

2026 Corrugated Maintenance Benchmark Report

How North America's corrugated plants stack up on uptime, reliability, maintenance spend, workforce, and safety — and what the top quartile is doing differently.

Prepared for: **Plant Managers | Operations Directors | Maintenance Leaders**
By Kelly Industrial Services

TABLE OF CONTENTS

Executive Summary	3	Section 5: Equipment-Specific Benchmarks	14
		Corrugator	14
Section 1: Corrugated Manufacturing in 2026	4	Rotary Die Cutter (RDC)	15
Why Maintenance Moved From Cost Center to Strategic Moat	5	Flexo Folder-Gluer (FFG)	16
		Why Dry Ice Blasting Matters	16
Section 2: Downtime, OEE & Uptime	6	Conveyors, Material Handling, and Ancillary Systems	17
Where OEE Leaks Come From	7		
The Real Cost of an Idle Line	8	Section 6: Safety, Compliance & ESG	18
Quick OEE Diagnostic	8	The Combustible Dust Reality	18
		OSHA Enforcement Posture	19
Section 3: PM Compliance, MTBF/MTTR & Reliability KPIs	9	What Audit-Ready Actually Looks Like	20
The Five Reliability KPIs That Matter	9	Beyond Dust: The Broader Compliance Landscape	20
PMP and the 80:20 Rule	10	The ESG Dimension	21
The Reliability Maturity Ladder	11		
		Section 7: Your 2026 Action Plan	22
Section 4: Maintenance Spend & Cost-Per-Ton	12	30 to 60 Days: Pick Two High-Leverage Moves	22
MC/RAV: The Universal Denominator	12	60 to 90 Days: Build The System	23
The Other Denominator: Cost Per Ton	13	A Simple ROI Framework	23
Where the Dollars Actually Go	13		

EXECUTIVE SUMMARY

We analyzed the most credible publicly available benchmarks across five domains that determine the operational health of a corrugated plant:

1. Uptime and OEE
2. Reliability and PM discipline
3. Maintenance spending
4. Workforce capacity
5. Safety/compliance



Top Findings

60%

OEE is the average operating benchmark for most plants.

80:20

is the planned-to-reactive maintenance ratio achieved by world-class operations.

1.9million

U.S. manufacturing jobs could remain unfilled by 2033.

Safety & Compliance

are now operational metrics, not just HR ones.

SECTION 1: THE STATE OF CORRUGATED MANUFACTURING IN 2026

The Fibre Box Association reported approximately 381 billion square feet of corrugated shipped in the U.S. in 2024, a number that has stayed remarkably resilient even through cyclical demand swings. Underneath that headline number sits a market that has fundamentally changed shape:

**Corrugated and folding-carton packaging is now a roughly
\$295 billion global market**

With North America holding about 35% of that revenue

SKU Fragmentation

E-commerce, subscription commerce, and right-sized packaging have multiplied the number of distinct box specifications a typical converter runs in a given week. Short runs are no longer the exception; they're the norm.

Speed Expectations

High-capacity corrugators now run at output speeds approaching 400 meters per minute. Modern lines are physically faster, mechanically more complex, and far more sensitive to fault conditions than their predecessors.

Sustainability Mandates

The European Packaging and Packaging Waste Regulation (PPWR), with applicability beginning mid-2026, will reshape spec requirements for any U.S. converter exporting to Europe.

Margin Pressure

Linerboard and kraft pricing volatility, energy cost swings, and tariff-driven supply chain reshuffling have compressed converter margins. Every recoverable hour of capacity matters more than it did five years ago.

Why Maintenance Moved From Cost Center to Strategic Moat

In a market growing at 4% to 5% annually with single-digit margin compression, the operational truth is straightforward: most converters cannot grow their way out of a maintenance problem. The plants pulling ahead in 2026 share a common operating philosophy — they treat maintenance not as a cost to be minimized but as a capacity-creation function.

Three forces have made this shift inescapable

Force 1: The cost of unplanned downtime keeps rising

Recent benchmark research from Siemens places the average annual cost of unplanned downtime per facility at large manufacturers at roughly

\$129 million
— a 65% increase from 2019–2020 levels.

Force 2: Insurance and customer pressure

Property insurers are increasingly requiring documented combustible-dust programs and PM compliance evidence as conditions of coverage and renewal pricing.

Major CPG and retail customers now embed supply-continuity audits into their qualification process. A poorly maintained plant is no longer just an internal cost — it's a liability on the customer relationship.

Force 3: The retiring workforce

The institutional knowledge that kept many plants running through the 2000s and 2010s is walking out the door. The maintenance technician who could troubleshoot a 1990s-vintage corrugator by sound alone is retiring — and the replacement market is structurally short. Converting tribal knowledge into documented, repeatable maintenance practice is no longer optional.

SECTION 2: DOWNTIME, OEE & UPTIME

OEE (Overall Equipment Effectiveness) is the single most useful operating metric in a corrugated plant, because it forces you to combine three things you normally measure separately: how often the line runs, how fast it runs when it's running, and how much of what comes off it is sellable.

$$\text{OEE} = \text{Availability} \times \text{Performance} \times \text{Quality}$$

A plant running at 90% availability, 95% performance, and 99% quality has an OEE of about 85%. Most plants don't.

OEE Tier	Score	What it means
World-class (top decile)	85%+	Mature reliability program, predictive maintenance in place, disciplined PM execution.
Top quartile	75% - 85%	Solid PM discipline, condition-monitoring on critical assets, low reactive ratio.
Industry average	60% - 75%	Mostly preventive program, periodic reactive crises, room to recover capacity.
Below average	40% - 60%	Predominantly reactive, frequent unplanned stops, significant capacity loss.
Critical	< 40%	Reactive firefighting, no real PM discipline, immediate intervention required.

