label	Requirement Category	Requirement	Source of requirement	Acceptance criteria (qualitative description)	Metrics	Acceptable metrics	Unacceptable failure modes	Source of metrics? (Default is Vx ERD)	Followup if failures are seen?	Destructive?	Subsystems to test	Order of Testing on 4/29/24, roughly	Estimated time to test (min)
1	Usability, thermal printer	System makes it easy to input thermal paper	ERD	Easy to input thermal paper.	1. **Time to input and align** thermal paper. (Assume access is already exposed.) Average from 3 people. Different brands of thermal paper may be tested. 2. **Number of steps** to input and align thermal paper. 3. Were any **errors** or difficulties encountered? Describe them. 4. Is it reasonably **easy to input the paper roll in the wrong orientation**?	1. <1 min 2. <20 3. no, or yes only if the errors can be sufficiently avoided with procedural/training solutions. 4. no	1. >=1 min 2. >=20 3. yes, and there are no acceptable procedural/training solutions 4. yes		Identify how to reproduce errors or simplify the process. Discuss design improvements.	no	MCM	1	20
2	Usability, thermal printer	System makes it easy to remove unused thermal paper	ERD	Easy to remove unused thermal paper.	1. **Time to remove** unused thermal paper. (Assume access is already exposed.) Average from 3 people. Different brands of thermal paper may be tested. 2. **Number of steps** to remove unused thermal paper. 3. Were any **errors** or difficulties encountered? Describe them.	1. <1 min 2. <20 3. no, or yes only if the errors can be sufficiently avoided with procedural/training solutions.	1. >=1 min 2. >=20 3. yes, and there are no acceptable procedural/training solutions		Identify how to reproduce errors or simplify the process. Discuss design improvements.	no	MCM	2	20
3	Paper path, thermal printer	System prints valid reports in standard conditions, for documented paper types	VVSG, ERD	Prints on documented thermal paper types	1. **Jam/error rate** when MCM prints reports under normal conditions, using recommended thermal paper brand(s): a. thermal paper roll (Vx-suggested brand) 2. Were any actual or potential **hazards or system damage** observed? 3. Can we **verify valid report tallies** after scanning ballots?	1. 0 misfeeds out of 500 prints, or <=1/500 misfeed rate. (It's unlikely to test 500 prints, so really just look for 0 misfeeds entirely) 2. no 3. yes	1. >1/500 misfeed rate 2. yes 3. no	1. Copying misfeed threshold from ballot VVSG requirements, but not actually defined in VVSG for reports Vx Test Plan F1	Identify how to reproduce errors. Discuss design improvements.		MCM	3	80
4	Usability, thermal printer	System makes it easy to remove printed reports	ERD	Easy to remove unused thermal paper.	1. **Time to remove** unused thermal paper. (Assume access is already exposed.) Average from 3 people. Different brands of thermal paper may be tested. 2. **Number of steps** to remove unused thermal paper. 3. Were any **errors** or difficulties encountered? Describe them. This may include damage to paper/report.	1. <1 min 2. <20 3. no, or yes only if the errors can be sufficiently avoided with procedural/training solutions.	1. >=1 min 2. >=20 3. yes, and there are no acceptable procedural/training solutions		Identify how to reproduce errors or simplify the process. Discuss design improvements.	no	MCM	4	20
5	Safety & Hazard Prevention (for MCM design)	MCM thermal printer features should not pose hazard to user or interfacing elements	ERD, VVSG indirectly	Safe for to arms/hands/fingers, during use	1. Are there **design features to prevent pinch points to fingers/hands** around thermal printer and paper mechanism? 2. Are all parts of the thermal printer and paper mechanism that **interface with the hand/fingers smooth, flat, rounded, deburred, and not sharp**? 3. Is there **minimal risk of injury from any cutting surfaces** or edges during regular use, maintenance, and transport? 4. Is there **minimal risk of injury to eyes or other body parts from components under tension/compression**, or fracturing, during regular use, maintenance, and transport?	1. yes 2. yes 3. yes 4. yes	1. no 2. no 3. no 4. no		Identify how to reproduce errors. Discuss design improvements.	no	MCM	5	5
