

Product Quality Addendum [PQA] for Purchased Electronic Components

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1. Scope:

This specification defines IBM's commodity specific requirements for electronic components purchased by IBM or IBM authorized sub-contractors. This document is to be used in conjunction with IBM specification 03N6596, "IBM Supplier Quality Requirements Document (SQRD)". This specification defines additional commodity specific requirements as an addendum to the SQRD. The major section numbers, from section 3 onward, of this document correspond to the major sections of the SQRD.

1.2 Applicability:

To be applicable, this specification shall be referenced by an IBM Part Number, [Supplier Part number EX-change file \(SPEX\)](#), or applicable procurement document and shall apply to all purchases made under that Part Number by IBM, IBM's Affiliates, or any third parties purchasing the product to IBM's part number.

2. General:**2.1 Definitions:**

Assembly	A part consisting of one or more components and or modules.
AVL	"Approved Vendor List" is a list of authorized/qualified Suppliers.
BGA	"Ball Grid Array".
BTR	"Business/Technical Review"
CCATS	"Commodity Classification Automated Tracking System"
CGA	"Column Grid Array"
CoO	"Country of Origin".
Component	A part which is not considered an assembly. It includes Ball Grid Array (BGA) packages and multi-die in a single package..
Contact	Conducting member of a connector consisting of a separable (non-permanent) end and a Termination (permanent) end.
CVS	"Cyclic Voltammetry Stripping"
DIMM	"Dual Inline Memory Module"
DRAM	"Dynamic Random Access Memory"
ECCN	"Export Control Classification Number"
EDLC	"Electric Double Layer Carbon"
ENC	"Encryption"

EOL	“End Of Life”, also know as Component Discontinuance
ERN	“Encryption Registration Number”
ESD	“Electro Static Discharge”.
ESI	“Electronic Supplier Interchange”.
Fab	“Fabrication” Facility
FAI	“First Article Inspection”
HTS	“Harmonized Tariff Schedule”
IBM	“International Business Machines”.
ICM	Integrated Connector Module
HIC	“Humidity Indicator Card” used to monitor moisture absorption for moisture sensitive components (see J-STD-033).
LIC	“License Exception”
Major Change	A change that may affect the form, fit, or function of the product or adversely affect the quality or reliability of the product
Module	A part which is constructed of multiple components on a substrate (also see “Subassembly”).
MRB	“Material Review Board”
N/A	“Not Applicable”, used to indicate that the item does not apply and also was not an accidental omission.
NLR	“No License Required”
Package	“The materials and construction that make up a component”
PCD	“Product Content Declaration”
PCN	“Process Change Notice”.
PGA	“Pin Grid Array”
PQA	The “Product Quality Addendum” is an optional document, provided by the Buyer to the Supplier, that sets forth specific quality requirements for a Product including technical, and or quality goals for the Product and any exceptions to the SQRD document.
PSL	Process Sensitivity Level
PTH	“Pin Through Hole”
PWB/PCB	“Printed Wiring Board/Printed Circuit Board” is the substrate material to which other component are attached in an assembly, also know by the term “raw card”.
QFP	“Quad Flat Pack”

RoHS	“Reporting of Hazardous Substances”. See IBM specification 46G3772 for further definition.
SAC	Tin-Silver-Copper Alloys, derived from the from the first element abbreviation letters (SnAgCu).
SER	“Soft Error Rate”
SMT	“Surface Mount Technology”
SPEX	The “Supplier Part number EXchange” system provides information on IBM part numbers to Suppliers.
SPC	“Statistical Process Control”
SQD	The “Supplier Quality Document” is an optional document, provided by the Supplier to the Buyer, that documents any or all of the following, as applicable: <ul style="list-style-type: none"> • Supplier’s commitments and methods to meet all quality requirements of the SQRD documents and the PQA. • Buyer Approved Waivers / Specification exceptions. • Supplier’s Quality and Reliability commitments.
SPQL	“Shipped Product Quality Level” is the quality level as seen at the next level of manufacturing or assembly.
SQR	“Supplier Quality Review”.
SQRD	The “Supplier Quality Requirements Document” (03N6596). outlines the minimum Supplier quality and process requirements for supplying Products to IBM or Authorized Third Parties.
SRR	“Supplier Readiness Review” is a business/technical review between IBM and a Supplier to review the Suppliers ability to support IBM program(s).
Subassembly	(see “Module”).
SVHC	“Substances of Very High Concern”
VPD	“Vital Product Data” is the identifier information preloaded on a device and accessible by the host system.

2.2 Precedence:

In case of conflict between IBM requirements, the order of precedence provisions set forth in the Applicable agreement shall apply. In the event of an inconsistency in the technical requirements, the following order of precedence shall apply:

- IBM Written Waivers (mutually agreed in writing)
- IBM Part Number Drawing (or equivalent component description documentation)
- IBM SQD
- This Specification
- IBM SQRD
- Other IBM Specifications
- Referenced Industry Standards
- Supplier Technical Specifications - (including such items as: electrical performance specs, quality and reliability commitments etc.)

2.3 Referenced Documents:

IBM Specification 03N6596 “SQRD” shall apply to any component referencing this specification. IBM specifications 77P0594 and or 26P0381 shall apply when referenced by the IBM part number drawing or equivalent IBM component description documentation, including IBM’s SPEX system.

The following documents in their current revision or successor shall form a part of this specification to the extent specified in the body of the document. In case of conflict see Section 2.2 “Precedence”.

IBM Document Number	Applicable Commodity	IBM Document Title
03N6596	All	IBM Supplier Quality Requirements Document (SQRD)
26P0381	All	IBM Environmental Lead(Pb)-Free Requirements for Purchased Electronic Components. (including Restriction on Hazardous Substances RoHS)
31L5345	All	Packaging and Handling (GA21-9261-11b)
34L4233	ICMs	Quality Requirements for Connectors
45U0750	Memory Modules	IBM DIMM PCB and Assembly Engineering Specification
46C3484	All	Product Content Declaration for IBM Suppliers
46G3772	All	Baseline Environmental Requirements for Supplier Deliverables to IBM
53P4082	Optics & Memory Modules	Generic Quality, Reliability and Performance Specification for IBM Systems Group Rigid Printed Circuit Boards
57G9271	All Semiconductors	Package Qualification Guideline Specification
5897660	All	Packaging Materials, Essential Requirements
61X5956	Components and Modules with Wiping Contacts	Printed Circuit Tab Requirements for Wiping Contacts (applicable only to modules with edge connectors)
77P3021	Memory Modules	Additions, Exceptions and Limitations to Industry Standards for IBM Memory DIMMs
77P0594	All	IBM Server and Storage System’s Environmental Requirements for Purchased Electronic Components Used in a Leaded(Pb) Solder System. (including Restriction on Hazardous Substances RoHS)
78P2860	Logic	IBM Logic Technology and Component Qualification Guidelines
78P3120	Memory	Memory Technology and Component Qualification Requirements
92F6933	Components and Modules with Batteries	Packaging Requirements for Dangerous Goods
C-S 1-1121-003	All	Country of Origin Labeling for Products, Sub-assemblies and Parts
C-S 3-0501-070	All Modules	Product Safety, IBM Requirements: Electrical, Mechanical, Flammability

Industry Document Number	Industry Document Name
ANSI/ESD S20.20	Protection Of Electrical And Electronic Parts, Assemblies And Equipment (Excluding Electrically Initiated Explosive Devices)
ANSI/ESD S54	Packaging Materials for ESD Sensitive Items for the Protection of Electrostatic Discharge Susceptible Items
ANSI/ESDA /JEDEC JS-001	For Electrostatic Discharge Sensitivity Testing, Human Body Model (HBM) - Component Level
ANSI/ESDA /JEDEC JS-002	For Electrostatic Discharge Sensitivity Testing, Charged Device Model (CDM) - Component Level
EIA 186-6	Mechanical Robustness of Terminals
EIA 186-13	Insulation Resistance Test
EIA-296	Lead Taping of Components in Axial Lead Configuration for Automatic Handling
EIA-468	Lead Taping of Components in Radial Configuration for Automated Assembly
EIA-481	8 mm through 200 mm Embossed Carrier Taping and 8 mm & 12 mm Punched Carrier Taping of Surface Mount Components For Automatic Handling
EIA 476	Date Code Marking
EIA-541	Packaging Material Standards for ESD Sensitive Items
EIA 599	National Electronic Process Certification Standard (NECQ)
EIA-763	Bare Die and Chip Scale Packages Taped in 8 mm and 12 mm Carrier Tape for Automatic Handling
EIA-977	Test Method – Electronic Passive Components Exposure to Atmospheric Sulfur
IEC-60068-2-6	Environmental Testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)
IEC-60695	Fire Hazard Testing
IEC 61340-5-1	Electrostatics - Part 5-1: Protection of Electronic Devices From Electrostatic Phenomena - General Requirements
IPC-A-600	Acceptability of Printed Boards
IPC-A-610	Acceptability of Electronic Assemblies
IPC-7711	Rework of Electronic Assemblies
ISO 2859	Sampling Procedures for Inspection by Attributes
ISO 3951	Sampling Procedures for Inspection by Variables
ISO 9001	Quality Management Systems - Requirements
J-STD-001	Requirements for Soldered Electrical And Electronic Assemblies
J-STD-002	Solderability Requirements for Electronic Components
J-STD-004	Requirements for Soldering Fluxes
J-STD-005	Requirements for Soldering Pastes
J-STD-020	Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices
J-STD-033	Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices
J-STD-046	Customer Notification Standard for Product/Process Changes by Electronic Product Suppliers
J-STD-048	Notification Standard for Product Discontinuance
J-STD-075	Classification of Non-IC Electronic Components for Assembly Processes
JESD22-A104	Temperature Cycling
JESD22-A109	Hermeticity
JESD22-A113	Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing
JESD22-B101	External Visual
JESD22-B103	Vibration, Variable Frequency
JESD22-B104	Mechanical Shock
JESD22-B105	Lead Integrity

Industry Document Number	Industry Document Name
JESD22-B106	Resistance to Soldering Temperature for Through Hole Mount Devices
JESD22-B107	Marking Permanency
JESD22-B114	Mark Legibility
JESD22-B115	Solder Ball Pull
JESD22-B117	BGA Ball Shear
JESD 38	Standard for Failure Analysis Report Format
JESD 50	Special Requirements for Maverick Product Elimination and Outlier Management
JESD 69	Information Requirements for the Qualification of Silicon Devices
JEP 95	JEDEC Registered and Standard Outlines for Solid State and Related Products
JESD-246	Customer Notification Process for Disasters
JESD-557	Statistical Process Control Systems
JESD 625	Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices
JESD 659	Failure-Mechanism-Driven Reliability Monitoring
JESD 671	Component Quality Problem Analysis and Corrective Action Requirements
JIS-C-5101-1	Fixed Capacitors For Use In Electronic Equipment. Part 1: Generic Specification
JIS-C-5201-1	Fixed Resistors For Use In Electronic Equipment -- Part 1: Generic Specification
MIL-STD 202	Test Methods for Electronic and Electrical Component Parts
MIL-STD 883	Test Methods and Procedures for Microelectronics
UL94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL1694	Tests for Flammability of Small Polymeric Component Materials

Copyrighted standards referenced above are available through many sources, including the following:

Agency (Abbreviation) Name	INTERNET Address
ANSI	http://www.ansi.org
Department of Defense (MIL Specifications)	http://dodssp.daps.dla.mil
Electronic Component Industry Association (ECIA)	http://www.eciaonline.org
International Electrotechnical Commission (IEC)	http://www.iec.ch
IPC	http://www.ipc.org
International Organization for Standardization (ISO)	http://www.iso.org
Joint Electron Device Engineering Council (JEDEC)	http://www.jedec.org
Japanese Standards Association (JIS)	http://www.jsa.or.jp/default_english.asp
Underwriters Laboratories (UL)	http://www.ul.com

2.4 Exceptions:

Any exception to the requirements of this specification shall constitute a change that must be approved in writing by IBM and documented in an SQD.

