MCP SERVER | NO CODE | CLOUD HOSTED

Grain Direction Restrictor MCP for AI Agents

Optimizing Plywood Cutting and Bin Packing Constraints

The Grain Direction Restrictor enforces strict material grain rules when cutting plywood. It prevents waste-inducing errors by calculating the true footprint of pieces based on their required horizontal or vertical orientation during complex bin packing.

A+ Quality Score 100/100

plywood | cutting-optimization | bin-packing | grain-direction | manufacturing-constraints

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vinkius.com/mcp/grain-direction-restrictor

SCAN TO VIEW

The connectivity layer between AI and the world's software.

Vinkius sits between AI and every application. All communication passes through Vinkius Cloud via the Model Context Protocol (MCP) — with governance, observability, and security at every layer.

Your AI Connections Run Through Vinkius Cloud

The world's largest managed MCP catalog

Vinkius is the connectivity layer where AI connects to the software your business already runs. We handle the hosting, the security, the credentials, the uptime — you get agents that actually do things.

We operate the world's largest managed MCP catalog. Major SaaS platforms, CRMs, databases, and cloud providers — running, monitored, production-ready. This MCP server is hosted and maintained by the Vinkius Cloud for AI Agents.

> *The agent doesn't manage credentials, doesn't manage uptime, doesn't manage security. Vinkius does.*
>
> — Architecture principle

Four Pillars of the Vinkius Runtime

01 — Security by design

Credentials stay encrypted at rest via AES-256. The AI agent never touches raw keys — they're injected into a sandboxed V8 isolate at runtime. Actions are logged, and connections have an emergency kill switch.

02 — Built on MCP Fusion

This MCP server was built with **MCP Fusion**, the open-source framework (Apache 2.0) that powers the entire Vinkius catalog. Schema-as-firewall strips undeclared fields, compiled PII redaction runs at zero overhead, and cryptographic lockfiles produce git-diffable audit trails.

03 — Deterministic observability

Eight immutable metrics per endpoint: request volume, p95 latency, error rate, active connections, cost attribution. A live payload feed logs every tool call with mutation detection.

04 — Autonomous operations

Servers are deployed, monitored, and patched autonomously. New capabilities and security patches ship weekly. Zero-downtime deployments ensure continuous availability across all managed MCP servers.

AES-256	Ed25519	24h TTL	V8 Isolate
Encryption at rest	PKI vault signatures	Ephemeral session keys	Sandboxed execution

One Token. Instant Access.

Every MCP server on Vinkius is accessed through a **Connection Token**. Tokens are generated in the cloud dashboard and produce a unique MCP endpoint URL. Paste this URL into any MCP-compatible client — no SDK required.

A single token can serve **multiple AI clients simultaneously**, or you can issue separate tokens per client for granular access control. Each token tracks its own request count, last activity timestamp, and can be individually enabled or revoked.

MCP ENDPOINT

```
https://edge.vinkius.com/{token}/mcp
```

Claude · Cursor · VS Code · Windsurf · Grok · Gemini

Security Is the Architecture

Security in Vinkius is not a feature — it's the foundation of the runtime. The gateway enforces multiple independent protection layers between AI agents and third-party APIs.

01 — Ed25519 PKI Vault

Every workspace has an Ed25519 Master Key. Session keys are generated ephemerally (24h TTL) and signed by the Master Key. Credentials never leave the vault boundary.

02 — V8 Isolate Sandboxing

Tool code runs inside isolated-vm V8 isolates with 64 MB memory caps and per-request timeouts. No filesystem access, no network access except through the SSRF-guarded fetch bridge.

03 — SSRF Guard

All outbound HTTP requests are DNS-resolved and validated before execution. Private IP ranges (10.x, 172.16-31.x, 192.168.x, AWS metadata 169.254.x) are blocked at the network layer.

04 — DLP & PII Redaction

A ResponseGuard pipeline intercepts every tool response. Configurable redaction patterns strip sensitive fields (emails, SSNs, card numbers) before data reaches the AI agent.