6	Safety & Hazard Prevention (for MCM design)	MCM thermal printer features should not pose hazard to user or interfacing elements	ERD, VVSG indirectly	Prevents damage to clothes, accessories	**Snag tests:** Load thermal paper, print report, remove report, and unload paper, under the following conditions: 1. Wear loose long-sleeve shirt or jacket, any material. 2. Wear short sleeves and loose arm accessory, e.g. watch or jewelry. **Does the clothing or accessory catch on any feature?**	no to all	yes to any		Identify how to reproduce errors. Discuss design improvements.	no	MCM	6	5
7	Paper path, thermal printer	System prints valid reports on thermal paper with realistic paper disruptions	ERD, VVSG indirectly	Prints on reasonably disrupted paper	Attempt to print reports on each of the following types of mildly "disrupted" thermal. Try each case at least 3x, for the multiple thermal paper brand of interest: a. torn (at corners, sides) b. slightly wrong size (e.g. A4 vs. letter) c. stored in >60% humidity for 24+ hours d. any other disruptions of interest For each "disrupted paper" type, answer this question (y/n): **Does the system print the report appropriately without causing failures?** **OR** **If the disruption is excessive, does the system jam appropriately, while alerting the user?**	For all cases: yes	For any case: no - System jams with difficulty removing the report. - Damages system. - Leaves significant debris in system. - Jams without alerts. - Jams for paper that only has a mild disruption. - System freezes for several seconds, or requiring restart.	VVSG requirement to "fail gracefully" Vx ERD	Discuss the difference between an "excessive" vs. "mild" paper disruption, and what should be accepted or not. Discuss if design improvements are needed.	possibly	MCM	7	20

label	Requirement Category	Requirement	Source of requirement	Acceptance criteria (qualitative description)	Metrics	Acceptable metrics	Unacceptable failure modes	Source of metrics? (Default is Vx ERD)	Followup if failures are seen?	Destructive?	Subsystems to test	Order of Testing on 4/29/24, roughly	Estimated time to test (min)
8	Paper path, thermal printer jammed paper	System handles thermal printer jams appropriately, or fails gracefully	ERD, VVSG indirectly	Paper jams can be removed. Paper jams do not cause system damage of failure.	Intentionally try to cause thermal paper jams using acceptale thermal paper types. Try to cause the following types of jams, at least 3x each: a. pull the thermal paper as it prints from the start, up or to the side b. let the report print, then try to pull it out mid-print, up or to the side c. push the paper back into the thermal printer as it prints d. input badly crumpled roll of paper e. input badly curled roll of paper at leading edge f. insert badly torn roll of paper at leading edge g. insert very wet paper roll (water, alcohol) h. insert paper roll that is folded at leading edge i. insert out-of-spec thermal paper (wrong brand, size, weight, etc) For each "disrupted paper" type, answer these questions (y/n): 1. If the system jams, can the **jam can be removed** easily? 2. Does the **system continue to work normally** after clearing the jam?	For all cases: yes Each case must not damage the system. The paper itself can get damaged/spoiled further, if it doesn't spoil multiple sheets.	For any case: no - System jams with difficulty removing the ballot. - Damages system. - Damages multiple sheets of thermal paper. - Leaves significant debris in system. - Rejects ballot without alerts. - System freezes for several seconds, or requiring restart.	VVSG requirement to "fail gracefully" Vx ERD	Discuss design improvements.	possibly	MCM	8	20
9	Paper path, thermal printer unexpected inputs	System handles unexpected inputs appropriately.	ERD	Rejects unexpected inputs into the thermal printer. Fails gracefully at unexpected inputs into the infeed.	Attempt to insert the following into the scanner infeed and outfeed, and observe the system. a. plastic sheet b. fabric / clothing d. thermal paper with tape on it e. cleaning sheet for a scanner f. smart card g. USB stick h. other items that might unintentionally go in by users i. other items that might go in by bad actors For each case, **does the system avoid catastrophic damage?**	yes to all The system can error out, jam, etc, as long as it does not cause any hazards od permanently destructive damage.	no to any Hazards, permanent damage	VVSG requirement to "fail gracefully" Vx ERD Vx Test Plan P3	Identify how to reproduce errors. Discuss design improvements and failure prevention strategies.	possibly	MCM, BR	9	20