2.5 IBM Part Number Alterations and Additions:

The Supplier Quality Document is maintained and controlled by IBM Procurement Engineering. Any change requests must be submitted in writing to the IBM Procurement Engineer. Alterations must be mutually agreed upon by the Supplier and IBM.

IBM and Supplier agree that the definition of IBM Corporate approved and managed part numbers will be communicated via e-mail using a process called the Supplier Part Number Exchange (SPEX). Under SPEX, IBM delivers two (2) part number drawing files per week by e-mail. These part number drawing files describe all pre-existing IBM part numbers as well as any new part number adds/changes that occurred over the last seven days. This process does not apply to IBM Divisionally managed/locally released part numbers. For each part number, this file will include, but not be limited to, the following information about the part number:

FILE COLUMNS	EXPLANATION
IBM Part Number	IBM Part Number
Supplier Part Number	Supplier part number published in supplier catalog
Product Rev Level	Applies to all IC's including memory and logic components
Commodity	Generic description/categorization of part
Additional IBM Requirements	Deltas to published Supplier part number specifications and/or additional IBM test requirements. This may include burn-in conditions, tighter electrical specs or other special requirements.
Applicable IBM Specifications	Generic IBM Specs (873444, 03N6596, 46G3772, others if needed)
Applicable RoHS Specifications	IBM ROHS /Lead(Pb)-free spec that the part number must comply with (26P0381, 77P0594, others if needed)
Responsible IBM Engineer	Procurement engineer's name
Create Date	Date when the record was first entered into IBM's database
Add / Change Date	Date that the record first appeared in this file or the date when the record was last changed, which ever date is more recent.
Supplier Name	Name of the supplier

Supplier shall have seven (7) calendar days to reject any additions or changes. Supplier rejections must be in writing. If Supplier fails to reject such changes within the seven (7) day period, such changes or additions shall be deemed to have been accepted. Once each year, IBM shall request the Supplier review and sign off on the most recent IBM Part Numbers Drawing file that is in effect. The most current part number information shall supersede all previous IBM SPEX part number information. Please contact the IBM Procurement Representative if you are not receiving this file or are a new supplier and need to request this file transfer.

3. Introduction:

There are no additional commodity specific requirements in addition to those stated in the Introduction section of the SQRD (03N6596).

4. Manufacturing Qualification and Process Control:

4.1 Process / Product Monitoring:

Suppliers shall analyze part failures returned by IBM, Third Parties purchasing the IBM part number or those failures detected by the Supplier or Supplier's sub contractor. This information will be fed back into their Product processes with the goal of defect elimination on each and every manufacturing line. If elimination of the Supplier's defect cannot be immediately achieved, the Supplier's execution of an IBM approved containment plan shall be an interim goal. This analysis information includes determination of failure mechanism, defect point of origin (process step), magnitude of each mechanism's contribution to overall Quality or Reliability, and prioritization of improvement

efforts based on magnitude of contribution and impact on customer. Techniques for generation of information may include, but are not limited to, the following:

- Periodic construction analysis
- Ongoing Reliability Monitor program (per JESD 659)
- Failure analysis of:
 - Customer returns
 - Reliability monitor failures (on actual product)
 - Burn-in and/or voltage-screen failures
 - Statistically low or high yielding lots (failing components and or wafers, see ISO 2859)
 - Normal-yielding lots (failing components and or wafers)
 - In-line test or in-line monitor failures (see ISO 3951)
 - Wafer-level- and assembly-level-reliability test structure failures
 - In-line inspection defects
 - Raw Materials
 - Nonconforming materials

Each Supplier will be required to generate a Quality Pareto diagram in addition to the Reliability Pareto of failure mechanisms required by JESD 659 and describe an appropriate improvement plan for the top items for each Pareto. This plan shall include implementation schedules for corrective actions. The measurement plan must demonstrate with high confidence that the expected improvement is being achieved. The measurements should be installed at the process point at which a meaningful indicator of improvement can be achieved. This information shall be reviewed upon request. Unless otherwise agreed to and documented in an SQD, IBM accepts the supplier default process controls and measurements per the SQRD section 4.1.

4.2 Maverick Product Elimination (MPE) Program:

Component quality and reliability performance currently being achieved by the electronic component industry is such that product anomalies become major impacts to the end user. These situations are called "Maverick Product". These anomalies can occur in any commodity and can significantly impact the expected performance of the commodity. The causes of the "Maverick Product" can vary across the entire spectrum of processes including, but not limited to, fabrication, assembly, test, packing, and handling operations.

The primary consideration is to protect the customer from the potential impact of processing variation anomalies. Problem prevention is accomplished by eliminating atypical product, and by using failure mechanism based product monitors, process controls and user data. Suppliers shall review their MPE plans with IBM during the Supplier Quality Review (SQR) or upon request. IBM recommends that the "best practice" industry standard "EIA JESD 50" be used.

The Supplier's MPE program shall include:

A) Identification of Abnormal Events: A methodology shall be in place which uses valid and effective statistical methods to identify abnormal events at all stages of the manufacturing process which affect product quality and reliability, including:

- Incoming materials, materials storage, and materials distribution
- In-line fabrication processes
- Parametric test (a.k.a. acceptance test, kerf test, electrical test)
- Sort test (a.k.a. functional test, final test)

B) Identification of Suspect Material: A methodology must be in place which ensures that for every abnormal event identified in A), above, all production material which could be affected by that abnormal event is identified. This material is to be considered suspect material until it receives adequate technical evaluation per C), below.

C) Evaluation of suspect material: A methodology must be in place which ensures all suspect material identified in B), above, is given adequate technical evaluation to determine if the material is expected to have the same quality and reliability characteristics as normal production material.

Adequate technical evaluation must be done:

- Only by personnel who have documented organizational authority to make such evaluations.
- Only by personnel who are recognized by the organization as subject-matter experts in quality and reliability.
- With clear and explicit documentation, including:
 - The outcome of the evaluation, e.g., the material is (or is not) expected to have the same quality and reliability characteristics as normal production material
 - Who made the evaluation: employee name(s) and organizational title(s)
 - Date of the evaluation
 - Data that were used to make the evaluation (e.g., test data, inspection data, other measurement data)
 - Report and data retention 10 years

Suspect material which has received adequate technical evaluation, and which is expected to have the same quality and reliability characteristics as normal production material, may only be shipped to IBM with IBM written approval.

Suspect material for which adequate technical evaluation does not result in confidence that the material is expected to have the same quality and reliability characteristics as normal production material is to be considered maverick material, and must not be shipped to IBM without prior written approval from IBM.

See section 6.14.4.5 for additional requirements for IBM Custom DIMMs.

4.2.1 Allowable Rework:

4.2.1.1 Component Package Rework (Semiconductor and Passive):

No component package rework is allowed, except for the following:

1. Second pass solder plate to ensure thickness (only for automated electroplating systems)
2. Lead straightening (both "combing" and "reforming"), as long as the lead finish is not damaged.
3. Remark (Ink only) prior to ink cure.
4. Solder ball attach (ceramic BGA only).
5. Solder ball attach prior to reflow (Plastic BGA)
6. Passive component attach on BGA substrates within allowed Passive supplier specifications.

If a supplier requests rework to perform 2nd reflow to attach a few missing BGA balls, the supplier must then precondition (JESD22-A113) their product with a fourth SMT reflow passes prior to their reliability qualification testing.

All other rework operations are not allowed without written IBM approval. (IBM approval will require a documented rework flow and qualification results).

4.2.1.2 Semiconductor Fabrication Rework:

No rework is allowed, except for the following:

1. Removal and re-application of photoresist, as part of a standard documented procedure for photo rework.

All such rework must be documented by the same means, and with the same level of detail, as all other normal fab processing operations. There must be a documented limit on the number of times a lithographic operation may be reworked before the entire affected wafer lot is put on hold for root-cause analysis and engineering disposition.

2. Additional ion implantation, in cases where ion implantation was interrupted and reliable dose-counter measurements are available to set the required additional dose.

All such rework must be documented by the same means, and with the same level of detail, as all other normal fab processing operations.

All other rework operations are not allowed without written IBM approval. IBM approval will require a documented rework flow and qualification results.

4.2.1.3 Manufacturing of Passive Component and Other Component Rework:

No additional rework is allowed to the initial construction of these components.

All other rework operations are not allowed without written IBM approval. IBM approval will require a documented rework flow and qualification results.

4.2.1.4 Module Assembly Rework:

This applies to Memory DIMMs, fiber optic transceivers, magnetic filters and other assemblies.

No rework is allowed, except for the following:

1. Rework of any single DRAMs is limited to one time only.
2. A maximum of 3 different component site reworks are permitted per DIMM. Reworked components must be marked for traceability.
3. A Surface Mount component site may be reworked/touched-up no more than 2 times using methods stated in IPC-7711 or an IBM approved alternative method. The reworked site must pass the visual inspection requirements as stated in this specification.

Printed Wiring Board (PWB) rework, including gold plate rework, is not permitted unless specifically approved by IBM.

For Surface Insulation Resistance testing, simulate rework by: applying primary paste and rework flux; reflow; and cleaning process (where used).

4.3 Product Traceability:

Component carrier/module marking must be maintained by the Supplier for all products to enable identification of the product back to all plants of manufacture (fab, assembly, and test locations), manufacturing process within a plant, as well as fabrication, assembly and test lots (e.g. Date Code). For electronic components with serial numbers, traceability to the serial numbers is preferred.

The Supplier must document their marking scheme format, per package/pin count and submit this information to the IBM purchasing organization for reference.

Parts must be marked in accordance with the applicable IBM specifications. In addition, the Supplier must be able to trace volumes, manufacturing lot numbers and quantities shipped to any IBM or IBM authorized subcontractor location (forward traceability), and from the marking on a defective component (on its packing for very small parts like SMT Passive) back to the manufacturing lot (backward traceability).

Where IBM part number(s) is being purchased by third parties, the product traceability requirements shall apply to all purchasers of the IBM part number and traceability data for such third party's purchases shall be made available to IBM. See section 6.14.4.2 for additional requirements for IBM custom DIMMs.

4.4 First Piece Build and Inspection Requirements:

Per the SQRD (IBM specification 03N6596) section 4.5, the data shall be available upon IBM request.

5. Process / Product / Engineering Change Controls:

5.1 PCN General Requirements:

A Process Change Notice (PCN) shall be sent to IBM per [J-STD-046](#). When the supplier submits a PCN, general information (see [J-STD-046](#) section 3.3) such as qualification data and Product samples shall be provided by the Supplier as appropriate. Qualification data shall include an analysis of the reliability data including the methodology used in the reliability calculations, a comparative electrical characteristic analysis and manufacturing line equivalency analysis for product line additions or moves. If qualification data and/or product samples are not available when the PCN is submitted, then a target date for data and samples shall be provided. Suppliers shall notify IBM of any reportable material changes (see IBM specification 46G3772)-

Suppliers shall meet the requirements in [J-STD-046](#) with the following exceptions:

1. Notification is required on all IBM part numbers regardless of the purchase activity level and only applies to components for which the Supplier had not already discontinued the component per section 5.2.4. At a minimum the scope of part numbers requiring PCN notification shall be defined by the IBM SPEX file that is provided regularly. This requirement overrides the "purchased in the last 2 years" requirement in the definition of "customer" within [J-STD-046](#).
2. Suppliers shall provide IBM annually their definition of "Major Changes" vs. "minor changes" per [J-STD-046](#) section 3.1

Per section 5.3 of the SQRD, PCNs require written notification to an IBM representative [or submission through IBM's Electronic Supplier Interchange (ESI) system] at least three months (90 days) in advance of any such changes. The following non proprietary information data shall be included for PCNs:

- Supplier PCN Number
- Supplier Contact Information (e.g. Contact name, phone, fax and e-mail)
- Commodity
- Date when IBM response is requested
- Supplier Name
- Is there a specification change? (Y/N)
- Original Supplier part numbers
- New Supplier part numbers (if applicable)
- Affected IBM Part Numbers
- Reason for change
- Impact on Quality or Reliability commitments / performance

- Qualification data (For semiconductor components see JESD-69)
- Supplier Audit results
- Supplier PCN Notice
- Type of PCN as one of the following general categories:
 - Fab Site Change
 - Assembly Site Change
 - Burn-in Change
 - Assembly/Material/Package change (May require a new materials declaration submission)
 - Mask/Design change or shrink
 - Change to Fab Process
 - Test Program Change
 - 1st level container change (Tray/T&R/Tube/etc.)
 - Packing/label/component marking change
 - [Change to Assembly Process](#)
 - Dimensional change to package
 - Circuit or Specification Change
 - Other. Describe in Comment Section
 - Test/Burn-in Site Change

5.1.1 PCN General Requirements for all Components and Modules:

IBM considers all changes listed below to be major changes and requires notification of all such changes.