05 — Cryptographic Audit Trail

Every request is signed into a SHA-256 hash chain with Ed25519 signatures. Events form a tamper-proof, SIEM-exportable forensic record.

06 — Honeytoken Trap System

Phantom credentials are injected into isolated environments. If a honeytoken is used outside Vinkius infrastructure, the server is quarantined instantly.

Emergency Kill Switch

EU AI Act Art. 14(1) Compliant

The kill switch is an **emergency halt** mechanism — not a simple toggle. When triggered, it executes three actions atomically:

01 — Server deactivated

The MCP server is immediately taken offline across the entire cluster.

02 — All tokens revoked

Every connection token is invalidated. Total lockout — reconnection blocked until new tokens are issued.

03 — WebSocket connections killed

Active connections terminated via Redis pubsub broadcast. Propagates to every runtime node in the cluster.

Full Visibility. Zero Guesswork.

The Vinkius cloud dashboard includes a full MCP Governance suite — real-time analytics and security controls for production AI operations.

Control Plane

KPI dashboard with request volume, latency, success rate, token consumption, and AI-generated operational briefings.

Agent Activity

Which AI clients are connecting, how often, and what they're doing — real-time session tracking.

FinOps

Cost tracking per tool, payload compression savings, budget optimization signals, and consumption trends.

Tool Health

Slowest and most error-prone tools, with actionable root-cause insights and performance baselines.

Firewall & DLP

PII redaction activity, sensitive data protection counters, and security event timeline.

Incident Log

Error trends, failure rates, status-code breakdowns, and forensic audit trail access.

> Get started at **cloud.vinkius.com** — connect your AI agent in under 60 seconds.

Grain Direction Restrictor MCP

3 tools available
Cloud-hosted on Vinkius

Cutting wood and plywood accurately is hard because you can't just rotate a piece arbitrarily; the structural integrity depends entirely on maintaining the grain direction. This connector solves that problem for manufacturing optimization. Instead of manually checking every single dimension against stock sheet limits, your AI client handles the complex geometry. It uses specialized algorithms to calculate how much space a piece actually takes up when its grain is locked in place. You can process groups of pieces or check individual components, ensuring everything fits within the raw material dimensions and structural requirements. With Vinkius, you connect this capability directly into your workflow, letting your agent handle the geometry checks so you don't waste time on impossible cuts.

Core Capabilities

01 — Assess batch constraints

Checks an entire group of pieces to see if they meet maximum required dimensions and structural validity.

02 — Calculate piece footprint

Determines the effective space a single piece needs based on its grain orientation (horizontal or vertical).

03 — Verify component fit

Confirms whether any isolated piece of plywood will physically fit inside standard stock sheet dimensions.

One Click on Vinkius — From Prompt to Execution

Available at **vinkius.com/mcp/grain-direction-restrictor** — connect your AI agent in three steps.

01 You provide the system with a set of raw material pieces and the size of the available stock sheets.

02 The MCP calculates the required effective footprint for each piece, respecting the grain direction constraints, and then checks these against the overall sheet dimensions.

03 Your AI client returns a detailed report on which individual components fit, or if an entire batch violates structural rules.

The bottom line is that your agent doesn't just check size; it understands how material properties constrain geometry when planning cuts.

Built For

This MCP targets woodworkers, manufacturing engineers, and operations planners who deal with optimizing materials like plywood. If you spend time manually checking cutting layouts for grain-specific waste, this is for you.

Nesting Engineer

Uses the MCP to validate complex cut patterns before sending them to the CNC machine, guaranteeing material yield and structural compliance.

Operations Planner

Checks incoming batches of ordered components against current inventory stock sheets to prevent over-ordering or unexpected waste.

Material Scientist/Consultant

Runs simulations to determine the theoretical maximum yield from a given sheet size while adhering to grain direction rules for different material types.

