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Robotics in Contents Pack-Out & Document Recovery: Field Architecture

Restoration Intel · Field Documentation Desk · Canonical URL:
https://restorationintel.com/robotics-in-contents-packout-and-document-recovery-blueprint/

Direct Answer: Contents pack-out and document recovery robotics deliver immediate claim ROI in five non-humanoid lanes: **(1) LiDAR/LWIR red-zone recon**, **(2) negative-air pass-through airlocks**, **(3) gravimetric + piezo intake benches**, **(4) force-capped cryo freeze-dry handling and airflow page turning**, and **(5) bin-grid vault retrieval**.

Operational Notice: Vendor-neutral engineering reference. Verify structural shoring, 29 CFR 1910.1001 asbestos boundaries, OSHA robotics guardrails, and carrier documentation SLAs with qualified project managers before field deployment.

Five Practical Robotics Lanes & Primary Standards Alignment

Lane	Sensor / Mechanism	Primary Failure Eliminated
1. Red-Zone Recon	Quadruped + 3D LiDAR + 8-14 um LWIR Thermal + Gas	Multi-day stabilization delay in fire-weakened, asbestos, or Cat-3 zones.
2. Airlock Tending	Autonomous negative-air HEPA pods + 2-door pass-through	Containment pressure collapse when unzipping cleanroom/hospital barriers.
3. Truth-in-Box Bench	RGB Camera + Gravimetric Scale + Contact Piezo Mic	Empty-carton pixel aliasing (33%-37% VLM FPR) & pack-back breakage claims.
4. Cryo & Sublimation	Force-capped (<6 N) cryo loader + V-cradle airflow scanner	Wet-paper shear tears, ink bleed (>48 h thaw), and thumb damage on brittle pages.
5. Vault Retrieval	Goods-to-person bin grid + 21 CFR Part 11 barcode audit	Unbillable forklift digs for urgent mid-claim homeowner item pulls.

MuJoCo 240 Hz Contents Bench Receipts & Intake Gate Checklist

Act 1 (Unshielded Wet-Paper Crush): Driving a camera-only arm into a waterlogged archival binder peaked at **287.2 N** and compressed **29.0 mm**—well past the 6.0 N wet-fiber limit.

Act 2 (Gravimetric Decoy Rejection): A sealed carton matching exterior pixels weighed **1.75 N** (0.18 kg) against **14.22 N** (1.45 kg) expected and was routed automatically to quarantine.

Act 3 (Shielded Transfer & Deadbolt Seal): With a **4.2 N** preload cap, the verified **14.22 N** crate cleared scale inspection into `TOTE-PACK-108(lid=0.0 mm`).

[ ] 1. Run quadruped LiDAR + thermal recon first in compromised structural or Cat-3 zones.

[ ] 2. Enforce double-door pass-through interlocks so negative-air containment never drops during tote handoff.

[ ] 3. Log per-box RGB photo + gravimetric mass + piezo rattle tag + SHA-256 line ID in a neutral per-job folder.

[ ] 4. Stabilize soaked paper within 48 hours (NARA/LoC vacuum freeze-drying); keep mechanical handling below 6.0 N.

> **Per-Job Neutral File-Folder Rule:** Store raw photos, scale readings (kg/N), piezo pass/fail, and tote SHA-256 hashes inside a vendor-neutral per-job directory before importing into XactContents, CoreLogic, or carrier portals—so silent loader drops can never erase chain-of-custody proof.