



Performing EMI and TEMPEST Pre/Post Compliance Evaluations Avoids Costly Overruns and Delays

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FOREWORD

Often times product manufacturers, when performing EMC, Shielding Effectiveness, TEMPEST or other similar product approval type testing, race to get their products into formal test. Contractual compliance testing is often the last step before product approval by the end user. This rush to get into the lab for formal testing and approval often results in test failures which can lead to critical program delays, cost overruns, and frustrated customers. By doing pre-compliance testing, many steps are removed from the process and time is saved.

Chassis redesigns, schematic changes, part changes, new RF gaskets, filtering changes, new software, and other critical ECN changes cannot be ignored or overlooked from a post compliance standpoint because implementing these changes would render previous compliance tests invalid. This would immediately require a new compliance test to be completed in order to ensure continued compliance.

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PRE-COMPLIANCE TESTING

Emissions Scans and RF Probing

At the prototype stage, API-CAS can take a unit and perform a conducted/ radiated emissions scan of the device or system and compare the tested levels to your applicable test standard limits (i.e. MIL-STD-461F, EN 55022, NSTISSAM TEMPEST 1-92, etc.). Even if your unit hardware and software are not fully operational at this point, API-CAS can often use embedded commands to activate circuitry that is similar to that of normal operation and can still be very effective in providing useful preliminary compliance data. Most importantly, API-CAS only tests with interface and power cables that will be used on the final production unit. Cables are the main cause for unintended radiation and can act like antennas protruding from your product. If unacceptable levels of emissions are detected, we will perform near-field probing to find the areas that are radiating. We probe all cables thoroughly, both at the connectors and along the cables to ensure proper grounding and shielding. There are various recommendations that can mitigate this issue such as signal and power line filters to reduce emissions generated by cables and ports. We may also test shielded cables to pass emissions testing, but it is difficult to control their use. Say it is a common Ethernet RJ-45 or similar port, assume your customer will likely not use a shielded cable on this port even if you recommend this in your installation manuals. Ferrite Cores put on cables at the signal source end are also very effective in reducing emissions at higher frequencies, but unless you control and supply the cable this may not be a viable fix. API-CAS can verify that unacceptable levels of emissions are from the unit or cabling. We can also test other production samples to assess the scope of the failure and determine if the failure was an anomaly, or if it affects more than one unit.

Grounding and Bonding Considerations

Have a ground stud on your product? We make sure it is ground to the test bench/ground plane during all emissions testing. We also ground large rack systems to the shielded test chamber floor if the rack is intended to be grounded in the actual installation. API-CAS can verify proper chassis sheet metal bonding at chassis seams, lids, and doors. It must be satisfactory metal to metal contact and use conductive plating. We look for paint overspray at seams, ground posts, and under connectors. We also verify good continuity to the ground and across chassis sections with a milliohm meter. Without proper grounding of your product, EMI filtering, shielding, and RF gaskets are all less effective. If we detect emissions coming from a chassis, it is also likely that radiated RF, similar to that generated from a radiated immunity or ESD test, can also get in.

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Susceptibility Testing Considerations

If your product must meet certain susceptibility test requirements like EFT, Lightning Surge, ESD, Radiated Immunity, voltage dips and surges, and similar requirements, API-CAS can perform these tests at a limited pre-compliance level to determine the robustness of your product design. We can evaluate your power supplies, EMI filters, transient suppressors, etc., to verify they are designed to meet MIL-STD-461F, EN 300-386 or whatever your market test specifications may be. Susceptibility failures can often be catastrophic especially when lightning transients are injected on power and signal ports. We can recommend off-the-shelf signal and power line EMI filters, TVSs, Transorbs, SIDACTors, and other suppressors available at reasonable cost. API-CAS stocks various vendor sample kits of EMI filters, ferrites, gaskets, suppressors, etc., which we can use to help you correct “out of spec” conditions. We check to make sure your transient suppressors are bipolar. You may pass a positive transient but remember many tests call out negative transient tests too; this is true for ESD events as well. Both positive and negative discharges are required by EN 61000-4-2 (the most common referenced ESD standard). We can also recommend MIL and commercial connectors with embedded EMI filtering and transient suppressors.

