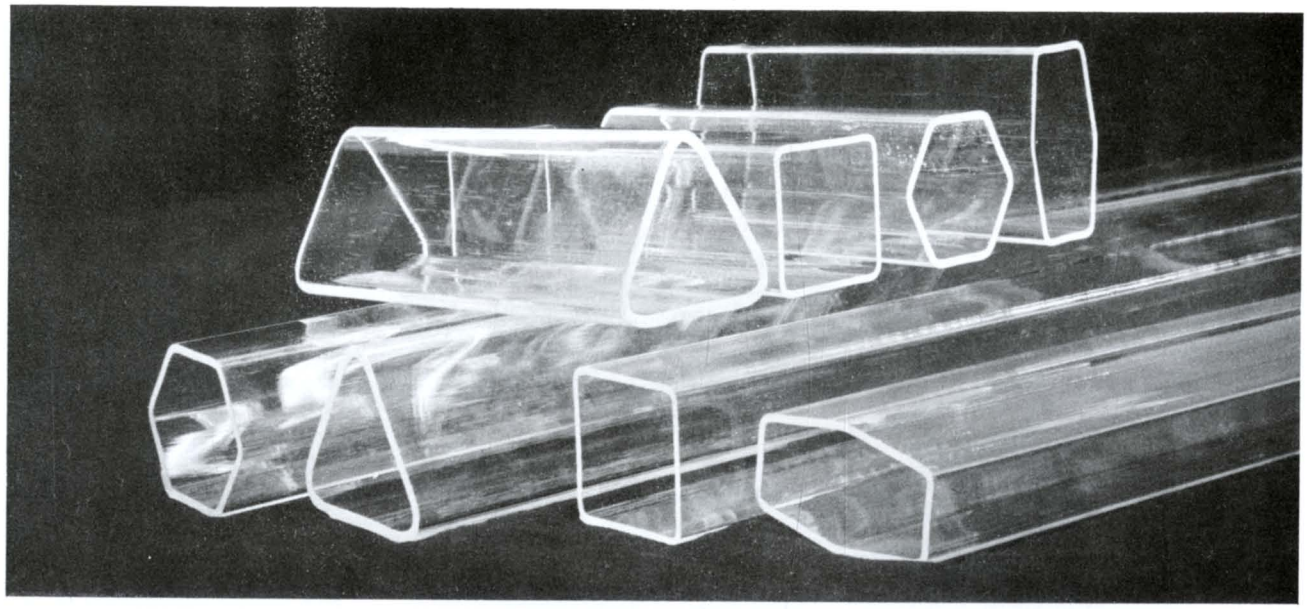
Random Lengths — 12″ through 72″

Cut Lengths
— Up to 12″ write for prices.
— 12″ through 72″—Catalog price plus 10% for cutting.
— Over 72″ available upon special request.

Size	Length	Length Tolerance
Through 25mm bore	Less than 12″	± .040″
	12″ thru 48″	± 1/16″
	Over 48″ thru 72″	± 1/8″
Over 25mm bore	Less than 12″	± 1/16″
	12″ through 48″	± 1/8″
	Over 48″ through 72″	± 1/4″

MINIMUM CHARGE—$10. per order.

CLEAR FUSED QUARTZ NON-CIRCULAR TUBING TYPE 204



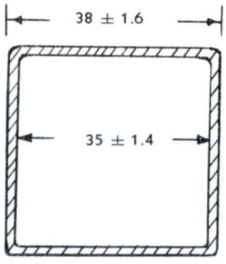
NON-CIRCULAR BORE

PRICE SCHEDULE

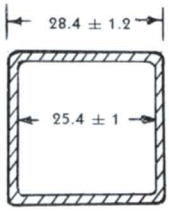
TYPE 204

NON-CIRCULAR BORE

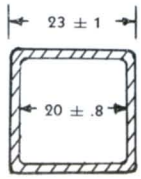
Effective March 16, 1959
Prices for random lengths listed below:



$10.00 per ft.



$7.00 per ft.



Wall:
1.5 ± .5mm

$5.75 per ft.

DESCRIPTION

Non-circular tubing is designated as Type 204, and is of the same high quality as General Electric circular bore Type 204. It has high transmission in the ultra-violet and infrared making it desirable for applications where special shapes are desired.

SIZE LIMITATIONS

Currently produced in three sizes as shown on the price list. Unusual shapes can be produced in any size that will fit into a circle as small as 20mm diameter and up to 55mm diameter. Write for quotations to your particular requirements.

Random Lengths — 12″ through 72″

Cut Lengths — 12″ thru 48″—Catalog price plus 10%

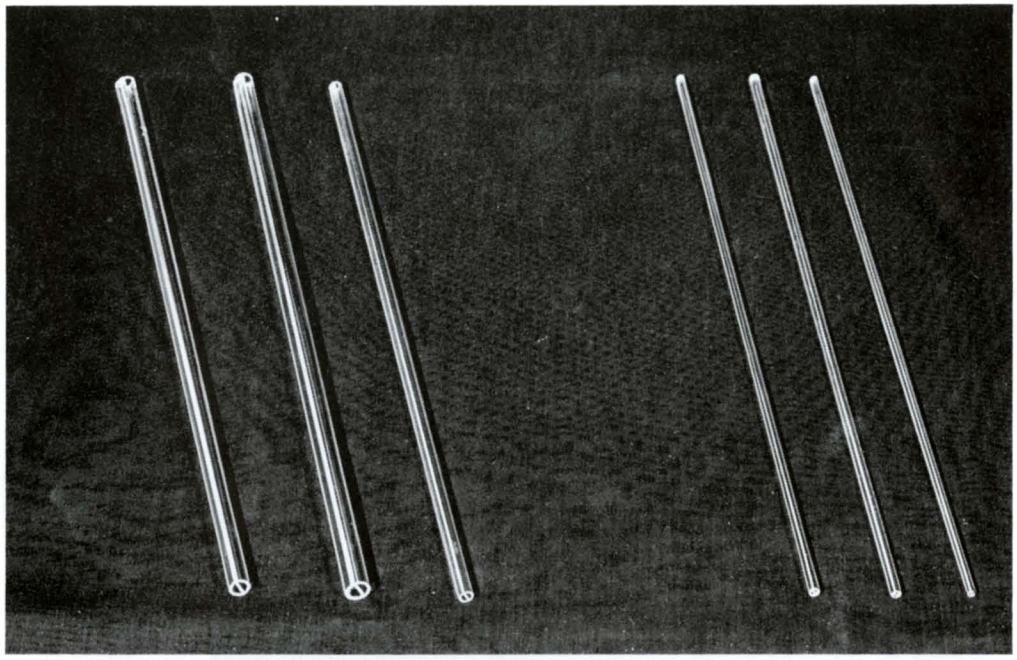
Length Tolerance —

Size	Length	Tolerance
Through 25.4mm bore	Less than 12″	± .040″
	12″ thru 48″	± 1/16
	Over 48″ thru 72″	± 1/8″
Over 25.4mm bore	Less than 12″	± 1/16″
	12″ thru 48″	± 1/8″
	Over 48″ thru 72″	± 1/4″

MINIMUM CHARGE—$10.00 per order.

CLEAR FUSED QUARTZ

DOUBLE BORE TUBING TYPE 204



DOUBLE BORE

PRICE SCHEDULE TYPE 204 DOUBLE BORE Effective March 16, 1959

Price for random lengths listed below:

Tolerance	OD in mm	Wall Thickness in mm	Web Thickness in mm	Price Per Foot
± 10%	6.5	.9 — 1.2	.8 — 1.1	$1.50
	9.0	1.2 — 1.8	1.0 — 1.5	2.80
	11.0	1.6 — 2.4	1.0 — 1.5	4.50

Ordering Number	OD in mm	Bore	Price Per Foot
Q-301	4mm max.	.025″ min. diameter each bore	$ .60
Q-301A	4.4mm max.	.022″ min. diameter each bore	.50

Random Lengths — 12″ through 72″

Cut Lengths — Up to 12″ Write for prices

— 12″ through 48″—Catalog price plus 10%

Length Tolerance —

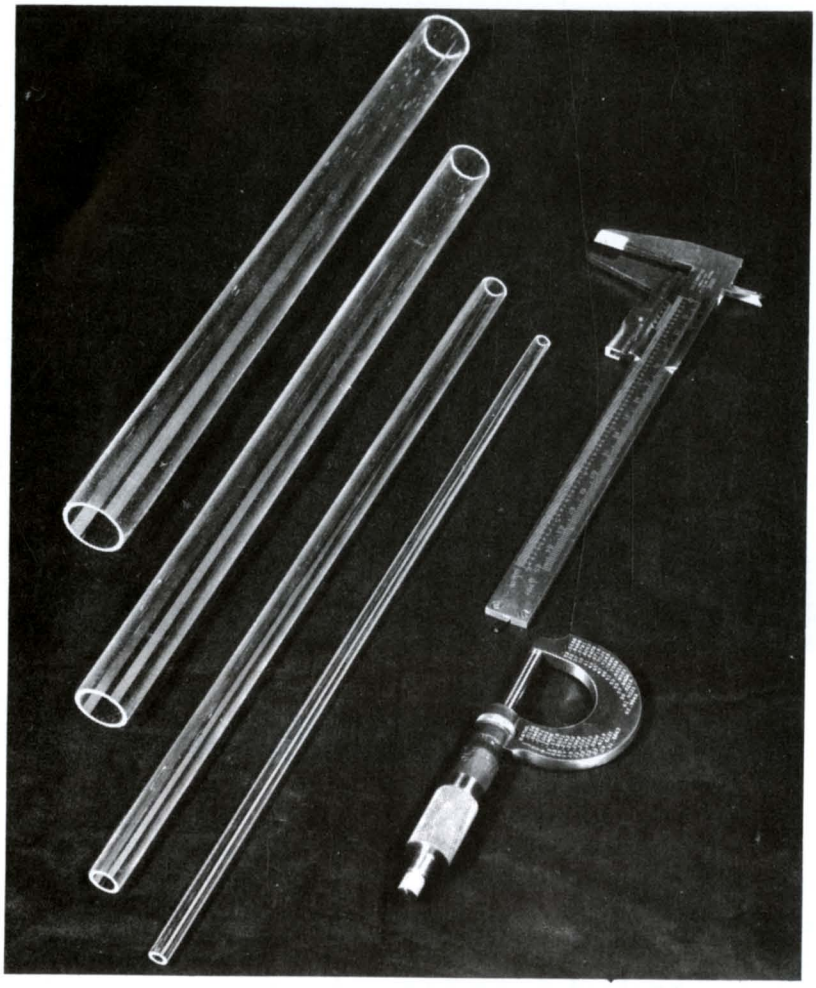
Size	Length	Tolerance
All Sizes	Less than 12″	± .040″
	12″ through 48″	± 1/16″
	Over 48″ through 72″	± 1/8″

General Electric Clear Fused Quartz double bore tubing is slightly oval in shape, and is of the same high quality as single bore tubing.

MINIMUM CHARGE—$10.00 per order.

CLEAR FUSED QUARTZ

PRECISION BORE TUBING TYPE 204



PRICE SCHEDULE TYPE 204 Effective March 16, 1959

Bore in Inches	Tolerance	Wall in mm	Price Per Foot
1/16	± .002	.5	$16.00
1/8	± .002	.5	6.50
3/16	± .002	1.0	7.00
1/4	± .002	1.0	7.50
5/16	± .002	1.0	8.00
3/8	± .002	1.0	8.50
1/2	± .002	1.0	10.50

Prices for closer tolerances or large quantities on request.

1/16" bore can be supplied up to 6" in length. All other sizes can be supplied up to 18" in length.

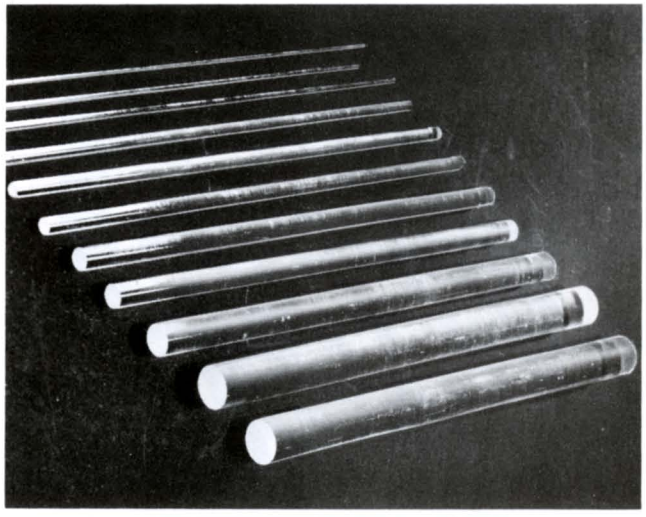
Cut Lengths — Catalog price plus 10%

Length Tolerance —

Size	Length	Tolerance
All Sizes	Less than 12"	± .040"
	12" through 18"	± 1/16"

MINIMUM CHARGE — $10.00 per order

CLEAR FUSED QUARTZ ROD TYPE 201



DESCRIPTION

Type 201 has high transmission in both the ultraviolet and infrared range. This type will contain some relatively large airlines.

SIZE LIMITATIONS

One millimeter up to and including 15 mm in diameter. Random lengths run from 12″ to 72″, however, clear rod can be supplied in cut lengths or lengths up to 108″ at extra cost.

PRICE SCHEDULE TYPE 201 Effective March 16, 1959

Prices for straight, random lengths are listed below:

Tolerance	Diameter in mm	Theo. Feet Per Lb.	Price Per Foot
± 20%	1	860.2	$ .15
	1.5 (1/16″)	382.31	.20
	2	215.05	.25
± 12%	2.4 (3/32″)	149.34	.30
	2.5	137.63	.35
	3.0	95.58	.40
	3.2 (1/8″)	84.00	.45
	4	53.76	.75
	4.75 (3/16″)	38.13	1.05
± 8%	5	34.41	1.20
	6	23.89	1.65
	6.4 (1/4″)	21.00	1.85
	7	17.56	2.30
	8	13.44	2.95
	9	10.62	3.80
	10	8.602	4.65
	12	5.973	6.65
	15	3.823	10.50
	20	2.154	19.00

Random lengths — 12″ to 72″

Cut lengths
- — Up to 12″—write for prices
- — 12″ through 48″—Catalog price plus 10%
- — Over 48″ up to and including 108″—Catalog price plus 15% for cutting plus $17.00 crating charge per crate for lengths over 72″.

Length Tolerance
- — Less than 12″—cut to ± .040″
- — 12″ through 48″—cut to ± 1/16″
- — Over 48″ through 72″—cut to ± 1/8″

MINIMUM CHARGE—$10. per order.

