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TECHNICAL GUIDES

Vibrating Screen G-Force Calculation: Optimizing Stroke and Speed Settings

Calculate optimal G-force for vibrating screens. Stroke, speed, and angle settings for different materials and applications.

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The difference between a vibrating screen that efficiently classifies material at 95%+ accuracy and one that blinds, plugs, and requires constant cleaning often comes down to a single parameter: G-force. This acceleration value—the result of stroke length and operating speed working together—determines whether particles stratify properly, whether near-size material separates efficiently, and whether your screen media survives the shift. Understanding G-force calculation enables operators to optimize screening performance without the trial-and-error approach that wastes time and reduces productivity.

Vibrating screens are often treated as simple "shaking boxes" when in reality they are precision machines where physics dictates performance. The gravitational acceleration (G-force) generated by the screen's motion must fall within specific ranges for the material being processed. Too low, and material simply rides along without separating. Too high, and particles bounce chaotically, near-size material is thrown rather than screened, and wear accelerates dramatically.

This guide covers G-force fundamentals, calculation methods, optimization strategies for different applications, and troubleshooting approaches when screens underperform. Whether you're commissioning a new screen, diagnosing efficiency problems, or optimizing an existing installation, mastering G-force principles transforms screening from an art into a science.

G-Force Fundamentals

What is G-Force in Screening?

G-force represents the peak acceleration experienced by material on the screen deck, expressed as multiples of gravitational acceleration (9.81 m/s^2). When we say a screen operates at 4G, material on the deck experiences momentary acceleration four times greater than gravity.

This acceleration has critical effects:

- **Stratification:** Higher G separates fines from coarse material, bringing near-size particles to the deck surface
- **Particle Throw:** Acceleration overcomes particle inertia, preventing material from simply lying on the deck
- **Blinding Prevention:** Acceleration throws wedged particles clear of apertures
- **Conveying:** The combination of G-force and screen angle determines material travel speed

The G-Force Formula

G-force is calculated from stroke length and rotational speed:

```
G = (4 × π² × N² × S) / (2 × g × 1000)

Simplified formula:
G = (N² × S) / 1790

Where:
- G = acceleration in multiples of gravity (dimensionless)
- N = operating speed in RPM
- S = stroke (total displacement) in mm
- g = gravitational acceleration (9.81 m/s²)
- π = 3.14159

Example:
For a screen operating at 900 RPM with 10mm stroke:
G = (900² × 10) / 1790 = (810,000 × 10) / 1790 = 4.53G
```

Understanding Stroke Measurement

Screen stroke refers to the total displacement of the screen deck during one complete vibration cycle:

STROKE TYPE	DEFINITION	TYPICAL RANGE	APPLICATION
Peak-to-Peak Stroke	Total distance from extreme position to opposite extreme	6-15mm	Standard measurement method
Amplitude	Half the stroke (distance from center to extreme)	3-7.5mm	Some European specifications
Circular Motion	Diameter of circular path	6-12mm	Circular throw screens
Linear Motion	Linear displacement at angle	8-15mm	Linear/banana screens

Important: Always clarify whether specifications refer to stroke (peak-to-peak) or amplitude (half-stroke). Confusing these doubles the calculated G-force error.

G-Force Ranges for Different Applications

Application-Specific G-Force Requirements

APPLICATION	OPTIMAL G-FORCE RANGE	TYPICAL SPEED (RPM)	TYPICAL STROKE (MM)	NOTES
Heavy Scalping (>50mm)	3.0-4.0G	750-850	10-14	Higher stroke for large material movement
Primary Screening (20-75mm)	3.5-4.5G	800-900	9-12	Balance of efficiency and throughput
Secondary Screening (6-25mm)	4.0-5.0G	850-950	8-10	Higher G for stratification
Fine Screening (<10mm)	4.5-6.0G	900-1050	6-9	Higher acceleration for fine separation
Dewatering	5.0-7.0G	1000-1200	4-7	High G forces water through deck
High-Frequency Screening	4.0-8.0G	1200-2000	2-4	Very short stroke, high speed
Wet Screening	3.5-4.5G	800-900	8-11	Moderate G prevents water splash

Why Different Applications Need Different G-Forces

Large Particle Applications (Lower G, Longer Stroke):

- Large particles have high inertia—need longer stroke for adequate displacement
- Excessive G causes particles to bounce unpredictably rather than stratify
- Longer stroke provides gentler handling, reducing media wear

Fine Particle Applications (Higher G, Shorter Stroke):

- Fine particles have low inertia—respond quickly to acceleration changes
- Higher G forces particles through apertures before they blind
- Shorter stroke allows higher frequency, more screening opportunities per unit time

Wet Screening (Moderate G):

- Water adds mass and changes particle behavior
- Excessive G causes water splash and carryover
- Must balance screening efficiency against water management

Calculating Optimal Screen Parameters

Method 1: Target G-Force, Solve for Speed

When you know the required G-force and have fixed stroke (common when replacing motors or drives):

```
N = √(G × 1790 / S)

Example: Target 4.5G with existing 9mm stroke
N = √(4.5 × 1790 / 9) = √(895) = 29.9 Hz × 60 = 895 RPM
```

Method 2: Target G-Force, Solve for Stroke

When motor speed is fixed (common with direct-drive screens):

```
S = (G × 1790) / N²

Example: Target 4.5G with 900 RPM motor
S = (4.5 × 1790) / 900² = 8055 / 810000 = 9.9mm stroke
```