Datasheet

- Change in electrical specification, parameters, limits, or tolerances
- Stepping change (silicon redesign) to correct errata
- Change in recommended layout (next level assembly)
- Change in recommended handling
- Degradation in MSL (moisture sensitivity level) rating or change in drypack requirements
- Change in PSL (process sensitivity level) rating
- Reduction in environmental storage condition
- Significant change of shipping labelling
- Change in carrier type (tube, reel, tray, etc.), carrier dimensions, or device orientation
- Change in material that affects environmental material declaration (updated Product Content Declaration (PCD) must be submitted to IBM)
- Change to process or package that might affect soft error rate (SER)

Physical Component/Module

- Change in any manufacturing site location (fabrication, assembly, bump, plating, other), including subcontracted operations
- Change in any test site location or test method including subcontracted facilities
- Change in design, internal layout, or internal dimensions (e.g., thickness)
- Change in process technology/technique affecting critical process steps
- Change in process/test flow or deletion of any process/test step
- Change in construction or external device dimensions
- Change of any material
- Change of supplier of a critical material, sub-component, or component
- Change in marking method or marking appearance
- Elimination or reduction of final electrical measurement/test or Burn-in conditions
- Change in firmware, VPD, code or equivalent loaded by supplier prior to shipment
- Change that could impact IBM incoming quality level or IBM reliability performance level (including potential impact on soft error rate)

5.1.2 Additional Requirements for Wafer Fab Changes:

- Change in wafer diameter
- Change in diffusion dopant
- Change in gate oxide material or thickness
- Change in dielectric material
- Change in polysilicon dopant type
- Change in metallization material or thickness
- Change in top protective layer material or thickness
- Change in die coating material or thickness
- Change in wafer substrate or silicon orientation
- Change in etching technique/material/chemical
- Major equipment Change

5.1.3 Additional Requirements for Package/Module Assembly Changes:

- Change in leadframe base material or significant change to internal leadframe dimensions. (e.g., paddle area change >25%)
- Change in substrate (for package) supplier, layout, stackup, or layer count or change to critical wiring path
- Change in PWB (for modules) supplier, layout, stackup, or layer count or change to critical wiring path
- Change in plating material or process technique
- Change in (BGA) Solder ball material composition
- Change in flipchip ball/bump and/or attach solder material composition
- Change in wire bond material or method
- Change in encapsulation material (mold compound, underfill, potting, etc.)
- Change in sealing material (hermetic package)
- Change in die attach material

5.2 Component Discontinuance (EOL - End Of Life):

Component discontinuances are sometimes called EOL PCNs.

The Supplier's ability to discontinue a component during the term of the applicable Purchase Agreement will be determined in accordance with the applicable Purchase Agreement. If the Purchase Agreement does not contain component discontinuance requirements, or there is no agreement in place, Suppliers shall conform to J-STD-048 with the following exceptions:

- Supplier shall Notify IBM Procurement of all Supplier component discontinuances.
- Supplier shall Notify IBM if IBM or IBM's sub contractor has ever purchased the Supplier's component using the IBM PN. This is an additional notification, where IBM may not be considered an "Affected Customer" per J-STD-048. At a minimum the scope of part numbers requiring EOL notification shall be defined by the IBM SPEX file that is provided regularly. This requirement overrides the "purchased in the last 2 years" requirement in the definition of "customer" within J-STD-048.

A Supplier's entry of an EOL notice into IBM's Electronic Supplier Interchange (ESI) system is considered notification per J-STD-048.

The following nonproprietary data should be included with a component discontinuance notice:

- Supplier discontinuance number
- Notification date
- Affected commodity
- Last buy date (must be a minimum of 6 months after the notification date)

- Last ship date (must be a minimum of 6 months after the last buy date)
- Supplier name
- Supplier contact information (e.g. Contact name, phone, fax and e-mail)
- Original supplier component part numbers (see note below)
- Affected IBM component part numbers (see note below)
- Suggested replacement component(s)
- Suggested replacement component(s) manufacturer(s) (if applicable)
- The specification differences between the original component and the available replacement component (assuming both components are built by the same manufacturer)
- Information on supply availability of the original component part number (die, finished goods, distributors and brokers)
- Comments (e.g. Reason for component discontinuance, anticipated impact on quality and reliability statement for the replacement component, qualification plan for the replacement component (if applicable), etc.)

Note: The original Supplier component part numbers and affected IBM component part numbers must be tabbed or documented in an electronic spreadsheet to facilitate data base searches.

If a Third Party purchases the IBM part number, the component discontinuance notice shall be provided to both the Third Party and IBM.

The Supplier shall make reasonable effort to have samples of their available replacement components (for customer build and functional application testing) and qualification data at the time of the component discontinuance notice submission.

5.3 Disruption of Shipments Due to Disasters or other Events:

The supplier shall have a customer notification process for disasters consistent with the requirements of JESD-246 and IBM requires that it be notified of all incidents affecting part numbers in the IBM SPEX file regardless of order activity.

6. Acceptance of Final Product by IBM:

6.1 Date Codes:

Acceptable date codes of qualified product are directly controlled by the responsible IBM component engineer. Where no stricter date code limits have been imposed, components with date codes older than 5 years shall not be shipped, with the exception of tactile switches which shall be 1 year. Within the allowable date codes, the Supplier shall only ship product which meets the current IBM and supplier documented requirements (especially the latest functional test tape and environmental compliance). Shipment of Product outside of the IBM documented allowable date codes requires IBM written approval. This date code restriction helps to insure product quality and reliability, especially in the following areas: solderability; environmental compliance; functional test; moisture sensitivity; and process or manufacturing/assembly sensitivity.

6.2 Component Marking and Labels:

1. Components shall be permanently and legibly marked as specified (see Section 2.2, "Precedence"). IBM requests that all marking be on the top side of the component, whenever possible.
2. If the component marking is not specified by a higher precedence document, the Supplier shall mark the component as follows (where possible):
 - Supplier Logo or EIA-476 source code number

- IBM or Supplier Part Number
 - Code or codes to identify the fabrication, assembly, and final test plants (I.C.s only)
 - EIA-476 or EIAJ Date Code
 - Lot number if required
 - A visual indicator for pin 1 where needed
3. Components too small to accommodate the above marking shall be marked with Supplier standard marking.
 4. Country of Origin (CoO) shall be marked on the component per C-S 1-1121-003, "Information Plates and Labels". Although IBM C-S 1-1121-003 is written for IBM Products, it also outlines IBM requirements for procured components.
 5. Components too small to be legibly marked need not be marked.
 6. Where adhesive labels are used for marking, they must withstand card assembly processing including aqueous and or solvent cleaning without loss of adhesion or legibility.
 7. All components shall conform to the requirements of JESD22-B107. Mark legibility shall be performed per JESD22-B114.

6.2.1 Component Copyright Marking, Maskwork Protection:

1. Where IBM copyright marking is required, modules shall be marked "(c) IBM XXXX" where XXXX is the year the code was copyrighted.
2. Where Maskwork protection is required, modules shall be marked circled M "IBM" or "*M* IBM".
3. Chip metal, and each metal (where possible) level of the chip containing an IBM design, as well as the top of the package, shall be mask protection marked.
4. Where joint copyright and mask work protection is required, components shall be marked (c) IBM XXXX *M*.

6.3 External Dimension and Visual:

These requirements apply to all components. See Section 6.14 for requirements for modules (card assemblies).

1. The Supplier shall meet the physical outline requirements in the order of precedence outlined in Section 2.2 "Precedence".
2. For external visual requirements, all components shall meet the requirements of JESD22-B101. Components which are not ESD sensitive are not required to follow the ESD Sensitive Guidelines in JESD22-B101.

6.4 Terminal, Lead, and Ball Requirements:

6.4.1 General Solderable Finish Requirements:

These requirements apply to all components that are soldered.

1. Solderable plating thicknesses are as follows based on the plating process:

A. Electroplated: The plating thickness of tin (Sn) and tin alloys shall be 5-25 microns

(197–984 μ -in). The preferred plating thickness for tin (Sn) or tin alloys on packages utilizing a lead frame is 7.5 microns (295 μ -in). The plating thickness of tin (Sn) and tin alloys for chip resistors manufactured on a metal base layer shall be 2-12 microns (79–472 μ -in). The plating thickness of Type A Gold shall be less than 90 micro-inches (2.23 microns).

B. Barrel Plated: The plating thickness of tin (Sn) and tin alloys shall be 3-15 microns (118–591 μ -in), except for chip packages 0201 and smaller where the minimum shall be 2 microns (79 μ -in). . The plating thickness of tin (Sn) and tin alloys for chip resistors manufactured on a metal base layer shall be 2-12 microns (79–472 μ -in). The plating thickness of Type A Gold shall be less than 90 micro-inches (2.23 microns).

C. Preplated: The plating thicknesses of nickel/palladium/gold (NiPdAu) or nickel/palladium/gold-silver (NiPdAu-Ag) preplated alloys shall meet the requirements specified by the Supplier.

2. No exposed silver (Ag) is permitted on component leads or at component lead exits. Only exception is silver flash on (NiPdAu-Ag) pre-plated finishes.
3. Chip component (i.e. chip resistors, chip capacitors, ferrite beads etc.) shall have a 1 micron (40 μ -in) minimum nickel barrier under the solderable finish and over precious metal terminations.
4. For BGA components referencing IBM RoHS specification 26P0381, the ball material must be an IBM approved tin-silver-copper (SnAgCu), tin-silver (SnAg) or a tin-copper (SnCu) alloy.

IBM prefers SAC alloys with silver concentrations of 2.5% or greater. IBM must be notified during Supplier's component qualification of the use of SAC alloys for BGA balls that have concentrations of silver less than 2.5%. This includes, but is not limited to the following alloys: SAC101, SAC105, and SAC125.

For BGA components referencing IBM RoHS specification 77P0594, the ball material must be one of the following: Eutectic tin-lead (Sn-Pb); Tin-lead-silver [(Sn(62%)Pb(36%)Ag(2%)); Tin-lead [Sn(10%)Pb(90%)].

5. All plated finishes must adhere to underlying metal and exhibit no flaking. Plated finishes shall not exhibit any evidence of corrosion.

6.4.2 Lead(Pb)-free Solderable Finish Requirements:

The following are the only acceptable lead(Pb)-free finishes (all percentages calculated from the component solderable finish weight):

- A. Pre-plated palladium lead frame with a nickel under-plate, with or without a gold flash". This is commonly referred to as a NiPdAu pre-plate (Au flash is optional). NiPdAu-Ag (gold and silver flash) is also acceptable.
- B. Fused, reflowed or hot dip of 100% tin (Sn) or tin (Sn) alloys, where the alloy elements can be: Silver (Ag); Bismuth (Bi); Copper (Cu); Zinc (Zn); Nickel (Ni). (Ni under-plating is not required with any of these finishes or processes.)
- C. 100% plated matte tin (Sn):
 1. Over 1 micron minimum Nickel (Ni).
 2. Over Copper (Cu) alloy base metal annealed at 150°C for a minimum of 1 hour within 2 weeks (24 hours preferred) of the tin (Sn) plating, where the lead pitch < 1mm (40 mils).
 3. Over Alloy 42 (Fe-Ni) base metal, with or without copper (Cu) underlay and anneal is not required.