CLEAR FUSED QUARTZ ROD TYPE 206

DESCRIPTION

Type 206 is a commercial grade rod generally used in large volume applications. This variety has the same high purity and transmission in the ultraviolet and infrared as Type 201. Characteristically Type 206 contains many relatively large airseams. It has been used successfully in applications where visual apperance is not of paramount importance.

SIZE LIMITATIONS

Currently available in a limited number of sizes. Additional sizes beyond those listed are sometimes available.

PRICE SCHEDULE TYPE 206 Effective March 16, 1959

Prices for straight random lengths are listed below:

Tolerance	Diameter	Theo. Feet Per Lb.	Price Per Foot
± 12%	1/8″	85.34	$0.10
± 12%	3/16″	37.93	0.25
± 8%	1/4″	21.33	0.50
± 8%	5/16″	13.65	0.75
± 4%	3/8″	9.48	1.05
± 4%	1/2″	5.33	1.90

Random Lengths — 12″ through 72″

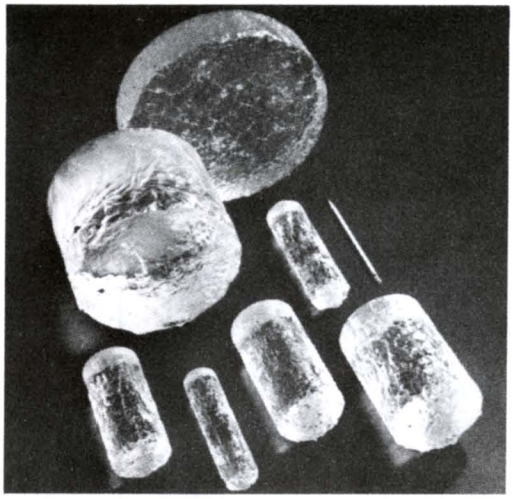
Cut Lengths — Up to 12″ write for prices.
— 12″ through 72″—Catalog price plus 10% for cutting.
— Over 72″ available upon special request.

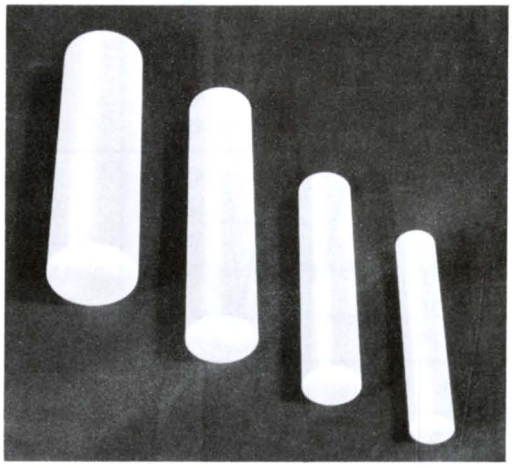
Length Tolerance —

Size	Length	Tolerance
Through 1/2″	Less than 12″	± .040″
	12″ through 48″	± 1/16″
	Over 48″ through 72″	± 1/8″

MINIMUM CHARGE—$10.00 per order.

CLEAR FUSED QUARTZ INGOTS TYPE 101





DESCRIPTION

This material is the standard commercial grade and is the lowest cost of all solid shape materials. It has a wide range of applications such as windows, lenses, prisms, optical flats and delay lines of a non-critical nature. As shown in the charts, high transmission in both the infrared and ultraviolet is evident.

SIZE LIMITATIONS

Available in rough cast form in sizes to finish 1″ diameter up to and including 18½″ in diameter. Centerless grinding of ingots is also available on request.

PROPERTIES

TRANSMISSION—See curve for representative values. BUBBLES—Contains a few relatively large bubbles, the largest approximately .060″ in diameter. Size and concentration of bubbles will depend on the diameter of the ingot. Larger bubbles are generally associated with larger ingots. STRIAE—May contain some striae visible to the naked eye, and may not be parallel to the faces of plates and discs cut from this type of material. INTERNAL STRESS—Exhibits definite, random stress pattern when examined under crossed polaroids.

TYPE COMPARISON CHART

FUSED QUARTZ INGOTS, PLATES, DISCS

TYPE	BUBBLE CONTENT	STRESS PATTERN	ULTRA-VIOLET TRANSMISSION	INFRA RED TRANSMISSION
101	Few—relatively large Approx. Maximum Diameter—.060	Definite pattern randomly oriented	High	High
102	Very few—minute	Uniform	Very high	Absorption at 2.7
103	May have many minute bubbles	Uniform	High	High
104	Very few minute	Uniform	Very high	Absorption at 2.7
105	No large bubble Few minute	Uniform	High	High
106	No large bubbles Some fine	Uniform	High	High

PRICE SCHEDULE TYPE 101 INGOTS Effective April 27, 1959

SELLING PRICE—$16.00 PER POUND

ORDERING INSTRUCTIONS

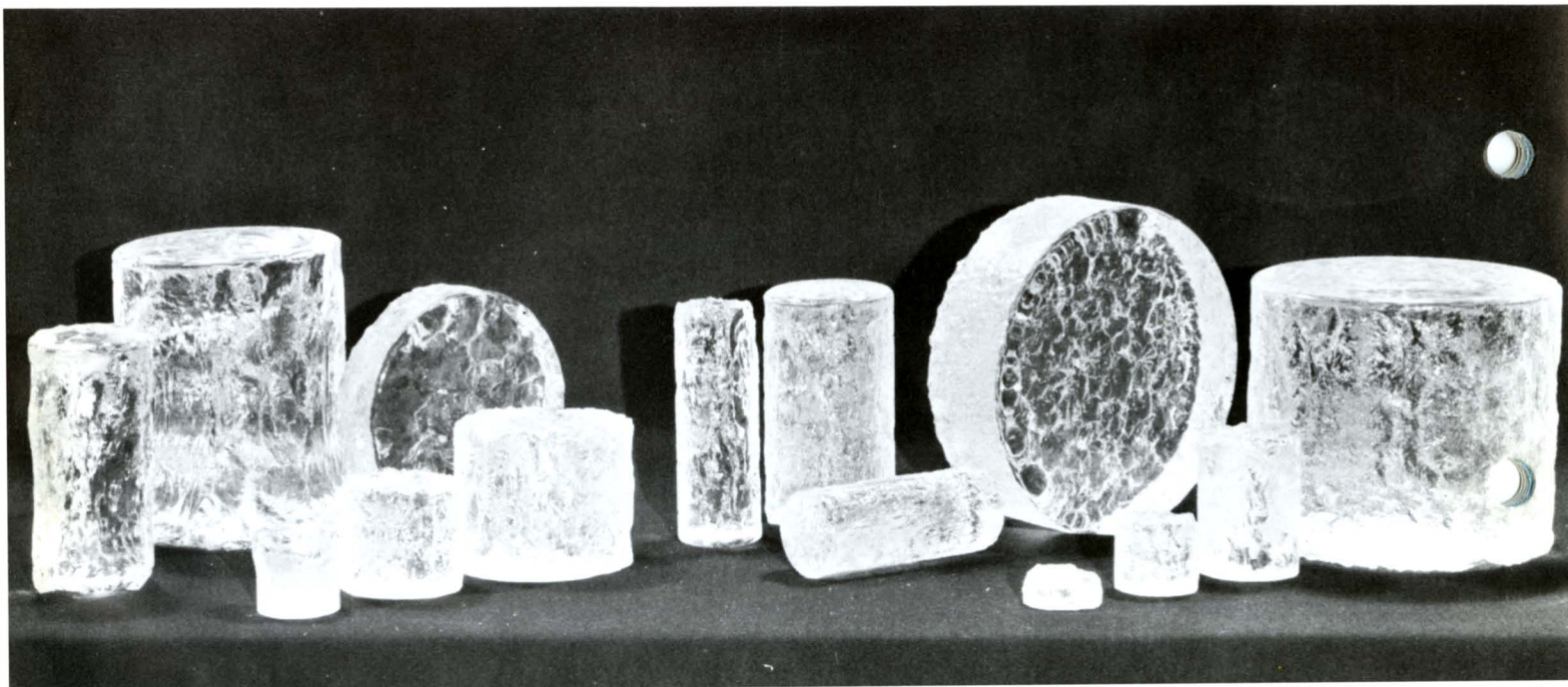
Specify Type 101 rough cast ingots followed by the finished diameter. Example: "Two rough cast ingots to finish to 6 inches in diameter". In every case sufficient stock to allow ingots to be finished to the correct diameter will be supplied. In the example above, an ingot up to $6\frac{9}{16}$" in rough form would be supplied.

GENERAL INFORMATION

Centerless grinding to close tolerances and special cut shapes are available. Quotations supplied on your exact requirements.

MINIMUM CHARGE
$10.00 per order

Diam. to finish in Inches	Max. Diam. of Rough Ingot	Lgth. Range of Rough Ingot	Ave. wt. of Rough Ingot in Lbs.	Area basis for Discs in Sq. Inches
1	1-13/16		1.5	1
1-1/4	2-1/16		1.5	2
1-1/2	2-5/16	6"-8"	2.0	2
1-3/4	2-9/16		2.5	3
2	2-9/16		3.0	4
2-1/2	3-1/16		4.0	5
3	3-9/16		6.0	7
3-1/2	4-1/16		7.0	10
4	4-9/16		12.0	13
4-1/2	5-1/16		14.0	16
5	5-9/16	8"-10"	17.0	20
5-1/2	6-1/16		20.0	24
6	6-9/16		24.0	29
7	7-5/8		33.0	39
8	8-5/8		40.0	51
8-3/4	9-5/8		42.0	61
9	9-5/8		45.0	64
10	10-5/8		45.0	79
11	11-5/8		50.0	95
12	12-5/8		75.0	113
14	14-11/16	5"-8"		154
15	15-11/16			177
16	16-11/16			201
18	18-3/4			255
18-1/2	19-1/4	3"-6"		269

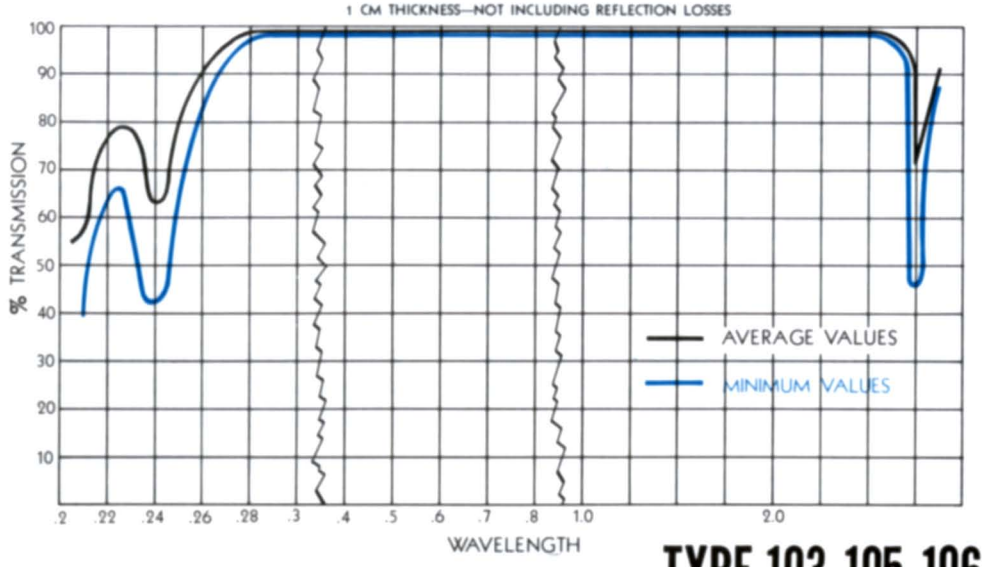


CLEAR FUSED QUARTZ INGOTS

TYPE 101

PERCENT TRANSMISSION–V.S.–WAVELENGTH G. E.

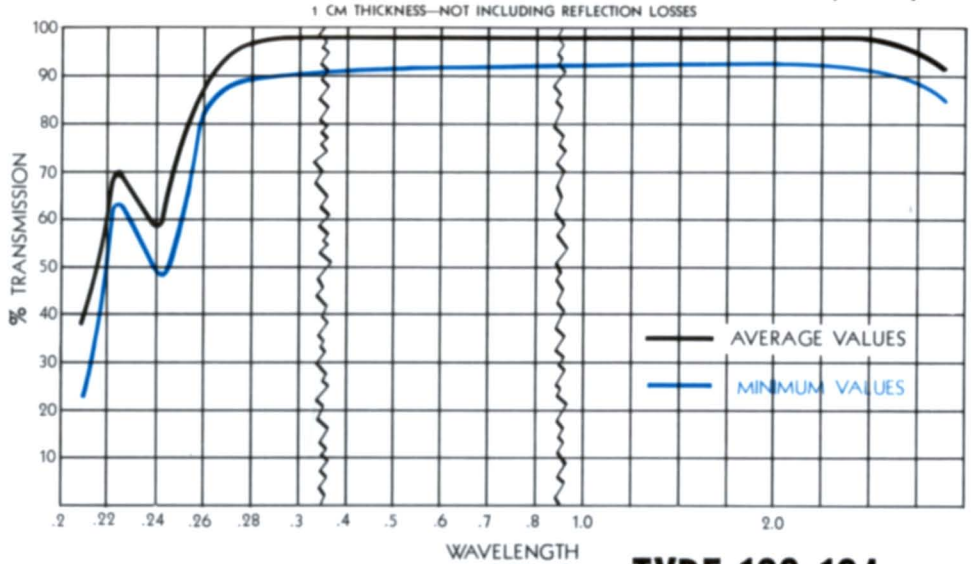
1 CM THICKNESS—NOT INCLUDING REFLECTION LOSSES



TYPE 103, 105, 106

PERCENT TRANSMISSION–V.S.–WAVELENGTH G. E.

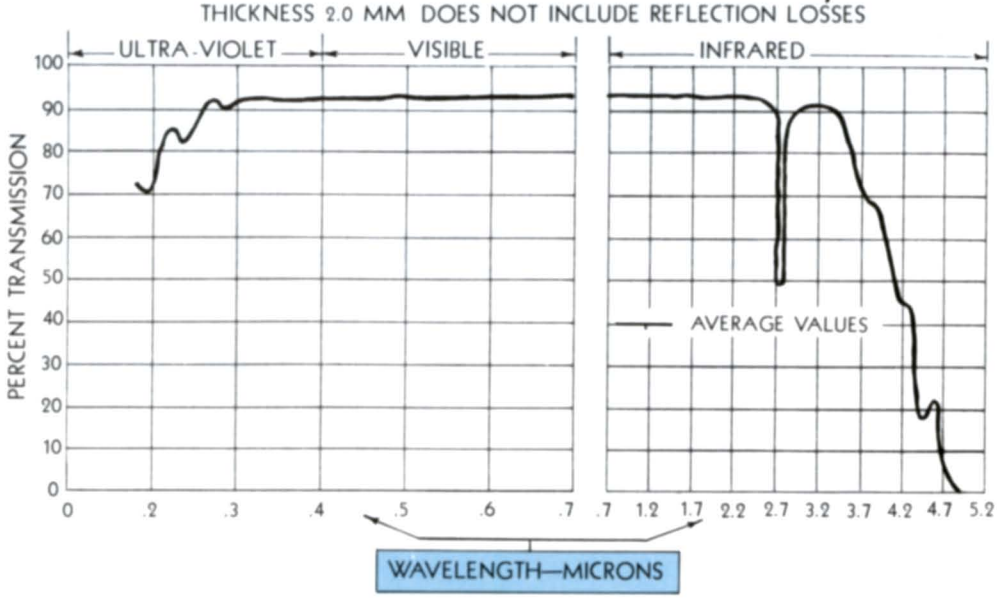
1 CM THICKNESS—NOT INCLUDING REFLECTION LOSSES



TYPE 102, 104

TRANSMISSION CURVE G. E.

