



**Verizon NEBS™ Compliance: NEBS
Requirements for the Physical Design and
Manufacture of Telecommunications
Products and Equipment**
Verizon Technical Purchasing Requirements
VZ.TPR.9306
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Trademark Acknowledgement – NEBS is a trademark of Telcordia Technologies, Inc.



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1. PURPOSE

The purpose of this Verizon Technical Purchasing Requirement document is to specify the Physical Design and Manufacturing Requirements for equipment purchased by Verizon.

2. SCOPE

This document specifies the Physical Design and Manufacturing requirements for equipment purchased by Verizon. It is a subset of the Verizon NEBS requirements. A listing of the complete Verizon NEBS requirements for network equipment can be found in the Telecommunications Carrier Group (TCG) NEBS Checklist at the following web page www.verizonnebs.com.

3. REFERENCES

GR-78-CORE	Generic Requirements for the Physical Design and Manufacture of Telecommunications Products and Equipment
GR-357-CORE	Generic Requirements for Assuring the Reliability of Components Used in Telecommunications Equipment
SIT.NEBS.TE.NPI.2004.015	Telecommunications Carrier Group NEBS Compliance Checklist

4. ACRONYMS

AOI	Automatic Optical Inspection
BGA	Ball Grid Array
CAF	Conductive Anodic Filament
DI	Deionized
ESD	Electrostatic Discharge
EMR	Electromigration Resistance
HASL	Hot Air Solder Levelling
IDC	Insulation Displacement Connector
IP	Industry Practice
IR	Insulation Resistance
ITL	Independent Test Laboratory
PB	Printed Board (Bare Printed Circuit Board w/o components)
PBA	Printed Board Assembly (Bare board with components)
RTF	Reverse Treated Foil
RMA	Rosin Mildly Activated



SEC	Solvent Extract Conductivity
SIR	Surface Insulation Resistance
SMC	Surface Mount Component
TCE	Thermal Coefficient of Expansion

5. **PHYSICAL DESIGN AND MANUFACTURING REQUIREMENTS**

Table 1 below specifies the Physical Design and Manufacturing Requirements for equipment purchased by Verizon. These requirements map those specified in the Telecommunications Carrier Group (TCG) Checklist: Appendix C, Section G – Physical Design Requirements. While only a brief description of the requirement is given in the table, a complete description is contained in GR-78-CORE under the referenced requirement number.

The requirements specified herein are a sub-set of the requirements contained in Telcordia document GR-78-CORE. The table below is designed to not only provide a listing of the Verizon specific requirements but to also provide the required format for reporting the results of a manufacturing facilities analysis. It makes provision for reporting the required items (design or measured parametric values), specifying their source in the identified supplier’s documents and summarizing their conformance to requirements.

In addition, in the case of product testing by a Verizon Certified Independent Test Laboratory (ITL), Vendors are required to self-declare their product’s conformance to the GR-78-CORE requirements listed in the table below by submitting, as part of a NEBS product Testing Report from an ITL, a completed copy of Appendix C, Section G of the Telecommunication Carrier Group Checklist. The current version of the TCG Compliance Checklist can be found on the following Verizon web page: (<http://www.verizonnebs.com/index.html#chklist>).

Each requirement listed in Table 1 below is identified by both a local and an absolute number. The local number consists of the document section number and its sequence number in the section (e.g., R3-1 is the first requirement in Section 3). The local number may change in subsequent issues of the document if other requirements are added or deleted. The absolute number is a permanently assigned number that will remain for the life of the requirement. It will not change with new issues of the document. The absolute number is presented in square brackets (e.g., [2] at the beginning of the requirement text). The absolute numbers provide the necessary mapping between various Issues of GR-78-CORE.



