

Automated Storage and Retrieval System (ASRS) Crash Recovery Procedure

1.0 Maintenance Objective & Frequency

The objective of this procedure is to safely recover an Automated Storage and Retrieval System (ASRS) after a crash event, such as a collision between the stacker crane and racking, a dropped load, or a runaway axis. This procedure ensures structural integrity is verified, alignment is restored, and the system is returned to service without risk of secondary damage or personnel injury. This is an as-needed recovery procedure, not a scheduled PM; however, a post-crash inspection should be performed immediately following any detected collision or fault.

2.0 Lockout/Tagout (LOTO) & Safety

- **Electrical Isolation:** Disconnect main power to the ASRS controller and all motor drives (horizontal, vertical, and shuttle). Apply personal lock and tag at the main disconnect.
- **Pneumatic Isolation:** Close the shut-off valve for any pneumatic actuators (e.g., shuttle extend/retract). Bleed residual air from the lines.
- **Hydraulic Isolation:** If the system uses hydraulic dampers or lifts, close the hydraulic isolation valve and relieve system pressure per OEM instructions.
- **Mechanical Lockout:** Install mechanical stops or blocks on the stacker crane rails to prevent unintended movement during inspection.
- **Mandatory PPE:** Safety glasses, steel-toed boots, hard hat, high-visibility vest, and cut-resistant gloves. If working at height, use a full-body harness and lanyard anchored to a certified point.

3.0 Required Tools, Parts & Lubricants

- Torque wrench (0-200 Nm) with appropriate sockets (typically 13mm, 17mm, 19mm)
- Dial indicator with magnetic base (0.001 inch resolution)
- Laser alignment tool (e.g., Hamar or Pinpoint Laser Systems)
- Feeler gauge set (0.001-0.040 inch)
- Crowbar or pry bar (for gently shifting components)
- Replacement shear pins or bolts (as per OEM part numbers)
- ISO VG 68 way oil (for linear guides and ball screws)
- Lithium complex grease (NLGI #2) for bearings and chains
- Digital multimeter (for verifying motor drive continuity)
- Flashlight and inspection mirror

4.0 Step-by-Step Maintenance Procedure

1. Perform LOTO as per Section 2.0. Verify zero energy state by attempting a manual jog command from the controller (with power off, no movement should occur).
2. Visually inspect the crash zone. Look for bent rack beams, damaged load bars, broken welds, or debris on the floor. Photograph the scene for documentation.
3. Inspect the stacker crane mast for vertical straightness. Use a laser alignment tool to check mast deflection. Acceptable deviation is ± 0.5 mm per meter of mast height. If out of spec, consult OEM for straightening procedure.
4. Check the horizontal rail alignment. Place a dial indicator on the carriage and run it along the rail (manually, with power off). Maximum lateral runout: 0.2 mm over 1 meter. If exceeded, loosen rail clamps and realign using shims.
5. Inspect the vertical lift chain or ball screw. For chain drives: check for kinked links, elongation (measure over 10 pitches; replace if $>2\%$ stretch), and proper tension (deflection 10-15 mm at mid-span under 50 N force). For ball screws: check for visible damage and measure backlash with a dial indicator; maximum 0.1 mm.
6. Examine the shuttle mechanism (extend/retract). Manually cycle the shuttle. Listen for grinding or binding. Check the shuttle forks for straightness using a straightedge; gap should be <0.5 mm.
7. Replace any damaged shear pins, bolts, or wear pads. Torque all fasteners to OEM specifications (e.g., M12 bolts to 80 Nm ± 5 Nm). Apply thread locker (Loctite 243) to critical fasteners.
8. Lubricate all linear guides, ball screws, and chains per OEM schedule. Apply way oil to guides and grease to bearings. Wipe off excess to prevent contamination.
9. Check all electrical connections in the crash zone. Look for damaged cables, loose terminals, or crushed conduits. Use a multimeter to verify continuity of limit switches and encoder cables. Replace any damaged components.
10. Manually move the stacker crane through the crash zone (using a hand crank or manual release) to ensure no mechanical interference. Verify that all limit switches actuate correctly.
11. Remove all mechanical stops and blocks. Restore power. Perform a slow-speed jog of each axis (horizontal, vertical, shuttle) from the controller. Monitor for abnormal noise or vibration. If any anomaly is detected, stop and re-inspect.
12. Run a full automatic cycle in the affected zone at reduced speed (50% of normal). Observe the system for smooth operation. If successful, increase to full speed and run three consecutive cycles without error.

5.0 Verification & Return to Service

1. Confirm that all axes move smoothly and within positional tolerance (e.g., horizontal positioning accuracy ± 1 mm, vertical ± 0.5 mm). Use the system's diagnostic screen to verify encoder feedback.
2. Perform a load test: retrieve and store a test load (or empty pallet) from the crash zone. Verify that the shuttle engages and disengages without binding.
3. Check for any error codes on the ASRS controller. Clear any non-critical alarms. If critical alarms persist, troubleshoot per OEM manual.
4. Document all findings, repairs, and measurements in the maintenance log. Attach photos of the crash site and post-repair alignment data.
5. Sign off on the PM work order in ServiceGrid, noting the crash recovery was completed and the system is returned to service.

Regulatory Disclaimer: This document is a generic maintenance template provided for educational and informational purposes only. It does not constitute professional engineering or reliability advice. The end-user assumes all liability for validating all step sequences, torque specs, and LOTO protocols against specific machinery OEM manuals before deployment to a live production floor.