THICKNESS 2.0 MM DOES NOT INCLUDE REFLECTION LOSSES



CLEAR FUSED QUARTZ INGOTS TYPE 102

DESCRIPTION

A high quality optical grade for use in applications where low bubble content is of primary consideration. Type 102 has the highest transmission in the ultraviolet, but exhibits an absorption at 2.7 micron in the infrared.

SEE COMPARISON CHART

SIZE LIMITATIONS

Available in rough ingot form to finish two inches diameter (tolerance on OD + .040″ to + .125″) x twelve inches long or shapes that can be cut from this size.

These discs or irregular shaped pieces can be supplied rough cut, ground to close tolerances, or ground and polished. Type 102 ingots can also be supplied centerless ground.

Quotations furnished on your exact specifications.

PROPERTIES

Transmission	— See curve for representative values.		
Bubbles	— Contains only a few very minute bubbles.		
Striae	— May contain minor striae observable under illumination.		
Internal Stress	— Uniform pattern when viewed under crossed polaroids.		
Resistivity	— Log_{10} Ohm per Centimeter D.C.		
	Representative values at 227°C		11.79
		250°C	11.28
		300°C	10.30
		350°C	9.48
		444°C	8.25
Dielectric Constant	— At room temperature	1 MC	3.69—3.81
		3 MC	3.69—3.81
		10 MC	3.66—3.79

PRICE SCHEDULE TYPE 102 Effective Jan. 1, 1955

SELLING PRICE—$45.00 per pound

Terms, conditions and general information is the same as for Type 101 material.

CLEAR FUSED QUARTZ INGOTS TYPE 103

PROPERTIES

TRANSMISSION

See curve for representative values.

BUBBLES

Has no large bubbles but may contain many small bubbles.

STRIAE

Orange peel effect. Does not conform to JAN G-174.

INTERNAL STRESS

Uniform under crossed polaroids.

RESISTIVITY

Log_{10} Ohm per centimeter D.C.

Representative values at 227°C	12.03
250°C	11.44
300°C	10.30
350°C	9.36
444°C	7.91

DESCRIPTION

This grade can be used where the stress pattern is critical and absence of bubbles is important. It is used in semi critical delay line applications, and has been widely used in the radome field because of its high infrared transmission and its adaptability to the forming of spherical shapes. Type 103 has a high transmission in the ultraviolet as well as in the infrared. Sizes and prices for hemispherical shapes are available on request.

SIZE LIMITATIONS

Diamater Range to Finish	Length of rough ingot	Maximum Rough Diameter
Up to 2″	5—7 inches	3/4—1″ larger than finished diameter
Over 2″—up to 3″	3—5 inches	
Over 3″—up to 4″	1—3 inches	
Over 4″—up to 18″	"To finish" 3/4″	

PRICE SCHEDULE TYPE 103 INGOTS Effective April 27, 1959

THICKNESS "TO FINISH" IN INCHES

Diameter	1/4	5/16	3/8	1/2	5/8	3/4
8	$145.00	$150.00	$155.00	$165.00		
8-1/2	155.00	160.00	165.00	170.00		
9	160.00	170.00	175.00	180.00		
9-1/2	170.00	175.00	180.00	185.00		
10	175.00	180.00	185.00	195.00		
10-1/2	185.00	190.00	195.00	200.00		
11	190.00	195.00	200.00	210.00		
11-1/2	200.00	210.00	215.00	230.00		
12	210.00	220.00	225.00	240.00		
12-1/2	220.00	230.00	235.00	250.00		
13	225.00	240.00	250.00	275.00		
13-1/2	235.00	250.00	260.00	285.00		
14	240.00	255.00	265.00	290.00		
14-1/2	250.00	265.00	275.00	295.00		
15	265.00	275.00	285.00	300.00		
15-1/2	275.00	285.00	295.00	305.00		
16	315.00	330.00	340.00	370.00	$405.00	$445.00
16-1/2	335.00	350.00	360.00	390.00	425.00	465.00
17	360.00	375.00	385.00	415.00	450.00	490.00
17-1/2	390.00	405.00	415.00	445.00	480.00	520.00
18	465.00	485.00	500.00	540.00	590.00	650.00
18-1/2	500.00	520.00	535.00	575.00	625.00	700.00

The above sizes are not always in stock.

CLEAR FUSED QUARTZ INGOTS TYPE 104

DESCRIPTION

Type 104 is an optical grade material essentially bubble free. It has high transmission in the ultraviolet but exhibits an absorption band at 2.7 micron in the infrared. Used for the most critical delay line applications or where high grade optical material is essential.

SIZE LIMITATIONS

Diameter "To Finish"	Maximum Diam. of Rough Ingot	Length of Rough Ingot
1 inch	1-1/8 inches	15—18 inches
2 inches	2-1/8 inches	9—12 inches
3 inches	3-9/16 inches	3—5 inches
4 inches	4-9/16 inches	2-1/2—3-1/2 inch.
5 inches	5-9/16 inches	1-1/2—2-1/2 inches
5-3/4 inches	6-5/16 inches	3/4—1-3/4 inches

PROPERTIES

TRANSMISSION

See curve for representative values.

BUBBLES

Contains only a few minute bubbles.

STRIAE

Essentially free of striae when viewed with naked eye.

INTERNAL STRESS

Uniform pattern under crossed polaroids.

PRICE SCHEDULE Effective March 16, 1959

Selling Price: $60.00 per pound

MINIMUM CHARGE—$10.00 per order.

CLEAR FUSED QUARTZ TYPE 105 INGOTS

DESCRIPTION

Type 105 is a high optical grade with a minimum of very small bubbles. This material has a wide range of applications due to its high clarity and high transmission in both the ultraviolet and infrared range.

SIZE LIMITATIONS

8″ minimum diameter to 17″ maximum diameter. Thickness limitation depends upon diameter.

PROPERTIES

TRANSMISSION

See curve for representative values.

BUBBLES

No large bubbles. Minimum quantity of fine bubbles.

STRIAE

No striae visible to naked eye.

INTERNAL STRESS

Uniform pattern under crossed polaroids.

Prices available on request.

CLEAR FUSED QUARTZ TYPE 106 INGOTS

DESCRIPTION

Type 106 is a high optical quality material with a minimum of bubbles. Transmission is high in the ultraviolet and infrared range.

SIZE LIMITATIONS

Available in rough ingot form from 5″ diameter up to and including 7½″. Ingot thickness is approximately 7″ to 9″. Discs, rectangles, squares and other shapes can be supplied if they are within the size limitations of the rough ingot.

PROPERTIES

TRANSMISSION

See curve for representative values.

BUBBLES

Contains some fine bubbles.

STRIAE

No striae visible to the naked eye.

INTERNAL STRESS

Uniform pattern under crossed polaroids.

Selling price: $35.00 per pound.
For prices on Type 106 discs, see appropriate schedule under section covering discs and plates.

PRICE SCHEDULE TYPE 101 ROUGH CUT DISCS Effective March 16, 1959

DISCS ROUGH CUT CLEAR FUSED QUARTZ TYPE 101

Diameter	THICKNESS IN INCHES																
	1/16″	1/8″	3/16″	1/4″	3/8″	1/2″	5/8″	3/4″	7/8″	1″	1-1/4″	1-1/2″	1-3/4″	2″	2-1/2″	2-3/4″	3″
1″	$ .60	$ .65	$ .70	$ .80	$ 1.15	$ 1.30	$ 1.45	$ 1.55	$ 1.70	$ 1.85	$ 2.40	$ 2.60	$ 2.90	$ 3.35	$ 4.50	$ 5.10	$ 5.50
1-1/4″	.90	1.00	1.10	1.20	1.75	1.95	2.10	2.30	2.55	2.80	3.60	3.90	4.40	5.00	6.75	7.70	8.25
1-1/2″	1.20	1.30	1.40	1.60	2.30	2.60	2.90	3.10	3.40	3.70	4.80	5.20	5.80	6.70	9.00	10.20	11.00
1-3/4″	1.80	1.95	2.10	2.40	3.45	3.90	4.35	4.65	5.10	5.60	7.20	7.80	8.70	10.00	13.50	15.30	16.50
2″	2.40	2.60	2.80	3.20	4.60	5.20	5.80	6.20	6.80	7.40	9.60	10.50	12.00	13.50	18.00	20.50	22.00
2-1/2″	3.00	3.25	3.50	4.00	5.80	6.50	7.30	7.80	8.50	9.30	12.00	13.00	14.50	16.75	22.50	25.50	27.50
3″	4.20	4.55	4.90	5.60	8.10	9.10	10.25	11.00	12.00	13.00	16.75	18.25	20.25	23.50	31.50	36.00	38.50
3-1/2″	6.00	6.50	7.00	8.00	11.50	13.00	14.50	15.50	17.00	18.50	24.00	26.00	29.00	33.50	45.00	51.00	55.00
4″	7.80	8.50	9.10	10.50	15.00	17.00	19.00	20.25	22.00	24.00	31.50	35.00	38.00	43.50	58.50	66.50	71.50
4-1/2″	9.60	10.50	11.25	12.75	18.50	20.25	23.25	25.00	27.50	29.50	38.50	42.00	46.50	53.50	72.00	82.00	88.00
5″	12.00	13.00	14.00	16.00	23.00	26.00	29.00	31.00	34.00	37.00	48.00	52.00	58.00	67.00	90.00	102.00	110.00
5-1/2″	14.50	15.75	17.00	19.25	27.50	31.50	35.00	37.50	41.00	44.50	57.50	62.50	70.00	81.00	108.00	123.00	132.00
6″	17.50	19.00	20.50	23.25	33.50	38.00	42.00	45.00	49.50	53.50	70.00	75.50	84.00	97.00	131.00	148.00	160.00
7″	23.50	25.50	27.50	31.00	45.00	51.00	56.50	60.50	66.50	72.50	94.00	102.00	113.00	130.00	175.00	200.00	215.00
8″	30.50	33.00	36.00	41.00	58.50	66.50	74.00	79.00	87.00	95.00	123.00	133.00	148.00	170.00	230.00	260.00	280.00
8-3/4″	36.50	39.50	43.00	49.00	70.00	79.50	88.50	95.00	104.00	113.00	147.00	158.00	177.00	205.00	275.00	310.00	340.00
9″	38.50	41.50	45.00	51.00	74.00	83.50	93.00	99.00	109.00	119.00	154.00	166.00	186.00	215.00	288.00	330.00	350.00
10″	47.50	51.50	55.50	63.00	91.00	103.00	115.00	123.00	134.00	146.00	190.00	205.00	230.00	265.00	360.00	400.00	440.00
11″	57.00	62.00	66.50	76.00	109.00	124.00	138.00	147.00	162.00	176.00	228.00	247.00	275.00	320.00	430.00	490.00	520.00
12″	68.00	73.50	79.00	90.50	130.00	147.00	164.00	175.00	192.00	209.00	271.00	295.00	330.00	380.00	510.00	580.00	620.00
14″	92.50	100.00	108.00	123.00	177.00	200.00	223.00	239.00	262.00	285.00	370.00	400.00	450.00	520.00	700.00	790.00	850.00
15″	106.00	115.00	124.00	142.00	201.00	230.00	257.00	274.00	300.00	330.00	425.00	460.00	520.00	600.00	800.00	900.00	970.00
16″	121.00	131.00	141.00	161.00	231.00	261.00	291.00	310.00	340.00	370.00	480.00	520.00	580.00	670.00	910.00	1025.00	1100.00
18″	153.00	166.00	178.00	204.00	293.00	330.00	370.00	395.00	435.00	470.00	610.00	660.00	740.00	850.00	1150.00	1300.00	1400.00
18-1/2″	162.00	175.00	188.00	215.00	309.00	350.00	390.00	420.00	460.00	500.00	650.00	700.00	780.00	900.00	1200.00	1375.00	1475.00

Ordering Instructions: Rough cut discs can be supplied "To finish" or "To Size". It is extremely important to specify either method on your purchase order. Interim diameters or thicknesses are priced at the next largest dimension.

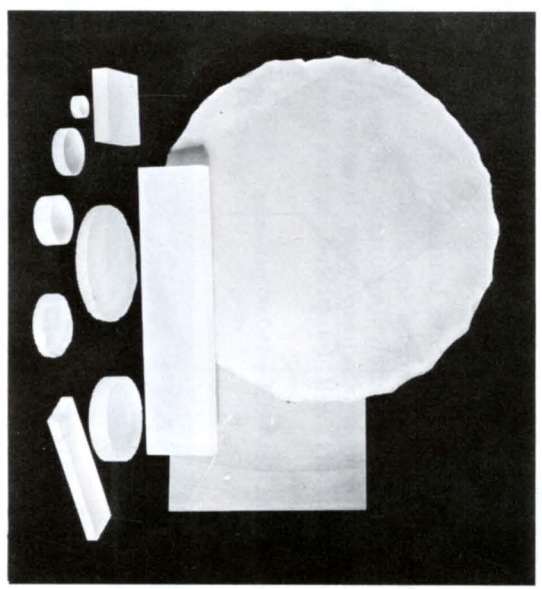
THICKNESS CUTTING TOLERANCES WHEN ORDERED "TO FINISH"

Diameter	Min. Thickness Supplied	Max. Thickness Supplied
A. Up to and including 10″ diameter	"To finish" dimension plus 1/16″	"To Finish" dimension plus 1/8″
B. Over 10″ and including 14″ diameter	"To finish" dimension plus 1/16″	"To Finish" dimension plus 3/16″
C. Larger than 14″ diameter	"To finish" dimension plus 1/16″	"To Finish dimension" plus 5/16″

THICKNESS CUTTING TOLERANCES WHEN ORDERED "TO SIZE"

Diameter	Cutting Thickness (up to 3″ thick)
A. Up to and including 10″ diameter	± 1/32″
B. Over 10″ and including 14″ diameter	± 1/16″
C. Larger than 14″ diameter	± 1/8″

NOTE: Please specify either "To finish" or "To size". Unless specified, discs will be furnished "To finish".
MINIMUM CHARGE: $10.00 per order.