10	Paper path, thermal printer	System prints valid reports in hotter environmental conditions	VVSG 1.2-G, 2.7-A, 2.7-B, 1.1.6-F	Prints on documented thermal paper in a hotter environment	1. **Jam/error rate** when MCM prints reports under hotter conditions (95 degrees F ambient temp), using the following thermal paper types: a. thermal paper roll brand #1, TBD, 20+ sheets printed b. thermal paper roll brand #2, TBD, 20+ sheets printed 2. Were any actual or potential **hazards or system damage** observed? 3. Can we **verify valid report tallies** after scanning ballots?	1. 0 misfeeds out of 20 prints, or <=1/500 misfeed rate 2. no 3. yes	1. 1+ misfeeds, or >1/500 misfeed rate 2. yes 3. no	1. Copying misfeed threshold from ballot VVSG requirements, but not actually defined in VVSG for reports Vx Test Plan F3 (simplified)	Identify how to reproduce errors. Discuss design improvements.	possibly	MCM	10	30
11	Shock testing, transit testing	Thermal printer subsystems and parts are robust.	ERD, VVSG 2.7-D	Thermal printer parts resist damage to benchtop drops during use and maintenance.	Take the major components of the removable thermal printer mechanism (printer roll fixture, etc). Drop them according to benchtop drop tests standards for all sides/edges (lifting one edge 4", or 45 degrees, or perfect balance point), and examine the damage. **Does it resist damage from the drop?**	yes damage is cosmetic; damaged but usable, no hazards to body	no broken parts, lost debris, deformation, etc	Vx Test Plan S2	Identify how to reproduce errors. Discuss design improvements.	possibly	MCM	11	20
12	Transit testing	Thermal printer subsystems and parts are robust.	VVSG 2.7-E, 3.1.5-K, TA2.7-E 1	Thermal printer parts resist damage from vibrations during travel.	Examine the thermal printer mechanism following air travel and travel in car. 1. Are there any **loose parts**, fasteners, or wires? 2. Is there any **evidence of damage due to vibration** or repeated high-frequency wear motion?	no to all	yes to any	Vx Test Plan T1 (simplified)	Identify how to reproduce errors. Discuss design improvements.	possibly	MCM	12	10
13	Paper path, thermal printer	Thermal printer resists misfeeds and jams	VVSG, ERD	Misfeed rate for prints	1. **Jam/error rate during bulk testing,** when MCM prints reports under normal conditions, using recommended thermal paper brand. Measure over the course of >500 sheets printed. 2. Were any actual or potential hazards or system damage observed?	1. 0 misfeeds out of 500 prints, or <=1/500 misfeed rate 2. no	1. >1/500 misfeed rate 2. yes	1. Copying misfeed threshold from ballot VVSG requirements, but not actually defined in VVSG for reports Vx Test Plan F1. Also assuming 10 years x 6 elections/year x 10 prints/election	Identify how to reproduce errors. Discuss design improvements.	possibly	MCM	13	300

label	Requirement Category	Requirement	Source of requirement	Acceptance criteria (qualitative description)	Metrics	Test Results, VxAustin, 7/3/24, w/ MCM only	Test Results, VxAustin, w/ MCM & BB	Test Results, VxBellingham	Test Results, other	Summary results	Notes	Followup plan	Order of Testing, roughly	Estimated time to test (min)	Actual time (min)
5	Safety & Hazard Prevention (for MCM design)	MCM thermal printer features should not pose hazard to user or interfacing elements	ERD, VVSG indirectly	Safe for to arms/hands/fingers, during use	1. Are there **design features to prevent pinch points to fingers/hands** around thermal printer and paper mechanism? 2. Are all parts of the thermal printer and paper mechanism that **interface with the hand/fingers smooth, flat, rounded, deburred, and not sharp**? 3. Is there **minimal risk of injury from any cutting surfaces** or edges during regular use, maintenance, and transport? 4. Is there **minimal risk of injury to eyes or other body parts from components under tension/compression**, or fracturing, during regular use, maintenance, and transport?	1. yes 2. yes - other than cutting edge, but that doesn't damage fingers easily 3. yes 4. yes				PASS	also good that the printer roll holder can't be put in backward. Wondering if exposed wire on right above scanner is vulnerable to dropping anything on it				