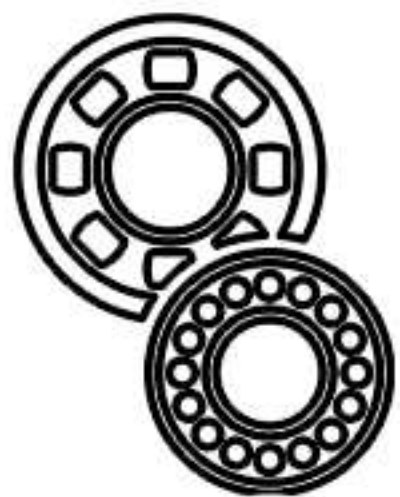
Where OEE Leaks Come From

Industry research consistently identifies the same loss categories.

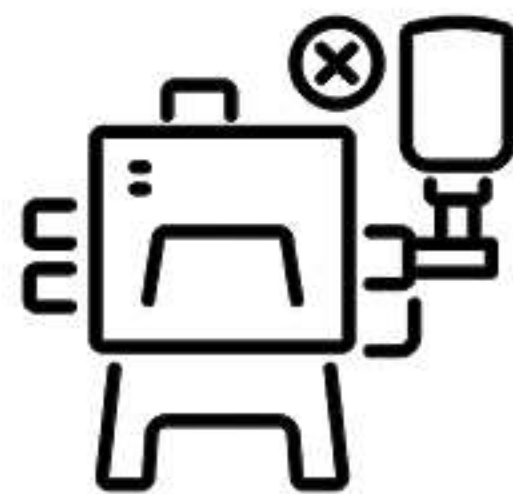
The Godlan 2024 data set attributes

$$\begin{array}{ccccc} \text{34\%} & + & \text{29\%} & = & \text{2/3} \\ \text{of efficiency losses to} & & \text{of efficiency losses to} & & \text{of OEE loss in discrete} \\ \text{unplanned downtime} & & \text{setup and changeover time} & & \text{manufacturing} \end{array}$$

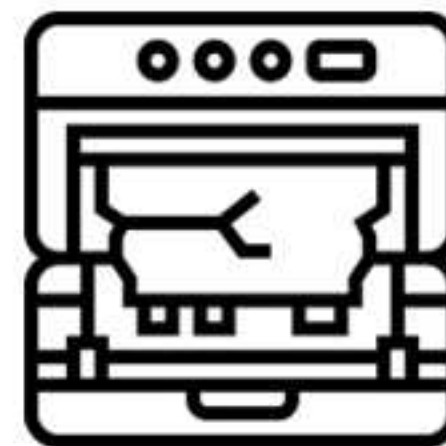
In corrugated specifically, the leading causes of unplanned downtime tend to cluster in five categories:



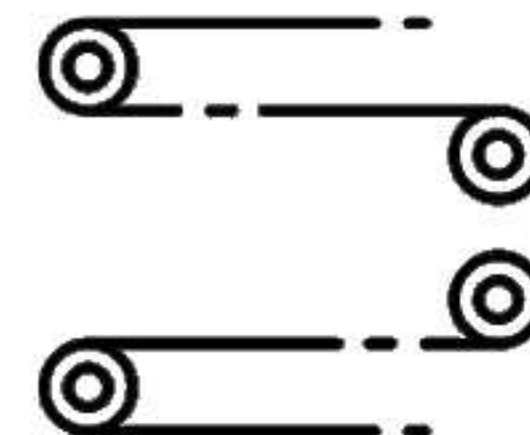
Wear-related component failures



Adhesive and starch system issues



Web break and feed jams



Conveyor and material handling failures



Electrical and sensor faults

The Real Cost of an Idle Line

The financial impact of unplanned downtime has risen sharply in the last five years. Several recent studies converge on a wide but consistent range:

**\$2 million
per incident.**

is the average loss associated with an unplanned downtime event that lasts approximately 4 hours.

**25 downtime incidents
per month**

is the average for manufacturers, adding up to roughly 800 hours of unplanned downtime annually.

A mid-sized converter producing \$30 million annually in net revenue with a contribution margin of 15% has roughly \$4,500 per hour of contribution at risk during a stoppage. Add idle labor costs, expedited freight on missed shipments, scrap startup, and the tendency for unplanned events to cluster in critical-customer windows, and the all-in cost typically lands between \$7,500 and \$15,000 per hour. Most plants underestimate their true cost by a factor of two.

Quick OEE Diagnostic

Honest answers to these five questions will place you on the OEE tier table on page 6.

1. *Do you measure OEE on your critical assets (corrugator, top 3 converting lines) at the shift level?*
2. *Do you have a running 12-month trend, or only spot data?*
3. *What share of your stops are categorized as “unknown”? (>10% means your data quality is too poor to act on.)*
4. *What’s your three-largest-stop-reason concentration? (If the top three reasons account for less than 50% of stoppage time, you’re not focused enough; if more than 80%, you have specific, fixable issues.)*
5. *Have you reduced your top stop reason in the last 12 months? (If not, your OEE program is not yet operating.)*

SECTION 3: PM COMPLIANCE, MTBF/MTTR & RELIABILITY KPIS

OEE tells you how productive your plant is. Reliability KPIs tell you why. If OEE is the patient's temperature, MTBF, MTTR, PM compliance, and Planned Maintenance Percentage are the diagnostic panel that explains what's actually wrong. There are five reliability KPIs every plant manager should be able to recite cold. Most can't. The plants that can are almost without exception in the top quartile of OEE performance.

The Five Reliability KPIs That Matter

1

PM Compliance

Definition:

Percentage of scheduled PMs completed on time.

World-class: 90%+

What it tells you:

Whether your team is executing the plan or letting the schedule slip.

2

Planned Maintenance %

Definition:

Share of total maintenance hours spent on planned (vs. reactive) work.