- 4. With no anneal or underplate for lead pitches > or = 1mm (40 mils).
- D. Noble metal plating is acceptable except for silver (Ag).
- E. Tin-Bismuth (SnBi) plating over copper (Cu), Nickel (Ni) or Alloy 42 (FeNi):
 - 1. With a nominal bismuth (Bi) concentration of 2-4%.
 - 2. With a total bismuth (Bi) concentration range of 1-6%.
- F. Tin - Copper (SnCu) plating over copper with anneal (at 150°C for a minimum of 1 hour within 2 weeks (24 hours preferred) of the tin (Sn) plating or over 1 micron (40 μ-in) minimum Nickel (Ni)
- G. Tin - Silver (SnAg) plating over copper (Cu) or Alloy 42 (FeNi) with a minimum silver (Ag) concentration of 1%.
- H. QFN style packages with organic substrates, Electroless Nickel with noble metal over plate, e.g., Electroless Nickel under Electroless Palladium under Immersion Gold Flash (ENEPIG) or IBM approved finish.

Zinc (Zn) plating is not allowed as a final solderable finish or metal package final coating.

The following solderable finishes are acceptable in addition to those listed above.

Commodity	Lead Material	Solderable Finish	Solderable Finish Under plate and Minimum Thickness	Smallest Lead Pitch
Aluminum Capacitors	Cu or Fe	Sn(99.5%)Bi(0.5%)	N/A	1mm (40 mils)
Tantalum Niobium & Niobium Oxide Capacitors	Cu	SnCu	Ni[0.5 micron (20 μ-in)]	1mm (40 mils)
Actives	Cu	SnAg	N/A	0.87mm 1mm (34 mils)
Crystal / Oscillators	Alloy42	Sn(97%)Cu(3%)	N/A	1mm (40 mils)
	Alloy42	Sn(93%)Cu(7%)	N/A	1mm (40 mils)
	Alloy42	Sn(99.3%)Cu(0.7%)	N/A	1mm (40 mils)
	Kovar	Sn(100%)	Cu[2 micron (80 μ-in)]	0.75mm (30 mils)
Magnetics	Cu(94%)Sn(6%)	Sn(95%-99.5%)Cu(0.5%-5%)	Ni[1micron (40 μ-in)]	1mm (40 mils)
	Cu(94%)Sn(6%)	Sn(95%-99.5%)Cu(0.5%-5%)	Ag	1mm (40 mils)
	Cu98%Sn(2%)	Sn(95%-99.5%)Cu(0.5%-5%)	N/A	1mm (40 mils)
Magnetics	Cu or Cu Alloy	Sn(95%-99.5%)Cu(0.5%-5%)	N/A	1mm (40 mils)
	Fe(70%)Cu(30%)	Sn(95%-99.5%)Cu(0.5%-5%)	N/A	1mm (40 mils)
	Ceramic	PdPtAg	N/A	1mm (40 mils)
Resistors	N/A	Sn (100%)	Cu	0.45mm (18mils)

6.4.3 Finishes for Socketed Components and Integrated Connector Modules (ICMs):

These requirements apply to all components and assemblies that are socketed and also for the contact finish for ICMs.

6.4.3.1 Pinned/Leaded Components:

Component pin/lead finish shall be 2.54 microns (100 μ -in) minimum Class A Gold over 2.54 microns (100 μ -in) Nickel.

6.4.3.2 Edge Connector Contact Pads on PWBs:

Copper contact pad finish shall be 30 μ -in (0.75 micron) minimum Gold over 75 μ -in (1.9 micron) minimum of Nickel.

6.4.3.3 Integrated Connector Modules (ICMs) Contact Plating Finish Requirements:

ICMs shall have a gold plated contact finish of 50 μ -in (1.27 microns) minimum over 50 μ -in (1.27 microns) minimum nickel, or an IBM approved equivalent finish.

6.4.3.4 Sliding contact Switches

Switches shall have a gold plated contact finish of 50 μ -in (1.27 microns) minimum over 50 μ -in (1.27 microns) minimum nickel, or an IBM approved equivalent finish.

6.4.4 Solderability:

This requirement applies to all components that are soldered, except for (SAC) ball BGAs.

1. Components shall conform to the solderability requirements of EIA/IPC J-STD-002, per Test A1, B1, C1 or S1.
2. All components shall conform to Preconditioning Condition Category E (155C dry baking) per J-STD-002.

6.4.5 Lead Integrity:

1. This requirement applies to all SMT and PTH components with leads and to pinned Memory modules. They shall conform to the requirements of JESD22-B105 with the following additional requirements: For test Condition A (Tension) the tensile load shall be 1.36 +0.23/-0 Kg (3 +0.5/-0 lbs) for PTH components; For test conditions B and D, an additional failure criteria shall be no flaking of the lead finish under the specified magnification.
2. Active and Passive PTH components shall conform to EIA 186-6, where the test load shall be that supported by the manufacturer. An additional criterion for type III, IV and V tests shall be no flaking of the lead finish under 10X magnification.
3. For hermetic components, a hermeticity test is required after performing lead integrity test. See section 6.6.

6.4.6 BGA Solder Ball Shear:

Applies to all ball grid array packages (BGA).

1. Components shall conform to the ball shear requirements of JESD22-B117, "BGA Ball Shear".
2. Test samples must be from 2 assembly lots. Sample size is 10 components per assembly lot. 10 balls per component must be sheared.
3. Test samples shall be split into 2 equal groups. One half aged for 168 hours at 125°C and remaining half

shall receive no aging.

4. Minimum allowed shear values for solder balls are stated in the table below: All values are average minus 3 sigma.

Solder Ball Pitch	Minimum allowed shear force for both with and without aging
≥ 1.27mm (50 mils)	600 grams
>1.27 mm (50 mils) and ≥ 1.0mm (40 mils)	350 grams
>1.0mm (40 mils) and ≥ 0.8mm (31 mils)	225 grams
≥ 0.5mm (20 mils)	80 grams
Bumped silicon (wafer or singulated)	60 grams

5. A fail mode of ball lift (Mode 3 in Table 4-1 in JESD22-B117) is not allowed. The lack of intermetallic formation denotes a potential reliability concern.
6. High speed ball shear testing per JESD22B-117 may be performed in lieu of standard (low speed) shear testing with prior written approval of IBM. High speed testing rate is 0.01 to 1.0 m/sec. Low speed testing rate is typically performed at 100 to 800 microns/second.

6.4.7 BGA Solder Ball Pull:

BGA packages shall meet JESD22-B115. With prior written approval of IBM, a supplier may substitute BGA solder ball shear data (see section 6.4.6) with solder ball pull data per JESD22-B115. Acceptance criteria will be mutually agreed to as part of the written approval.

6.5 Soldering Process Compatibility:

These requirements apply to components referencing IBM specification 26P0381.

1. All non solid-state components (e.g. LEDs, and Passive components, resistors, capacitors inductors etc.) shall be evaluated and classified per J-STD-075.
2. Any surface mounted, solid state device that has been classified per J-STD-020 and can withstand the thermal profile stated in J-STD-020 is not required to be classified per J-STD-075 for thermal limitations. Similarly, any through hole mounted, solid state device that meets the requirements of JESD22-B106 is not required to be classified per J-STD-075 for thermal limitations. However, any solid state device that has a history of thermal limitations or may not be subjected to cleaning or other commonly performed assembly processes must be classified for those process limitations per J-STD-075.

6.5.1 Process Sensitivity Classification Additional Data Requirements:

For components not classified as either “R0” or “W0” per J-STD-075, the Supplier shall fill out IBM’s PSL questionnaire. Typical information required for a process sensitive Component, beyond the PSL rating, are:

Wave Solder Sensitive
Maximum Wave Solder Temperature (°C)
Maximum Time in Wave (s)
Maximum Thermal Spike (°C)
Number of Reflows Allowed
Details of Any Wash, Flux, or Other Restrictions (ex. PSL 3 digit of a “Y”)

Reflow Sensitive
Maximum Peak (t _p) Temperature (°C)
Maximum Time at Peak Temperature (s)
Time (t _L) above 217 °C (s)
Preheat Minimum Temperature (°C)
Preheat Maximum Temperature (°C)
Preheat Duration (s)
Ramp Down Rate (°C/s)
Number of Reflows Allowed
Details of Any Wash, Flux, or Other Restrictions (ex. PSL 3 digit of a “Y”)

6.5.2 Wet Reflow Shock (Moisture Sensitivity) Test for SMT Components:

1. Active, Logic and Memory components shall meet the requirements of J-STD-020, at the moisture sensitivity level supported by the Supplier. The moisture soak is not required for (fine leak) hermetic SMT components.
2. All non solid-state components shall be evaluated and classified per J-STD-075.
3. IBM must be notified if any solid state component which is not compatible with lead(Pb)-free hot air rework at 260C per J-STD-020.

6.5.3 Requirements for Through-Hole Components:

1. All IC components in Through-Hole packages shall meet the requirements of JESD22-B106 for lead(Pb)-free solder conditions, with an additional requirement that components shall provide no delamination or crack path for process chemicals to reach any feature that can be damaged by flux, or to bridge any two features of opposite polarity. This can be demonstrated through dye penetration testing and cross-sectioning, Acoustic Microscopy, or (for Memory only) Saltwater Boil testing; or can be verified by performing reliability tests after reflow simulation (preconditioning).
2. All hybrid, passive, other components in Through-Hole packages shall be evaluated and classified per J-STD-075.
3. The allowable hand solder conditions are defined by the Supplier of the component.

6.5.4 Requirements for Backside-Wave Soldered SMT Components:

1. Active, Logic and Memory components shall not be wave soldered.
2. The following Passive SMT components shall be evaluated and classified per J-STD-075:
 - Chip resistor packages 0603 and larger
 - Chip resistor and resistor-capacitor array packages with 50 mil. (1.27mm) or greater nominal pitch
 - Ceramic chip capacitors listed in per the Table 13-2 of J-STD-075. Ceramic capacitor packages smaller than 0603 and larger than 1206 shall not be wave soldered.

6.6 Hermeticity:

This requirement applies to sealed components with an internal cavity.

1. Hermetic components shall meet the requirements of JESD22-A109, Test Condition A, 'Helium Fine Leak Test', or test Condition B, 'Radioisotope Fine Leak Test'. Upon completion of either fine leak test, components shall then be tested and meet the requirements of Test Condition C, 'Fluorocarbon Bubble Gross Leak'.
2. Non-hermetic cavity packages such as PPGA or Metal QFP shall meet the requirements of Test Condition C, 'Fluorocarbon Bubble Gross Leak', only.

6.7 Additional Process Compatibility Requirements (Post Initial Attach):

These requirements apply to all components and modules (SMT and PTH) soldered to cards. The processes defined below may be performed on an IBM assembled card as part of IBM's manufacturing processes. Therefore, all components and modules on the card could be exposed to the conditions described below. All components and modules must be able to withstand these conditions without degradation to functionality, quality, or reliability. If a component/module cannot be subjected to any of these conditions, the supplier shall notify IBM and provide safe, alternate conditions. Note: Electrical bias is not applied during any of these processes.

6.7.1 Cleaning Compatibility (Card Assembly Flux Removal):

Non- solid state Components and modules shall be classified per J-STD-075 for cleaning compatibility. Solid state components shall be classified per J-STD-075 for aqueous cleaning processes only.

6.7.2 Rework Compatibility:

Components and modules shall be able to withstand an adjacent component rework temperature of 180C for 5 minutes.

If this thermal exposure exceeds the capabilities of the component or module, the supplier must provide written definition of the maximum temperature to which the component can be subjected for 5 minutes which will not degrade its functionality, quality, or reliability. This process occurs after initial card assembly.

6.7.3 Short Duration Cure (Bake) Compatibility (Encapsulant or Adhesive Cure on Card Assembly):

Components and modules shall be able to withstand a thermal exposure of 125C for 90 minutes (1.5 hours). If this thermal exposure exceeds the capabilities of the component or module, the supplier must provide written definition of the maximum temperature to which the component can be subjected for 90 minutes which will not degrade its functionality, quality, or reliability. This process occurs after initial card assembly.