label	Requirement Category	Requirement	Source of requirement	Acceptance criteria (qualitative description)	Metrics	Test Results (week of 5/6)	Summary results	Notes	Followup plan	Test Results, Vx (Bellingham)	Order of Testing on 4/29/24, roughly	Estimated time to test (min)	Actula time (min)
1	Usability, thermal printer	System makes it easy to input thermal paper	ERD	Easy to input thermal paper.	1. **Time to input and align** thermal paper. (Assume access is already exposed.) Average from 3 people. Different brands of thermal paper may be tested. 2. **Number of steps** to input and align thermal paper. 3. Were any **errors** or difficulties encountered? Describe them. 4. Is it reasonably **easy to input the paper roll in the wrong orientation**?	decurling mechanism might be too complicated,	mixed	Insert centrally; 100 sheets can fit on roll for tested paper weight (~0.06" thickness, ~55gsm?);	thinking of getting rid of decurling; dealing withi t with thermal paper choice app should have instructions on screen about installing		1	20	
2	Usability, thermal printer	System makes it easy to remove unused thermal paper	ERD	Easy to remove unused thermal paper.	1. **Time to remove** unused thermal paper. (Assume access is already exposed.) Average from 3 people. Different brands of thermal paper may be tested. 2. **Number of steps** to remove unused thermal paper. 3. Were any **errors** or difficulties encountered? Describe them.		no difficulties reported				2	20	
3	Paper path, thermal printer	System prints valid reports in standard conditions, for documented paper types	VVSG, ERD	Prints on documented thermal paper types	1. **Jam/error rate** when MCM prints reports under normal conditions, using the following thermal paper types: a. thermal paper roll brand #1, TBD, 20+ sheets printed b. thermal paper roll brand #2, TBD, 20+ sheets printed 2. Were any actual or potential **hazards or system damage** observed? 3. Can we **verify valid report tallies** after scanning ballots?		pass	Tabitha: would prefer save money if allowing level of curl; values adding roll vs sheets; depends on IF it's easy of change out -- must be doable by anyone. May need to give options about separate sheets or not. Chris (SF EAC): Also reduces the number of signatures needed on report.			3	30	
4	Usability, thermal printer	System makes it easy to remove printed reports	ERD	Easy to remove printed thermal paper.	1. **Time to remove** report. (Assume access is already exposed.) Average from 3 people. Different brands of thermal paper may be tested. 2. **Number of steps** to remove unused thermal paper. 3. Were any **errors** or difficulties encountered? Describe them. This may include damage to paper/report.	tearing was OK, when not pulling at optimal angle may not get a clean tear	no difficulties reported		adjust margins to account for bad tearing;		4	20	
5	Safety & Hazard Prevention (for MCM design)	MCM thermal printer features should not pose hazard to user or interfacing elements	ERD, VVSG indirectly	Safe for to arms/hands/fingers, during use	1. Are there **design features to prevent pinch points to fingers/hands** around thermal printer and paper mechanism? 2. Are all parts of the thermal printer and paper mechanism that **interface with the hand/fingers smooth, flat, rounded, deburred, and not sharp**? 3. Is there **minimal risk of injury from any cutting surfaces** or edges during regular use, maintenance, and transport? 4. Is there **minimal risk of injury to eyes or other body parts from components under tension/compression**, or fracturing, during regular use, maintenance, and transport?	1. pinch point around leaf spring on paper roll holder, some sharp edges? 2. yes 3. yes 4. yes	mixed		think about some design solutions		5	5	
6	Safety & Hazard Prevention (for MCM design)	MCM thermal printer features should not pose hazard to user or interfacing elements	ERD, VVSG indirectly	Prevents damage to clothes, accessories	**Snag tests:** Load thermal paper, print report, remove report, and unload paper, under the following conditions: 1. Wear loose long-sleeve shirt or jacket, any material. 2. Wear short sleeves and loose arm accessory, e.g. watch or jewelry. **Does the clothing or accessory catch on any feature?**		pass	no			6	5	