What Changes When You Connect

01 Stop wasting material on impossible cuts. Use the `validate_single_piece` tool to instantly confirm if a component fits before planning.

02 Reduce manual checking time drastically. The MCP handles complex grain geometry calculations, letting your agent manage structural constraints automatically.

03 Maximize yield potential. By using `get_oriented_dimensions`, you calculate the true effective footprint of pieces, not just their raw length and width.

04 Plan entire runs in one go. Run `evaluate_batch_constraints` to check an entire set of parts for compliance with stock sheet limitations simultaneously.

05 Avoid costly mistakes. You eliminate waste-inducing errors common in complex bin packing algorithms where rotation is restricted by material properties.

Real-World Applications

Checking if custom furniture parts fit a single sheet

A millworker needs to know if three different components, each with specific grain directions, can all be cut from one 4×8 plywood sheet. The agent uses `validate_single_piece` repeatedly and then runs `evaluate_batch_constraints` to confirm the entire set is viable.

Calculating space for variable components

An operations planner has a batch of parts where some must be oriented vertically and others horizontally. The agent uses `get_oriented_dimensions` on each part type, giving accurate effective footprints to plan the optimal layout.

Optimizing large-scale pallet cuts

A factory needs to cut thousands of standardized parts from massive sheets. Running `evaluate_batch_constraints` against a predefined set of common part types ensures that no single sheet contains invalid or non-compliant cuts.

Patterns to Avoid

Assuming pieces can be rotated freely

✗ AVOID

A user tries to place a 10×50 piece in a layout, ignoring the fact that the grain runs the length. They calculate its area but forget the structural constraint.

✓ INSTEAD

You must first use `get_oriented_dimensions` to find the correct footprint (e.g., 50×10). Then, you can feed those calculated dimensions into `evaluate_batch_constraints` for accurate planning.

Checking pieces one by one manually

✗ AVOID

The engineer checks piece A, then piece B, then piece C... wasting time and risking human error when the batch gets large.

✓ INSTEAD

Instead of individual checks, group all your parts into a list. Use `evaluate_batch_constraints` to scan the entire collection at once for maximum required dimensions and general validity.

Ignoring stock sheet limits

✗ AVOID

The user designs a perfect layout but forgets that one piece is slightly too long, exceeding the raw material width.

✓ INSTEAD

Before finalizing anything, run `validate_single_piece` on every component. This tool immediately flags any part that exceeds the available stock dimensions.

The Right Fit

Use this MCP when your cutting problem is governed by material science constraints, specifically grain direction (plywood, lumber). You need to know if rotating a piece changes its effective size or structural validity. Don't use it if you are simply optimizing for volume without considering material orientation; basic geometric solvers will suffice then. If the primary bottleneck is ensuring every single component fits within the sheet's hard limits, run `validate_single_piece`. If you need to assess a full collection of parts at once, use `evaluate_batch_constraints` instead.

Grain Direction Restrictor MCP for Plywood Cutting Optimization

When planning plywood cuts in a shop environment, the process is tedious. You have to constantly switch between calculating the area and checking if the grain direction allows the piece to be rotated or cut without creating structural weakness. This means endless manual checks: 'Does this dimension fit? Can I flip it? Will flipping it waste too much material?'

With this MCP, your agent handles that complex geometry instantly. You give it the raw dimensions and the sheet size; you get back a guaranteed layout plan that respects intrinsic grain directions, telling you exactly what cuts are physically possible.

Grain Direction Restrictor MCP for Bin Packing Material Constraints

The biggest manual drain is the 'batch check.' You have a list of 50 required components, and you need to confirm they all fit together on one stock sheet. Manually running fifty individual checks is time-consuming and prone to error.

Now, just pass that batch into the system. It runs `evaluate_batch_constraints` and gives you a single 'all clear' or a pinpoint list of parts that violate structural rules—period.