Table 1: NEBS Sub-Set of Requirements from GR-78-CORE

GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
3. Materials and Finishes Requirements					
	R3-4 [41]	Fire and Toxicity	As per law, contract or herein		
	R3-5 [42]	Qualification	All materials shall be qualified		
	R3-7 [44]	Requalification	Requalification shall be done if significant problems or changes		
3.2.2 Fire Resistance Requirements					
	R3-10 [47]	Fuel Load	Shall provide upon request		
	R3-11 [48]	Fire Database	Shall provide upon request		
	R3-12 [49]	PB Fire Assessment	Reflect actual conditions of use		
3.2.3 Fluxes					
	R3-14 [51]	Non conforming fluxes	SIR and SEC testing required		
3.2.4 Silver					
	CR3-15 [52]	Silver	Shall not be used where migration may occur		
3.2.5 Silicones					
	R3-16 [53]	Silicone bearing materials	Shall be qualified or not used		
3.3 Finishes					
	R3-17 [54]	Adhesion	As per industry standards		
	O3-18 [55]	Porosity	Pore and contamination free		



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
	CR3-19 [56]	Whiskers	No pure tin, zinc or cadmium to be used		
	R3-20 [57]	Whisker prevention	2% lead required and/or review of processes used		
4 Separable Connector Requirements					
4.1.1 Design considerations					
	R4-1 [61]	Same metals	Required for all contacts		
	R4-2 [62]	CNF and LLCR	Connectors shall be qualified		
	R4-3 [63]	Noble metal CR	20 mohms max.		
	R4-4 [64]	Base metal CR	30 mohms max.		
	R4-5 [65]	Contact geometry	Convex surface		
	R4-6 [66]	Mating stresses	Shall not be transmitted to contacting surfaces		
	IP4-7 [67]	PB attachment	Shall be physically attached in addition to pin attachment		
	R4-8 [68]	Max. press-fit force	45 pounds/pin		
	R4-9 [69]	Min. press-fit force	7.7 pounds/pin		
	R4-10 [70]	Hole deformation	0.0015 inch avg; 0.002 inch max.		
	R4-11 [71]	Copper thickness	0.0003 inch avg.		
	R4-12 [72]	Wrapped connections	PUB 48010		
	R4-13 [73]	SMT connectors	Location features		
	R4-14 [74]	Connector interface	Worst case tolerancing		
	R4-15 [75]	Materials	Compatible matls. reqd.		



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
	R4-16 [76]	Conventional connectors	Non-noble contact metallizations shall not be used		
	R4-17 [77]	EOL CNF	100 grams min.		
	R4-18 [78]	In-service CNF	CNF shall be maintained during service		
	R4-19 [79]	Maximum use temperature	Shall not exceed distortion temp. of any polymeric material used		
	R4-20 [80]	Shall be permanently marked			
4.1.2 Noble Metallizations					
	R4-21 [81]	Gold-to-gold metallization system	As per Tables 4-1 and 4-2		
	CR4-22 [82] and CR4-23 [83]	Other noble metallization systems	Shall be qualified		
	R4-24 [84]	Plating controls	Retain porosity and thickness data for one year min.		
	R4-25 [85]	Control applicability	Contact area		
	R4-26 [86]	Testing finish	Suppliers methods		
	R4-27 [87]	Porosity testing	Ongoing routine		
	R4-28 [88]	Plating color	Uniform color		
	R4-29 [89]	Surface damage	No base metal exposure		
	R4-30 [90]	Surface scratches	20μ inch CLA max.		
	R4-31 [91]	Plating Adhesion	Shall be tested		



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
4.1.3 Base Metallizations					
	R4-32 [92]	Nodular conditions	Shall be minimized		
	R4-33 [93]	Relative movement	Shall be minimized		
	R4-34 [94]	Hermeticity	Gas tight interface		
4.1.4 Lubrication (Contacts)					
	R4-35 [95]	Contact lubrication	Supplier responsible		
	R4-36 [96]	Noble lubricant type	As per Table 4-3		
	R4-37 [97]	Equivalent type	Shall be qualified		
	R4-38 [98]	Base lubricant type	As per Table 4-4		
	R4-39 [99]	Shall be qualified			
	R4-40 [100]	Petroleum/silicone	Shall not be used		
4.3 Component Sockets					
	R4-66 [126]	Durability	Determined by test		
4.4 Insulation Displacement Connectors					
	R4-69 [129]	Strain relief	Shall be provided		
4.5 Zero Insertion Force Connectors					
	R4-72 [132]	Contact engagement	Not during insertion		
4.6 Co-axial Connectors					
	R4-75 [135]	Engage/disengage	Forces in specification		
4.7 Optical Connectors					
	R4-76 [136]	Corrosion	No corrosion		
	R4-77 [137]	Solvent resistance	Shall be met		
6 Printed Wiring Board (Bare Board) Requirements					
6.1 General					
	R6-1 [171]	Applicability	All technologies		