7	Paper path, thermal printer	System prints valid reports on thermal paper with realistic paper disruptions	ERD, VVSG indirectly	Prints on reasonably disrupted paper	Attempt to print reports on each of the following types of mildly "disrupted" thermal. Try each case at least 3x, for the multiple thermal paper brand of interest: a. torn (at corners, sides) b. slightly wrong size (e.g. A4 vs. letter) c. stored in >60% humidity for 24+ hours d. any other disruptions of interest For each "disrupted paper" type, answer this question (y/n): **Does the system print the report appropriately without causing failures?** **OR** **If the disruption is excessive, does the system jam appropriately, while alerting the user?**		not fully tested				7	20	

label	Requirement Category	Requirement	Source of requirement	Acceptance criteria (qualitative description)	Metrics	Test Results (week of 5/6)	Summary results	Notes	Followup plan	Test Results, Vx (Bellingham)	Order of Testing on 4/29/24, roughly	Estimated time to test (min)	Actula time (min)
8	Paper path, thermal printer jammed paper	System handles thermal printer jams appropriately, or fails gracefully	ERD, VVSG indirectly	Paper jams can be removed. Paper jams do not cause system damage of failure.	Intentionally try to cause thermal paper jams using acceptale thermal paper types. Try to cause the following types of jams, at least 3x each: a. pull the thermal paper as it prints from the start, up or to the side b. let the report print, then try to pull it out mid-print, up or to the side c. push the paper back into the thermal printer as it prints d. input badly crumpled roll of paper e. input badly curled roll of paper at leading edge f. insert badly torn roll of paper at leading edge g. insert very wet paper roll (water, alcohol) h. insert paper roll that is folded at leading edge i. insert out-of-spec thermal paper (wrong brand, size, weight, etc) For each "disrupted paper" type, answer these questions (y/n): 1. If the system jams, can the **jam can be removed** easily? 2. Does the **system continue to work normally** after clearing the jam?		not tested, but expected to perform well based on previous tests from Pump				8	20	
9	Paper path, thermal printer unexpected inputs	System handles unexpected inputs appropriately.	ERD	Rejects unexpected inputs into the thermal printer. Fails gracefully at unexpected inputs into the infeed.	Attempt to insert the following into the scanner infeed, and observe the system. a. plastic sheet b. fabric / clothing d. thermal paper with tape on it e. cleaning sheet for a scanner f. smart card g. USB stick h. other items that might unintentionally go in by users i. other items that might go in by bad actors For each case, **does the system avoid catastrophic damage?**		not tested				9	20	
10	Paper path, thermal printer	System prints valid reports in hotter environmental conditions	VVSG 1.2-G, 2.7-A, 2.7-B, 1.1.6-F	Prints on documented thermal paper in a hotter environment	1. **Jam/error rate** when MCM prints reports under hotter conditions (95 degrees F ambient temp), using the following thermal paper types: a. thermal paper roll brand #1, TBD, 20+ sheets printed b. thermal paper roll brand #2, TBD, 20+ sheets printed 2. Were any actual or potential **hazards or system damage** observed? 3. Can we **verify valid report tallies** after scanning ballots?						10	30	
11	Shock testing, transit testing	Thermal printer subsystems and parts are robust.	ERD, VVSG 2.7-D	Thermal printer parts resist damage to benchtop drops during use and maintenance.	Take the major components of the removable thermal printer mechanism (printer roll fixture, etc). Drop them according to benchtop drop tests standards for all sides/edges (lifting one edge 4", or 45 degrees, or perfect balance point), and examine the damage. **Does it resist damage from the drop?**						11	20	
12	Transit testing	Thermal printer subsystems and parts are robust.	VVSG 2.7-E, 3.1.5-K, TA2.7-E 1	Thermal printer parts resist damage from vibrations during travel.	Examine the thermal printer mechanism following air travel and travel in car. 1. Are there any **loose parts**, fasteners, or wires? 2. Is there any **evidence of damage due to vibration** or repeated high-frequency wear motion?						12	10	