6.7.4 Long Duration Bake Compatibility (Moisture Bake of Card Assembly):

Components and modules shall be able to withstand a thermal exposure of 125C for 48 hours.

If this thermal exposure exceeds the capabilities of the component or module, the supplier must provide written definition of the maximum temperature to which the component can be subjected for 48 hours which will not degrade its functionality, quality, or reliability. This process occurs after initial card assembly.

6.7.5 Temperature Cycling Compatibility (Card Level Thermal Cycling):

Components and modules shall be able to withstand temperature cycling from 0C to 100C, at 1 cycle per hour (15 minute dwell/soak) for 100 cycles.

If this thermal exposure exceeds the capabilities of the component or module, the supplier must provide written definition of the maximum temperature the component can be subjected to 100 temperature cycles at 1 cycle per hour which will not degrade its functionality, quality, or reliability. This process occurs after initial card assembly.

6.8 Temperature Cycling / Thermal Shock for Shipping:

Components shall withstand JESD22-A104, Condition B, 10 cycles. MIL-STD-883 method 1010 condition B , or MIL-STD-202 method 107 condition B (with low temperature as -55C) for 10 cycles are equivalent test methods and may be used in lieu of JESD22-A104, except as noted below:

Commodity	Temperature (maximum)	Temperature (minimum)
Aluminum Capacitors	(Maximum Supplier component rated usage temperature)	(Minimum Supplier component rated usage temperature)
Can/Coin Type Electric Double Layer Carbon – Special Capacitors	(Maximum Supplier component rated usage temperature)	(Minimum Supplier component rated usage temperature)
LEDs	75°C	(Minimum Supplier component rated usage temperature)

6.9 Flammability:

This requirement applies to all components that contain organic materials. Only those components that contain only ceramic and metallic materials are exempt.

1. Components shall meet UL 1694 or UL 94V-0 (material tests, where the test specimen shall be the component). IEC 60695-11-5 is also acceptable.
2. For all module (card assemblies), the assembly shall meet the Flammability requirements for "commercial components" as stated in C-S 3-0501-070.
3. The use of red phosphorus is prohibited as a flame retardant system.

6.10 Mechanical Shock and Vibration:

This requirement applies to hermetic and non-hermetic cavity packaged components.

Components, except switches, shall meet the requirements of JESD22-B104 for Mechanical shock, at the condition supported by the Supplier, and JESD22-B103 for vibration. MIL-STD-883 method 2002 condition B or higher, and MIL-STD-202 method 213 condition F are equivalent for shock. MIL-STD-883 Method 2007 conditions A, B, or C or MIL-STD-202 method 204 condition B or higher, and IEC 60068-2-6 are equivalent test methods for vibration. Switches shall meet MIL-STD-202 Method 201 test condition A and Method 213 test condition B.

6.11 Resistance to Board Bending:

SMT ceramic capacitors shall comply with JIS-C-5101-1 section 4.35. SMT resistors shall comply with JIS-C-5201-1 section 4.33.

6.12 Insulation Resistance:

This requirement applies to components designed for use in applications over 24 volts.

1. Components shall meet the requirements of EIA RS-186-13, 100 V.
2. Electrode configuration and leakage limits shall be defined in the part number drawing.

6.13 Environmental Compliance:

All components shall meet the requirements of IBM corporate environmental specification 46G3772. Additional IBM Environmental information can be found at:

<http://www.ibm.com/ibm/environment/products/especs.shtml>

IBM encourages suppliers to eliminate Substances of Very High Concern (SVHC) in all electronic components, modules and shipping materials, as soon as appropriate economic alternative technology/materials are available (see IBM specification 46G3772). Suppliers should work with their IBM procurement / technical interface to assess the feasibility of eliminating SVHC(s) and to develop a plan and schedule for the removal of the substance(s).

6.13.1 Reporting Requirements:

Supplier shall report environmental compliance per IBM’s Product Content Declaration (PCD) form, IBM part number 46C3484.

<http://www.ibm.com/ibm/environment/products/ecpquest.shtml>

6.13.2 EU RoHS Exemption Requirements:

IBM has determined some of the exemptions will not be allowed for IBM products. IBM has tighter requirements for certain exemptions as noted in the “Expiration Date (if applicable)” column. The following are the applications which are exempt from the requirements of RoHS as cited by the EU Directive, and subsequent amendments as outlined in Section 2.2.1 of 46G3772. Exemptions no longer allowed are listed in the “Expiration Date (if Applicable)” column. All other data contained in this column if for informational purposes.

IBM may order older Product for spare parts for the repair and reuse of equipment placed on the market prior to a specific date. Suppliers are to ship any Product based on the IBM specifications.

RoHS Exemptions

No.	Exemption	Current EU Expiration Date	IBM Requirements
1	Mercury in single capped (compact) fluorescent lamps not exceeding (per burner):		
1(a)	For general lighting purposes < 30 Watts: 2.5 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.

No.	Exemption	Current EU Expiration Date	IBM Requirements
1(b)	For general lighting purposes ≥ 30 Watts and < 50 Watts: 3.5 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
1(c)	For general lighting purposes ≥ 50 Watts and < 150 W: 5 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
1(d)	For general lighting purposes ≥ 150 Watts: 15 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
1(e)	For general lighting purposes with circular or square structural shape and tube diameter ≤ 17 mm: 7 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
1(f)	For special purposes: 5 mg		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
1(g)	For general lighting purposes < 30 W with a lifetime equal or above 20 000 h: 3.5 mg or less	31 December 2017	This exemption is not allowed.
2(a)	Mercury in double-capped linear fluorescent lamps for general lighting purposes not exceeding (per lamp):		
2(a)(1)	Tri-band phosphor with normal lifetime and a tube diameter < 9 mm (e.g., T2): 4 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
2(a)(2)	Tri-band phosphor with normal lifetime and a tube diameter ≥ 9 mm and ≤ 17 mm (e.g., T5): 3 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
2(a)(3)	Tri-band phosphor with normal lifetime and a tube diameter > 17 mm and ≤ 28 mm (e.g., T8): 3.5 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
2(a)(4)	Tri-band phosphor with normal lifetime and a tube diameter > 28 mm (e.g., T12): 3.5 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
2(a)(5)	Tri-band phosphor with long lifetime ($> 25,000$ h): 5 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
2(b)	Mercury in other fluorescent lamps not exceeding (per lamp):		
2(b)(1)	Linear halophosphate lamps with tube > 28 mm (e.g., T10 and T12): 10 mg or less	13 April 2012	This exemption is not allowed.
2(b)(2)	Non-linear halophosphate lamps (all diameters): 15 mg or less.	13 April 2016	This exemption is not allowed.
2(b)(3)	Non-linear tri-band phosphor lamps with tube diameter > 17 mm (e.g., T9): 15 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.

No.	Exemption	Current EU Expiration Date	IBM Requirements
2(b)(4)	Lamps for other general lighting and special purposes (e.g., induction lamps): 15 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
3	Mercury in cold cathode fluorescent lamps and external electrode fluorescent lamps (CCFL and EEFL) for special purposes not exceeding (per lamp):		
3(a)	Short lamp length (≤ 500 mm): 3.5 mg		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
3(b)	Medium lamp length (> 500 mm and ≤ 1500 mm): 5 mg		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
3(c)	Long lamp length (> 1500 mm): 13 mg		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
4(a)	Mercury in other low pressure discharge lamps (per lamp): 15 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
4(b)	Mercury in High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner) in lamps with improved colour rendering index $R_a > 60$:		
4(b)-I	$P \leq 155$ W: 30 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
4(b)-II	155 W $< P \leq 405$ W: 40 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
4(b)-III	$P > 405$ W: 40 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
4(c)	Mercury in other High Pressure Sodium (vapour) lamps for general lighting purposes not exceeding (per burner):		
4(c)-I	$P \leq 155$ W: 25 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
4(c)-II	155 W $< P \leq 405$ W: 30 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
4(c)-III	$P > 405$ W: 40 mg or less		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
4(d)	Mercury in High Pressure Mercury (vapour) lamps (HPMV)	13 April 2015	This exemption is not allowed for IBM Deliverables.

No.	Exemption	Current EU Expiration Date	IBM Requirements
4(e)	Mercury in metal halide lamps (MH)		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
4(f)	Mercury in other discharge lamps for special purposes not specifically mentioned in this Annex		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
4(g)	Mercury in hand crafted luminous discharge tubes used for signs, decorative or architectural and specialist lighting and light-artwork, where the mercury content shall be limited as follows: (a) 20mg per electrode pair + 0.3 mg per tube length in cm, but not more than 80 mg, for outdoor applications and indoor applications exposed to temperatures below 20 °C. (b) 15 mg per electrode pair + 0.24 mg per tube length in cm, but not more than 80mg, for all other indoor applications.	31 December 2018	This exemption is not allowed for IBM deliverables.
5(a)	Lead (Pb) in the glass of cathode ray tubes		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
5(b)	Lead (Pb) in glass of fluorescent tubes not exceeding 0.2% by weight		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
6(a)	Lead (Pb) as an alloying element in steel for machining purposes and in galvanized steel containing up to 0.35% lead by weight		An extension for 3 more years and/or change in scope is expected and pending.
6(b)	Lead (Pb) as an alloying element in aluminum containing up to 0.4% lead by weight		An extension for 3 more years and/or change in scope is expected and pending.
6(c)	Copper alloy containing up to 4% lead (Pb) by weight		An extension for 3 more years and/or change in scope is expected and pending.
7(a)	Lead (Pb) in high melting temperature type solders (i.e. lead-based alloys containing 85% by weight or more lead)		An extension for 3 more years and/or change in scope is expected and pending.
7(b)	Lead (Pb) in solders for servers, storage and storage array systems, network infrastructure equipment for switching, signaling, transmission, and network management for telecommunications	21 July 2016	If RoHS specification 26P0381 is referenced this exemption is not allowed. If RoHS specification 77P0594 is referenced this exemption will not be allowed for IBM Deliverables assigned an IBM part number released after January 16th , 2015.
7(c)-I	Electrical and electronic components containing lead (Pb) in a glass or ceramic other than dielectric ceramic in capacitors, e.g., piezoelectronic devices, or in a glass or ceramic matrix compound		An extension for 3 more years and/or change in scope is expected and pending.
7(c)-II	Lead (Pb) in dielectric ceramic in capacitors for a rated voltage of 125V AC or 250V DC or higher		An extension for 3 more years and/or change in scope is expected and pending.
7(c)-III	Lead (Pb) in dielectric ceramic in capacitors for a rated voltage of less than 125V AC or 250V DC	01 January 2013	This exemption is not allowed for IBM Deliverables (Expired on 1 January 2013 and after that date may be used in spare parts for EEE placed on the market before 1 January 2013)