Method 3: Verify Current Operation

Measure actual stroke and speed, calculate operating G:

```
Measured values:
- Speed: 870 RPM (measured with tachometer)
- Stroke: 11mm (measured with vibration analyzer or dial indicator)

G = (870² × 11) / 1790 = (756,900 × 11) / 1790 = 4.65G
```

Stroke Measurement Techniques

METHOD	EQUIPMENT	ACCURACY	PRACTICAL NOTES
Vibration Analyzer	Accelerometer + analyzer	±0.1mm	Most accurate; provides speed and stroke simultaneously
Dial Indicator	Magnetic base dial gauge	±0.2mm	Requires screen stopped for setup, measured while running
Stroke Card	Pre-printed graduated card	±0.5mm	Visual method; observer holds card against screen frame
Laser Tachometer	Laser device + reflector	Speed only	For speed; combine with stroke card for G calculation
Stroboscope	Adjustable flash rate device	±0.3mm	"Freeze" motion visually; read stroke from scale

Factors Affecting G-Force Selection

Material Properties

MATERIAL PROPERTY	G-FORCE ADJUSTMENT	REASON
High Bulk Density	Increase G by 5-10%	Heavier material needs more force to move
High Moisture	Decrease G by 10-15%	Wet material splashes at high G; may blind at any G
Sticky/Clay Content	Increase G by 15-25%	Higher acceleration breaks adhesion; consider heated screens
Friable Material	Decrease G by 10-15%	Excessive G degrades material, creates unwanted fines
Elongated Particles	Increase G by 10-15%	Need extra force to orient and pass through apertures
High Near-Size %	Increase G by 10-20%	More stratification needed to present near-size to apertures

Screen Design Factors

SCREEN FACTOR	IMPACT ON G-FORCE	NOTES
Inclination Angle	Higher angle allows lower G	Gravity assists material flow; typical 15-25°
Deck Length	Longer decks can use lower G	More retention time compensates for lower efficiency
Deck Number	Lower decks need proportionally higher G	Reduced material bed thickness on lower decks
Media Type	Rubber/poly media tolerate higher G	Wire mesh may fatigue at sustained high G
Motion Type	Linear motion typically needs 10-15% higher G	Circular motion has inherent throwing action

Screen Angle and Material Flow

Screen inclination affects required G-force and material travel speed:

SCREEN ANGLE	TRAVEL SPEED FACTOR	G-FORCE ADJUSTMENT	BEST APPLICATION
10-15°	Slow	Higher G needed	Accurate sizing, difficult materials
15-20°	Moderate	Standard G	General aggregate screening
20-25°	Fast	Lower G acceptable	High throughput, easy materials
25-30°	Very Fast	Lowest G	Scalping, easy separation
Horizontal (0°)	Controlled by G	Highest G needed	Horizontal screens, banana screens

Troubleshooting with G-Force Analysis

Problem: Poor Screening Efficiency

Symptoms: Excessive oversize in undersize product; undersize material in oversize product

G-FORCE CONDITION	TYPICAL CAUSE	EVIDENCE	SOLUTION
G too low	Worn bearings, slipping belts, motor issue	Measured G <3.5; material rides deck without separating	Restore stroke/speed to specification
G too high	Incorrect weights, excessive speed	Measured G >6; material bounces, doesn't stratify	Reduce speed or stroke
G correct but uneven	Unbalanced weights, structural issue	Different G readings across deck width	Rebalance, check structure
G within range but insufficient	Wrong G for application	Calculation shows within range but performance poor	Increase G toward upper range for application

Problem: Screen Media Blinding/Plugging

Symptoms: Apertures blocked by near-size particles or material buildup

CAUSE	EVIDENCE	G-FORCE SOLUTION	OTHER CONSIDERATIONS
G too low	Particles not ejecting from apertures	Increase G by 15-25%	Check for structural resonance limiting G
G acceptable, aperture wrong	High near-size percentage	Increase G or change aperture	May need different media type (self-cleaning)
Moisture-related	Blinding worse in humid/wet conditions	Reduce G 10%; add heated/spray bars	Consider polyurethane tensioned media
Material adhesion	Clay or fines coating media	Maximum practical G + ball deck cleaning	Consider rubber balls between decks

Problem: Excessive Screen Media Wear

Symptoms: Premature wear, broken wires, torn polyurethane

G-FORCE ISSUE	EVIDENCE	SOLUTION
G too high for media type	Fatigue failure, uniform wear	Reduce G; switch to heavier-duty media
G inconsistent	Wear concentrated in specific areas	Balance screen; check mounting

G-FORCE ISSUE	EVIDENCE	SOLUTION
G correct but media inappropriate	Wear rate exceeds material processed calculation	Change media type; consider rubber or polyurethane

Conclusion

G-force is the fundamental parameter controlling vibrating screen performance, yet it's often overlooked in favor of adjusting feed rates, changing media, or accepting suboptimal efficiency. Every screening problem—blinding, carryover, excessive wear, inadequate throughput—has a G-force component that can be measured, analyzed, and optimized.

The calculations presented here transform G-force from a theoretical concept into a practical tool. Measure your current operation, calculate actual G-force, compare to application requirements, and adjust systematically. The 30 minutes invested in proper measurement and calculation often solves problems that have frustrated operations for months.

Remember: G-force is the product of stroke and speed working together. When troubleshooting or optimizing, consider both parameters. A screen running low on G-force might need more speed, more stroke, or both—the specific solution depends on equipment limitations and application requirements.

Master G-force principles, and you master vibrating screen performance. The physics are straightforward; the results are transformative.

Topics: #Screening #Technical #vibrating screen

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