World-class: 80%+

What it tells you:

Whether the plan is actually big enough to dominate reactive work.

3

MTBF

Definition:

Mean Time Between Failures — average operating hours between unplanned failures on a given asset.

World-class: Increasing

What it tells you:

Whether your reliability is improving over time.

4

MTTR

Definition:

Mean Time To Repair — average time from failure to operational status.

World-class: Decreasing

What it tells you:

Whether your team's response capability is improving.

5

MC/RAV

Definition:

Annual maintenance cost as a percentage of replacement asset value.

World-class: 2–3%

What it tells you:

Whether you're spending the right amount, given what you're protecting.

Planned Maintenance Percentage (PMP) and the 80:20 Rule

PMP is the share of your total maintenance hours spent on planned, proactive work versus reactive emergency response. The widely accepted target is 80:20 — 80% planned, 20% reactive.

Most corrugated plants are nowhere near it. Industry research from Reliabilityweb and Plant Services suggests that the typical plant operates with closer to 60% - 70% reactive work, an exact inversion of the world-class target.

A few practical observations on PMP that matter for corrugated specifically:

PMP includes condition-based and predictive maintenance, not just calendar-based PMs.

A plant doing vibration monitoring, IR thermography, or oil analysis on critical assets is doing planned maintenance even when the work itself is triggered by a condition reading.

PMP > 90% is often a warning sign, not a celebration.

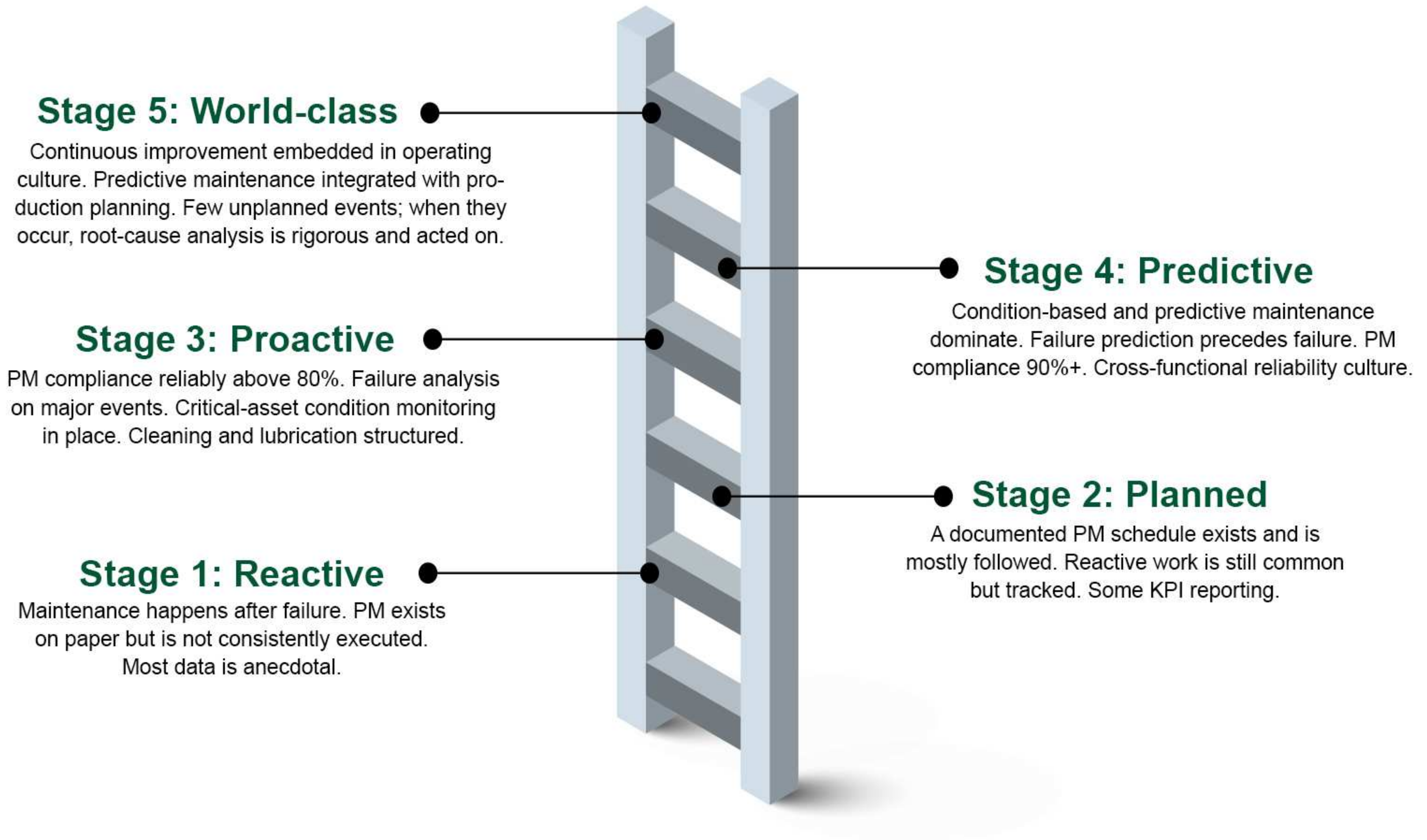
It usually means corrective work is being deferred or misclassified. Realistic world-class is 85–90%.

Cleaning is maintenance.

In corrugated environments, structured cleaning of corrugators, flexo decks, conveyors, and dust-accumulation zones is not housekeeping — it's preventive maintenance that should be tracked, scheduled, and reported in PMP.

The Reliability Maturity Ladder

A useful mental model for placing your plant in context:



SECTION 4: MAINTENANCE SPEND & COST-PER-TON BENCHMARKS

There is no virtue in a small maintenance budget if it produces a fragile plant, and there is no virtue in a large maintenance budget if it's funding the wrong work. The right maintenance spend is the one calibrated to the value of the assets you're protecting and the production you're trying to deliver.

