

# PIND Task Group Report

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September 14, 2021

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# PIND Task Group Members

- PIND Task Group Work participant members represent the manufacturers, industry, and government agencies, and international partners:
  - Manufacturers such as: Microchip, Texas Instruments, IR Hi Rel/ Infineon, VPT Components, Semicoa, Teledyne Microwave Solutions, BAE Systems, Micropac Industries Inc.
  - Industry Test Laboratories – Hi Rel Labs, ORS Labs, Golden Altos
  - Government Agencies and their contractors – NASA, NSWC Crane Division, US Air Force, US Army, Aerospace Corporation, DLA Land and Maritime,
  - International Partners – ESA, NASAM, TESAT/ DLR

## Sept 14, 2021 PIND Task Group Metrics

- Conducted three (3) PIND Webex/ Teleconferences since May 2021 JEDEC meeting
- Meetings held on monthly basis
- Average meeting attendance was (10 ).

# JC13 TG17-01 Task Group Charter Review

- Clarify the intent of MIL-STD-883 TM 2020 PIND test in regards to:
  - Device positioning onto the transducer head (i.e. centering).
  - Training/ Testing a device within the boundaries of the transducer.  
Simulated/ Golden PIND unit – do we have to run every time? If so, what are the parameters of the Golden PIND unit.
  - Condition A Frequency and G force if the internal cavity height is larger than 0.250 inches (6.35 mm).
  - Advances in equipment (e.g. degaussing) verification/ setup techniques shall be addressed.

# JC13 TG17-01 Task Group Charter Review

- Clarify the intent of MIL-STD-883 TM 2020 PIND test in regards to:
  - Static vs. dynamic setup and operation.
  - Knowledge/certification of the equipment for their application (i.e. theory of operation), equipment verification and setup.
  - Equipment degaussing and equivalent part degaussing.
  - Batch testing is/ is not prohibited.
  - Other items – received an email from a user with concerns about false rejects due to bond wires touching during pind testing. Task Group Work is requesting data on this subject from device manufacturers, users, test laboratories, and equipment manufacturers.

# JC13 TG17-01 Task Group Charter Review Results

- Clarify the intent of MIL-STD-883 TM 2020 PIND test in regards to:
  - Device positioning onto the transducer head (i.e. centering). **Test method is concise as written. No change is needed.**
  - Training/ Testing a device within the boundaries of the transducer. Simulated/ Golden PIND unit – do we have to run every time? If so, what are the parameters of the Golden PIND unit. **Training is available from the equipment manufacturer. Golden PIND unit usage may be problematic due to difficulty of obtaining those parts.**
  - Condition A Frequency and G force if the internal cavity height is larger than 0.250 inches (6.35 mm). **Less than 40Hz operation and 20g peak vibration could damage the PIND test equipment as per both equipment manufacturers operation manual.**

# JC13 TG17-01 Task Group Charter Review Results

- Clarify the intent of MIL-STD-883 TM 2020 PIND test in regards to:
  - Advances in equipment (e.g. degaussing) verification/ setup techniques shall be addressed. Degaussing may be good practice, but how effective is it in improving detection? Repeat passes, should there be specific requirements?
  - Static vs. dynamic setup and operation. Dynamic is preferred method, better detection.
  - Knowledge/certification of the equipment for their application (i.e. theory of operation), equipment verification and setup. Equipment qualification, how is that performed by manufacturers and/or users? Operator & test equipment training, what should be required?

# JC13 TG17-01 Task Group Charter Review

- Clarify the intent of MIL-STD-883 TM 2020 PIND test in regards to:
  - Equipment degaussing and equivalent part degaussing. *What is real value? Any quantifiable data for better particle detection as result of degaussing? Could parts be damaged by degaussing?*
  - Batch testing is/ is not prohibited. *Prohibited by test method paragraph 3.3.1.*
  - Other items – received an email from a user with concerns about false rejects due to bond wires touching during pind testing. Task Group is requesting data on this subject from device manufacturers, users, test laboratories, and equipment manufacturers.

# JC13 TG17-01 Task Group Work Since January 2021

- Reviewed Verification unit comments/concerns from May 2021 meeting
  - Verification units may be difficult for test labs and users to obtain.
    - Not being recommended as a requirement to add to the test methods.
    - Only have data for gold spheres as particles. Not reflective material used in the manufacturing of current devices.
    - Purpose of verification unit – to verify the three fail modes, not calibrate the equipment!!!
      - Visual, fail indicator led, and audible
  - A known good and created failure verification units would be considered a best practice.
- Task group considering adding a definition for verification unit to the test methods.