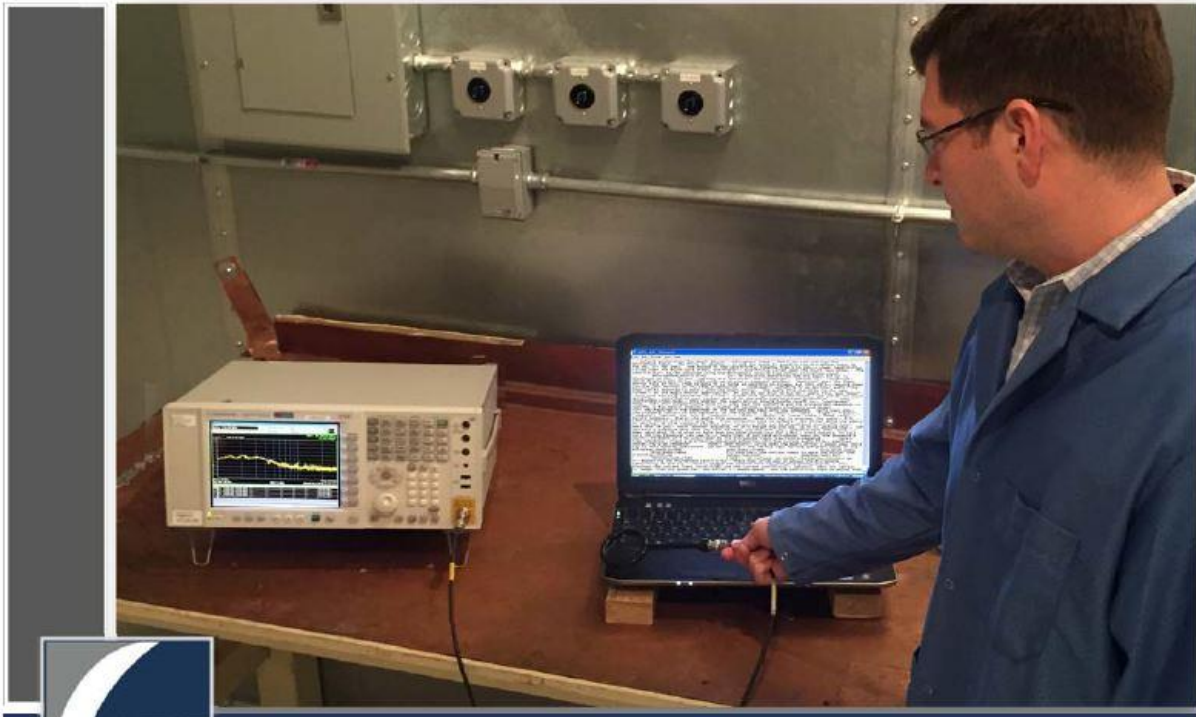
Pre-Compliance Summary

API-CAS can address all of your emissions and susceptibility test issues at the initial design/prototype phase by performing pre-compliance testing which eliminates the need for costly fixes later. This avoids ECNs, rework, scrapping inventory, and the possibility of increasing “Time-to-Market”, thus keeping you on schedule and in budget.



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API CAS Offers Pre and Post-Compliance Test Services to Avoid Costly Program Overruns and Delays

POST-COMPLIANCE TESTING

Production Sample Testing

After the formal test program has completed, API-CAS can perform post-compliance (a.k.a production sample testing), on a sample size of the production lot (say 3% or 3 out of a 100 unit run). This will ensure that a product continues to meet compliance requirements (EMI, TEMPEST, etc.), especially if TEMPEST requirements are part of the product requirements. Even if it is not a contractual requirement, limited testing can be performed by API-CAS to verify that the production samples continue to meet the applicable emissions test limits. API-CAS performs sample testing for many current customers.