Across industry, the most widely accepted benchmark for normalizing maintenance spend across plants of different size and asset profile is Maintenance Cost as a percentage of Replacement Asset Value (MC/RAV).

MC/RAV: The Universal Denominator

MC/RAV is calculated as: total annual maintenance spending (labor + parts + contracted services + lubricants + consumables) divided by the cost of replacing all maintained assets at today's prices. Expressed as a percentage.

SMRP and Reliabilityweb research, along with multiple CMMS-vendor benchmark studies, converge on this scale:

MC/RAV	Tier	Interpretation
2% - 3%	World-class	Mature reliability program, predictive maintenance reducing unplanned spend.
2% - 3%	Top quartile	Solid PM discipline, controlled costs, healthy reinvestment.
3% - 4%	Industry average	Acceptable in older plants; warning sign in newer ones.
4% - 6%	Below average	Reactive-heavy spend, elevated emergency parts purchasing, likely under-PM'd.
> 6%	Critical	Maintenance is propping up failing assets; capital replacement decision overdue.

The Other Denominator: Cost Per Ton

For converters and integrated plants, maintenance cost per ton of saleable corrugated produced is a useful operational denominator alongside MC/RAV. It tells you whether maintenance is scaling with output or eating into it. **As a directional guide, three principles hold:**

Cost per ton should decline as production volume rises, not increase.

Cleaning costs are typically 8% – 15% of total maintenance spend in a corrugated plant.

Outside services should be 15% – 30% of maintenance spend in healthy plants.

Where the Dollars Actually Go

A useful exercise: pull your last 12 months of maintenance spend and categorize it. Most plants are surprised by what they find.

Spend Category	Typical Healthy Range	Warning Sign
In-house labor (wages, benefits)	40% - 55%	Below 35% suggests you're too dependent on contractors; above 60% suggests over-staffing or under-utilization.
Spare parts and materials	20% - 30%	Above 35% often signals reactive parts purchasing at premium; emergency parts are 30% - 40% more expensive than planned.
Contracted services (specialized)	15%–30%	Above 30% suggests core capability gaps; near zero suggests in-house team is overburdened.
Cleaning, painting, coatings	8% - 15%	Below 5% in a corrugated plant is almost always a sign of under-investment.
Lubricants and consumables	3% - 6%	Wide variability is normal; the trend matters more than the level.

SECTION 5: EQUIPMENT-SPECIFIC BENCHMARKS

Plant-level OEE is a useful summary number, but it's a poor diagnostic tool. Real reliability work happens at the asset level. This chapter walks through the four asset families that drive corrugated plant performance and the failure modes, intervention windows, and cleaning protocols that distinguish high-performing operations.

Corrugator (single-facer, double-backer, dry end)

The corrugator is typically the highest-replacement-value asset in the plant and the asset whose unplanned downtime cascades fastest into customer-facing problems. It's also the asset where preventive discipline pays the highest dividends.

Critical Failure Modes



Bearing failures on glue rollers, pressure rollers, and corrugating rolls — typically driven by heat, contamination, and inadequate lubrication.



Steam-system issues at the single-facer and double-backer — leaking traps, inadequate condensate removal, fouled heat-exchange surfaces.



Glue system failures — starch viscosity drift outside the standard 35–40 second range, contaminated glue tanks, pump wear.



Heat plate and hot plate maintenance issues — surface buildup that compromises bonding and creates rejected board.



Slitter-scoring wear — dulled blades and worn scoring wheels that produce rough cuts, fishtailing, or poor box squareness downstream.

Cleaning Intervention Windows

Daily

Glue pans, glue rollers, anvil clean-down, surface debris removal at infeed and outfeed.

Weekly

Detailed cleaning of doctor blades, scoring wheels, slitter heads, and accessible hood interiors.

Monthly

Deep cleaning of internal hood surfaces, steam-system traps and lines, accessible bearings.

Quarterly to Semi-Annual

Comprehensive corrugator cleaning during scheduled outages — typically requiring specialized cleaning resources to handle hot, hard-to-reach areas safely without damaging surfaces or sensors.

Rotary Die Cutter (RDC)

Rotary die cutters share many failure modes with FFGs but add specific concerns around die quality, anvil wear, and stripping system performance. RDC reliability is often the constraining factor on more complex SKUs (display packaging, regular slotted containers with windows, custom dies).

Critical Failure Modes



Anvil cover wear

uneven wear creates dimensional variability and requires increasingly frequent rotation.



Die rule wear and damage

dulled or chipped rule produces ragged cuts and excessive scrap.



Stripping system failures

worn stripping pins or jam-prone stripping sections produce downstream box defects.



Vacuum belt and transfer system issues

leading to feeding inconsistency and increased misfeeds.



Bearing and drive issues on the cutting cylinder

typically late-symptom failures with significant lead time if monitored.

Flexo Folder-Gluer (FFG)

FFGs are the converting workhorse of the corrugated plant and the most common source of plant-level OEE leakage outside the corrugator itself. Their reliability profile is dominated by two things: setup quality (which drives changeover time and first-piece yield) and contamination (which drives mid-run stoppages and quality issues).

Critical Failure Modes



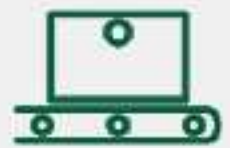
Anilox roller fouling — dried ink and contamination that causes uneven ink transfer, pinholing, and color shifts.



Glue nozzle clogs and uneven glue application — leading to weak manufacturer's joints and box compression failures.



Print plate damage and registration drift — driven by buildup on impression cylinders or worn bearings.



Folder belt tension and wear — a leading cause of fishtailing and out-of-square boxes.



