

FluxGen Industries Ltd.

Forging Tomorrow's Welds

Airdrie, Alberta, Canada

<http://www.fluxgenindustries.ca>

Technical Specifications & Manufacturing Process

Manufacturing Process Overview

FluxGen Industries employs advanced manufacturing processes to produce high-quality submerged arc welding (SAW) flux and specialty alloys. The manufacturing system is designed for flexibility, quality, and scalability.

Core Manufacturing Philosophy:

- Quality First: Every batch meets or exceeds industry standards
  - Consistency: Reproducible processes and standardized procedures
  - Flexibility: Ability to produce custom formulations
  - Efficiency: Optimized processes for competitive production costs
  - Sustainability: Environmentally responsible manufacturing practices
- Production Capabilities:** FluxGen's phased production approach allows for controlled growth while maintaining quality standards.

Production Capacity by Phase

Phase	Monthly Capacity (kg)	Facility Type	Automation Level	Staffing
Phase 1 - Pilot	60,000	Pilot line (semi-automated)	TBD	2-3 operators per shift
Phase 2 - Scale	180,000	Automated line + bulk handling	TBD	2-3 operators per shift
Phase 3 - Expansion	320,000	Fully automated plant	TBD	2-3 operators per shift

Manufacturing Principles:

- Batch processing for quality control and traceability
- Statistical process control for consistency
- Preventive maintenance for equipment reliability

- Continuous improvement and lean manufacturing practices
- Environmental compliance and waste minimization

**Technology Integration:**

- Process control systems for parameter monitoring
- Quality management system with full traceability
- Inventory management with real-time tracking
- Automated testing and certification processes

## Detailed Manufacturing Process Flow

### Manufacturing Process Steps

Step	Process	Equipment	Key Parameters	Quality Controls
1	Raw Material Receiving	Scales, testing equipment	Weight, moisture, composition	Incoming inspection, certificates
2	Material Storage	Silos, climate control	Temperature, humidity	Inventory tracking, FIFO rotation
3	Weighing & Batching	Automated batching system	Accuracy $\pm 0.1\%$	Scale verification, batch records
4	Blending	High-intensity mixers	Mix time, uniformity	Sample testing, homogeneity check
5	Agglomeration	Pelletizing equipment	Binder ratio, pellet size	Size distribution, strength testing
6	Drying	Rotary dryers	Temperature, residence time	Moisture content, temperature profile
7	Screening	Vibrating screens	Particle size distribution	Size analysis, rejects handling
8	Final Testing	Laboratory equipment	Chemistry, performance	Full analysis per AWS standards
9	Packaging	Automated packaging	Weight, seal integrity	Package inspection, labeling
10	Shipping	Warehouse systems	Inventory accuracy	Order verification, logistics tracking

### Critical Process Parameters

**Raw Material Specifications:**

- Silica Sand:  $\text{SiO}_2$  content 95%+, particle size 50-200 mesh
- Dolomite: MgO content 20-22%, CaO content 30-35%
- Calcite:  $\text{CaCO}_3$  content 95%+, low sulfur content
- Ferroalloys: Specific chemistry per application requirements
- Moisture content: <0.5% for all raw materials

**Blending Parameters:**

- Mix time: 15-30 minutes depending on batch size
- Uniformity: Coefficient of variation <3%
- Binder addition: 2-5% by weight (sodium silicate solution)
- Temperature control: Ambient to 50°C maximum

**Agglomeration Controls:**

- Pellet size: 0.7-4.0 mm (per AWS classification)
- Green strength: >5 kg crush strength
- Moisture: 8-12% after pelletizing
- Sphericity: >80% for optimal flow characteristics

**Drying Specifications:**

- Final moisture: <0.5%
- Temperature: 300-600°C (product dependent)
- Residence time: 45-90 minutes
- Cooling rate: Controlled to prevent thermal shock