Grain Direction Restrictor: 3 Tools for Plywood Bin Packing Optimization

These tools allow you to validate individual parts, calculate oriented dimensions, or assess entire batches against structural and size limits.

#	TOOL	DESCRIPTION
01	`evaluate_batch_constraints`	Scans an entire group of pieces, checking them for maximum required dimensions and general validity.
02	`get_oriented_dimensions`	Calculates the effective footprint a piece requires based on whether its grain runs horizontally or vertically.
03	`validate_single_piece`	Verifies if one specific, individual component can fit within standard stock sheet dimensions while respecting material rules.

See It in Action

Real prompts you can use once this MCP is connected to your AI agent through Vinkius Cloud.

U I need to check if a 30cm x 75cm part with horizontal grain will fit in my standard 240×120 sheet.

Assessment Status: ✅ Compatible. The effective footprint required for the piece is 30cm (width) by 75cm (length). This easily fits within the 240cm x 120cm stock dimensions.

U Which parts can I cut from this sheet? We have pieces that are 50×120, and another set at 30×80.

Batch Analysis: The available sheet size is 240cm x 120cm. **Result:** You cannot fit all parts. The combination of the two sets creates a structural conflict. Specifically, the required dimensions for the combined group exceed the stock width by 5cm.

U Tell me the actual size needed for this piece if I orient it vertically.

Orientation Calculation: For the component measuring 40cm x 100cm, when oriented vertically (grain running up), the effective footprint is calculated as follows: Width: 40cm; Length: 100cm. This calculation accounts for material stress and structural needs.

Frequently Asked Questions

01 **How does Grain Direction Restrictor handle complex plywood cutting layouts?**

It solves the layout problem by respecting physics, not just math. It ensures that every piece's required dimensions are calculated based on its grain orientation (horizontal or vertical), preventing waste and structural failure.

02 **Can I use this MCP to check if one specific component fits in a sheet?**

Yes, you can. Use the tool designed for single components; it checks that an individual piece adheres to both size constraints and material grain direction rules against your stock dimensions.

03 **Is Grain Direction Restrictor good for optimizing large groups of parts?**

Absolutely. If you have a whole batch of items, the MCP can assess all of them at once. It will tell you if the group meets structural requirements or if specific pieces are causing violations.

04 **Does Grain Direction Restrictor only work for plywood?**

No. While it's optimized for wood and plywood, its core function is enforcing material grain constraints in any cutting optimization scenario where rotation matters.

05 **What kind of dimensions does this MCP use for calculating cuts?**

It uses the effective footprint—the true space a piece occupies after factoring in its required grain orientation. This is much more accurate than just using raw measurements.

Go Live in 60 Seconds

Get your connection token from **cloud.vinkius.com**, then paste the endpoint URL into any MCP-compatible client.

YOUR MCP ENDPOINT

```
https://edge.vinkius.com/[TOKEN]/mcp
```

CLIENT	WHERE TO CONFIGURE
Claude AI	Profile → Customize → Connectors → "+" → Add custom connector → Paste endpoint
Cursor	Settings → Features → MCP Servers → "+ Add New MCP Server" → Type: SSE → Paste endpoint
VS Code	Ctrl/Cmd+Shift+P → "MCP: Add Server" → add `"grain-direction-restrictor": { "url": "…" }`
Windsurf	MCP Settings → `mcp_settings.json` → Add endpoint URL
ChatGPT	Settings → Tools & plugins → Add MCP server → Paste endpoint
Gemini	Extensions → Add MCP Server → Paste endpoint URL

ASK AN AI ABOUT THIS

Let your preferred AI explain this MCP server

- Ask ChatGPT
- Ask Claude
- Ask Perplexity
- Ask Gemini
- Ask Grok

READY TO CONNECT

Grain Direction Restrictor is live on Vinkius Cloud.

Get your connection token, paste it into your AI agent, and start building. No SDK. No deployment. Just results.

Start at cloud.vinkius.com →

vinkius.com · support@vinkius.com

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