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
6.1.1.1 Materials - Laminates					
	R6-2 [172]	Flammability	Shall conform		
	R6-3 [173]	Laminate type	FR-4		
6.1.1.2 Materials – Solder Masks					
	R6-4 [174]	Flammability	Shall conform		
	R6-5 [175]	Qualification	Shall conform		
6.1.1.4 Materials – Repair Polymers					
	R6-7 [177]	Qualification	Shall conform		
6.1.2.3 Design – Interlayer Connection					
	R6-16 [186]	Elec. continuity	PTH to be used		
	R6-17 [187]	Other holes	Not functional PTHs		
6.1.2.4 Design - Warpage					
	R6-19 [189]	Warpage	To be specified		
6.1.2.4 Design – Protective Coatings					
	R6-21 [191]	PB Protection	Solder mask reqd.		
6.1.2.4 Design – Resistance to Airborne Contaminants					
	R6-22 [192]	Tolerant to	Shall conform		
6.1.3.2 Manufacturing – Conductor Widths and Spacings					
	R6-26 [196]	Minimum dimension	70% of nominal		
	R6-27 [197]	Outer metal space	0.0035 inch min.		
	R6-28 [198]	Inner metal space	0.0025 inch min.		
	R6-29 [199]	Conductor width	35% of nominal min.		
	R6-30 [200]	Defects of 30- 50%	4 x nominal max.		
	R6-31 [201]	Defects of 50- 70%	8 x nominal max.		
	R6-32 [202]	Trace thickness	50% of nominal min.		
6.1.3.3 Manufacturing – Conductor Adhesion					
	R6-33 [203]	Conductor adhesion	Shall conform		
6.1.3.6 Manufacturing - Solderability					
	R6-49 [219]	Solderability	Shall conform		



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	Req. #	Topic/Element Description	Requirement		
6.1.3.7 Manufacturing – Solder Masks					
	R6-50 [220]	Coverage	All circuitry		
	O6-51 [201]	Edge coverage	Shall not cover edge		
	R6-52 [202]	PTH coverage	Up to hole		
	R6-53 [203]	PTH	Shall not enter		
	R6-54 [204]	Via holes	Allowed conditional		
	R6-55 [205]	Plugging/tenting	Both sides required		
	R6-56 [206]	Plugging/tenting	One side conditional		
	R6-57 [207]	Blind via holes	Solder mask allowed		
	R6-58 [208]	Solder mask tents	Shall be robust		
	R6-59 [209]	Solder masks	Shall conform to IPC		
	R6-60 [210]	Flux entrapment	Defects not allowed		
	R6-61 [211]	Adhesion	Shall conform		
	R6-61 [212]	Particulate matter	Shall conform		
	R6-61 [213]	Appearance	Shall be uniform		
	R6-61 [214]	Thickness	0.0005 inch min.		
6.1.3.7 Manufacturing – (Surface) Insulation Resistance Testing					
	R6-78 [248]	Minimum SIR	1×10^4 M Ω min.		
	R6-79 [249]	Frequency of test	Weekly to monthly		
	R6-80 [250]	Test failure	No product shipping		
	R6-81 [251]	Non conforming flux	7×10^3 M Ω min.		
	R6-82 [252]	Frequency of test	Weekly to monthly		
	R6-83 [253]	Test failure	No product shipping		
	R6-84 [254]	Non conforming flux	7.1.3.8 shall be met		