Die-cutter anvil wear — uneven wear creates inconsistent cut depth, requiring frequent rotation or replacement.



Slot wheel and scorer issues — worn or misaligned scorers cause crease-line tearing.

Cleaning And PM Windows

End-of-shift / Changeover

Anilox cleaning, doctor blade inspection, ink system flushing, glue nozzle inspection.

Weekly

Detailed cleaning of print decks, glue circulation systems, folder section, accessible cylinders.

Monthly

Comprehensive print station cleanup, deep clean of folding section and gluing system, lubrication of accessible components.

Quarterly

Deep cleaning of frame interiors, hard-to-reach areas, and electrical cabinets exposed to dust.

Why Dry Ice Blasting Matters

Traditional cleaning methods on FFGs face two problems: water can damage sensitive electronics and bearings, and abrasive media can damage critical surfaces like anilox rollers and impression cylinders. Dry ice (CO₂) blasting is non-conductive, leaves no secondary waste, and allows clean-in-place on most components — substantially reducing the disassembly time that traditionally made deep cleaning a multi-shift exercise. For plants running tight schedules with limited maintenance windows, this matters.

Conveyors, Material Handling, and Ancillary Systems

Plant-level OEE is often constrained not by the marquee converting equipment but by the conveyors, transfers, scrap systems, and material-handling infrastructure between them. These assets are typically less glamorous, less monitored, and more failure-prone than the equipment they serve.

Critical Failure Modes and Intervention Areas



Belt wear, slippage, and tracking issues

on takeaway and transfer conveyors.



Scrap conveyor and pit accumulation

paper debris and starch buildup that creates fire risk, pest risk, and mechanical jams.



Pneumatic system contamination

dust and moisture in compressed air systems that cascade into reliability problems.



Photoeye and sensor failures

caused by dust accumulation on lenses and emitters, often dismissed as random but actually highly preventable.



Floor coating and traffic surface degradation

worn epoxy creates slip hazards and degrades over time, requiring periodic refresh.

SECTION 6: SAFETY, COMPLIANCE & ESG

Safety and compliance used to live in HR and EHS reports, separate from the operating metrics that drove daily decision-making. That separation no longer holds. In 2026, the maintenance discipline that produces uptime is the same discipline that produces audit-ready compliance and reduced incident rates.

This chapter focuses on the safety and compliance issues most directly tied to corrugated plant maintenance: combustible dust, NFPA standards, OSHA enforcement posture, and the emerging ESG dimension of facility maintenance.

The Combustible Dust Reality

Corrugated plants generate paper fiber and dust as an inherent byproduct of operation. Under the right combination of suspension concentration, particle size, and ignition source, that dust is combustible — a fact codified in the relevant NFPA standards. The three standards that apply most directly to corrugated and packaging operations are:

NFPA 654

Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids. The general standard for combustible dust handling.

NFPA 664

Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities — referenced in many paper and corrugated facility analyses given fiber composition similarities.

NFPA 652

Standard on the Fundamentals of Combustible Dust — the umbrella standard requiring a documented Dust Hazard Analysis (DHA) for each process and facility area.

OSHA Enforcement Posture

OSHA issued a revised Combustible Dust National Emphasis Program (CPL 03-00-008) in January 2023, replacing the original 2008 NEP [25]. The revised program signals continued and increased enforcement focus on combustible-dust hazards — enforced primarily through the General Duty Clause when no specific OSHA standard applies, with NFPA standards cited as evidence of industry-recognized hazards and feasible controls.

Practically, this means three things for corrugated plant operators:



A documented Dust Hazard Analysis (DHA) is now a baseline expectation, refreshed at least every five years.



Visible accumulation of combustible dust on horizontal surfaces, structural members, ductwork, and equipment is citable as a General Duty Clause violation — typically with reference to the NFPA 654 layer-thickness threshold.



Insurance carriers are tightening on dust-related underwriting. FM Global, AIG, and other major industrial property carriers increasingly require documented dust programs as conditions of coverage.

What Audit-Ready Actually Looks Like

A facility prepared for an OSHA inspection or insurance audit has, at minimum:

- ✓ A current Dust Hazard Analysis (DHA), reviewed in the last five years, covering all operating areas and process equipment.
- ✓ A documented housekeeping and cleaning program with frequency, scope, and verification — not just “sweep daily.”
- ✓ Photographic and dated records of dust remediation activities in elevated and concealed areas (rafters, joists, ductwork, on top of equipment).
- ✓ Training records for personnel performing combustible-dust cleaning, including use of explosion-proof vacuums and appropriate equipment.
- ✓ Vendor and contractor documentation — evidence that any specialized cleaning vendors are using NFPA-compliant equipment and methods.

Beyond Dust: The Broader Compliance Landscape

Dust is the most visible compliance area, but a maintenance-driven safety profile extends across several adjacent domains:

Compliance Area	Maintenance Connection	Typical Audit Trigger
Combustible dust (NFPA 654/664)	Cleaning frequency, scope, documentation	Visible accumulation; missing DHA; reactive cleaning only.
Hot work permits and fire watch	Cleaning before welding/grinding work near accumulated dust	Inadequate pre-work cleaning; missing fire watch.
LOTO (Lockout/Tagout)	Energy-isolation procedures for maintenance	Inadequate procedures or training during PM and cleaning work.
Confined space	Pit cleaning, silo work, tank work	Missing entry permits, monitoring, rescue plans.
Fall protection	High-reach cleaning, roof coatings, structure access	Inadequate fall arrest systems; non-certified personnel at heights.
Hazard Communication (GHS)	Cleaning chemicals, coatings, lubricants on site	Missing or outdated SDSs; inadequate labeling.
Environmental (air, water, waste)	Coating overspray; wash water; waste disposal	Improper disposal of cleaning chemicals or coatings; uncontrolled discharge.