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Keeping Your Product Compliant

API-CAS can identify and address workmanship, cabling and other test failure issues quickly. We can use near field probing to identify any unintended radiation sources. API-CAS also offers design and ECN reviews to evaluate the impact of any compliance critical component or feature change. Board re-spins are often necessary for cost reduction or to design-out obsolete parts. API-CAS recommends that with these changes, a compliance re-test or post-compliance scan should be done. New data is compared to the previous full test data reports to see if levels have significantly changed or caused above-limit conditions. API-CAS can also provide cost savings by testing several units simultaneously, and if all emissions are below limits then all units pass. If a unit fails, we will identify the unit and we can perform a failure analysis to determine why one failed and the others passed. Once identified, the entire production lot should be scrubbed to resolve any issues.

Software and Compliance

Watch your software releases! API-CAS can check to see what your software release does. Does it add any new data rates? Does it turn on new circuitry or features that were not active during previous pre-compliance or full compliance testing? Are there oscillators now active that were not active before? If there is any question that the radiated profile of a product could change, API-CAS recommends performing an emissions scan (radiated and conducted). We can also perform radiated susceptibility testing to see if the dwell tests, required by some standards at the new oscillator frequencies or bus rates, cause interference to normal operation of the product.

Post-Compliance Summary

API-CAS can perform post-compliance production sample testing and help correct issues before production shipments to avoid costly product recalls, rework, customer issues, and even payment delays. API-CAS recommends software release reviews should remain a robust part of the compliance program.



API-CAS Pre/Post Compliance Checklist

Pre-Compliance

- Perform Radiated and Conducted Emissions pre-scans on prototype unit to your test limits.
- Prototype hardware and software for test must emulate normal operation.
- Test with production quality power and interface cables. Also, make sure all ports are terminated in their characteristic impedance load for test.
- Use near field probes and an SA to identify any out-of-spec emissions locations. (Especially probe cables!)
- Make sure the shield/drain wires are terminated properly at each end. Use ohm-meter to verify.
- Metal-to-metal chassis bonds/seams must be free from paint and overspray.
- Connectors must be bonded to good metal contact.
- Conductive plating should be used.
- Use ferrites as emissions fixes only on cables that you control and supply.
- Bond units to the test bench or chamber floor ground during testing to simulate normal installation.
- Perform limited susceptibility/immunity testing to verify chassis and circuit RF and transient protection is adequate.

Post-Compliance

- Review all ECNs to determine if product changes could cause change emissions or other compliance profile.
- 3% of production lot units should be limited sample tested for compliance.
- Post-compliance test data should be compared to pre/full test program data to compare data and emissions levels.
- Probe any out-of-spec emissions locations.
- Board respins, cable changes, circuit/component changes and new software releases should be tested to ensure continued compliance of the product.

CONCLUSION

While API-Cyber Assurance Services (CAS) lab can perform your formal test program, we have taken the guesswork out of product approval by offering commercial and military EMC and TEMPEST pre-compliance test services and consulting, prototype test and design services and production sample testing services.

Often just a few days in the lab performing pre-compliance testing, identifying and resolving design issues, can save weeks and thousands of dollars vs. getting into a costly “fail-and-fix” mode during the formal test program.

API-CAS currently has seven shielded enclosures, and more under construction, to accommodate your test needs with one of the largest staffs of NSA Certified TEMPEST and iNarte EMC Certified professionals. We can quickly accommodate your test schedule and will work with you to resolve any test issues. API-CAS can also offer schematic review, ECN/ECP review, production sample testing, or limited testing on design changes to make sure you maintain your EMC or TEMPEST product integrity. Have a shielding material to test? We can test the shielding effectiveness of thin films up to 2-1/2 inch thick glass windows and to the latest ASTM F3057-14, 3-foot by 3-foot required sample size.

Many of our test customers are already taking advantage of these services. Let API-CAS quote compliance test or consulting services for you based on your product and test requirements.

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For further information and a list of testing we perform, visit <http://www.advprograms.com/testservices.htm>

Disclaimer: This paper is not meant to be an all-inclusive instruction to pre/post compliance evaluations, but, offers a guideline to follow for good compliance engineering and product management practices in your product development phase.

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