CLEAR FUSED QUARTZ DISCS ROUGH CUT TYPE 101

DESCRIPTION

This material is the standard commercial grade and is cut from Type 101 ingots. All properties such as transmission, bubbles, striae, internal stress, etc., are identical to those shown in the description for Type 101 ingots.

Rough cut discs will have smooth finely etched surfaces due to diamond wheel cutting.

SIZE LIMITATIONS

A complete range up to and including 18½″ in diameter. Special disc thicknesses can be supplied up to the length of the ingot from which it is cut. Quotation requests for smaller diameter discs than listed are invited. If discs require close tolerances or must be clear, see schedule on "Ground and Polished Discs".

CLEAR FUSED QUARTZ

ROUGH CUT DISCS TYPE 106

PRICE SCHEDULE TYPE 106 ROUGH CUT DISCS Effective March 16, 1959

Diam.	THICKNESS IN INCHES											
	.125″	.175″	.250″	.312″	.325″	.375″	.400″	.425″	.500″	.625″	.750″	1.000″
5	$25.00	$30.00	$35.00	$40.00	$42.00	$45.00	$48.00	$50.00	$55.00	$60.00	$ 85.00	$100.00
5-1/2	30.00	35.00	40.00	43.00	45.00	50.00	53.00	55.00	60.00	65.00	90.00	105.00
6	35.00	40.00	45.00	55.00	58.00	60.00	63.00	70.00	75.00	80.00	105.00	125.00
6-1/2	40.00	45.00	53.00	60.00	65.00	70.00	73.00	80.00	85.00	90.00	115.00	145.00
7	45.00	50.00	60.00	70.00	75.00	80.00	83.00	90.00	95.00	100.00	125.00	155.00
7-1/2	55.00	60.00	70.00	80.00	85.00	90.00	93.00	100.00	105.00	110.00	135.00	165.00

Ordering Instructions

Rough cut discs can be supplied "to finish" or "to size". It is extremely important to specify either method on your purchase order. Interim thicknesses or diameters will be priced at the next largest dimension.

MINIMUM CHARGE—$10.00 per order.

Cutting tolerance when ordered—"To Finish"
All diameters—.062″ to .125″ over "To Finish" thickness

Thickness cutting tolerance when ordered—"To Size"
All diameters $\pm\frac{1}{32}$″ (up to 3″ thick)

NOTE: Please specify either "to finish" or "to size". Unless specified, discs will be furnished "to finish".

GROUND & POLISHED DISCS TYPE 101

PRICE SCHEDULE TYPE 101 GROUND AND POLISHED DISCS Effective March 16, 1959

Diameter	THICKNESS IN INCHES									
	1/16″	1/8″	3/16″	1/4″	3/8″	1/2″	5/8″	3/4″	7/8″	1″
1″	$ 1.25	$ 1.30	$ 1.35	$ 1.45	$ 2.00	$ 2.15	$ 2.45	$ 2.55	$ 2.90	$ 3.05
1-1/4″	2.10	2.20	2.30	2.40	3.10	3.30	3.50	4.10	4.50	4.75
1-1/2″	2.40	2.50	2.65	2.80	3.75	4.05	4.60	4.80	5.40	5.70
1-3/4″	3.40	3.55	3.70	4.00	5.40	5.80	6.60	6.90	7.60	8.10
2″	4.00	4.20	4.40	4.80	6.50	7.10	8.00	8.40	9.30	9.90
2-1/2″	5.70	6.00	6.30	6.70	9.00	9.70	10.75	11.25	12.50	13.25
3″	8.00	8.30	8.70	9.40	12.75	14.00	15.25	16.00	17.25	18.30
3-1/2″	11.50	12.00	12.50	13.50	17.75	19.25	21.00	22.00	24.00	25.50
4″	14.75	15.50	16.25	17.25	22.75	24.75	27.00	28.25	30.50	32.50
4-1/2″	21.00	21.75	22.75	24.00	31.00	33.50	36.00	38.00	40.50	43.00
5″	23.25	24.25	25.50	27.50	35.50	38.50	42.00	44.00	47.50	50.50
5-1/2″	30.00	31.50	32.50	35.00	45.00	49.00	52.50	55.00	59.00	62.50
6″	33.00	34.50	36.00	39.00	51.00	55.50	60.00	63.00	67.50	72.00

Ground and Polished Discs Standard sizes—See above schedule.

Non-standard sizes—Standard catalog price for next largest diameter and thickness—refer to schedule shown above.

Example—4-1/4″ diameter x 5/16″ thick.
Use 4-1/2″ diameter size and 3/8″ for thickness.

Special pricing—1. Less than 1″ diameter and over 6″ diameter.
2. Under 1/16″ thickness and over 1″.
3. Over 750 total square inches per size.

TOLERANCES: Thickness ± .005″
Diameter:
Up to and including 4″ ± .005″
Over 4″ up to and including 8″ ± .015″

MINIMUM CHARGE—$10.00 per order.

PRICE SCHEDULE TYPE 101 ROUGH CUT PLATES Effective August 17, 1959

SQUARE PLATES, CLEAR FUSED QUARTZ TYPE 101 ROUGH CUT

Length of side	THICKNESS IN INCHES																	
	1/16″	1/8″	3/16″	1/4″	3/8″	1/2″	5/8″	3/4″	7/8″	1″	1-1/8″	1-1/4″	1-3/8″	1-1/2″	1-5/8″	1-3/4″	1-7/8″	2″
1″	$ .80	$ .90	$1.00	$1.10	$1.30	$1.50	$1.75	$2.00	$2.30	$2.75	$ 3.25	$ 3.75	$ 4.00	$ 4.25	$ 4.50	$ 4.75	$ 5.00	$ 5.50
1-1/4″	1.25	1.45	1.60	1.75	2.05	2.35	2.75	3.15	3.60	4.30	5.10	5.90	6.25	6.65	7.05	7.45	7.85	8.60
1-1/2″	1.80	2.05	2.25	2.50	2.95	3.40	3.95	4.50	5.20	6.20	7.35	8.45	9.00	9.60	10.15	10.70	11.25	12.40
1-3/4″	2.45	2.80	3.10	3.40	4.00	4.60	5.40	6.20	7.10	8.50	10.00	11.50	12.25	13.00	13.80	14.60	15.40	16.75
2″	3.20	3.60	4.00	4.40	5.20	6.00	7.00	8.00	9.20	11.00	13.00	15.00	16.00	17.00	18.00	19.00	20.00	22.00
2-1/2″	5.00	5.70	6.30	6.90	8.20	9.40	11.00	12.50	14.50	17.25	20.50	23.50	25.00	26.75	28.25	29.75	31.25	34.50
3″	7.20	8.10	9.00	9.90	11.75	13.50	15.75	18.00	20.75	24.75	29.25	33.75	36.00	38.25	40.50	42.75	45.00	49.50
3-1/2″	9.80	11.00	12.25	13.50	16.00	18.50	21.50	24.50	28.50	34.00	40.00	46.00	49.00	52.00	55.50	58.50	61.50	67.50
4″	13.00	14.50	16.00	17.75	20.75	24.00	28.00	32.00	37.00	44.00	52.00	60.00	64.00	68.00	72.00	76.00	80.00	88.00
4-1/2″	16.25	18.25	20.25	22.25	26.50	30.50	35.50	40.50	46.50	56.00	66.00	76.00	81.00	86.00	91.00	96.00	101.00	112.00
5″	20.00	22.50	25.00	27.50	32.50	37.50	44.00	50.00	57.50	69.00	81.50	94.00	100.00	106.00	112.00	119.00	125.00	138.00
5-1/2″	24.25	27.50	30.50	33.50	39.50	45.50	53.00	60.50	70.00	83.00	98.50	113.00	121.00	129.00	136.00	144.00	151.00	166.00
6″	29.00	32.50	36.00	40.00	47.00	54.00	63.00	72.00	83.00	99.00	117.00	135.00	144.00	153.00	162.00	171.00	180.00	198.00

Larger squares or irregular shaped pieces available. Prices on request.

Ordering Instructions—Rough cut plates can be supplied "To Finish" or "To Size". It is extremely important to specify either method on your purchase order. The tolerances are as follows:

CUTTING TOLERANCES WHEN ORDERED "TO FINISH"

Size	Min. Thickness Supplied	Max. Thickness Supplied
A. Any cut that can be inscribed in a 10″ square	"To Finish" dimension plus 1/16″	"To Finish" dimension plus 1/8″
B. Any cut larger than "A" that can be inscribed in a 14″ circle	"To Finish" dimension plus 1/16″	"To Finish" dimension plus 3/16″
C. Any cut that can be inscribed in a circle over 14″ diameter up to and including 18-1/2″ diameter.	"To Finish" dimension plus 1/16″	"To Finish" dimension plus 5/16″

Length Tolerance—"To Finish"	Min. Length Supplied	Max. Length Supplied
A. 1″ and under	"To Finish" dimension	Min. plus 1/16″
B. 1″ up to and including 3″	plus .040″	Min. plus 1/8″
C. Over 3″ and including 10″	plus .040″	Min. plus 1/4″
D. Over 10″	plus .040″	Min. plus 1/2″

These are standard tolerances—prices for closer tolerances on request.

CUTTING TOLERANCES WHEN ORDERED "TO SIZE"

Size	Thickness up to 3″ Thick
A. Any cut that can be inscribed in a 10″ square	± 1/32″
B. Any cross section larger than "A" that can be inscribed in a 14″ diameter circle.	± 1/16″
C. Any cut that can be inscribed in a circle over 14″ diameter up to and including 18-1/2″ diameter	± 1/8″

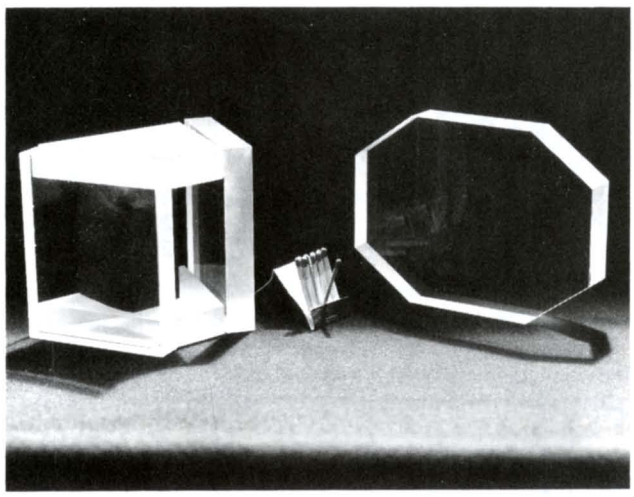
Length of Side Tolerance	
A. 1″ and under	± 1/32″
B. 1″ up to and including 3″	± 1/16″
C. Over 3″ and including 10″	± 1/8″
D. Over 10″	± 1/4″

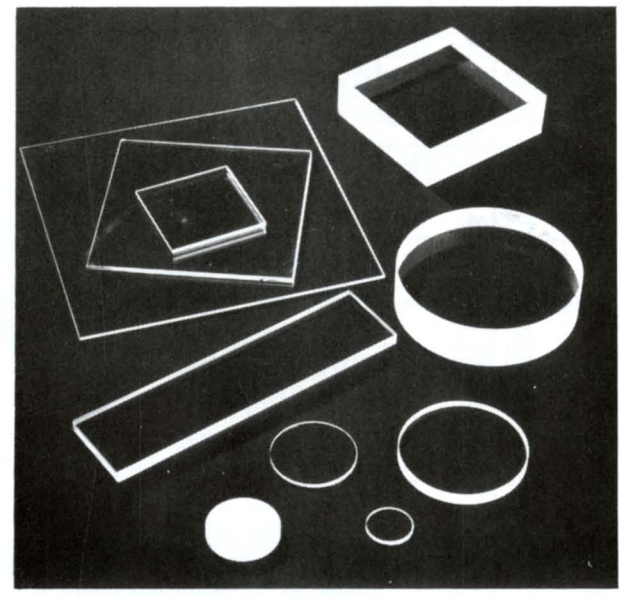
NOTE: Please specify "To Finish" or "To Size". Unless specified plates will be furnished "To Finish". These are standard tolerances—prices for closer tolerances on request.

MINIMUM CHARGE: $10.00 per order.

CLEAR FUSED QUARTZ

GROUND & POLISHED PLATES TYPE 101





PRICE SCHEDULE TYPE 101 GROUND AND POLISHED SQUARE PLATES

	THICKNESS IN INCHES									
Length of Side	1/16″	1/8″	3/16″	1/4″	3/8″	1/2″	5/8″	3/4″	7/8″	1″
1″	$ 1.65	$ 1.75	$ 1.85	$ 1.95	$ 2.30	$ 2.50	$ 2.95	$ 3.20	$ 3.70	$ 4.15
1-1/4″	2.50	2.65	2.80	2.95	3.50	3.85	4.50	4.85	5.60	6.30
1-1/2″	3.05	3.25	3.50	3.70	4.40	4.85	5.70	6.25	7.15	8.15
1-3/4″	4.45	4.75	5.05	5.35	6.25	6.90	7.95	8.70	9.95	11.30
2″	5.20	5.60	6.00	6.40	7.50	8.30	9.60	10.60	12.10	13.90
2-1/2″	8.30	8.90	9.55	10.15	11.75	13.00	14.90	16.50	18.70	21.50
3″	11.90	12.80	13.70	14.60	17.00	18.80	21.40	23.65	26.70	30.75
3-1/2″	15.90	17.10	18.35	19.55	22.70	25.15	28.50	31.50	35.65	41.15
4″	20.30	21.90	23.50	25.00	29.00	32.25	36.50	40.50	45.50	52.95
4-1/2	29.95	31.95	34.00	36.00	41.30	45.35	50.75	55.85	62.25	71.35
5″	33.75	36.25	38.75	41.25	47.50	52.50	59.10	65.35	73.00	84.45
5-1/2″	39.80	42.80	45.85	48.85	56.80	62.85	70.75	78.35	87.75	101.00
6″	44.40	48.00	51.50	55.00	64.30	71.50	80.85	89.85	101.00	117.00