The ESG Dimension

ESG (Environmental, Social, Governance) reporting has moved from voluntary disclosure to genuine business expectation in the last 24 months. Major customers — particularly large CPG, food and beverage, and consumer products brands — are increasingly embedding facility-level sustainability questions into their supplier qualification processes. Several aspects of plant maintenance touch ESG directly:



Energy efficiency

Steam-system maintenance at the corrugator (trap inspection, insulation integrity, condensate recovery) typically delivers 5% -15% energy reduction in poorly maintained plants.



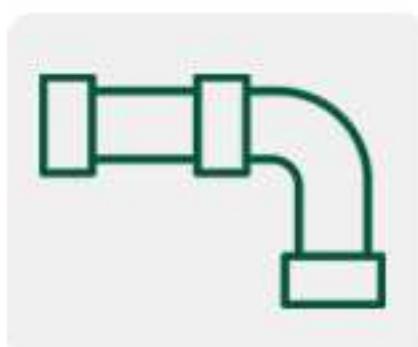
Coatings and chemistry

Industrial coatings have evolved substantially in the last decade. Replacing legacy coatings during scheduled maintenance windows is an ESG-positive move.



Worker safety performance

Plants with documented, consistent maintenance discipline report systematically lower incident rates than reactive plants.



Compressed air

Compressed air leaks consume 20 - 30% of compressed-air energy in industrial facilities, making routine leak audits and repairs one of the highest-ROI energy-efficiency interventions.



Waste reduction

Dry ice blasting, in particular, has emerged as an ESG-favorable cleaning method for corrugated equipment because it eliminates secondary waste streams.

SECTION 7: YOUR 2026 ACTION PLAN

30 to 60 days: Pick Two High-Leverage Moves

Most plants have ten things they could improve. The plants that actually improve pick two and stay with them. Based on the patterns we see across the corrugated industry, four moves consistently produce outsized returns:

Move 1: Get cleaning right

A structured, documented cleaning program — covering machinery, conveyor pits, dust accumulation zones, and high-reach areas — typically improves OEE 2–5 points within the first six months and resolves multiple compliance issues simultaneously.

For most plants, the right approach combines daily and weekly in-house cleaning with quarterly or semi-annual specialized deep cleaning by a contracted partner with appropriate equipment (industrial vacuums, dry ice blasters, high-reach platforms).

Move 2: Fix PM compliance first

If your PM compliance is below 80%, that's the single high-leverage place to invest effort — not new sensors, not predictive maintenance, not a CMMS upgrade. Get the existing PM program executed reliably first; everything downstream gets easier.

Practical tactic: review every PM in your library and ask, "If this PM weren't done, would something fail?" If the honest answer is no, retire it. A leaner PM library that gets executed at 95% beats a comprehensive one that runs at 60%.

Move 3: Tighten the changeover

For most converters, changeover time is the second-largest component of OEE loss after unplanned downtime. SMED (Single-Minute Exchange of Dies) frameworks, applied rigorously to FFGs and rotary die cutters, can reduce changeover times 30–60% with relatively modest investment.

Cleaning is often a hidden contributor here — ink and glue residue from the previous job extends changeover and creates first-piece defects. Better between-job cleaning protocols typically pay for themselves in throughput within a single quarter.

Move 4: Document and protect institutional knowledge

For your top five assets, build documented maintenance procedures, troubleshooting trees, and failure-mode catalogs. Use your most experienced technicians as the source. Treat this as a quarterly project, not a one-time exercise.

This is the move with the longest payback but the highest insurance value against workforce attrition.

60 to 90 days: Build the System

With your baseline established and two high-leverage moves underway, the third month is about embedding the work in standing operating practice:

1. **Establish a weekly reliability review — 30 minutes, same time, same KPIs, same decisions. The discipline matters more than the format.**
2. **Implement a monthly KPI report at the plant-leadership level that includes the five reliability KPIs alongside the production and financial KPIs you already track.**
3. **Set quarterly targets for each KPI — small, achievable, with clear ownership.**
4. **Identify the next two moves to start in the second quarter, based on what the first two have surfaced.**
5. **Define your specialized-services partner strategy. The plants that get this right have a small number of trusted partners they work with repeatedly, not a different vendor for every project.**

A simple ROI framework

Most maintenance investments don't need a sophisticated business case. A back-of-envelope ROI calculation, done honestly, usually demonstrates the case clearly:

Step 1

Calculate your true cost of unplanned downtime per hour.

Step 2

Multiply by your annual unplanned downtime hours.

Step 3

A 25% reduction in unplanned downtime

Step 4

Compare against the all-in cost of the maintenance investments

SOURCES AND REFERENCES

Industry and Market Data

- Persistence Market Research. (2026). Corrugated & Folding Carton Packaging Market — Size, Share & Industry Outlook 2026–2033. <https://www.persistencemarketresearch.com/market-research/corrugated-and-folding-carton-packaging-market.asp>
- Future Market Insights. (2026). Corrugated Box Machine Market: How E-commerce Packaging Demand Is Pushing Automation Forward. (Cites Fibre Box Association data: 381 billion sq ft U.S. corrugated shipped in 2024.) <https://www.futuremarketinsights.com/articles/corrugated-box-machine-market-how-e-commerce-packaging-demand-is-pushing-automation-forward>
- Market Reports World / Global Market Insights. (2026). Corrugated Boxes Market Size & Share Trends Report 2033. (References high-capacity corrugator output speeds approaching 400 m/min.) <https://www.marketreportsworld.com/market-reports/corrugated-boxes-market-14721607>