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
6.1.3.10 Manufacturing – Solvent Extract Conductivity					
	R6-85 [255]	Contamination	1 µg/cm ² max.		
	R6-86 [256]	Pre solder mask	SEC once/shift		
	R6-87 [257]	SEC solvent	50/50% or 75/25%		
	R6-88 [258]	Test failure	No product shipping		
	R6-89 [259]	Non conforming materials	1 µg/cm ² max.		
	R6-90 [260]	Frequency of test	Once per shift		
	R6-91 [261]	SEC solvent	50/50% or 75/25%		
	R6-92 [262]	Test failure	No product shipping		
	R6-93 [263]	Non conforming flux or process chemical	7.1.3.8 shall be met		
6.1.3.11 Manufacturing Damage					
	R6-95 [265]	Applicability	Small percentage		
	R6-96 [266]	Conductor cracks	Not permitted		
	R6-97 [267]	Isolated conductor cracks	Not permitted		
	R6-98 [268]	Conductor – PTH	Not permitted		
	R6-99 [269]	PTH – PTH cracks	Not permitted		
	R6-100 [270]	PB cracks	Not thru lamine		
	R6-101 [271]	Hole wall cracks	Not permitted		
	R6-102 [272]	Chips under conductors	Not permitted		
	R6-103 [273]	Chips in lamine	50% max.		
	R6-104 [274]	Tool marks	No delaminations		
	R6-105 [275]	Isolated defects	No base exposure		
	R6-106 [276]	Charring	Not allowed		



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
	R6-107 [277]	Dents	No thru cracks or pattern damage		
	R6-108 [278]	Conductor patterns	No separations		
6.1.3.14 Manufacturing - Repairs					
	R6-122 [292]	Conductor short	Max. of 6 per PB		
	R6-123 [293]	Outer layer conductor repair	Max. of 5 per single defect		
	R6-124 [293]	Outer layer conductor repair	Welded strap		
	R6-125 [293]	Outer layer conductor repair	Adequate overlap for strap		
	R6-126 [293]	Outer layer conductor repair	No encroachment to pads, etc.		
	R6-127 [293]	Open circuit repairs	Min. spacing and dielectric thickness		
	R6-128 [293]	Strap across isolated conductors	Insulating material		
	R6-129 [293]	Outer layer conductor repair	SM or CC protection required		
	R6-130 [293]	Lifted pads/conductors	No repair		
	R6-131 [293]	PTHs	No repair		
	R6-132 [293]	Previous repairs	No repair		
	R6-133 [293]	Repaired PB	Shall conform		
6.2 Multilayer PWBs – General Requirements					
6.2.1.1 Design - Dimensioning					
	R6-165 [335]	Artwork shifts	Allowances required		
	R6-166 [336]	Insulation thickness	0.004 inch min.		
	R6-167 [337]	Conductor-PB edge	0.020 inch min.		
	R6-168 [338]	Insulation thickness	0.004 inch min.		



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
	CR6-169 [339]	Insulation thickness less than 0.004 inch	Qualification and Hi-pot testing		
	R6-170 [340]	Insulation PTH walls-conductors	0.004 inch min.		
	R6-171 [341]	Layer connection	PTHs		
	R6-172 [342]	Buried/blind vias	Shall conform to outer layer PTHs		
	R6-173 [343]	Thermal isolation	Shall be provided		
	O6-174 [344]	PTH pads	On each layer		
6.2.1.3 Design - Construction					
	R6-175 [345]	Finished dimension	Specified by designer		
	R6-176 [346]	Warpage	Balanced construction		
	R6-177 [346]	Warpage	Symmetrical construction		
	R6-178 [346]	Warpage	Balanced laminates and pre-pregs		
	R6-179 [346]	Warpage	Laminate and pre-preg warp and fill		
	R6-180 [346]	Pre-preg between layers	At least two sheets		
6.2.2.3 Design – Plated through Holes					
	R6-183 [353]	Drill smear	None permitted		
	R6-180 [354]	Etchback and wicking	0.003 inch max.		
	R6-180 [355]	Negative etchback	0.0005 inch max.		
	R6-180 [356]	Test coupons	Last drill hit shall be included		
	R6-180 [357]	Coupon failure	Traceability shall be maintained		
	R6-180 [358]	Cross sections	Shall be made		



