**INTRODUCTION**

Cistelaier is proud to announce that on October 3, 2024, it received official notification from the European Space Agency – ESA – of having achieved certification according to the ECSS-Q-ST-70-60C standard for the production of sequential rigid and rigid-flex multilayer printed circuit boards.

This represents, in fact, the outcome of a four-year project aimed at ensuring the quality standards required by the Space sector. Achieving this goal necessitated, first and foremost, a substantial revision of the mindset used to approach the production process and, even more so, of the related control logic.

The qualification process was initiated with the endorsement of ten OEMs, customers, and leaders in the Space market, who confirmed to ESA their interest and the need to rely on a supplier with the technological expertise of Cistelaier, capable of addressing growing technological challenges.

As is well known, this sector is becoming increasingly strategic worldwide, and Europe, with its Space community, also requires growing technological and production capabilities, particularly in the field of PCBs.

**STARTING POINT**

Cistelaier's qualification journey began in 2020, and it was clear from the outset that initiating production of a test vehicle in its current state would not be the correct way to approach this challenge.

An in-depth reading of the ECSS-Q-ST-70-60C Standard reveals the central role ESA assigns to the "PCB object" as the heart of the electronic apparatus and, therefore, the indispensability of its quality and reliability.

To follow up on this postulate, a thorough gap analysis was conducted to highlight both the strengths and weaknesses of our company. The results of this analysis became the backbone of Cistelaier's industrial development project.

This development plan, aimed at driving a profound evolution—or, perhaps more accurately, a revolution—within our company, was designed to avoid conditioning its production capacity and minimize the impact on our customers.

Nonetheless, the project and its scheduling faced an unexpected and unprecedented event: the pandemic that erupted in 2020, which led to the postponement of some activities and generally made operations management more complex.

**THE PROJECT**

The revision project, particularly of the production departments, derived from encountering the concepts and requirements expressed by the ECSS standards for products intended for Space applications. It involved Cistelaier's sites and was internally named "flow, handling, and cleanliness."

While it is evident that such products must not cause failures in the equipment in which they will be installed, the definition of the aspects that an organization like ESA, based on decades of experience, considers essential in monitoring the PCB manufacturing process may be less intuitive, transcending the purely technological aspect.

In this sense, to determine or confirm the real improvement needs of the departments, targeted internal checks were carried out, along with the production of specific coupons, such as those used in the THB test (Temperature, Humidity, Bias), aimed at measuring the cleanliness of production areas, as required by the ECSS-Q-ST-70-60C Standard.

Assessing the actual level of product risk due to internal contamination is, in fact, one of the main aspects that elevated Cistelaier's DNA to a new level of awareness: a printed circuit board installed in a flight device cannot be replaced or repaired. For this reason, it is necessary to take all possible precautions in terms of equipment, procedures, and corporate culture.

Several company areas underwent profound changes:

• The pressing department was modernized, controlling the cleanliness of work areas with particular attention to avoiding "cross-contamination" between resins of different natures. To achieve this, two clean areas (ISO 7) were created for multilayer stackup preparation and a dedicated area for coverlay preparation and application;

• The areas related to wet processes, image printing, and automated optical inspection (AOI) were completely reorganized to achieve a more homogeneous process flow for the production of inner and outer layers, installing new systems capable of handling inner layers with a total thickness of 25 µm and traces/spaces down to 50 µm, a new etching line for outer layers, and two AOI machines with analysis resolutions down to 15 µm;

• All production lines were equipped with load/unload systems based on cobot systems capable of managing protective material between inner layers, thus limiting direct handling.

In parallel with the development of the production area, the project also required a significant integration of personnel: the company hired new staff for production management, product engineering, project management, and, last but not least, specific training in IPC and ECSS standards.

To complete the updates, all processes were individually revalidated. Subsequently, the overall enhancement achieved was evaluated through a new execution of the tests already conducted before the project's start, starting with the THB test.

Comparison of the results highlighted the improvements achieved: the company was now effectively able to guarantee results in line with the Space sector's expectations, primarily with ECSS standards.

Once the production process was frozen and requalified, it was then possible to initiate the true qualification process, which required producing two pilot batches to fine-tune the process, followed by the production of the definitive qualification batches.

Test vehicle production was carried out parallel to the factory's regular production, ensuring the samples were made under realistic and repetitive conditions: from the beginning, our goal was to ensure Cistelaier's quality and reliability on any given production day. Once completed, the test vehicles were subjected to the two prescribed testing steps for the initial qualification phase: Evaluation first and Qualification immediately after.

Evaluation is a preliminary verification phase intended to confirm that the production process under assessment can ensure certain basic product parameters. This step is therefore preparatory for starting the actual qualification journey, Qualification.

The qualification phase dedicated to sample verification is divided into four groups of tests—excluding the THB test, which represents a separate preparatory group, as seen—conducted alternately on specific coupons or PCBs, in accordance with the flow outlined in the ECSS-Q-ST-70-60C Standard detailed below:



The purpose of the tests conducted is to characterize the product's quality and reliability by simulating operating conditions, not only during the initial phases following assembly but also up to the expected service time limit.

In agreement with ESA, the testing and qualification activities were carried out not only by ESTEC but also at external qualified laboratories to ensure the complete impartiality of the results obtained, specifically:

• IIS Italian Welding Institute - Italy
• Hitek – Denmark
• PWB Inc – Canada

**THE NUMBERS**

The activities and commitment of Cistelaier in developing the ESA qualification project can be summarized in the following numbers:

• 3 floors of the Genoa plant significantly renovated
• 8 departments rebuilt
• Over 30 machines, including 15 new ones, installed or repositioned
• 6 cobots introduced into the company
• Over 30K man-hours of department design and modification
• 23 new hires
• 2 test vehicles and as many THB tests conducted before and after the plant upgrades
• 4 batches of test vehicles produced for the product qualification phase
• Over 500 metallographic samples for monitoring, validation, and qualification of all activities carried out during the 4-year project.

**THE FUTURE**

The Finmasi Group, through its President Marcello Masi, has supported the company and the Cistelaier team with great foresight in achieving this important milestone and has expressed strong determination to continue supporting future development projects. This commitment aims to ensure that Cistelaier, first and foremost, and no less so the other companies of the Finmasi Group's PCB Division—Techci Rhône-Alpes in France and EPN Electroprint in Germany—maintain state-of-the-art technological standards.

Achieving ESA qualification has been defined as "Phase A" of a more ambitious and extensive project, whose "Phase B" involves extending the current PID's technological scope until achieving, with "Phase C," Cistelaier's qualification for the production of rigid HDI PCBs based on polyimide for space applications.

To this end, at the end of 2024, Cistelaier submitted a project under ESA’s General Support Technology Programme – GSTP.

In conclusion, Cistelaier will make its technological and production capabilities available to the European Space Community to ensure its actions become increasingly effective in the years to come.