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O. Fr.

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# CLASSIFICATION OF QUARTZ REACTOR TUBES AND HOLDERS DESIGNED FOR INSERTION INTO DIFFUSION AND OXIDATION FURNACES FOR THE PRODUCTION OF SEMICONDUCTOR WAFERS (REQUEST FROM THE WTO)

(Item VIII.10 on Agenda)

## I. ORIGIN OF THE QUESTION

1. On 1 July 2001 the Secretariat received from the World Trade Organization (WTO) a note from the Chairman of the WTO Committee of Participants on the Expansion of Trade in Information Technology Products (ITA), seeking the Harmonized System Committee's opinion on the classification of certain products.

2. One of the questions posed by the WTO concerns the classification of quartz reactor tubes and holders designed for insertion into diffusion and oxidation furnaces for the production of semiconductor wafers. The WTO rapporteur's summary on this question is reproduced in paragraph 4 below.

3. In addition, the International Chamber of Commerce (ICC) has submitted information and comments about these articles (annexed hereto).

## II. NOTE BY THE WTO (RAPPORTEUR'S SUMMARY)

4. "**Quartz reactor tubes and holders designed for insertion into diffusion and oxidation furnaces for the production of semiconductor wafers**

The bulk of the products concerned could be classified within heading 70.20. However, the EC suggested heading 70.17 may be appropriate for the following reason : in a pilot phase, prior to eventual production, there will be development in a laboratory environment. This environment may be considered as part of the production process, and thus should be included.

File No. 2870

The group suggested that this issue be referred to the HSC. The issue of laboratory glassware was the pertinent issue to be examined.

The Philippines noted their classification under 7017.10. Norway adds 7020.00.

{6815.99}
7017.10
7020.00".

## III. SECRETARIAT COMMENTS

5. As suggested by the WTO rapporteur, the two headings which appear to merit consideration for the classification of these products are headings 70.17 and 70.20.

6. However the Secretariat wishes to inform the Committee that, in response to a query received from a Member administration in 1981, the Secretariat expressed an opinion on the classification of articles for diffusion furnaces. On that occasion classification in Chapter 68 was decided upon, given that the articles concerned had not been obtained by firing, and were made from pure silica as opposed to fused silica or fused quartz.

7. Although the WTO did not provide a detailed description of the goods at issue, it appears from the documentation provided by the ICC and from material consulted on the Internet, that these goods are made from fused quartz or other fused silica. Therefore, by application of Note 5 to Chapter 70 they should be treated as articles of glass and classified in that Chapter.

8. According to the information available, tubes and holders of fused quartz or other fused silica are characterized by high purity (silica content exceeding 98 %) and excellent resistance to temperature and corrosion.

9. These properties enable the articles concerned to be used in the "front-end" production of semiconductor wafers. The reactor tubes encapsulate the wafers, protecting or isolating them inside the thermal processing equipment. The quartz holders are used to move the wafers or hold them in place inside the quartz tube.

10. The ICC also indicates that "quartz products are used in wafer processing equipment to enable a high purity, non-contaminating environment in which the wafer can be subjected to desired chemical reactions. Thermal processing equipment is always used in a "clean room" to reduce the incidence of atmospheric contamination such as dirt, dust, humidity, etc. The quartz reactor tube protects or surrounds the wafer, within the thermal processing equipment, creating an additional barrier to undesired atmospheric contamination. This encapsulation also provides a sterile environment for controlled chemical reactions to take place….".

11. These clarifications from the ICC suggest that the various articles under examination are used for specific purposes, meeting specified needs in a special environment.

12. They are specially adapted for the purpose, being manufactured in accordance with criteria established by the semiconductor industry.

13. Items of this kind include processing tubes, weighing boats, stands, rinsing baths, engraving tanks, bell-jars, crucibles and other accessories.

14. The Secretariat wishes to point out that special tubes, special bell-jars, crucibles and weighing boats are among the “glass articles of a kind in general use in laboratories” (research, pharmaceutical, industrial, etc.)" which are listed in the Explanatory Note to heading 70.17 (first paragraph, page 1025).

15. Moreover, the fourth paragraph of that Explanatory Note states that “laboratory glassware is frequently of borosilicate glass, fused quartz or other fused silica because of the greater chemical stability and low coefficient of expansion of such glass”.

16. The Secretariat cannot agree with the ICC that laboratory glassware is generally not made of fused quartz, when in fact there is a subheading – subheading 7017.10 – specifically for this type of glassware.

17. For the reasons given above, the Secretariat could agree that most of the articles referred to above should be treated as laboratory glassware of heading 70.17 rather than as glassware for industrial use (industrial articles of glass) of heading 70.20, even though the latter may also be made of fused silica or fused quartz.

## IV. CONCLUSION

18. The Committee is invited to rule on the classification of quartz reactor tubes and holders, in the light of the information and comments from the ICC (appended hereto) and the Secretariat comments reproduced in paragraphs 5 to 17 above, and to indicate what measures should be taken in respect of this question.