TOLERANCES:—Thickness ± .005″
Edging ± .005″

PRICES ON IRREGULAR SHAPES ON REQUEST

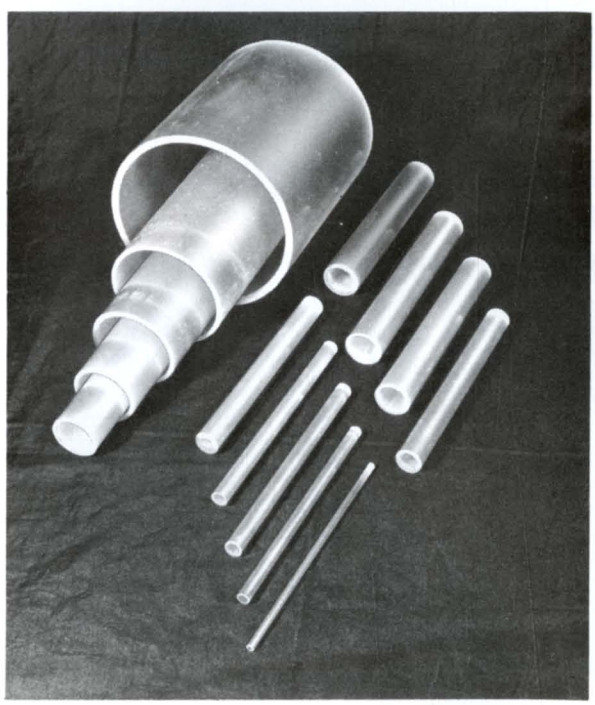
RODS
TUBING

TRANSLUCENT FUSED QUARTZ

IMMERSION THERMOCOUPLE TUBES
COMBUSTION TUBES

PRICE SCHEDULE — TYPE 301 — TRANSLUCENT TUBING

Effective December 12, 1960



Random Lengths — 12″ through 72″

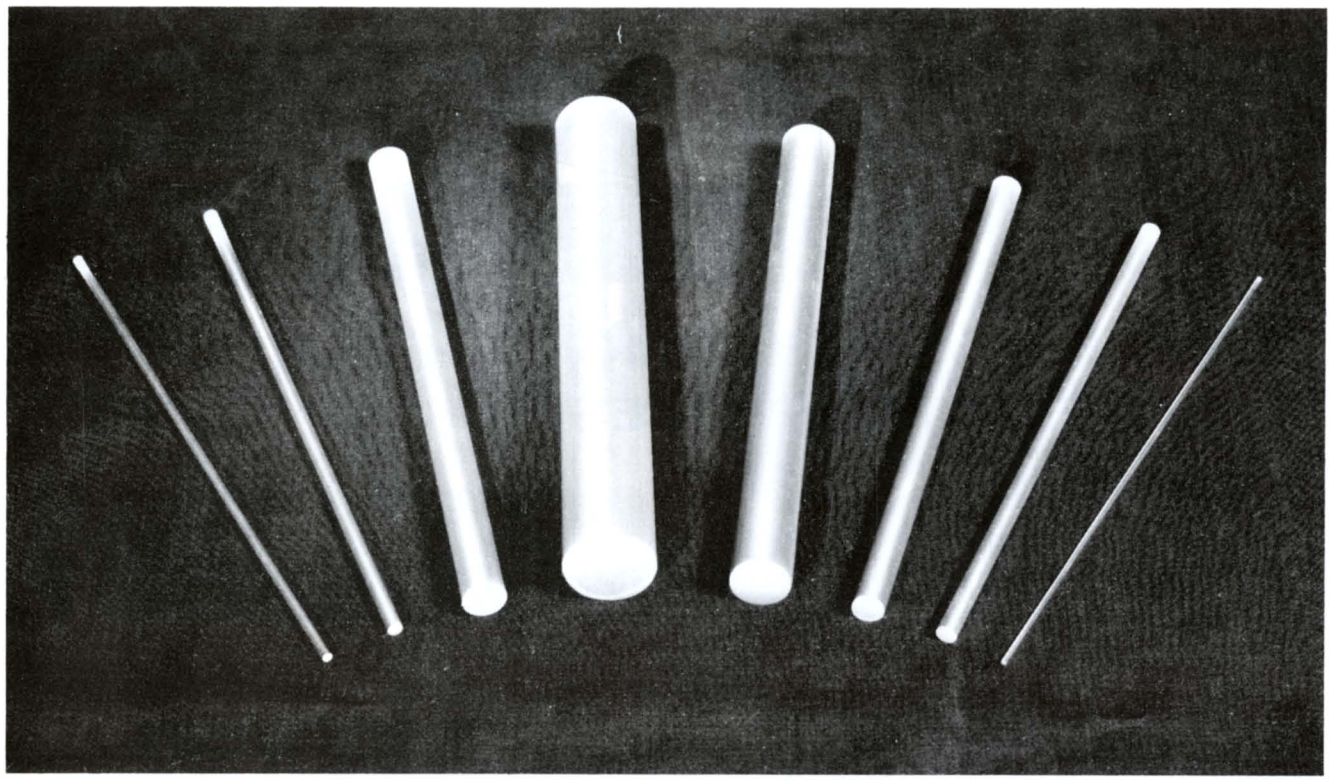
Cut Lengths
- — Up to 12″ write for prices
- — 12″ through 72″ catalog price plus 10% for cutting.
- — Over 72″ up to 120″—catalog price plus 15% for cutting plus $17.00 crating, per crate.

MINIMUM CHARGE—$10.00 per order.

Prices for random lengths are listed below:

Size in Inches Except as Noted	Tolerance	Theo. Feet Per Pound	Small Volume Price Per Foot	Large Volume Minimum Ft. To Be Ordered	Large Volume Price Per Foot
.105 x .220	Bore ± 8%	37.90	.35	5000	.30
1/8 x 1/4		30.23	.35	5000	.30
4.5 x 6.5—8.0mm		28.29	.35	5000	.30
3/16 x 5/16		22.667	.40	4300	.35
3/16 x 7/16	O.D. ± 4%	9.069	1.00	1800	.85
.250 x .450		10.119	.90	2000	.75
1/4 x 3/8		18.135	.50	3600	.40
5/16 x 7/16		15.119	.60	3000	.50
7.75 x 9.75mm		26.120	.35	5000	.30
3/8 x 1/2		12.953	.60	2500	.50
3/8 x 3/4		3.358	2.25	650	2.00
1/2 x 5/8		10.074	.80	2000	.65
1/2 x 3/4		4.533	1.60	900	1.40
9/16 x 3/4		5.759	1.25	1150	1.10
5/8 x 3/4	Bore ± 8%	8.243	.95	1600	.80
3/4 x 1		3.238	2.25	650	2.00
7/8 x 1-1/8		2.833	2.50	550	2.20
1 x 1-1/4		2.518	2.80	500	2.50
1-1/8 x 1-3/8		2.267	3.10	450	2.70
1-3/32 x 1-1/2		1.344	3.85	270	3.40
1-1/4 x 1-7/16		2.811	2.60	560	2.20
1-1/4 x 1-1/2		2.061	3.30	400	2.95
1-3/8 x 1-13/16		1.016	6.75	200	6.00
1-1/2 x 1-3/4		1.744	4.00	350	3.50
1-5/8 x 1-7/8	O.D. ± 4%	1.619	4.30	325	3.75
2 x 2-1/4	O.D. ± 8%	1.333	5.00	260	4.40
2-1/4 x 2-5/8		775	8.25	155	7.25
2-3/8 x 2-3/4		.737	8.50	145	7.75
3 x 3-1/4		.907	9.50	140	8.00
3-1/4 x 3-1/2		.840	10.25	135	8.75
3-1/2 x 3-3/4		.782	11.00	130	9.50
3-3/4 x 4		.731	12.00	125	10.00
6 x 6-1/2		.227	32.00	50	28.00

TRANSLUCENT FUSED QUARTZ ROD TYPE 301



PRICE SCHEDULE TYPE 301 TRANSLUCENT ROD

Effective August 17, 1959

PRICES FOR STRAIGHT RANDOM LENGTHS ARE LISTED BELOW:

Random Lengths — 12″ to 72″

Cut Lengths — Up to 12″—write for prices.

— 12″ through 72″—Catalog price plus 10% for cutting.

— Over 72″ up to and including 108″—Catalog price plus 15% for cutting plus $17.00 for crating per crate.

Length Tolerance — Less than 12″ cut ± .040″

— 12″ through 48″ cut to ± 1/16″

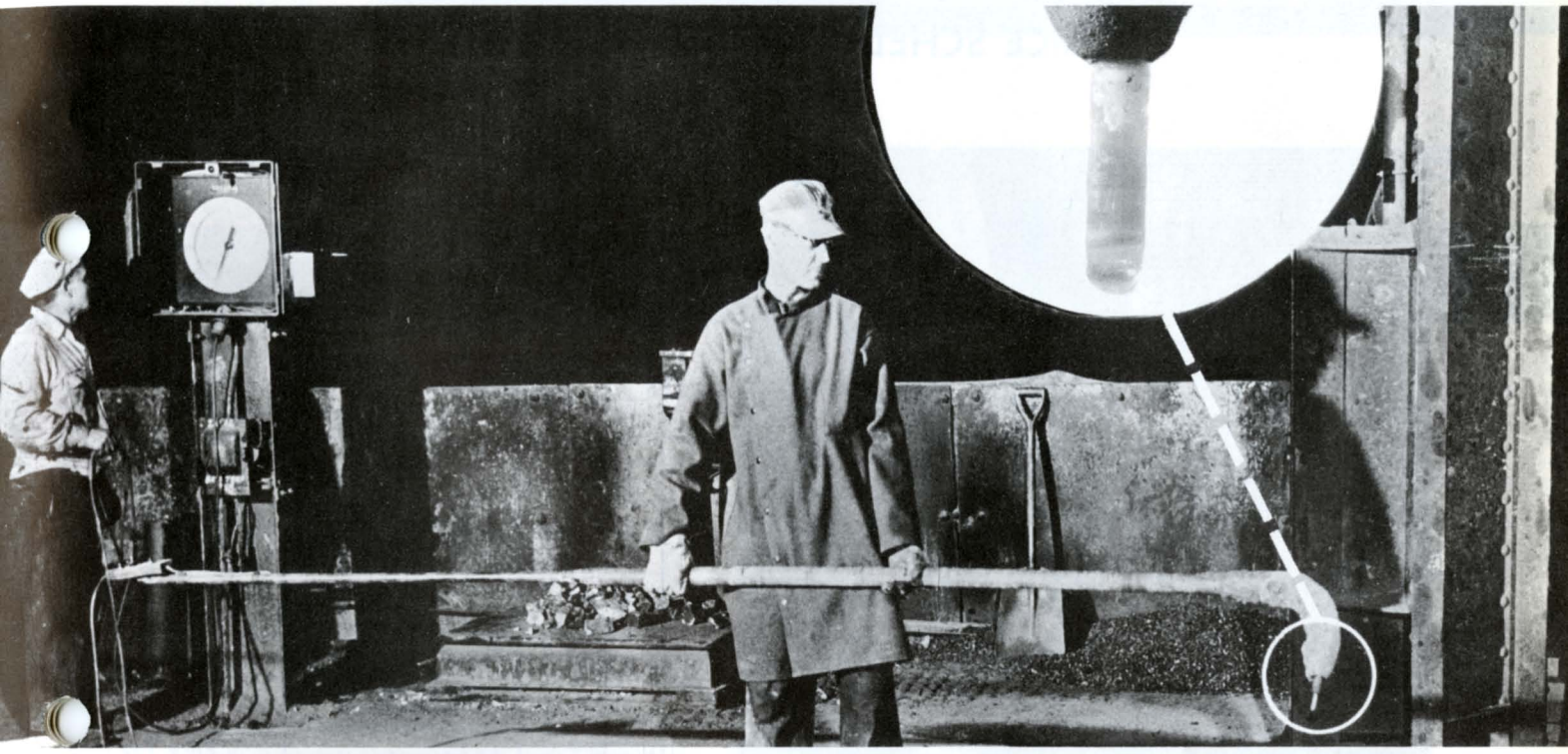
— Over 48″ through 72″ cut ± 1/8″

MINIMUM CHARGE—$10.00 per order.

Size In Inches	Tolerance	Theo. Feet Per Pound	Price Per Foot
1/8″	± 10%	90.70	$0.25
3/16		40.36	0.30
.210 — .250		26.78	0.45
1/4		22.67	0.55
5/16		14.52	0.85
3/8	± 4%	10.075	1.25
1/2		5.667	2.10
5/8		3.627	3.10
3/4		2.518	4.50
1		1.417	7.50

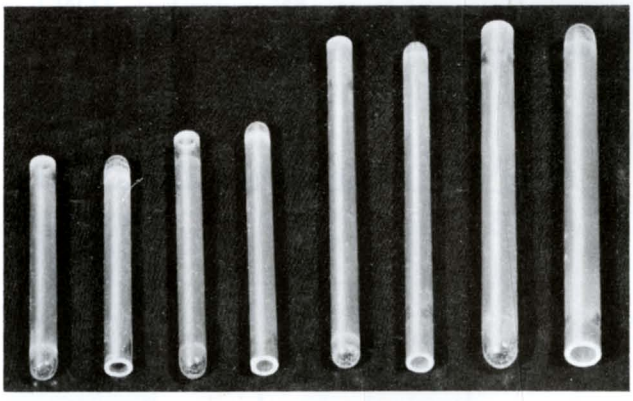
IMMERSION THERMOCOUPLE TUBES

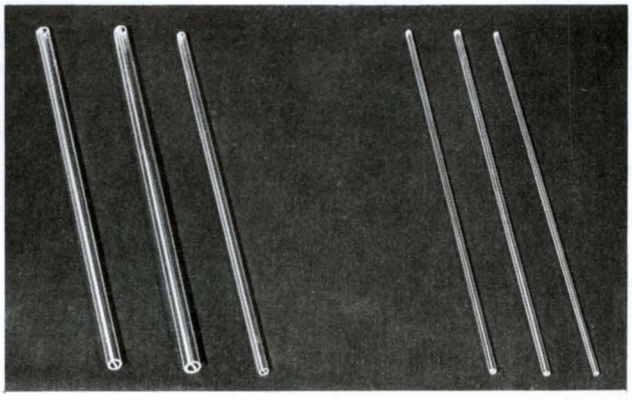
SPECIFY GENERAL ELECTRIC FUSED QUARTZ FOR IMMERSION THERMOCOUPLE TUBES



This is one type of assembly used in the steel industry for rapid temperature determination. Inset shows immersion thermocouple tube inserted in graphite nipple.