# JC13 TG17-01 Task Group Work Since January 2021

## Degaussing—

- Government personnel stated that the program which had degaussed parts or parts that sat around for awhile would fail PIND testing. Degaussing data not documented in a way that can be shared.
- Degauss data from the nickel flake era in the early 2000's – availability of that data, if available? No data was available to review to determine whether degaussing is effective in enhancing particle detection.
- No device degaussing standard available for device degaussing.
- Recommendation is to allow use of degauss process as part of PIND test process as applicable.

# JC13 TG17-01 Task Group Work Since May 2021

- Discussed items from JEP-1 14.01 that might be applicable to PIND test methods:
  - 3.3.4 Control sample verification
  - A control sample should be used each time the machine is set up, conditions are changed or whenever the operator is away from the machine for an extended period of time (e.g., lunch break). The control sample(s) should be a metal can, such as a TO-5 that contains a particle of known size and material that produces a consistent output signal under vibration during test. A gold sphere of 0.002“ diameter works well.

# JC13 TG17-01 Task Group Work Since May 2021

- Operator training – do we need to add reference in the test methods about training?
- options:
  - Add a training guideline referencing JEP114.01 or add a statement specifying ‘qualified test personnel’?
  - Example of this is in MIL-STD-883-2, Test method 2012 paragraph 1.1.6:
    - 1.1.6 Qualified Test Personnel. An individual trained on the apparatus being used for radiography, and who is qualified to image or inspect. Personnel involved in acquisition or interpretation of radiographic images shall have training in radiographic imaging procedures and techniques so that defects revealed by this method can be validly interpreted and compared with applicable standards. Training shall be specific to the radiographic system (film or digital) as well as DUT design and failure criteria. The company employing the test personnel shall have a documented training program and will qualify test personnel internally.

# Summary

- Control Sample – do we add a paragraph similar to what is in JEP114-01? Task group believes that this paragraph from JEP-114 should be added to the military test methods and would be considered a best practice.
- Training – do we add a paragraph similar to what is in MIL-STD-883 method 2012 for operator training? Consensus at the May 2021 JEDEC PIND meeting was to add a general training statement in the front section of the Military Test Methods.
- These recommendations would be added to the previous recommendations listed at the May 2021 and September 2020 JEDEC PIND meetings presentation documents.

# Suggested Recommendations for Test Methods and JEP-114

- Recommend adding the following note to the test methods and JEP-114:  
Degaussing may be effective depending on particle type and package construction and is allowed but not required.
- Recommend that a statement be added to MIL-STD-883 method 2020, MIL-STD-750, method 2052, and JEP114 that devices not being PIND tested (e.g., waiting for test or completed test) should be located at a minimum of 12 inches away from the side of the magnetized shaker portion of the PIND test equipment

# Suggested Recommendations for Test Methods and JEP114

- Recommend operating the PIND equipment for 30 minutes with no device under test attached to verify system operation with no false positives including but not limited to the following examples:
  - Initial installation and qualification of PIND equipment in a facility including manufacturer, user, test laboratory etc.
  - After a PIND system has been re-calibrated by the equipment manufacturer.
  - Where a PIND system has been moved from one location to another in the same facility or in different facility.

# Suggested Recommendations for Test Methods and JEP114

- Recommend that the PIND equipment shall be warmed up for a 'period of 20 minutes' prior to system verification and operation
- Run the system noise verification test periodically during the shift for 30 to 60 seconds might be a better option than running the PIND tester for 30 minutes prior to usage.
- JEDEC Publication JEP114 reference is not listed in MIL-PRF-38534 but should be listed considering various hybrid device classes such as class K, sometimes class H, non hermetic cavity devices, classes L and F open architecture cavity devices require PIND testing.

# Status

- Task group has addressed the concerns listed in the charter.
- Task group has developed list of recommendations for inclusion into MIL-STD-883 and MIL-STD-750 PIND test methods. Task group ready to submit those recommendations to DLA for inclusion in the test methods.
- Task group is also working the longer shock pulse width proposal from Spectral Dynamics that started as a result of particle detection issues in small device packages.

# Future Work

- Recommend close this task group since the task group has addressed the questions/concerns in the original charter
  
- Recommend that we start another PIND task group focused only on the longer shock pulse width PIND study?
  
- Can the PIND test methods in MIL-STD-883-2, test method 2020 and MIL-STD-750-2, test method 2052 be combined?
  - Are there enough differences between the two PIND test methods to warrant having separate test methods?
  - What is DLA's position on combining the microcircuit and discrete semiconductor PIND test methods?