* * *

INFORMATION RECEIVED FROM THE ICC

**Description of Quartz Tubes and Holders :**

Quartz tubes and holders can best be described in the context of the entire semiconductor manufacturing process, as briefly explained below.

Semiconductor chips, or integrated circuits (IC's), are manufactured from a silicon substrate, commonly called a "wafer." This manufacturing is divided into two categories : "Front End" (wafer fabrication) and "Back End" (assembly / test / packaging). Wafer fabrication equipment deals with :

1. Photographic imagining (lithography), which is the transfer of circuit patterns onto the silicon wafer.

2. Depositing (or layering) material (thin films) onto the wafer. Common names and descriptions of these processes are Oxidation, Chemical Vapor Deposition (CVD), Diffusion, and Epitaxy.

3. Removal of selected layers. Equipment for this process is referred to as Etchers (or plasma etch), strippers, and ashers. Wafer cleaning and washing equipment (wet bench) would also be a part of this material removal group.

"Front end" wafer fabrication is also referred to as thermal processing. Thermal processing equipment (furnaces, reactors, chambers) use high temperature to expedite and/or control desired chemical reactions on the surface of the wafer. Quartz reactor tubes and holders are used during this "front end" wafer fabrication process, as follows :

**Quartz Reactor Tubes.** Quartz reactor tubes protect or surround the wafer, *within the thermal processing equipment*, to create an additional barrier to undesired atmospheric contamination. This encapsulation also provides a sterile environment for controlled chemical reactions to take place. Quartz reactor tubes are also commonly referred to as : diffusion tubes, oxidation tubes, LPCVD tubes, isolation tubes, reactor tubes, reaction chambers, chamber liners, process tubes, etc.

**Quartz Holders.** Quartz holders are wafer transport devices, used for holding (locating) wafers inside the process tube, or for moving wafers in/out of the process chamber. Quartz holders are also referred to as : boats, carriers, trays, end effectors, or blades.

These quartz reactor tubes and quartz holders are ideal for use in wafer fabrication because of the following factors :

1. High purity. Quartz glass, also known as fused quartz or fused silica, is 99.99 % SiO2 (Silicon Dioxide), i.e. chemically compatible (non-contaminating) to a silicon (Si) wafer.

2. Resistance to temperature : Quartz glass is a very hard material (softening point is 1600*C). This means that dimensional integrity of the quartz parts is maintained during thermal cycling.

3. Resistance to corrosion : Quartz glass is not attacked by most acids or cleaning agents. Thus apparatus made from quartz glass does not contaminate the silicon wafers.

4. Compatibility of physical properties : All materials expand under temperature. Quartz glass (fused quartz) has a similar coefficient of thermal expansion as silicon, meaning any growth or movement of the silicon wafer during thermal processing will match the growth or movement of the quartz. This reduces stress or strain across the wafer by eliminating any possibility of pinching or restricting of the wafer by the wafer holder.

As stated above, quartz products are used in wafer processing equipment to enable a high purity, non-contaminating environment in which the wafer can be subjected to desired chemical reactions. Thermal processing equipment is always used in a “clean room” to reduce incidence of atmospheric contamination such as dirt, dust, humidity, etc. The quartz reactor tube protects or surrounds the wafer, *within the thermal processing equipment*, creating an additional barrier to undesired atmospheric contamination. This encapsulation also provides a sterile environment for controlled chemical reactions to take place. Quartz holders are wafer transport devices used for holding (locating) wafers inside the process tube.

**Do all quartz reactor tubes and holders operate the same ?**

Quartz reactor tubes and holders are different only in function; the quartz material is the same for both tubes and holders.

All quartz reactor tubes are designed to protect, isolate, or insulate the wafer, regardless of whether they are used in a plasma etcher, diffusion furnace, CVD reactor, or other device. As a result, all quartz reactor tubes operate the same.

All quartz holders move, locate, or support wafers within a process chamber (i.e., the quartz tube). As a result, all holders operate the same.

**Quartz in the Semiconductor Environment versus Laboratory Glassware :**

Quartz for processing semiconductors should not be confused with “Laboratory Apparatus.” Laboratory glassware is generally not fused quartz, but is another type of glass known as Borosilicate (trade name : pyrex). This glass is generally referred to as soft glass, meaning a low SiO2 content (~80 % vs. 99.99 of quartz glass). The impurity level, plus a low softening point (600*C) make it unacceptable for semiconductor processing equipment.

Quartz glass has unique properties and characteristics which are specific to the ultra pure / high temperature processing requirements of silicon wafers. These unique properties of fused quartz are not required in the lab.

Not only is the SiO2 content different between quartz glass for semiconductor equipment (99 %) and laboratory glassware (less than 98 %), but the coefficient of thermal expansion is different (quartz glass is a very hard material (softening point is 1600*C), whereas laboratory glass is generally referred to as soft glass (softening point is 600*C).

As a result, quartz used for processing semiconductors is different than the laboratory glassware in HS heading 70.17.