PRICE SCHEDULE IMMERSION THERMOCOUPLE TUBES
Effective March 16, 1959





G-E THERMOCOUPLE TUBES

Ordering Number	Bore in mm	O.D. in mm	Wall in mm	Length in Inches	Price Per Piece
Q290	4.5 min.	6.5-8.0	1.0-1.3	3	$0.10
Q291	4.5 min.	6.5-8.0	1.0-1.3	3-1/2	.11
Q292	4.5 min.	6.5-8.0	1.0-1.3	4-3/4	.14
Q306	1/4"	3/8"	1/16"	5	.40

Q301	.025 inch min. Dia. Each Bore 4mm max O.D.	Random Lengths 12"-44" $0.60 per Foot
Q301A	.022 inch min. Dia. Each Bore 4.4mm max O.D.	$0.50 per Foot

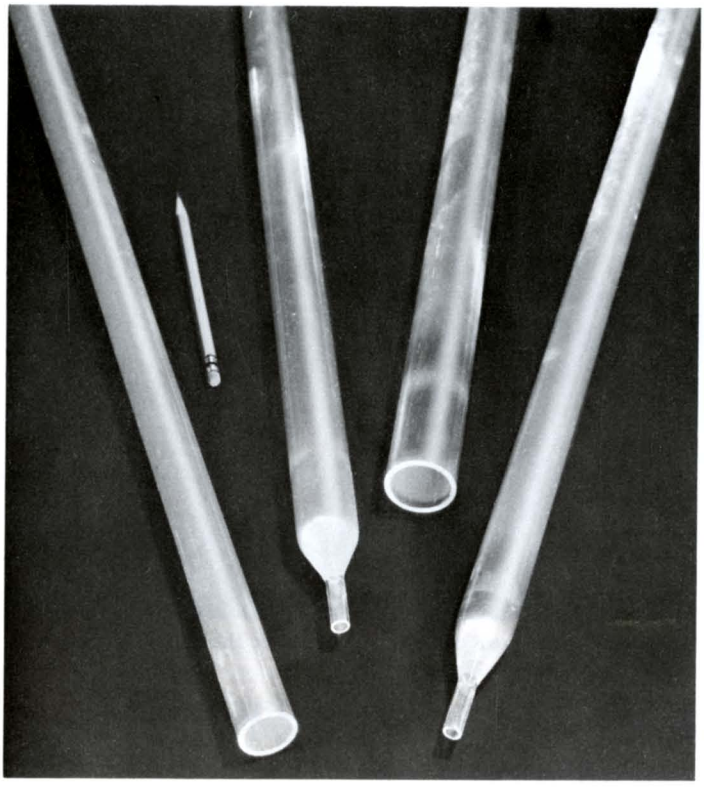
G. E. Clear Double Bore Tubing to use in all of the immersion tubes listed above.

MINIMUM CHARGE—$10.00 per order.

All General Electric thermocouple tubes are completely fused from translucent tubing and are closed at one end. A special General Electric process makes the closed ends clear, and allows easy viewing of thermocouple wires.

COMBUSTION TUBES

PRICE SCHEDULE Effective August 17, 1959



Nipples on reduced end tubes are drawn to 1/8" id, 5/16" od over a length of one inch. Ends finished for hose connections and rubber stoppers.

Combustion tubes are completely fused and have smooth inner and outer surfaces.

COMBUSTION TUBES

SATIN SURFACE

Open End

Bore Size	Length	Price Each
3/4"	24"	$7.00
3/4"	30"	8.00
7/8"	24"	7.50
7/8"	30"	9.00
1"	24"	8.50
1"	30"	10.00
1-1/8"	24"	9.00
1-1/8"	30"	10.50
1-1/4"	24"	9.50
1-1/4"	30"	11.00

Reduced End

Bore Size	Length	Price Each
3/4"	25"	10.50
3/4"	31"	11.50
7/8"	25"	11.00
7/8	31"	12.50
1"	25"	12.00
1"	31"	13.50
1-1/8"	25"	12.50
1-1/8"	31"	14.00
1-1/4"	25"	13.00
1-1/4"	31"	14.50

MINIMUM CHARGE—
$10.00 per order.

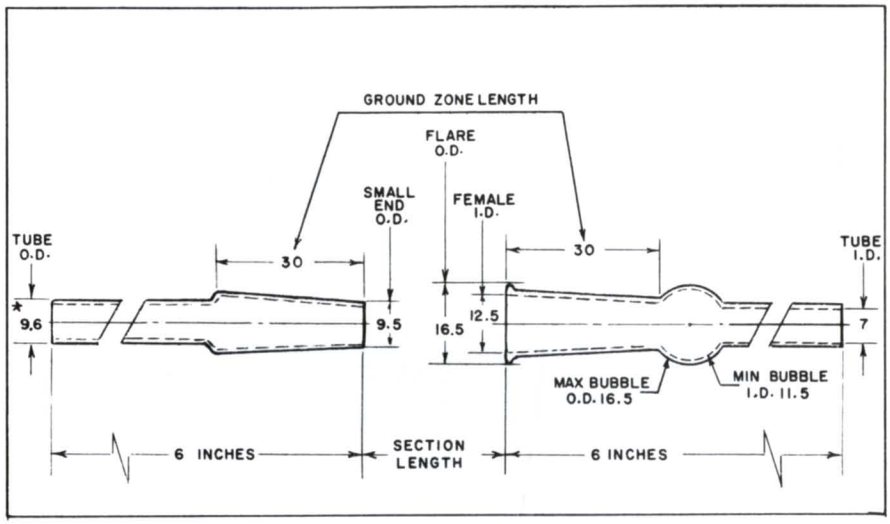
JOINTS
GRADED SEALS

FABRICATED QUARTZWARE

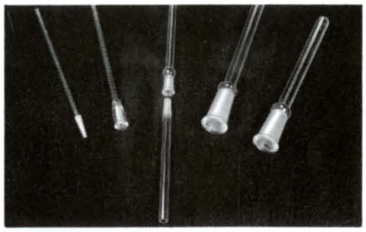
BEAKERS
SEMI-CONDUCTOR COMPONENTS

CLEAR FUSED QUARTZ STANDARD TAPER JOINTS

PRICE SCHEDULE Effective August 17, 1959



EXAMPLE OF QT 12/30 JOINT



STANDARD TAPER JOINTS CS 21-58

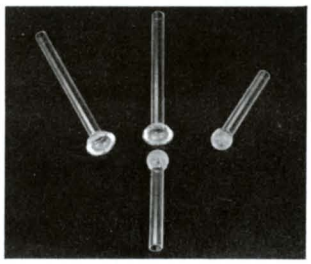
Ordering Designation	Tube O.D.	Tube I.D.	Small End O.D.	Ground Zone Length	Outer Member I.D.	Min. Bubble I.D.	Max. Bubble O.D.	Flare O.D.	Section Length (Inches)	PRICE Inner	PRICE Outer
QT 7/25	5	3	5.0	25	7.5	6	11.0	11.0	4.5	$6.25	$6.25
QT 10/30	7.4	5	7.0	30	10.0	8	14.0	14.0	4.5	6.50	6.50
QT 12/30	9.6	7	9.5	30	12.5	11.5	16.5	16.5	4.5	6.75	6.75
QT 14/35	11	8	11.0	35	14.5	13	19.5	19.5	5.0	7.25	8.00
QT 19/38	15.2	12	15.0	38	18.8	17	24.0	24.0	5.0	8.00	9.00
QT 24/40	20	16	20.0	40	24.0	22	29.0	29.0	5.0	9.00	10.00
QT 29/42	25.8	22	25.0	42	29.2	27	34.2	34.2	5.0	10.00	11.00
QT 34/45	30	26	30.0	45	34.5	32	39.5	39.5	5.0	12.00	13.00
QT 40/50	36	32	35.0	50	40.0	37	45.0	45.0	5.5	16.00	18.00
QT 45/50	40	36	40.0	50	45.0	42	50.0	50.0	5.5	19.00	22.00
QT 50/50	45	40	45.0	50	50.0	47	55.0	55.0	5.5	22.00	26.00
QT 55/50	50	43.7	50.0	50	55.0	52	61.0	61.0	5.5	26.00	30.00
QT 60/50	55	50	55.0	50	60.0	57	65.5	65.5	5.5	29.00	35.00
QT 71/60	65	60	65.0	60	71.0	67	77.0	77.0	6.0	35.00	45.00

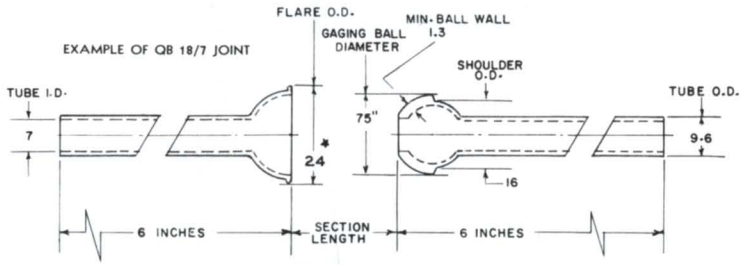
MINIMUM CHARGE: $10.00 per order. All Standard Taper Joints are interchangeable and made according to:

National Bureau of Standards
Specifications CS-21-58

CLEAR FUSED QUARTZ BALL & SOCKET JOINTS

PRICE SCHEDULE Effective September 1, 1959





STANDARD BALL & SOCKET JOINTS CS 21-58

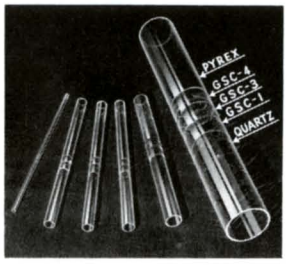
MINIMUM CHARGE: $10.00 per order.

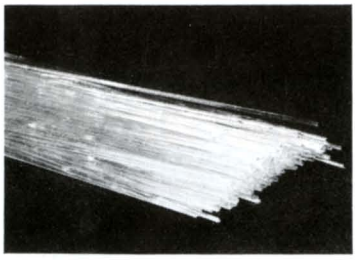
All Ball and Socket Joints are interchangeable and made according to: National Bureau of Standards Specifications CS-21-58

Ordering Designation	Tube O.D.	Tube I.D.	Min. Ball Wall	Gaging Ball Diam. Max. Ball O.D. Min. Socket I.D. (Inches)	Flare O.D.	Shoulder O.D.	Section Length (Inches)	PRICES Ball Only	PRICES Socket Only
QB12/1	5	1	CONSTANT BORE	0.50000 ± .00010	18	10	3.5	$7.00	$7.00
QB12/1.5	5	1.5		0.50000 ± .00010	18	10	3.5	7.00	7.00
QB12/2	5	2		0.50000 ± .00010	18	10	3.5	7.00	7.00
QB12/3	5	3		0.50000 ± .00010	18	10	3.5	7.00	7.00
QB12/5	7.4	5		0.50000 ± .00010	18	10	3.5	7.00	7.00
QB18/7	9.6	7	1.3	0.75000 ± .00010	24	16	3.5	8.00	8.00
QB18/9	11.8	9	1.4	0.75000 ± .00010	24	16	3.5	8.50	8.50
QB28/12	15.2	12	1.6	1.12500 ± .00015	35	26	4.5	10.50	10.50
QB28/15	18	15	1.5	1.12500 ± .00015	35	26	4.5	11.00	11.00
QB35/20	23.6	20	1.8	1.37500 ± .00015	41	32	4.5	14.00	14.00
QB35/25	28.8	25	1.9	1.37500 ± .00015	41	32	4.5	15.00	15.00
QB40/25	28.8	25	1.9	1.62500 ± .00015	48	37	4.5	20.00	20.00
QB50/30	34	30	2.0	2.00000 ± .00015	59	47	6.0	25.00	25.00
QB65/40	44	40	2.0	2.50000 ± .00020	71	59	6.0	32.00	32.00

GRADED SEALS AND SEALING CANE

PRICE SCHEDULE Effective August 17, 1959





GRADED SEALING CANE

Type	Price per Lb.
GSC-1	$45.00
GSC-3	45.00
GSC-4	45.00

GRADED SEALS

Ordering Designation	Quartz Tubing Size I.D. x O.D.	Quartz Tubing Length (Inches)	Seal Length in M.M.	Pyrex Tubing Size I.D. x O.D.	Pyrex Tubing Length (Inches)	Price Each
QGS 3	3 x 5	3	12	3.4 x 5	4	$4.00
QGS 4	4 x 6	3	12	4 x 6	4	4.25
QGS 5	5 x 7	3	12	5 x 7	5	4.50
QGS 6	6 x 8	3	12	6 x 8	4	4.75
QGS 7	7 x 9	3	12	7 x 9	4	5.00
QGS 8	8 x 10	3	12	8 x 10	4	5.25
QGS 9	9 x 11	3	12	9 x 11	4	5.75
QGS 10	10 x 12	3	12	10 x 12	4	6.25
QGS 11	11 x 13	3	13	10.6 x 1	4	6.75
QGS 12	12 x 14	3	14	11.6 x 14	4	7.00
QGS 13	13 x 15	3	15	12.6 x 15	4	7.25
QGS 15	15 x 17	3	17	14.6 x 17	4	8.25
QGS 16	16 x 18	3	18	15.6 x 18	4	8.75
QGS 17	17 x 20	3	20	16.6 x 19	4	9.25
QGS 19	19 x 22	3	22	19 x 22	4	10.00
QGS 20	20 x 23	3	23	19 x 22	4	11.00
QGS 22	22 x 25	3	25	22 x 25	4	12.00
QGS 25	25 x 28	3	28	25 x 28	4	13.00
QGS 27	27 x 30	3	30	26.4 x 30	4	15.00
QGS 30	30 x 33	3	30	31 x 35	4	17.00
QGS 32	32 x 35	3	30	31 x 35	4	19.00
QGS 35	35 x 38	3	30	34 x 38	4	21.50
QGS 37	37 x 40	3	30	37 x 41	4	24.00
QGS 40	40 x 43	3	30	41 x 45	4	25.50
QGS 50	50.8 x 54.3	3	30	47.2 x 54	4	45.00

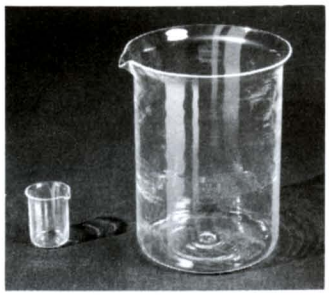
Graded sealing cane is supplied in rod form .100±.030 diameter for making quartz to tungsten seals. GSC-1 for capping the quartz and GSC-3 for beading the tungsten.

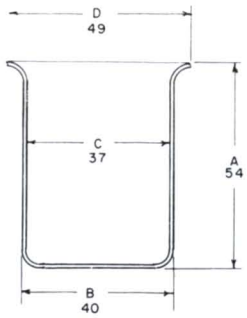
MINIMUM CHARGE: $10.00 per order.

BEAKERS

PRICE SCHEDULE Effective August 17, 1959

EXAMPLE OF QBR 50L LOW FORM BEAKER

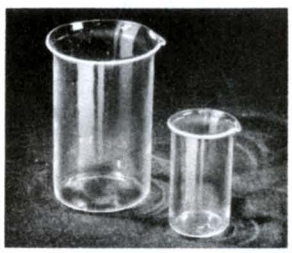


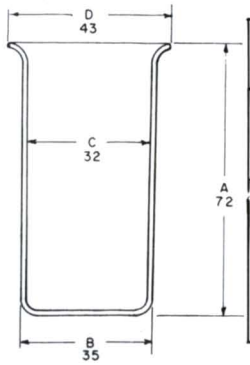


MINIMUM CHARGE:
$10.00 per order.