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6.2.2.5 Design – (Surface) Insulation Resistance Testing					
	R6-192 [362]	SIR test method	Shall conform		
6.2.2.6 Design – Solvent Extract Conductivity (SEC) Testing					
	R6-193 [363]	Inner layer SEC	1 $\mu\text{g}/\text{cm}^2$ max.		
	R6-194 [364]	Inner layer SEC	Once per shift		
	R6-195 [365]	SEC solvent	50/50% or 75/25%		
	R6-196 [366]	Test failure	No product shipping		
6.2.2.10 Design – Repairs: Finished Multilayer PWBs					
	R6-208 [378]	Drill repairs	1 per 100 sq. in. max.		
	R6-209 [379]	Innerlayer repair	Not permitted		
6.3 Printed Wiring Boards for Surface Mount					
6.3.1.1 Materials -Laminates					
	R6-214 [384]	Degradation	Not significant		
6.3.1.2 Materials – Solder Masks					
	R6-215 [385]	Degradation	Not significant		
6.3.1.3 Design – Component Mounting Pads					
	R6-216 [386]	Pad size	Shall be similar		
	R6-217 [387]	Pad separation	Separate solder joints		
	R6-218 [388]	Conductor between pads	Shall be solder masked		
6.3.1.4 Design – Solder Masks					
	IP6-222[392]	Bleed avoidance			
6.3.1.6 PWBs for Adhesive-and-Wavesolder Soldering Processes – Component Mounting Pads					
	IP6-224 [394]	Solder mask pads	Photoimageable type of SM		
	R6-225 [395]	Pad extensions beyond component	Good joint with all tolerances		
	R6-226 [396]	Pad extensions under component	Good joint with all tolerances		
	R6-227 [397]	Orientation of PB and components	Shall be considered during design		
6.3.1.6 PWBs for Reflow Surface Mount Soldering Processes – Conductor Finish					
	R6-228 [398]	SMOBC	Shall be used for reflow attachment		



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7 Printed Wiring Board Assembly Requirements					
7.1.1 Materials – Conformal Coatings					
	R7-1 [419]	Flammability	Shall conform		
	R7-2 [420]	Flammability	Shall be qualified		
7.1.1 Materials - Fluxes					
	R7-4 [422]	Non-conforming flux	R7-41 thru R7-45 and 7.1.3.8/9 shall be met		
7.1.2.2 Assembly Design - Components					
	R7-19 [437]	Qualification	Shall include pre-conditioning		
	R7-20 [438]	Non flush mounted leaded components	Mechanically secured in addition		
	R7-21 [439]	Large capacitors	Vents not blocked		
	R7-22 [440]	Piggy-backing	Not permitted		
7.1.2.4 Assembly Design – Layout: Thermal Considerations					
	R7-33 [451]	Component placement	Heat dissipation shall be considered		
	R7-34 [452]	Hot spots	Shall conform		
	R7-35 [453]	PB charring	Not acceptable		
	R7-36 [454]	Component temperatures	Shall not exceed max. spec.		
7.1.2.6 Assembly Design – Layout: Component Lead Forms					
	R7-48 [466]	Soldered stress relief	Shall be provided when soldered		
	R7-49 [467]	Rigid terminal stress relief	Shall be provided on at least one lead		
	R7-50 [468]	Thermal damage	Shall be prevented		
	R7-51 [469]	Lead bending	2 x diameter min. from body		
	R7-52 [470]	Inside bend radius	Lead diameter min.		