No.	Exemption	Current EU Expiration Date	IBM Requirements
7(c)-IV	Lead (Pb) in PZT based dielectric ceramic materials for capacitors being part of integrated circuits or discrete semiconductors	21 July 2016	This exemption is not allowed for IBM Deliverables.
8(a)	Cadmium and its compounds in one shot pellet type thermal cut-offs (expires 21 July 2016)	1 January 2012	May be used in spare parts after 1 Jan 2012 for EEE placed on the market before 1 January 2012.
8(b)	Cadmium and its compounds in electrical contacts		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
9	Hexavalent chromium as an anticorrosion agent of the carbon steel cooling system in absorption refrigerators up to 0.75 % weight in the cooling solution		This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
9(a)	DecaBDE in polymeric applications	30 June 2008	This exemption is not allowed IBM Deliverables.
9(b)	Lead (Pb) in bearing shells and bushes for refrigerant-containing compressors for heating, ventilation, air conditioning and refrigeration (HVACR) applications	Expiration dates below:	This exemption is not allowed for IBM Deliverables (in categories 1 thru 7 and 10) assigned an IBM part number released after January 16th , 2015.
9(b)-i	Lead (Pb) in bearing shells and bushes for refrigerant-containing compressors for heating, ventilation, air conditioning and refrigeration (HVACR) applications.	21 July 2023 for Category 8 in vitro diagnostic medical devices	This exemption is allowed only for Category 8 in vitro diagnostic medical devices.
9(b)-ii	Lead (Pb) in bearing shells and bushes for refrigerant-containing compressors for heating, ventilation, air conditioning and refrigeration (HVACR) applications.	21 July 2024 for Category 9 industrial monitoring and control instruments.	This exemption is allowed only for Category 9 industrial monitoring and control instruments.
9(b)-iii	Lead (Pb) in bearing shells and bushes for refrigerant-containing compressors for heating, ventilation, air conditioning and refrigeration (HVACR) applications.	21 July 2021 for other subcategories of Categories 8 and 9.	This exemption is allowed only for subcategories of Categories 8 and 9.
9(b)-(I)	Lead (Pb) in bearing shells and bushes for refrigerant-containing hermetic scroll compressors with a stated electrical power input equal or below 9kW for heating, ventilation, air conditioning and refrigeration (HVACR) applications.	21 July 2019 for Category 1. Expried for all other categories.	This exemption is not allowed for IBM deliverables.
11(a)	Lead (Pb) used in C-press compliant pin connector systems	24 September 2010	This exemption is not allowed for IBM Deliverables. Exemption may be used in spare parts for EEE placed on the market before 24 Sept 2010.
11(b)	Lead (Pb) used in other than C-press compliant pin connector systems	1 January 2013	This exemption is not allowed for IBM Deliverables. (Expired on 1 January 2013 and after that date may be used in spare parts for EEE placed on the market before 1 January 2013)
12	Lead (Pb) as a coating material for the thermal conduction module C-ring	24 September 2010	This exemption is not allowed for IBM Deliverables. . Exemption may be used in spare parts for EEE placed on the market before 24 Sept 2010.
13(a)	Lead (Pb) in white glasses used for optical applications	Expiration dates below:	

No.	Exemption	Current EU Expiration Date	IBM Requirements
13(a)-i	Lead (Pb) in white glasses used for optical applications.	21 July 2023 for Category 8 in vitro diagnostic medical devices	
13(a)-ii	Lead (Pb) in white glasses used for optical applications.	21 July 2024 for Category 9 industrial monitoring and control instruments and for Category 11.	
13(a)-iii	Lead (Pb) in white glasses used for optical applications.	21 July 2021 for all other categories and subcategories	Please note: this row has the expiration date for Category 3 Information Technology and Telecommunications equipment.
13(b)	Cadmium and lead (Pb) in filter glasses and glasses used for reflectance standards. Applies to Categories 8, 9 and 11.		Applies to Categories 8, 9 and 11.
13(b)-i	Cadmium and lead (Pb) in filter glasses and glasses used for reflectance standards	21 July 2023 for category 8 in vitro diagnostic medical devices	Applies to Category 8 in vitro diagnostic medical devices.
13(b)-ii	Cadmium and lead (Pb) in filter glasses and glasses used for reflectance standards	21 July 2024 for Category 9 industrial monitoring and control instruments and for Category 11.	Applies to Category 9 industrial monitoring and control instruments and Category 11.
13(b)-iii	Cadmium and lead (Pb) in filter glasses and glasses used for reflectance standards	21 July 2021 for all other subcategories of categories 8 and 9.	Applies to all other subcategories of Categories 8 and 9.
13(b)-I	Lead (Pb) in ion colored optical filter glass types	21 July 2021 for categories 1 to 7 and 10.	Applies to categories 1 to 7 and 10
13(b)-II	Cadmium in striking optical filter glass types; (excluding applications falling under exemption 39 of RoHS Annex III.)	21 July 2021 for categories 1 to 7 and 10.	Applies to categories 1 to 7 and 10
13(b)-III	Cadmium and lead (Pb) in glazes used for reflectance standards	21 July 2021 for categories 1 to 7 and 10.	Applies to categories 1 to 7 and 10
14	Lead (Pb) in solders consisting of more than two elements for the connection between the pins and the package of microprocessors with a lead content of more than 80% and less than 85% by weight	1 January 2011	This exemption is not allowed for IBM Deliverables. . Exemption may be used in spare parts for EEE placed on the market before 1 January 2011.
15	Lead (Pb) in solders to complete a viable electrical connection between semiconductor die and carrier within integrated circuit flip chip packages		This exemption is allowed but set to expire July 21 st , 2016. A change in scope is expected, but some applications will likely expire in 2017. This expiration date for this exemption is pending.
16	Lead (Pb) in linear incandescent lamps with silicate coated tubes	1 September 2013	This exemption is not allowed for IBM Deliverables.

No.	Exemption	Current EU Expiration Date	IBM Requirements
17	Lead (Pb) halide as radiant agent in High Intensity Discharge (HID) lamps used for professional reprography applications		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
18(a)	Lead (Pb) as activator in the fluorescent powder (1% lead by weight or less) of discharge lamps when used as specialty lamps for diazoprinting reprography, lithography, insect traps, photochemical and curing processes containing phosphors such as SMS ((Sr,Ba) ₂ MgSi ₂ O ₇ :Pb)	1 January 2011	This exemption is not allowed for IBM Deliverables.
18(b)	Lead (Pb) as activator in the fluorescent powder (1% lead by weight or less) of discharge lamps when used as sun tanning lamps containing phosphors such as BSP (BaSi ₂ O ₅ :Pb)		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
19	Lead (Pb) with PbBiSn-Hg and PbInSn-Hg in specific compositions as main amalgam and with PbSn-Hg as auxiliary amalgam in very compact Energy Saving Lamps (ESL)	1 June 2011	This exemption is not allowed for IBM Deliverables.
20	Lead (Pb) oxide in glass used for bonding front and rear substrates of flat fluorescent lamps used for Liquid Crystal Displays (LCDs)	1 June 2011	This exemption is not allowed for IBM Deliverables.
21	Lead (Pb) and Cadmium (Cd) in printing inks for the application of enamels on glasses, such as borosilicate and soda lime glasses		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
22	Lead (Pb) as impurity in RIG (rare earth iron garnet) Faraday rotators used for fibre optic communications systems	31 December 2009	This exemption is not allowed for IBM Deliverables.
23	Lead (Pb) in finishes of fine pitch components other than connectors with a pitch of 0.65 mm and less	23 September 2010	This exemption is not allowed for IBM Deliverables.
24	Lead (Pb) in solders for the soldering to machined through hole discoidal and planar array ceramic multilayer capacitors		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
25	Lead (Pb) oxide in surface conduction electron emitter displays (SED) used in structural elements, notably in the seal frit and frit ring		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
26	Lead (Pb) oxide in the glass envelope of black light blue lamps	1 June 2011	This exemption is not allowed for IBM Deliverables.
27	Lead (Pb) alloys as solder for transducers used in high-powered (designated to operate for several hours at acoustic power levels of 125 dB SPL and above) loudspeakers	24 September 2010	This exemption is not allowed for IBM Deliverables.
28	Hexavalent chromium in corrosion preventive coating of unpainted metal sheeting and fasteners used for corrosion protection and Electromagnetic Interference Shielding in equipment falling under category three of Directive 2002/96/EC (IT and telecommunications equipment)	01 July 2007	This exemption is not allowed for IBM Deliverables.
29	Lead (Pb) bound in crystal glass as defined in Annex I (Categories 1, 2, 3 and 4) of Council Directive 69/493/EEC		An extension for 3 more years and/or change in scope is expected and pending.

No.	Exemption	Current EU Expiration Date	IBM Requirements
30	Cadmium alloys as electrical/mechanical solder joints to electrical conductors located directly on the voice coil in transducers used in high-powered loudspeakers with sound pressure levels of 100 dB (A) and more		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
31	Lead (Pb) in soldering materials in mercury free flat fluorescent lamps (which e.g. are used for liquid crystal displays, design or industrial lighting)		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
32	Lead (Pb) oxide in seal frit used for making window assemblies for Argon and Krypton laser tubes		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
33	Lead (Pb) in solders for the soldering of thin copper wires of 100 µm diameter and less in power transformers		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
34	Lead (Pb) in cermet-based trimmer potentiometer elements		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
35	Cadmium in photoresistors for optocouplers applied in professional audio equipment	31 December 2009	This exemption is not allowed for IBM Deliverables.
36	Mercury used as a cathode sputtering inhibitor in DC plasma displays with a content up to 30 mg per display	01 July 2010	This exemption is not allowed for IBM Deliverables.
37	Lead (Pb) in the plating layer of high voltage diodes on the basis of a zinc borate glass body		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
38	Cadmium and cadmium oxide in thick film pastes used on aluminum bonded beryllium oxide		This exemption is not allowed for IBM Deliverables in Categories 1 to 7 and 10 assigned an IBM part number released after January 16 th , 2015.
39	Cadmium in colour converting II-VI LEDs (< 10 µg Cd per mm ² of light-emitting area) for use in solid state illumination or display systems	01 July 2014	This exemption is not allowed for IBM Deliverables.
40	Cadmium in photoresistors for analogue optocouplers applied in professional audio equipment	31 December 2013	This exemption is not allowed for IBM Deliverables.
41	<i>Lead (Pb) in solders and termination finishes of electrical and electronic components and finishes of printed circuit boards used in ignition modules and other electrical and electronic engine control systems, which for technical reasons must be mounted directly on or in the crankcase or cylinder of hand-held combustion engines (classes SH:1, SH:2, SH:3, of Directive 97/68/EC of the European Parliament and the Council)</i>	31 Dec 2018	This exemption is not allowed for IBM Deliverables.

*Exemptions 1, 2, and 4, which are expected not to be used in IT equipment, have been altered in this table to reflect the future allowable amount of mercury.

Batteries are exempt from the EU RoHS Directive but have their own requirements for material restrictions in other EU Directives and legal requirements in other jurisdictions. See IBM Engineering Specification 46G3772 for material restrictions for batteries.

6.14 Module Requirements:

This section applies to AOP, Logic, and Memory small card assemblies that are socketed or soldered to a larger planar / motherboard. Some examples are: DIMMs, memory cards, Board Mounted Power assemblies and Fiber Optic Modules.

Raw cards (PWBs) with an immersion silver finish shall not be used without IBM written approval.

6.14.1 Module Final Assembly Visual Requirements (Component, Laminate, Solder Joint, etc.):

Card assemblies shall be inspected to and meet the requirements of J-STD-001 and IPC-A-610, Class 2.

6.14.2 Module Cleanliness Requirements for Water Wash:

Per J-STD-001, Class 2, card assemblies shall have a cleanliness designator of C-22 and IBM requires that the surface contamination shall be less than 1.56 micrograms/cm² NaCl equivalent ionic or ionizable flux residue.

6.14.3 Module Gold Connector Tab Contact Requirements:

Gold plated tabs shall be inspected to and meet the "Printed Contacts" requirements of the IPC-A-600, Class 2, including plating adhesion.

6.14.4 Module Raw Card Requirements:

6.14.4.1 Module Raw Card Solderable Finish Requirements:

Except for the specific exemptions listed in section 6.13, printed circuit boards must not contain lead(Pb) in amounts greater than those shown in Table 1 of IBM specification 46G3772., including printed circuit board finishes. The RoHS-compatible finishes listed in the table below must also pass further IBM standard qualifications outside the scope of this specification. The acceptable raw card finishes are as follows:

Finish	Notes
Immersion Tin	Requires approval from IBM Procurement Engineering
Organic Solder Preservatives (OSPs)	Preferred, for example benzotriazole (BTA). Refer to IBM Procurement Specification 53P4082 for guidelines in selecting the appropriate OSP.
HASL (Hot Air Solder Leveled) Tin or Tin Alloy	Requires approval from IBM Procurement Engineering
Immersion Silver	Requires approval from IBM Procurement Engineering
Electroless Nickel Immersion Gold	Requires approval from IBM Procurement Engineering
Electrolytic Nickel with noble metal over plate, e.g., Electroless Nickel under Electroless Palladium under Immersion Gold Flash (ENEPIG)	Requires approval from IBM Procurement Engineering

6.14.4.2 Module Raw Card Solder Process Compatibility Requirements:

The raw card / laminate material must be compatible with Lead(Pb)-free assembly process. The surface finish must be compatible with the Lead(Pb)-free solder alloys. Note that other IBM specifications may be applicable to the qualification of a PCB IBM Engineering Specification Supplier's use of any surface finish on a PCB used for IBM. Contact IBM PCB Procurement Engineering for further information.