# Thank you!

- We would like to express our appreciation to the task group members, NASA NEPAG and SLS programs, Government Working Group, and TTM Technologies for their continued support of this effort.

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# Acronyms

- DLA – Defense Logistics Agency
- DLR – German Aerospace Center
- DPA – Destructive Physical Analysis
- ESA – European Space Agency
- ESD – Electrostatic Discharge
- JEDEC – JEDEC Solid State Technology Association
- NASA – National Aeronautics and Space Administration
- MSFC- Marshall Space Flight Center
- NSWC Crane – Naval Surface Warfare Center, Crane Division
- PIND – Particle Impact Noise Detection
- STU – Sensitivity Test Unit

# Backup Data

# JC13 TG17-01 Task Group Work Since January 2021

## Verification unit comments –

- How should verification units be selected or constructed?
- Differences in particle size detection between 883 and 750 – should they both have the same requirement?
- Should there be verification units for each package style to be tested?
- Availability of verification units?
- Which package styles are worse for PIND testing for particle detection?

# Task Group Work Since September 2020 Meetings

- Verification units comments
  - Verification unit selection and/or construction? Electrical rejects, empty packages etc.? One recommendation is that empty packages be used. Use of empty packages is the best option to eliminate particle lodging issues. Recommendation is to perform PIND test on empty packages prior to seeding and sealing devices. This would be a best practice.
  - Verification units provide qualitative indication that the equipment can detect particles. Use of verification units doesn't replace the STU in verifying system functionality.
  - Differences in particle size detection between 883 and 750 – should they both have the same requirement?

# Task Group Work Since September 2020 Meetings

- Verification units comments Cont.'d.
  - Should there be verification units for each package style to be tested? Not practical for users.
  - Which package styles are worse for PIND testing for particle detection? The manufacturer/user would have to determine the worst package styles for PIND testing.
  - Recommendation that the particles in the verification unit be 1 mil gold spherical shape. Verification unit should not be a requirement as the purpose is to indicate functionality.

# Task Group Work Since September 2020 Meetings

- Verification units comments Cont.'d.
  - Verification units for hybrid devices.
  - Still in discussion
  - Recommendation only?

## Task Group Work Since September 2020 Meetings

- Comments about not recommending degaussing for inclusion in the PIND test methods? September meeting comment feed back on degauss recommendations for PIND. Feedback was they were unable to locate anything definitive in their archives and as result are withdrawing their comment. They are 'OK' with not recommending degaussing be included as a requirement in the PIND test methods.
- Recommend adding note to test methods and JEP-114: Degaussing may be effective depending on particle type and package construction and is allowed.

# Task Group Work Since September 2020 Meetings

- Gauss measurements performed at user facility
  
- Gauss measurements for both equipment manufacturers

# Task Group Work Since September 2020 Meetings



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## PIND TEST magnetic field check

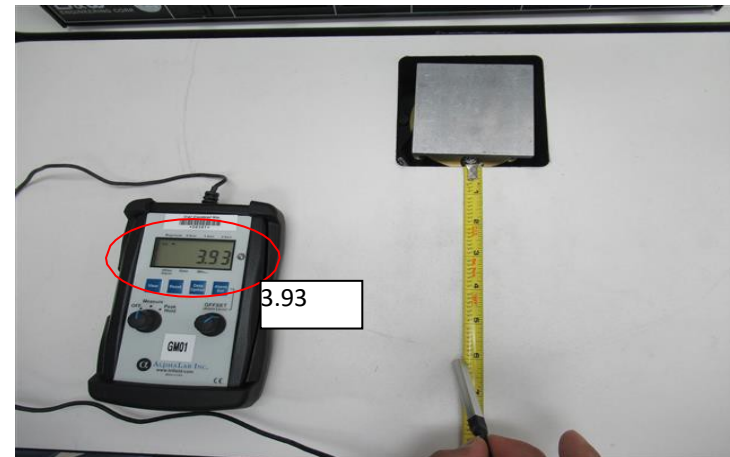
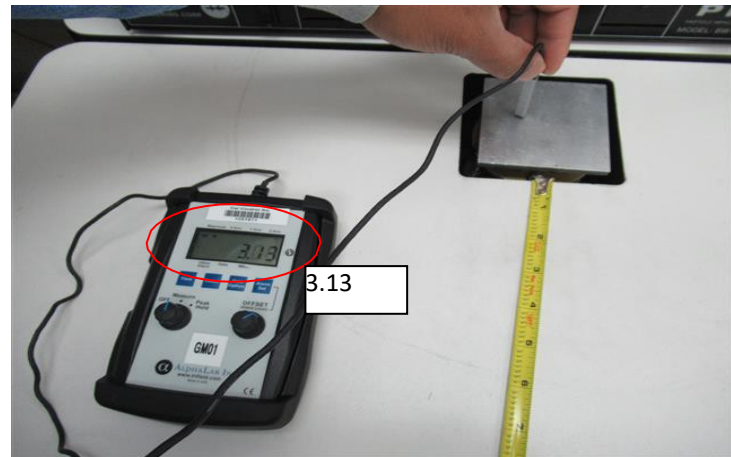
- Turn Gauss meter machine to measure
- Put wand on 4 spots and check magnetic fields on fields on gauss meter
- The reading should not exceed 5 gauss