Downtime & OEE

- Siemens Digital Industries Software. (2024). The True Cost of Downtime 2024 Report. (Findings: \$1.4 trillion in unplanned-downtime losses across Fortune Global 500; 11% of revenues; ~\$129M average per facility.) Summarized at <https://blog.siemens.com/2024/07/the-true-cost-of-an-hours-downtime-an-industry-analysis/> and <https://www.ismworld.org/supply-management-news-and-reports/news-publications/inside-supply-management-magazine/blog/2024/2024-08/the-monthly-metric-unscheduled-downtime/>
- ABB Motion Services. (2024). Value of Reliability Report. Survey of 3,200+ global plant maintenance leaders. (Finding: two-thirds experience unplanned downtime at least once per month, average cost \$125,000 per hour.) See also ABB press release, October 2025: <https://new.abb.com/news/detail/129763/industrial-downtime-costs-up-to-500000-per-hour-and-can-happen-every-week>
- Lean Production / Vorne. OEE.com — Overall Equipment Effectiveness Reference. (Source for benchmark of 60% typical OEE, 85% world-class for discrete manufacturing.) <https://www.oeec.com/> and <https://www.leanproduction.com/oeec/>
- Evocon. (2025). World-Class OEE: Industry Benchmarks From More Than 50 Countries. (Analysis of 3,500+ machines.) <https://evocon.com/articles/world-class-oeec-industry-benchmarks-from-more-than-50-countries/>
- Godlan. (2025). OEE Benchmarks by Manufacturing Industry Vertical: 2025 Data. (Analysis of 1,470+ discrete manufacturing operations; loss-category attribution: 34.2% unplanned downtime, 28.7% setup/changeover.) <https://godlan.com/oeec-benchmark-industry/>
- Fabrico. (2026). OEE Benchmarks by Industry: What Good Actually Looks Like in Manufacturing in 2026. <https://www.fabrico.io/blog/oeec-benchmarks-by-industry-manufacturing-2026/>
- Aberdeen Strategy & Research. Industrial downtime cost benchmarks. (Finding: average industrial manufacturer loses ~\$260,000 per hour of unplanned downtime, all-in.) Cited in multiple industry summaries including <https://www.infodeck.io/resources/blog/unplanned-downtime-trillion-dollar-crisis/> and <https://reliamag.com/articles/cost-unplanned-downtime-manufacturing/>
- Vanson Bourne / Senseye (Siemens). Manufacturing downtime survey. (Finding: ~82% of companies experiencing unplanned downtime reported events lasting an average of four hours, costing roughly \$2 million per incident.) Summarized at <https://www.teamsense.com/blog/cost-of-downtime-manufacturing>
- Industry composite benchmark drawn from Siemens, ABB, Vanson Bourne, and Innovapptive analyses. (Finding: average manufacturer experiences ~25 downtime incidents per month and ~800 hours of unplanned downtime per year.) See <https://www.arda.cards/post/the-alarming-costs-of-downtime-how-lost-production-time-threatens-your-bottom-line-in-2025> and <https://www.innovapptive.com/blog/cost-of-unplanned-downtime-in-manufacturing>

PM compliance & reliability KPIs

- CMMS-vendor benchmark consensus on PM compliance (90% world-class). Sources include: Coast (Preventive Maintenance Compliance Guide, 2025) <https://coastapp.com/blog/preventive-maintenance-compliance/> ; Fiix (PM Compliance) <https://fiixsoftware.com/maintenance-metrics/preventive-maintenance-compliance/> ; MaintainX (Planned Maintenance Percentage) <https://www.getmaintainx.com/learning-center/planned-maintenance-percentage> ; OxMaint (PMP Benchmark) <https://www.oxmaint.com/blog/post/planned-maintenance-percentage-benchmark>
- Limble CMMS. (2025). Why PM Compliance Doesn't Mean Less Reactive Maintenance. (Finding: reactive organizations average 64% unplanned work vs. 36% in preventive-focused environments.) <https://limble.com/blog/pm-compliance-still-reactive-maintenance>
- Reliabilityweb. Benchmarking research on global maintenance practice mix — typical preventive vs. reactive distribution and target ratios (15–20% time-based PM, 25–30% predictive, ~10% reactive). https://reliabilityweb.com/articles/entry/benchmarking_a_better_understanding

Maintenance spend & RAV benchmarks

- Society for Maintenance & Reliability Professionals (SMRP). Best Practices Metric 5.4.1: Total Maintenance Cost as a Percentage of Replacement Asset Value. (World-class benchmark: 2–3% MC/RAV.) <https://smrp.org/>
- CMMS-vendor MC/RAV benchmark consensus. Sources include: Fiix (MC/RAV Guide) <https://fiixsoftware.com/maintenance-metrics/mcrav/> ; Limble (Replacement Asset Value) <https://limble.com/learn/replacement-asset-value> ; Traction (RAV Definition & Calculator) <https://traction.com/en/blog/replacement-asset-value-rav-what-is-it> ; ServiceChannel (Balancing RAV with Maintenance Cost) <https://servicechannel.com/blog/balance-replacement-asset-value-maintenance-cost/>

Workforce & skills gap

- The Manufacturing Institute & Deloitte. (2024). State of the Manufacturing Workforce. (Projection: 1.9 million unfilled U.S. manufacturing jobs by 2033 of 3.8 million openings.) <https://themanufacturinginstitute.org/the-state-of-the-manufacturing-workforce-in-2025-20621/> ; analysis at <https://www.manufacturingdive.com/news/manufacturing-labor-shortage-2033-deloitte-mi-report-2024/713133/>
- U.S. Bureau of Labor Statistics. Occupational Outlook Handbook — Industrial Machinery Mechanics, Machinery Maintenance Workers. (Projection: ~53,000 annual openings 2023–2033, 16% growth.) <https://www.bls.gov/ooh/installation-maintenance-and-repair/industrial-machinery-mechanics-and-maintenance-workers.htm>
- Lightcast / Area Development. (2025). The Workforce Bottleneck in America's Manufacturing Revival. (Finding: ~2.9M annual skilled-trades openings vs. ~1.25M qualified graduates; 1.7M annual shortfall; ~2.4 openings per machinist graduate, ~4 per maintenance worker.) <https://www.areadevelopment.com/skilled-workforce-STEM/q4-2025/the-workforce-bottleneck-in-americas-manufacturing-revival.shtml>
- World Economic Forum. (2025). Future of Jobs Report 2025. (Finding: 40% of core manufacturing/supply chain skills will change in 3–5 years; 54%+ of incumbent workers will need upskilling by 2030.) <https://www.weforum.org/stories/2025/04/indiana-college-manufacturing-talent-skills-gap/> and <https://www.weforum.org/stories/2025/06/manufacturing-tech-usability/>