Beaker No.	Capac. CC	A	B	C	D	Price With Pourout	Each Without Pourout
QBR 25L	25	42	33	30.5	41	$ 6.00	$ 3.50
QBR 50L	50	54	40	37	49	7.00	4.50
QBR 100L	100	65	51	48	61	9.50	6.50
QBR 150L	150	73	57	54	68	13.00	10.00
QBR 200L	200	80	63	60	75	16.00	13.00
QBR 250L	250	86	68	65	81	19.00	16.00
QBR 300L	300	91	72	69	86	21.00	18.00
QBR 400L	400	100	78	75	93	25.00	22.00
QBR 500L	500	107	84	81	100	28.00	25.00
QBR 600L	600	114	89	86	106	33.00	30.00
QBR 800L	800	126	99	95	117	48.00	45.00
QBR 1000L	1000	136	106	102	125	63.00	60.00
QBR 1500L	1500	154	121	117	141	83.00	80.00
QBR 2000L	2000	169	133	129	154	103.00	100.00

EXAMPLE OF QBR 50T TALL FORM BEAKERS





MINIMUM CHARGE:
$10.00 per order.

Beaker No.	Capc. CC	A	B	C	D	Price With Pourout	Each Without Pourout
QBR 25T	25	57	28	26	35	$ 6.00	$ 3.50
QBR 50T	50	72	35	32	43	7.00	4.50
QBR 100T	100	89	44	41	53	9.50	6.50
QBR 150T	150	101	49	46	59	13.00	10.00
QBR 200T	200	111	54	51	65	16.00	13.00
QBR 250T	250	119	58	55	70	19.00	16.00
QBR 300T	300	126	61	58	74	21.00	18.00
QBR 400T	400	140	68	64	82	25.00	22.00
QBR 500T	500	150	73	69	88	28.00	25.00
QBR 600T	600	159	78	74	94	33.00	30.00
QBR 1000T	1000	186	91	87	108	43.00	40.00

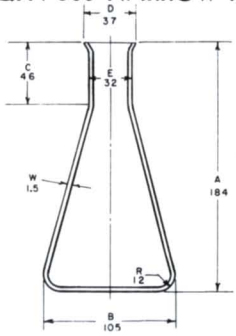
CLEAR FUSED QUARTZ

ERLENMEYER FLASK
BOILING FLASK
DISTILLING FLASK
KJELDAHL FLASK

PRICE SCHEDULE Effective August 1, 1959

EXAMPLE OF QFN 500 NARROW MOUTH ERLENMEYER FLASK

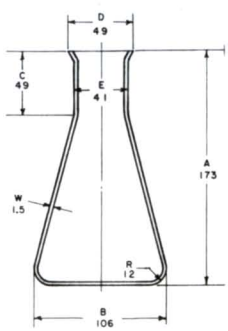
MINIMUM CHARGE: $10.00 per order



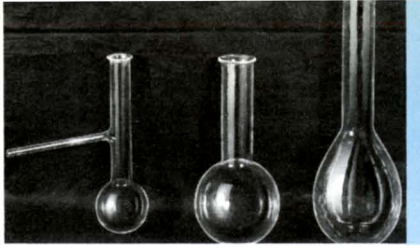
Ordering Designation	Cap. CC	A	B	C	D	E	R	W	Price Each
QFN 10	10	51	30	13	13	10	6	1	$ 5.00
QFN 25	25	67	40	17	17	13	6	1	5.25
QFN 50	50	85	49	21	19	15	6	1	7.25
QFN 100	100	107	62	27	23	19	8	1	11.00
QFN 150	150	123	71	31	26	23	10	1.5	13.50
QFN 200	200	136	78	34	28	24	10	1.5	16.00
QFN 250	250	146	84	37	30	26	10	1.5	20.00
QFN 500	500	184	105	46	37	32	12	1.5	30.00
QFN 750	750	208	119	52	41	37	12	1.5	38.00
QFN 1000	1000	230	132	58	47	41	15	2	50.00
QFN 1500	1500	264	151	66	53	45	18	2	60.00
QFN 2000	2000	288	166	72	58	50	20	2	70.00

EXAMPLE OF QFW 500 WIDE MOUTH ERLENMEYER FLASK

MINIMUM CHARGE: $10.00 per order



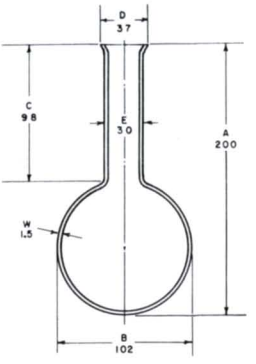
Ordering Designation	Cap. CC	A	B	C	D	E	R	W	Price Each
QFW 10	10	48	30	13	16	12	6	1	$ 5.00
QFW 25	25	65	40	18	20	16	6	1	5.25
QFW 50	50	81	50	23	25	20	6	1	7.25
QFW 100	100	101	62	29	29	24	8	1	11.00
QFW 150	150	117	72	33	34	28	10	1.5	13.50
QFW 200	200	128	79	36	37	31	10	1.5	16.00
QFW 250	250	138	85	39	40	33	10	1.5	20.00
QFW 500	500	173	106	49	49	41	12	1.5	30.00
QFW 750	750	198	121	56	54	46	12	1.5	38.00
QFW 1000	1000	218	134	62	60	52	15	2	50.00
QFW 1500	1500	248	152	71	66	58	18	2	60.00
QFW 2000	2000	273	167	78	71	64	20	2	70.00



FLASKS

EXAMPLE OF QFB 500 BOILING FLASK

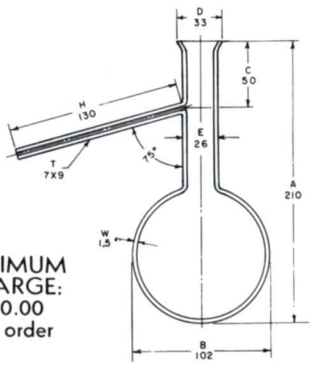
PRICE SCHEDULE Effective August 17, 1959



MINIMUM CHARGE: $10.00 per order

Ordering Destination	Capacity CC	A	B	C	D	E	W	Price Each
QFB 10	10	64	29	35	20	17	1	$ 5.00
QFB 25	25	79	39	40	23	20	1	5.25
QFB 50	50	98	48	50	24	20	1	7.25
QFB 100	100	120	60	60	26	22	1	11.00
QFB 150	150	135	69	66	30	25	1.5	13.50
QFB 200	200	148	76	72	33	27	1.5	16.00
QFB 250	250	158	82	76	34	28	1.5	20.00
QFB 500	500	200	102	98	37	30	1.5	30.00
QFB 750	750	229	116	113	41	33	1.5	38.00
QFB 1000	1000	251	128	123	44	36	2	50.00
QFB 1500	1500	286	146	140	47	39	2	60.00
QFB 2000	2000	309	161	148	51	43	2	70.00
QFB 3000	3000	343	183	160	51	43	2	100.00

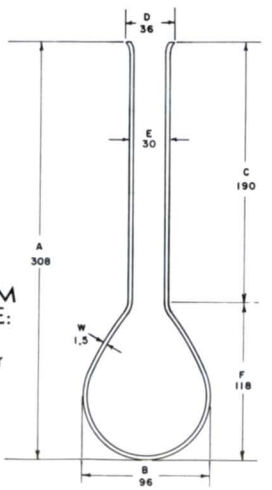
EXAMPLE OF QFD 500 DISTILLING FLASK



MINIMUM CHARGE: $10.00 per order

Ordering Designation	Cap. CC	A	B	C	D	E	H	W	T	Price Each
QFD 10	10	94	29	30	19	15	100	1	4 x 6	$ 5.50
QFD 25	25	109	39	35	24	19	100	1	5 x 7	5.75
QFD 50	50	128	48	40	24	19	100	1	5 x 7	7.75
QFD 100	100	150	60	40	25	20	100	1	5 x 7	11.50
QFD 150	150	165	69	40	28	23	100	1.5	6 x 8	14.00
QFD 200	200	178	76	45	30	24	130	1.5	6 x 8	16.50
QFD 250	250	188	82	45	30	24	130	1.5	6 x 8	20.50
QFD 500	500	230	102	50	33	26	130	1.5	7 x 9	32.00
QFD 750	750	259	116	50	33	26	130	1.5	7 x 9	40.00
QFD 1000	1000	281	128	60	36	28	140	2	8 x 11	52.00
QFD 1500	1500	316	146	60	38	30	140	2	8 x 11	62.00
QFD 2000	2000	339	161	60	40	32	140	2	8 x 11	72.00
QFD 3000	3000	373	183	70	40	32	140	2	8 x 11	102.00

EXAMPLE OF QFK 500 KJELDAHL FLASK

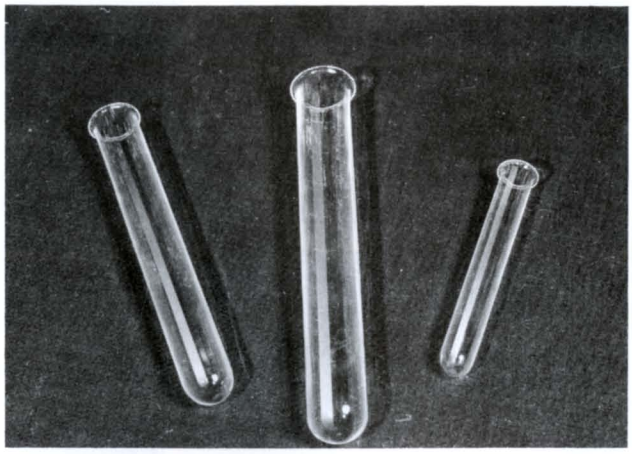


MINIMUM CHARGE: $10.00 per order

Ordering Designation	Capacity CC	A	B	C	D	E	F	W	Price Each
QFK 100	100	199	56	130	22	20	69	1	$11.00
QFK 300	300	289	80	190	32	27	99	1	25.00
QFK 500	500	308	96	190	36	30	118	1.5	30.00
QFK 650	650	318	104	190	36	30	128	1.5	35.00
QFK 800	800	326	110	190	43	35	136	1.5	40.00

TEST TUBES

PRICE SCHEDULE Effective August 17, 1959



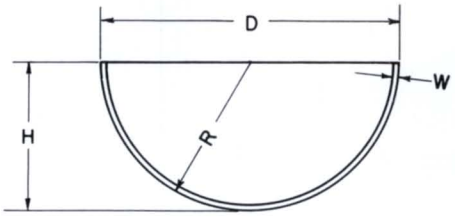
Bore in mm	Length in mm	Price Each
11	100	$2.80
13	125	3.00
14	150	3.30
16	150	3.50
18	150	3.70
20	175	3.90

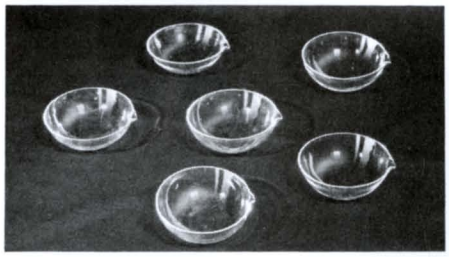
Prices for clear or translucent test tubes for radiation laboratories available on request.

MINIMUM CHARGE—$10.00 per order.

EVAPORATING DISHES

PRICE SCHEDULE Effective August 17, 1959



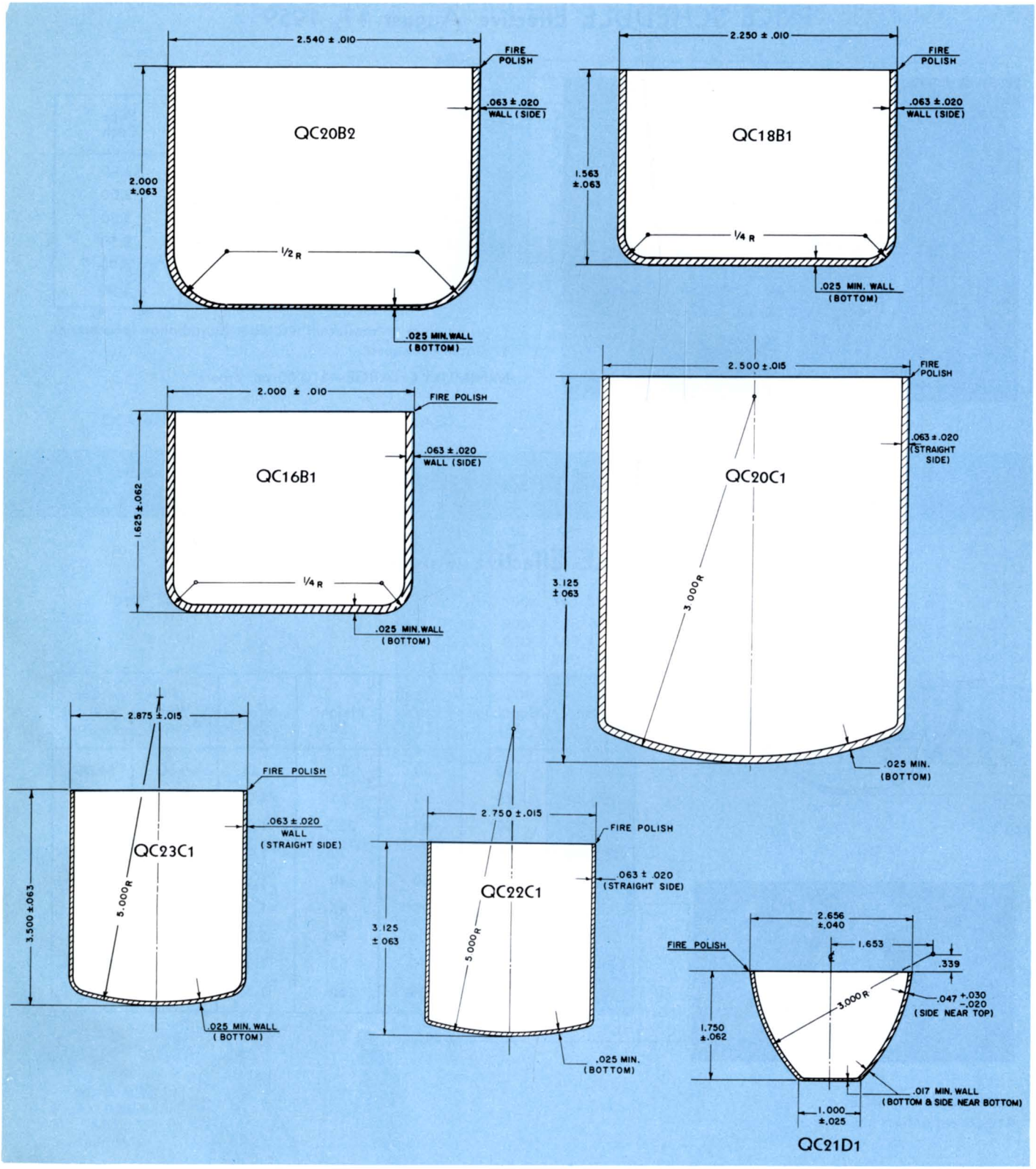


Dish No.	Capacity ML	Outside Dia. D	Height H	Wall W	PRICE EACH With Pourout	PRICE EACH Without Pourout
QED 10	10	40	20	1.0	$6.00	$4.00
QED 25	25	50	25	1.0	7.00	5.00
QED 50	50	65	32.5	1.0	8.00	6.00
QED 75	75	70	35	1.0	11.00	9.00
QED 100	100	80	40	1.5	12.00	10.00
QED 150	150	90	45	1.5	16.00	14.00
QED 200	200	100	50	1.5	20.00	18.00
QED 250	250	110	55	1.5	25.00	23.00
QED 500	500	130	65	1.5	35.00	33.00