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7.1.3 Manufacturing					
7.1.3.3 Solderability					
	R7-84 [502]	PB solderability	Shall conform and shall be verified after 6 months		
	R7-85 [503]	Component solderability	As per GR-357		
7.1.3.4 Soldering					
	R7-86 [504]	Charring	None		
	R7-87 [505]	Solder joints	Shall conform		
	R7-88 [506]	Stress Relief	Shall not be adversely affected		
	R7-89 [507]	Wire insulation	Shall not be damaged		
	R7-90 [508]	Thermal damage avoidance	Heat shunt shall be used		
	R7-91 [509]	Soldered connections	Shall conform		
	R7-92 [510]	Soldered connections	No safety or clearance violations		
	R7-93 [511]	Solder contamination	Shall be controlled		
	R7-94 [512]	Contamination level	Shall conform		
	R7-95 [513]	Process monitoring	Shall be done		
7.1.3.5 Warpage					
	R7-96 [514]	PBA warpage	Not acceptable		
7.1.3.6 Solder Masks					
	R7-97 [515]	Solder mask on laminate damage	Not allowed		
	R7-95 [516]	Solder mask over non-melting metal damage	Not allowed		
	R7-95 [517]	Solder mask over melting metal damage	Not allowed		



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7.1.3.7 Conformal Coatings					
	R7-100 [518]	Coating coverage	100% except for PB contact fingers		
7.1.3.13 Repair of PWB Assemblies – Component Removal and Replacement					
	R7-117 [535]	Component removal	Shall not disturb adjacent items		
	R7-118 [536]	Multileaded components	Proper tools shall be used		
	R7-119 [537]	Clinched components	Damage shall be avoided		
	IP7-120 [538]	THT components	Heat applied to side opposite component		
	O7-121 [539]	Removed components	Shall not be reused		
	R7-122 [540]	Thermal damage	Heat shunt shall be used		
	R7-123 [541]	Surplus solder removal	Mechanical shock shall not be used		
	R7-124 [542]	Conforming fluxes	Shall be used		
	R7-125 [543]	Replacement components	Additional flux shall be used		
	R7-126 [544]	Hand soldering of replacement components	Individual leads only. No multi-lead tools shall be used		
7.1.3.17 Modifications to PWB Assemblies – Wire Routing					
	R7-138 [556]	Wire routing	Not over any component		
	R7-139 [557]	Wire routing	Not under SMT components		
	R7-141 [558]	Wire routing	Under THT radial comp. if insulation undamaged		
	R7-142 [559]	Wire routing	Not under multi-leaded components		



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7.1.3.17 Modifications to PWB Assemblies – Securing of Modification Wires					
	R7-148 [566]	Soldering of modification wires	Shall not be soldered to component leads unless qualified		
	R7-149 [567]	Revised artwork	Documented process required before modification		
	R7-150 [568]	Marking	Modified PBA shall be clearly marked		
	R7-151 [569]	Requalification	Shall be done		
8 Equipment Sub-Assembly and Assembly Requirements					
8.1.3 Design					
	R7-6 [424]	Electrical breakdown	Voltage gradient shall be specified		
	R7-7 [425]	Connector contact pitch and density	Shall be specified		
	R7-8 [426]	Voltage limit for screen printed solder mask	Shall be specified		
	R7-9 [427]	Shielding of exposed leads and pins	Shall be included in design rules		
	R7-10 [428]	Repair methods	Shall be consistent with coating used		
	R8-3 [670]	Fan cooled eqpt.	Filters required		
	R8-4 [671]	Filter dust arrestance	80% minimum		
	R8-5 [672]	Filter fire rating	UL Class 2 min.		
	R8-6 [673]	Air bypass	None permitted		
	R8-7 [674]	Filter replacement	With fans shut down or blocked		
	R8-8 [675]	Filter replacement schedule	Equipment manufacturer shall provide schedule		