Safety, compliance & combustible dust

- National Fire Protection Association. NFPA 654: Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids. <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=654>
- National Fire Protection Association. NFPA 664: Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities. <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=664>
- National Fire Protection Association. NFPA 652: Standard on the Fundamentals of Combustible Dust. (Requires Dust Hazard Analysis; review every 5 years.) <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=652>
- Occupational Safety and Health Administration. (2023, January 30). Directive CPL 03-00-008: Revised Combustible Dust National Emphasis Program. https://www.osha.gov/sites/default/files/enforcement/directives/CPL_03-00-008.pdf ; supporting hazard communication guidance at <https://www.osha.gov/sites/default/files/publications/3371combustible-dust.pdf>
- U.S. Chemical Safety and Hazard Investigation Board. (2006). Combustible Dust Hazard Study. (Documented 281 dust incidents 1980–2005 with 119 fatalities; basis for OSHA NEP and ongoing enforcement focus.) <https://www.csb.gov/>

Equipment-specific operations & maintenance

- Vector Solutions / RedVector. Box Plant Basics: Flexo Folder-Gluers (training course). <https://www.vectorsolutions.com/courses/box-plant-basics-flexo-folder-gluers/>
- TAPPI. Cleanup Procedures for Flexo Folder Gluer / Rotary Die Cutters (technical information sheet). <https://www.complianceonline.com/cleanup-procedures-for-flexo-folder-gluer-rotary-die-cutters-standards-500727-prdp>
- TAPPI. Test Methods T 811 (Edge Crush Test) and T 804 (Box Compression Test).
- BW Papersystems. G-Grafix Flexo Folder Gluer technical documentation. <https://www.bwpapersystems.com/products/machine/new/g-grafix>
- Industry technical references on starch viscosity targets (35–40 second range) and corrugator operating practice.

Industry associations & standards bodies referenced throughout

- Fibre Box Association (FBA). <https://www.fibrebox.org/>
- AICC — The Independent Packaging Association. <https://www.aiccbox.org/>
- TAPPI — Technical Association of the Pulp and Paper Industry. <https://www.tappi.org/>
- Society for Maintenance & Reliability Professionals (SMRP). <https://smrp.org/>
- National Fire Protection Association (NFPA). <https://www.nfpa.org>
- Occupational Safety and Health Administration (OSHA). <https://www.osha.gov/>
- U.S. Chemical Safety and Hazard Investigation Board (CSB). <https://www.csb.gov/>
- U.S. Bureau of Labor Statistics (BLS) — Occupational Outlook Handbook. <https://www.bls.gov/ooh/>
- The Manufacturing Institute. <https://themanufacturinginstitute.org/>
- Plant Engineering & Plant Services magazines — annual maintenance survey reporting

ABOUT KELLY INDUSTRIAL SERVICES

We didn't write this report to sell you services. We wrote it because the corrugated industry has needed a single, focused benchmark resource for plant operations leaders, and we're in a position to publish one. That said, if any of the chapters above resonated with where your plant is, here's what we do and how we work.

Who We Are

Kelly Industrial Services is a nationwide industrial facility services company serving the corrugated, paper, manufacturing, and food and beverage industries for more than 30 years. We provide specialized cleaning, painting, coatings, and dust remediation services to facilities across the lower 48 states. Our customer base includes International Paper, Georgia-Pacific, Mercedes, and a long list of other industry leaders who choose us for the work that requires specialization beyond what general contractors deliver.

What We Do



NFPA 654 / 664 combustible
dust remediation



Dry ice (CO₂) blasting



Industrial machinery cleaning



Conveyor and pit cleaning



Industrial coatings and
facility painting



Roof coatings and
high-structure maintenance



Boiler painting



Floor and safety striping

How We Work

Three things distinguish how we partner with corrugated plants:

No Subcontractors

Every technician on your site is a full-time, trained, drug-tested Kelly Industrial employee — never outsourced contractors. In a corrugated plant, the difference between a properly executed deep cleaning and a poor one shows up months later in OEE, compliance, and safety performance. We refuse to outsource that risk.

Nationwide Reach

We operate across the lower 48 states. For multi-plant operators, this means the same team, the same standards, and the same documentation across every site you run — something subcontractor-broker contractors structurally cannot deliver.

Built For Tight Schedules

Most of our work fits into your scheduled maintenance windows — nights, weekends, holiday shutdowns. We can typically mobilize within 48–72 hours for unplanned needs. We understand that in corrugated, downtime is the cost we're managing against, not adding to.

What Working With Us Looks Like

Most engagements with Kelly Industrial start one of two ways:

1. A specific project — a planned outage cleaning, a coatings refresh, a one-time dust remediation to clear an audit finding. We scope, schedule, and execute, and you decide whether ongoing partnership makes sense.
2. A broader facility services partnership — typically structured as scheduled deep cleanings (quarterly or semi-annual), planned coatings work tied to your capital plan, and rapid-response capability for unplanned needs. This is the model that works best for most multi-plant operators.

Get In Touch



888-422-2623



www.kellyindustrialservices.com



Kelly Industrial Services