# Task Group Work Since September 2020 Meetings



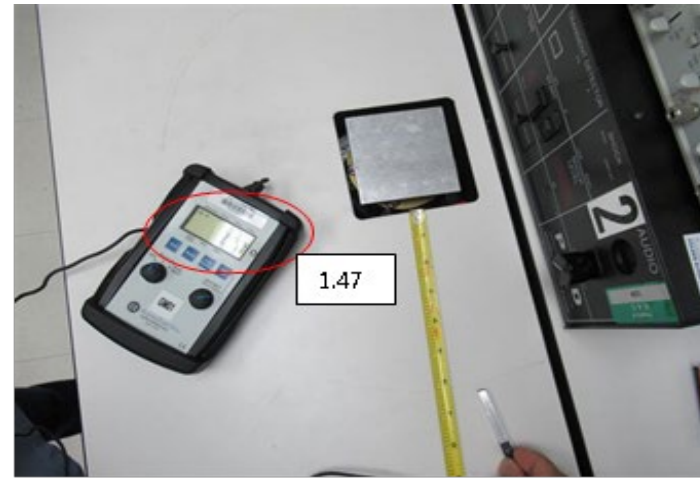
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# Task Group Work Since September 2020 Meetings



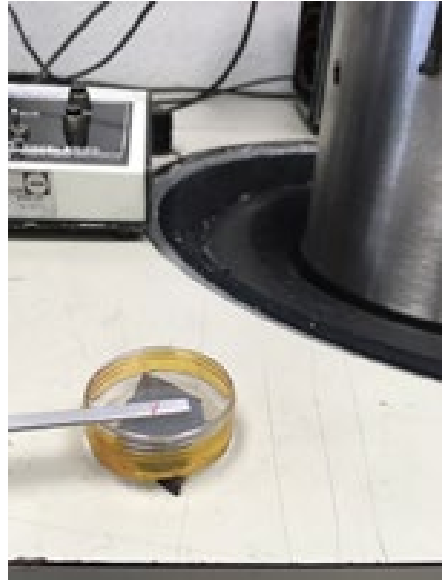
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# Task Group Work Since September 2020 Meetings

## Degaussing

- PIND equipment manufacturer Gaussian measurement example. The DUT is mounted on the top of the container with the magnet attached to the bottom of the container. The container is simulating the top of the shaker. So, Since the distance of the DUT to the magnet is closer using the container, the magnetic field increases significantly.



# Task Group Work Since September 2020 Meetings

PIND equipment manufacturer Gauss measurements cont.'d



339 gauss  
side of unit



16 gauss  
top of unit

# Task Group Work Since September 2020 Meetings

PIND equipment manufacturer Gauss measurements cont.'d



11 gauss  
side of unit



15 gauss  
top of unit

# Task Group Work Since September 2020 Meetings

- Degaussing measurements continued:
  - Test laboratory Z personnel stated that they had performed Gauss measurements on their PIND equipment using a 10 Gauss meter and shared those results.
  - Top of platen at device under test location
  - 2 Gauss while not running
  - 3 – 5 Gauss while testing
  - Gauss readings taken 0 inches from the side of shaker location found:
    - Gauss meter with a 10 Gauss maximum reading was off the scale.
    - Gauss readings taken 6 to 7 inches away from side of shaker
    - 0 Gauss was measured.

# Summary of Task Group Work

- Degaussing discussion results are:
  - Not quantifiable. No data available to review whether it is effective in enhancing particle detection.
  - No device degauss standard available for use.
  - Degauss is not listed as a requirement in test method.
  - Recommendation is to allow use of degauss process as part of PIND test process as applicable.

# Summary of Task Group Work

- Verification unit usage:
  - Provides qualitative indication equipment particle detection
  - Not a replacement for STU
  - Should utilize empty package
  - Best practice
  - Only recommendation, not a requirement