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
	R8-23 [690]	Grounding jacks	Equipped and clearly labelled		
	R8-25 [692]	Contact breakers and other service affecting switches	Designed to avoid accidental activation during maintenance		
9 Electrostatic Discharge Requirements					
9.4.2.2 Circuit Pack Susceptibility					
	R9-1 [721]	ESD requirements	Shall be capable of meeting reqts.		
	R9-2 [722]	PBA test voltages	8 and 15 kV ± 10%		
9.4.2.3 Circuit Pack Performance Criteria					
	R9-3 [723]	CP performance	Shall be met before and after ESD test		
9.4.2.4 Circuit Pack Specifications					
	R9-4 [724]	Documentation	Shall indicate any special ESD items		
	R9-5 [725]	Special requirements	Shall be clearly specified		
	R9-6 [726]	Information to field personnel	Shall contain explicit warnings to be followed		
	R9-7 [727]	Packaging materials	Warnings to use only ESD safe materials shall be specified		
9.5.1 ESD Caution Label Requirements					
	R9-19 [739]	Caution labels	Shall be affixed to all packages and to the front of equipment assemblies		
10 Product Identification and Marking Requirements					



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
	R10-1 [747]	Marking durability and legibility	Shall last for the life of the equipment and be clearly legible.		
	R10-4 [750]	Label adherence and legibility	Shall adhere for the life of the equipment and be clearly legible		
	R10-5 [751]	Markings on CPs	Shall conform		
	R10-6 [752]	Firmware ID	Marking shall show software compatibility and feature ID		
	R10-7 [753]	Hot swapping	Markings shall identify CPs that require power disconnect before insertion/removal		
11 Packaging Requirements					
	R11-1 [773]	Packaging materials	Shall conform to SR-NWT-2759		
	R11-2 [774]	Packaging materials	Shall conform to contract or as specified by supplier		
	R11-3 [775]	Installation information	Shall be packed with, accompany units or be separately shipped as per contract		
	R11-4 [776]	Units with varying storage times	Shall be protected from damage as per customer's requirements		
	R11-5 [777]	PBA packaging	PBAs shall be packaged individually		



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
	R11-6 [778]	PBA packaging	PBAs shall be packaged to prevent damage and contamination		
	R11-7 [779]	PBAs with solid state devices	Shall be protected against ESD		
	R11-8 [780]	ESD sensitive components	Bags and pouches shall conform to GR-870 reqts.		
	R11-9 [781]	Package marking	Final and individual containers shall be marked as per contract or as per supplier if no contract		
	R11-10 [782]	Handling and transportation	Shall meet requirements of GR-63		
12 Repair and Modification of Customer Returns					
12.1 General					
	R12-1 [789]	Marking	As per Sect. 12.2		
	R12-2 [790]	Repairs and modifications	As per GR-78 (this document)		
	R12-3 [791]	Vintage	Returned PBAs shall be of similar or more recent vintage to the returned units		
	R12-4 [792]	Testing	Returned units shall be tested as new units		
	CR12-5 [793]	No trouble found	Returned units shall be tested before upgrading		



GR-78-CORE Section Number and Title	GR-78-CORE Requirements			Ref. Supplier's Document #	Conforms? Yes/No/NA
	Req. #	Topic/Element Description	Requirement		
	R12-6 [794]	Repair markings	Shall use N, R, NN, etc. as per Sect. 12.2		
	R12-7 [795]	Repair markings	Shall be tested again if marked NN. If NTF, engineering analysis reqd.		
	R12-8 [796]	Failure rate	The FIT rate for repaired units shall be no higher than for new units		
12.2 Marking					
	R12-9 [797]	Legends	Repaired units shall be marked as per 12.2		
12.1 Repairs					
	R12-10 [798]	Repairs	Repairs shall conform to reqts. of GR-78 (this document)		
	R12-11 [799]	Authorized components	Replacement components shall be as currently authorized		
	R12-12 [800]	Surfaces of PBs	Shall conform		
	R12-13 [801]	Field charring	PBs charred in the field shall be evaluated to determine cause		
	R12-14 [802]	Repair of charred surfaces	As specified in GR-78 (this document)		
13 Qualification Test Requirements					
	R13-1 [803]	Flux qualification	1. Copper mirror 2. Halides 3. SIR 4. Elec./migration		

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