6.14.5 Export Control Classification:

Upon request the supplier will provide the following export control information to facilitate IBM transportation of product:

- Export Description - the description the supplier uses when they export the component
- Harmonized Tariff Schedule (HTS) - the number used for determining the tariff classifications of a component exported
- Export Control Classification Number (ECCN) - the alphanumeric code that identifies the level of export controls for the component being exported

- If the ECCN reflects encryption elements within the component, then additional information is required:
 - License Exception (LIC) - "No License Required (NLR)" or "Encryption (ENC)" must be specified
 - In addition:
 - For an ECCN of 5A002 a CCATs number (GXXXXXX) or an Encryption Registration Number (ERN) (RXXXXXX) is required to allow the supplier to self-classify. The applicable Regulatory Reference Number 740.17 (b)(1), 740.17 (b)(2), 740.17 (b)(3) is also required.
 - For ECCN of 5A992, the supplier may provide either a CCATs number (GXXXXXX), an Encryption Registration Number (ERN) (RXXXXXX) or a statement that the item has limited encryption.

6.15 Electric Double Layer Carbon (EDLC) Capacitors, Components and Modules with Batteries:

These requirements apply to all components, modules, and subassemblies that contain a battery (this includes 'button cells').

1. All components, modules, and subassemblies must meet the content and labeling requirements of IBM specification 46G3772, section 2.4, and IBM specification 92F6933.
2. For batteries, information regarding the battery chemistry must be provided to IBM during the qualification of the component, module, or subassembly. This information must be reported on the Product Content Declaration (PCD) form. See section 6.13.1.

6.16 Additional Requirements for Integrated Connector Modules (ICMs):

The requirements of IBM specification 34L4233 "Quality Requirements for Connectors" also apply to all ICMs.

6.17 Additional Requirements for Passive Components:

Any passive component that is classified as "anti-sulfurated" must be able to pass the requirements of EIA-977, test condition B, with a sample size of 15pcs x 3 separate production lots.

6.18 Shipping and Packing:

The supplier shall guarantee that the shipping and packaging materials must ensure that the product can be safely shipped with no degradation to electrical nor mechanical properties of the product.

6.18.1 Component Packing and Labeling:

1. The original manufacturer's label shall remain visible on first and interim level containers whenever possible.
2. All levels of containers and packing materials shall not adversely affect the functionality, quality and reliability of the component.
3. Shipping requirements and labeling of shipping containers shall be specified by the ordering location where not in conflict with this specification and section 6 of IBM 31L5345 (GA21-9261-11).

6.18.2 Shipping Container:

This container contains multiples of interim level containers and / or multiple first level containers. This container may have multiple IBM part numbers and or IBM purchase order numbers.

6.18.3 Shipping Container Label:

When a shipment consists of multiple part numbers and/or purchase orders the appropriate label field(s) shall be marked "MULT", including the Date Code and Quantity fields. All such shipping containers must have interim containers. The contents of a mixed IBM part number shipment shall not be divided between multiple shipping containers.

6.18.4 Interim Container:

This package level contains multiples of first-level containers. This container must be of the same IBM part number and purchase order number.

6.18.5 Interim Container Label:

The interim container label requirements are the same as the shipping container label.

6.18.6 First-Level Container:

This package level contains multiples of the individual electronic components. Components are of the same IBM part number. Examples of these containers are: Tape and Reel (pizza box), Tubes, Tube boxes (bags), Tray stacks, Ammo boxes, etc.

6.18.7 First-Level Container Label:

Labels shall be placed on all component/module containers (e.g. Tape & reels, tubes or tube boxes, ammo boxes, reel, tube or tray stack dry packs, or bags), with the exception of tubed product with less than 100 components.

Label Placement:

- Tube labels (required where more than 100 components are in each tube) shall be placed on the tube surface opposite component lead tips near the lengthwise center of the tube, per Section Item.

Labels may wrap around the sides provided they are readable.

- Tube box labels shall be placed on the box front.
- Reel labels shall be placed on or as close to the reel flange as possible, on the reel face opposite the tape round sprocket holes.
- Ammo Box labels shall be located per EIA 468.
- Tray stack labels shall be on the ESD / dry bag. If no bag is used, the label shall be placed on the next level container.
- Dry Packed components shall have a label on the dry pack.
- If the inner component container is not labeled at dry packing, a second, peelable label shall be placed on the dry pack.
- If the first-level container is shipped in a bag or box, where the label is not viewable on the first-level container through the bag or box, the bag or box containing the first-level container must also be marked with a copy of the label.
- See section [6.18.9](#) for moisture sensitive label requirements.

A maximum of two date codes are permitted per component/module first level container. Multiple lot codes per first level container carrier are acceptable. In this situation, the date code on the first level container shall be the one with the greatest number of parts in the container.

The first-level container label shall have the following human readable machine generated label information:

- Customer Part Number (e.g., IBM Part Number)
- Supplier Name
- Quantity
- Date Code
- Country of Origin (per IBM C-S 1-1121-003). [Although IBM C-S 1-1121-003 is written for IBM Products, it also outlines IBM requirements for procured components.]

The following additional information is preferred, but not required:

- Lot Code
- Supplier Part Number

Bar coding requirements of the first-level container label information is optional. Bar coding may be specified by the ordering location, but the bar code label must include or not cover-up the human readable data requirements outlined in this section.

6.18.8 Electrostatic Discharge (ESD) Control Requirements and ESD Sensitivity:

These requirements apply to all shipments of components characterized as ESD sensitive.

1. Components shall be characterized according to ANSI/ESDA/JEDEC JS-001-2014, “[For Electrostatic Discharge Sensitivity Testing, Human Body Model \(HBM\) - Component Level](#)”; and [ANSI/ESDA/JEDEC JS-002-2014, “For Electrostatic Discharge Sensitivity Testing, Charged Device Model \(CDM\) – Component”](#).

This information shall be provided to IBM by the Supplier during the Supplier’s qualification or re-qualification.

2. All component handling process should comply with ANSI/ESD S20.20 or IEC 61340-5-1.
3. All components shall be packaged according to ANSI/ESD S541.

6.18.9 Moisture Sensitive Component Packing for Shipping and Handling:

This applies to components classified by their manufacturer as moisture sensitive per J-STD-020.

1. Moisture sensitive components must conform to the requirements of J-STD-033 for Supplier packing and labeling. For polymer technology capacitors, where the classic "popcorn" effect defect mechanism does not exist, color changing silica gel may be used in place of the HIC card.
2. All moisture level 6 components shall be marked with the word "bake".
3. Moisture sensitive components shall have a minimum of 6 months before expiration of the desiccant at the time of shipment. This does not apply to components which are classified as moisture sensitivity levels 1, 2 and 6.
4. Cardboard [material and/or bubble wrap](#) shall not be enclosed inside the moisture barrier bag.
5. [IBM does not allow the use of Humidity Indicator Cards \(HICs\) that contain cobalt dichloride.](#)

6.18.10 Process Sensitive Component Labeling:

This applies to components classified by their manufacturer as process sensitive per J-STD-075.

1. Process sensitive components shall be labeled per J-STD-075

6.18.11 Tape and Reel Requirements for Surface Mount Components:

1. All surface mount components shipped to IBM must be packaged in tape and reel according to the requirements of EIA 481, with the following exceptions:
 - Quad flat packs of greater than 14 mm square body size and BGA's of greater than 27 mm square body size shall use trays.
 - Blank programmable logic and memory components shall use tubes, trays or tape and reel. Tape and reel only is allowed where component programming is occurring after card assembly.
 - Components requiring a bake before assembly shall use bakeable trays with a minimum rating of 125deg.C.
2. If a component can be placed in multiple pocket pitches or widths, the Supplier shall request IBM approval for the Supplier suggested pocket pitch and width before an initial shipment is made. In addition Supplier shall request IBM approval for changes to a parts existing pocket pitch and width, using the Process Change Notice (PCN) process.

6.18.12 Tape and Reel Requirements for Radial and Axial Lead Components:

1. Part numbers referencing these replaced specifications: 6496427, 82G6730 or 6188635, shall be packaged in ammo boxes.
2. Part numbers referencing these replaced specifications: 57G8318 or 2412436, shall be packaged in reels.
3. Radial components in both tape reel and ammo box shall comply with EIA-468.
4. Axial Lead components shall comply with EIA-296.

6.18.13 Tray Packing Requirements For PTH and SMT Components:

These requirements apply to BGA's (too large for tape and reel), QFP's of body size greater than 14 mm, PGA's unless tubes are called out in the part number drawing, and any component requiring a customer bake before assembly.

1. PGAs shall be packaged in JEP 95 CO-010 trays. Quad Flat Packs shall be packaged in Appropriate JEP 95 or EIAJ thin (6.35 mm nominal stacked thickness) matrix trays.
2. Trays shall be injection molded.
3. All SMT components shall be captive in the tray cavities such that the terminal leads or BGA balls do not contact the tray during shipping and handling.
4. Pin one of each component shall point towards the tray chamfer. Trays shall be stacked each with the chamfer in the same orientation.
5. Tray stacks shall be no more than 12 high.
6. Trays shall be bound together with plastic straps. Rubber bands are not allowed. Velcro straps are allowed for PTH components only.
7. Components classified as level 5 or 6 per of J-STD-020 shall be packaged in 125° C minimum temperature rated bakeable trays, which must be electrostatically dissipative per EIA-541.

6.18.14 Slide Tube Packing Requirements:

These requirements apply to all components shipped in tubes.

1. PGA's shall be shipped in tubes only where the replaced specification 6413033 is referenced on the part number drawing. Otherwise use trays.
2. Modules shall be oriented in the same direction in tubes. Orientation shall not vary from tube to tube or lot to lot.
4. Tube or slide pack material shall be transparent or have a transparent window so that module orientation and marking can be seen.
5. Modules shall slide freely in tubes.
6. Tube closure shall be mechanical, no tape is allowed.
7. When loading ceramic or other hermetic modules in tubes, tilt shall be 30 degrees or less from

horizontal.

8. Modules shall not be allowed to move in closed tubes. PLCC's shall not be placed in compression by the tube closure.
9. Tubes of ceramic and other hermetic modules such as oscillators shall have the module column placed in compression by an electrometric closure.

6.18.15 Bulk Packing Requirements:

These requirements apply to any component shipped in bulk packing. Where IBM does not specify second level packing, use the above industry standard auto insertable methods. Where IBM specifies bulk packing, or Suppliers cannot supply auto insertable product, the following requirements must be met:

1. Components shall be placed in a clear poly-type bags, either "zip lock", heat sealed, or closed with two or less staples.
2. Bags shall be placed in corrugated cardboard boxes with suitable filler to separate bags, protect components, and stop movement.
3. Where practical, full bag quantities shall vary in increments of 100.

6.18.16 Shipping Requirements For Components Used In Manual Assembly:

1. Components should be packed for manual assembly with suitable filler or additional packing levels to protect components and stop movement.

6.18.17 Bare Die and Chip Scale Package Shipping And Handling Requirements:

1. Bare Die and Chip Scale Packages shall be taped and reeled according to EIA-763.
2. All product, which cannot be taped and reeled or when IBM documents that the part shall not be tape and reeled, shall be shipped in waffle packs or equivalent in sealed bags as follows:
 - a. When placed in the waffle pack pocket, the total clearance between the chip and the waffle pack side wall shall be no greater than 0.5 mm in either direction.
 - b. Maximum chip rotation allowed relative to the pocket is 5 degrees.
 - c. Waffle packs may contain an insert to prevent chipping or breakage.
 - d. Material water soluble contamination levels shall be less than 1ug/cm² NaCl equivalent.
 - e. 1 to 12 waffle packs shall be stacked and banded or boxed securely.
 - f. Components in a pack and packs in a stack shall have the same orientation.
 - g. A stack may contain only one wafer lot. All stacks of one lot must be in the same carton.