MINIMUM CHARGE:
$10.00 per order

CLEAR FUSED QUARTZ

STANDARD SEMICONDUCTOR CRUCIBLES



PRICE SCHEDULE Effective December 1, 1960

Shape	Ordering Number	O.D.	Height	Price Each
Round Bottom	QC16A1	2.000″	2.000″	$4.00
	QC16A2	2.000″	1.250″	3.70
	QC20A1	2.500″	2.500″	5.25
	QC22A1	2.750″	1.575″	4.30
	QC23A1	2.886″	2.068″	5.80
Flat Bottom	QC16B1	2.000″	1.625″	4.25
	QC18B1	2.250″	1.563″	4.75
	QC20B2	2.540″	2.000″	5.00
Semi-Round Bottom	QC20C1	2.500″	3.125″	7.00
	QC22C1	2.750″	3.125″	7.30
	QC23C1	2.875″	3.500″	8.50
Platinum	QC21D1	2.656″	1.750″	3.50

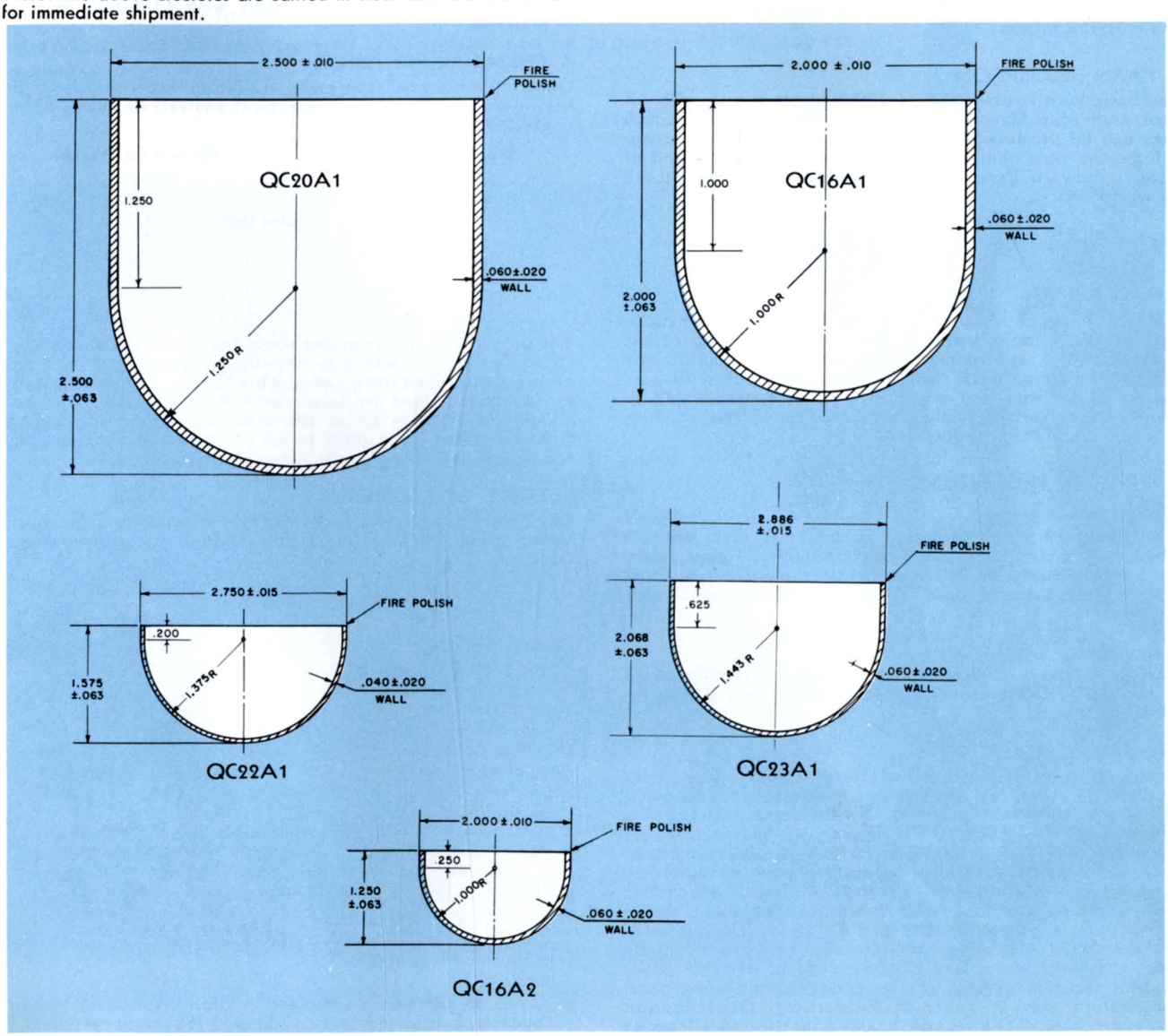
MINIMUM CHARGE—$10.00 per order.

Note: The above crucibles are carried in stock and are available for immediate shipment.

All crucibles are now made from a very high purity, semiconductor grade fused quartz. Special care is exercised in every phase of manufacture to insure the highest quality possible.

Maximum contamination has been greatly reduced as shown in the table below. To compare with regular grade fused quartz see page 10.

	PPM	%
Al_2O_3	80	.008
Fe_2O_3	15	.0015
TiO_2	12	.0012
CaO	25	.0025
MgO	trace	
K_2O	10	.001
Na_2O	15	.0015
Li_2O	5	.0005
B	.65	.000065
ZnO_2	5	.0005
P, As	.08	.000008



CLEAR FUSED QUARTZ YARN

1. GENERAL DESCRIPTION

General Electric's new Quartz Thread is spun from tiny monofilaments that are only 1/10th as thick as human hair. Made from rock-like crystals, the monofilament is twisted into thread . . . then woven into a fabric that withstands thermal erosion and retains its tensile strength at elevated temperatures far in excess of any other textile. Cloth made from this new G-E Quartz Thread provides plastics with a greater per cent retention of strength, making them suitable for rocket and missile applications.

Continuous-length quartz (vitreous silica) fibers are similar to standard "E" glass continuous fibers. The multiple-fiber strand thus produced is processed on conventional textile twisting, plying and winding machinery to produce threads and yarns. These may be used directly on wire-serving equipment and on standard warping and quilling equipment prior to a weaving process.

2. YARN DESCRIPTION

The basic yarn is essentially a 200-filament strand with 1Z twist. Individual filament diameter is .0004 inches, but other sizes can be produced. In the usual fiber glass yarn terminology, the yarn number (hundreds of yards per pound of thread), the yarn diameter and the average breaking strength are given below.

Yarn Number	— 135 ± 15
Yarn Diameter	— .008 inches
Average Strength	— 3 lbs.
Minimum Strength	— 2.6 lbs.

The large yardage variation is due to the nature of the material and the manufacturing process. Binder content of the basic thread is approximately 2% ± ½% by weight. The basic 200-filament yarn can be plied and twisted to give heavier yarns with any multiple of 200 filaments. These heavier yarns can be further processed into tape or cloth on commercial textile equipment.

3. PHYSICAL PROPERTIES

Tensile Strength

At ordinary temperatures, quartz yarn exhibits high strength which is comparable to that of conventional "E" glass yarns. Quartz yarn strengths at room temperature average about 130,000 p.s.i., based upon the total cross-sectional area of the fibers.

Elongation

Quartz yarn has a very low elongation under maximum stress of about 3%. Dimensional stability under stress is thus inherent in this material.

Temperature Resistance

Tensile tests at elevated temperatures indicate that, with increasing temperature, the strength of quartz yarn decreases. At 1800°F., the strength of 200-filament quartz yarn is about 15,000 p.s.i. Conventional "E" glass yarn has no strength above 1300°F. Thus, quartz fiber yarns will sustain substantial loads at temperature where glass fiber yarns are softened. In addition to high-temperature strength, quartz fiber yarns have extremely low coefficients of thermal expansion, being approximately one-tenth that of "E" glass. Thus, dimensional stability at high temperatures is a property of quartz yarns. Vitreous silica, like glasses, tends to devitrify when held for extended periods of time above the annealing point temperature (see 5. Table of Properties). Devitrification causes mechanical failure, and the devitrification rate depends upon the temperature, and surface conditions.

Viscosity

Glasses are classically thought of as undercooled liquids. As a consequence, glasses do not have melting points and viscosity is used to describe the fluidity at different temperatures. The softening point, annealing point and the strain point are defined as the temperatures at which glasses exhibit certain viscosities. Ordinary glasses when heated above the softening point become increasingly more fluid. Silica also behaves in this manner, but it also starts to vaporize appreciably at temperatures just above its softening point.

Density

The density of amorphous silica is 2.20 g./cc., as compared with 2.53 g./cc. for "E" glass. The high-strength, high-temperature and dimensional stability properties of quartz fiber yarn are thus available with 15% less weight of material.

4. CHEMICAL PROPERTIES

Quartz fiber yarns (currently available) are composed of high-purity vitreous silica. A typical analysis of quartz fiber is given below:

Ingredient		Percent by Weight
SiO_2		99.97 +
Fe_2O_3		.001
TiO_2	Less than	.0001
Al_2O_3		.0150
CaO		.0032
K_2O		.0007
Na_2O		.0022
Li_2O		.0003

The quartz yarn also contains about 2% by weight of organic sizing compound, which is essentially a starch and oil type binding and lubricating agent. This binder may be removed by subsequent heat treatment at 650°F. The resistance to alkali and acids is about the same for quartz and glass. Quartz is chemically inert to all acids except hydrofluoric and hot phosphoric. Quartz dissolves in strong alkali.

5. TABLE OF PROPERTIES

The properties of clear fused quartz, "E" glass and Corning Vycor glass (96% silica) are compared in the following table—a:

	Clear Fused Quartz	Typical "E" Glass	Corning Vycor Glass
Density, gm. /cc.	2.20	2.53	2.18
Young's Modulus, p.s.i.	10×10^6	12.7×10^6	9.7×10^6
Average Coefficient of Thermal Expansion, 1/°C. 0 to 300°C.	0.55×10^{-6}	4.2×10^{-6}	0.80×10^{-6}
Softening Point, °C	1667	915	1500
Annealing Point, °C	1140	720	910
Strain Point, °C	1070	675	820
Dielectric Constant/Mc., 20°C	3.78	6.3	3.8
Power Factor/Mc., 20°C	.0002	.0037	.00024
Loss Factor/Mc., 20°C.	.0009[b]	.023	.00091
Index of Refraction (Sod. D)	1.458	1.534	1.458
Thermal Conductivity at 0°C g.cal./cm.²/sec./°C./cm.	.0033		
True Specific Heat at 0°C g.cal./g-°C.	.165	.170	

a– Based on information contained in Glass Engineering Handbook, by E. B. Shand, Section Edition, 1958 (except as noted).

b– General Electric Quartz Catalog.

FUSED QUARTZ YARN FIBER MATS

PRICE SCHEDULE Effective March 16, 1959

ORDERING INFORMATION

Immediately available are two types of quartz fibers:

A. 200 filament continuous quartz yarn. Packaged on returnable throwing bobbins containing 1 to 1½ pounds per bobbin.

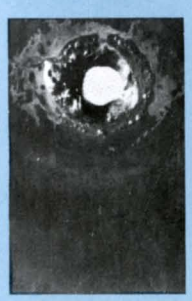
B. Mats of quartz fiber of .001 inch diameter. A typical mat—24 inches long, 9 inches wide, and ¼ inch thick. The .001 inch fibers are laid together longitudinally. Mats are normally supplied without a binder but can be produced with binders or sizing compounds.

Quartz yarn in other forms, and quartz mats of fibers other than .001 inch diameter and mats of different package dimensions can be produced to fill your requirements.

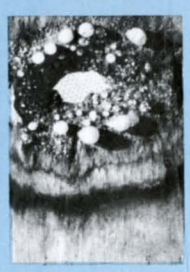
MINIMUM CHARGE—$10.00 per order.

	Price Per Pound
	$65.00
	$25.00

STEEL



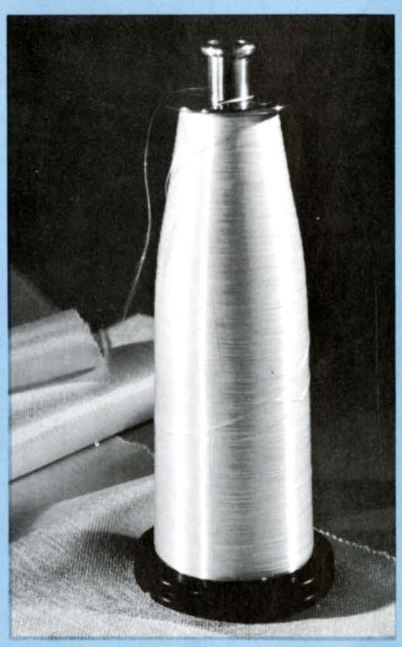
GLASS-REINFORCED PLASTIC



QUARTZ-REINFORCED PLASTIC

FLAME TEST—Here are samplings of materials burned with an oxyhydrogen torch at 5000° Fahrenheit. Note how steel and glass reinforced plastic melted and burned through.

Only the General Electric quartz-reinforced plastic (at right) withstood the flame and retained its structural strength—yet the flame was kept on this sample over three times as long!



Today this fabric is being tested by the military in space craft only. Soon, however, many non-defense applications will be using G-E Quartz Thread to solve heat problems and act as a thermal barrier.

GENERAL ELECTRIC

Address correspondence to Willoughby Quartz Plant,
Euclid Avenue and Campbell Road, Willoughby, Ohio
Telephone WHitehall 2-9300

Form Q8