6.18.18 Environmental Requirements for Shipping Materials:

For all shipments directly to an IBM manufacturing location, the shipping materials used by the supplier must comply to 5897660.

7. Stopship / Stop Build Procedures:

“Stop Ship” per the SQRD refers to only Product being manufactured for IBM.

7.1 Failure Analysis and Corrective Action Plans:

Written corrective action is required for all returned verified component failure mechanisms. This information is a measure of quality / reliability, and is an aid for continuous improvement.

Failure analysis response times will comply with the guidelines in [Table 1](#) in JESD 671, or as requested by IBM. IBM identified "Box" and "Field" failures are considered "Urgent" and IBM identified "Card" failures are considered "Standard".

The Physical Failure Analysis Report shall, at a minimum, meet the requirements of JESD 38.

7.2 Quality Problem Notification:

The Supplier must notify IBM and any third party procuring the affected IBM parts number(s) of any quality or reliability problems that have been identified either by the Supplier's or Supplier's subcontractors internal testing (that is: production or reliability monitoring test data, process control data, burn-in data, etc.) or by another customer when the problem may affect IBM product. (See ISO 9001)

In case of a problem, the Supplier shall provide IBM with the requested traceability data (P/N, Lot number, Date code, Volumes, Ship to locations, etc.) within 48 hours. IBM may request a faster response on severe problems.

The notification should address an immediate containment plan and indicate a schedule for definition and implementation of permanent corrective actions per JESD 671.

Supplier shall make no shipment of suspect product to IBM or IBM's authorized subcontractors without written IBM approval. All repaired or re-screened product requires written IBM approval prior to reshipment to any ordering location.

8. Quality Goals, Continuous Improvement and Reporting:

8.1 Quality System and Program Compliance:

The Supplier shall have a Quality System and Program capable of maintaining an uninterrupted flow of product and meeting IBM's quality / reliability requirements set forth in this Specification, or as may be agreed in a separate Supplier Quality Document (SQD). The Supplier's Quality System and Program shall include documentation control, procedural control, Supplier internal certification, Supplier internal audit, and established statistical process controls which correlate with functional performance.

The Supplier shall maintain an internal certification program designed to assure the adequacy of their quality system as well as conformance to that system. To assure Environmental compliance, the Supplier shall have a comprehensive

physical product composition verification / compliance process for their product(s) and their subcontractor’s product(s).

The Supplier shall meet all requirements of IBM specification 03N6596, “IBM Supplier Quality Requirements Document (SQRD)”.

See IBM specification 45U0750 for additional IBM custom DIMM quality monitoring requirements.

8.2 Continuous Improvement:

The Suppliers shall strive to continuously improve their products and services. The objective of continuous improvement is to meet or out perform the mutually agreed IBM requirements for quality and reliability. The IBM SQR, which is sometimes included as part of the IBM BTR, shall be used to evaluate Supplier’s Continuous Improvement Program.

Continuous improvements must be measurable. IBM recommends that the following “best practice” industry specifications / standards be used:

Document Number	Document Name
EIA 599	Continuous Improvement
ISO 2859	Sampling Procedures for Inspection by Attributes
ISO 3951	Sampling Procedures for Inspection by Variables
JESD 50	Special Requirements for Maverick Product Elimination and Outlier Management
JESD 659	Failure-Mechanism-Driven Reliability Monitoring

8.3 Supplier Quality Review (SQR):

Supplier agrees to use reasonable efforts to participate in Supplier Quality Review meetings, sometimes conducted as part of a Business Technical Review (BTR), with a frequency mutually agreed by the parties. If Supplier is failing to meet the committed quality levels, IBM shall have the right to request SQR meetings on a frequency consistent with the magnitude and urgency of the problem(s). At those meetings, Suppliers shall review their Quality System and Program, product performance, continuous improvement plans and related topics (listed below). (Contact your procurement engineering contact for a copy of your commodity’s SQR agenda). The following agenda items are typical for an electronic components SQR meeting:

- Review of Supplier manufacturing and subcontractor manufacturing facilities locations and addresses by product / component part family. This includes silicon fabrication (Fab), assembly and test locations.
- Historical quality performance for all shipments of IBM part numbers and total customer base, including root cause and written corrective actions.
 - Quality testing and monitoring
- Historical reliability performance for IBM and total customer base including root cause and written corrective actions.
 - Reliability testing and monitoring
- Manufacturing process control and monitoring programs
- Maverick Product Elimination (MPE) Program
 - Non-Conforming Material Management (Scrap Control)
 - Down-level part management (where applicable)
 - Sub-Contractor and Sub-Tier Supplier Management
 - Production Electrical Test Management
- Internal audit results and corrective actions
- Current (Execute PCN) and future (Advance Notice PCN) Process Change Notifications

- Supplier Major vs. Minor Process Change Definitions to [J-STD-046](#)
- Past and Future Component Discontinuance (EOL)
- Continuous improvement plans, resulting in meeting or out performing SQD quality and reliability commitments
- Methodology used to derive reliability and quality commitments
- Specification conformance to IBM and industry specifications
 - Review of recent specification changes
 - Component Process Sensitivity (PSL) and Additional Process Compatibility Requirements
- Environmental compliance and reporting
 - Physical verification process of content
 - Content change management including Sub-Contractor and Sub-Tier Suppliers
 - Reporting management
 - Supplier elimination plans for Substances of Very High Concern (SVHC)
- Supplier SQD Status
 - Supplier specification exceptions
 - Quality and Reliability Commitments
 - SPEX Process Agreement
- Supplier Product and Supplier Facility Qualification Status
- Open Technical Issues
- Supplier Product and Technology Road Maps
 - Recent new Product introductions

9. Audits:

See the SQRD (03N6596) for general auditing requirements. See specification 45U0750 for additional requirements for DIMMs.

10. Quality Records:

10.1 Statistical Process Control and Data Retention:

Suppliers must demonstrate that they have a process capable of consistently meeting this requirement. A well developed Statistical Process Control (SPC) program is necessary to achieve and demonstrate this capability. IBM recommends that the “best practice” industry specification / standard JESD557 be used.

The SPC program for Suppliers facilities and at their respective subcontractors facilities must be broad in scope, encompassing not only the manufacturing processes and tools, but also include incoming raw materials, sub components and completed Product,. The SPC limits must be reviewed on a predetermined basis for continued adequacy and improvements, along with updates as the process capability improves.

Non-confidential Supplier SPC data (such as, raw data or control charts, Cp/Cpk and Pp/Ppk for critical/identified process operations) shall be available for review by IBM upon request. IBM will review the Supplier's SPC data upon receipt and/or during audits to determine the level of process improvement. Supplier and their respective subcontractors shall establish and maintain procedures for identification, collection, indexing, filing, storage, maintenance, and disposition of all quality records including, but not limited to: Statistical Process Control (SPC) data and Supplier's and their respective subcontractor's traceability data. The required retention period is a minimum of 10 years or the Supplier's standard retention period (for ISO certified Suppliers).

11. Standard Compliance Requirements:

See section 6.13 for additional IBM environmental requirements.

12. Equipment Control:

There are no additional commodity specific requirements, including the ESD requirements, in addition to those stated in the SQRD (03N6596).

13. Training and Workmanship:

There are no additional commodity specific requirements in addition to those stated in the SQRD (03N6596).

14. IT Toolsets:

There are no additional commodity specific requirements in addition to those stated in the SQRD (03N6596).

15. Buyers Qualification of Product:

There are no additional commodity specific requirements in addition to those stated in the SQRD (03N6596).

16. Related Documents:

Upon IBM's request, IBM and Supplier shall negotiate Supplier's specific quality and reliability commitments to IBM in a Supplier Quality Document (SQD). The SQD shall be referenced in the IBM / Supplier Agreement.

The following minimum information shall be contained in the SQD, which shall be signed by IBM and the Supplier's Quality Manager:

- Yearly (ppm) Quality commitments for the current year through the next three years.
- Yearly Reliability (failure rate in ppm/Khr.) commitments for the current year through the next three years.
- Supplier specification exceptions.

IBM may require additional quality or reliability monitoring requirements, which will be referenced in the IBM business agreement or equivalent documentation. The frequency of the SQD and subsequent signatures will vary by commodity. The IBM Procurement Engineer shall initiate initial SQD process and all subsequent updates, as required. IBM may provide an SQD template.

Appendix A: Documents Replaced By This Specification

The following IBM specifications have been replaced by this specification:

IBM Specification	Specification Title
866348	Mechanical Requirements for Surface Mount Components
871300	Electrical Components General Requirements
873443	Supplier Shipping Specifications
873506	Electrical Components General Requirements
873511	Module Package Seal Requirements
873522	Components Glass to Metal Construction
873523	Glass to Metal Package Seal Requirements
873531	Axial Lead Discrete Diode Package Mechanical Requirements
873532	Axial Lead Discrete Diode Package Seal Requirements
873540	Power Semiconductor Device Mechanical Requirements
873587	Dual Inline Module Mechanical Requirements
873589	General Requirements (Technical) for Purchased Electronic Components
873641	Mechanical and Chemical Requirements for Plastic Semiconductors
873657	Supplier Component Parts Minimums
873658	Packaging RC Form Factor Modules - SIP
873728	Power Package Mechanical Requirements
1590087	Packaging of Ceramic Dipped Capacitors
19F7472	Ceramic SPT Capacitors Mechanical Shock Test Procedure
23F0325	Packaging of Modules in Matrix Trays
23F0353	Single In-Line Package (SIP) Assembly Mechanical Requirements
23F0365	Die Handling, Shipping and Storage
2412322	Packaging of Dual Inline Modules
2412436	Packaging of Axial Leaded Components
2413138	Engineering Flammability Specification for Purchased
2413145	Packaging of Dipped Mica Capacitors
4429688	Hermetic Dual-In-Line Module Seal Requirements
42F2811	Multilayer Plastic Pin Grid Array Chip Carrier (PPGA)
42F2894	Silicon Chip Specification
4481265	Packaging SIP Type Components in Plastic Slide Tubes
55X0213	Shipping Specification, Category III
57G8318	Packaging of Radial Leaded Components
5892841	Special Handling Procedure - Mosfets
6016050	FET LSI / VLSI Anti-ESD Handling Procedure
6016060	Multi-Layer Ceramic Chip Carrier with Hermetic Seal and Brazed Area Array Terminal Leads
6188544	Category 3 Module Physical Outline Requirements
6188600	Lead Taping and Packaging of Radial Leaded Aluminum Capacitors
6188635	Packaging of Axial Leaded Components in Ammo Boxes
6231587	Mechanical Requirements for Surface Mount Components
6413033	Shipping of Pin Grid Array Modules
6413056	Electrostatic Discharge Sensitivity Measurement Procedure
6496427	Packaging Radial Leaded Components for Automatic Handling

IBM Specification	Specification Title
6496700	Tape and Reel for Leadless SMT Components
68X5409	Packaging of Large Aluminum Capacitors
68X5436	Packaging Crystal Oscillators for Shipment
68X5508	Packaging Discrete Crystals for Shipment
68X5655	Moisture Sensitive Component Requirements
68X5727	Bar Code Marking Requirement for Mechanical Electrical and Electronic Carriers
71F7704	SMT Hybrid Card Assembly Requirements
74G1388	IBM Requirements for Industry Plus Parts
78G9129	Quality Requirements for Purchased Electronic Components
82G6730	Packaging of Single-In-Line Packages in Ammo Boxes
8519509	Electro-static Discharge (ESD) Control Handling Procedure
8519558	Protection Notice Marking Requirements for Personalized IC
8519913	Packaging Gold Leaded SIP Rpacks in Plastic Slide Tubes