# Equipment Specifications & Layout

## Major Equipment Specifications

Equipment	Specification	Capacity	Power Req.	Key Features
Batch Mixer	High-intensity paddle mixer	1,000 kg/batch	75 kW	Variable speed, jacketed
Pelletizing Disc	Inclined disc pelletizer	500 kg/hr	15 kW	Variable angle & speed
Rotary Dryer	Co-current flow design	800 kg/hr	120 kW	Temperature control, dust collection
Vibrating Screen	Multi-deck screening	1,200 kg/hr	5 kW	Multiple size fractions
Packaging System	Automated bagging	20 bags/min	10 kW	Weight control, heat sealing
Dust Collection	Baghouse filtration	15,000 CFM	25 kW	Pulse-jet cleaning
Raw Material Silos	Steel construction	50 ton capacity	N/A	Level monitoring, discharge gates
Process Control	PLC-based system	Plant-wide	5 kW	HMI interface, data logging
Quality Lab	Testing equipment	Full analysis	15 kW	Automated analyzers, calibration
Material Handling	Conveyors, elevators	2,000 kg/hr	30 kW	Enclosed, dust-tight design

## Facility Layout & Infrastructure

### Production Area Layout:

- Raw Material Storage: 2,000 sq ft with segregated bays
- Processing Area: 3,500 sq ft with overhead crane service
- Packaging & Warehouse: 2,500 sq ft with shipping dock
- Quality Laboratory: 400 sq ft with fume hoods and testing equipment
- Maintenance Shop: 600 sq ft with spare parts storage
- Office Space: 1,000 sq ft for administration and technical staff

### Utility Requirements:

- Electrical: 480V, 3-phase, 500 kW total demand
- Natural Gas: 2 million BTU/hr for dryer operation
- Compressed Air: 100 SCFM at 100 PSI for pneumatic systems
- Water: 500 gal/day for process and cleaning
- Wastewater: Treatment system for process water recycling

**Environmental Systems:**

- Dust collection with 99.5% efficiency baghouse filters
- Noise control with equipment enclosures and barriers
- Spill containment and emergency response systems
- Storm water management and runoff control

**Safety & Security:**

- Fire suppression system with dry chemical and water spray
- Emergency shower/eyewash stations throughout facility
- Lockout/tagout procedures for equipment maintenance
- Security system with access control and surveillance

**Quality Control & Testing Procedures**

**Quality Control Testing Matrix**

Test Category	Parameter	Test Method	Frequenc y	Acceptance Criteria
Chemical Analysis	SiO $\blacksquare$ , Al $\blacksquare$ O $\blacksquare$ , CaO, MgO	XRF Spectroscopy	Every batch	AWS A5.17 limits
Physical Properties	Particle size distribution	Sieve analysis	Every batch	0.7-4.0 mm range
Physical Properties	Moisture content	Loss on drying	Every batch	<0.5%
Physical Properties	Bulk density	Standard cup method	Every batch	1.4-1.8 g/cm $^3$
Welding Performance	Tensile strength	AWS test procedure	Weekly	>70 ksi minimum
Welding Performance	Charpy impact	Impact testing	Weekly	>27 J at -29°C
Welding Performance	Chemical analysis of weld metal	Spectrographic	Weekly	Customer specification
Quality Systems	Traceability records	Document review	Continuous	100% traceability
Quality Systems	Calibration status	Equipment check	Monthly	All equipment current
Environmental	Dust emissions	Stack testing	Quarterly	<20 mg/m $^3$ outlet

## Quality Management System

**ISO 9001:2015 Quality Management System:** FluxGen implements a comprehensive quality management system based on ISO 9001:2015 principles, ensuring consistent product quality and continuous improvement.

**Document Control:**

- Standard Operating Procedures (SOPs) for all processes
- Work instructions with revision control
- Quality forms and checklists
- Training records and competency assessments
- Change control procedures for process modifications

**Statistical Process Control:**

- Control charts for key process parameters
- Capability studies for critical characteristics
- Trend analysis and corrective action procedures
- Process improvement initiatives based on data analysis

**Supplier Quality:**

- Approved supplier list with qualification criteria
- Incoming material inspection and testing
- Supplier audits and performance monitoring
- Certificate of analysis verification
- Non-conforming material procedures

**Customer Quality:**

- Customer specification review and approval
- Custom product qualification procedures
- Customer feedback and complaint handling
- Performance monitoring and reporting
- Continuous improvement based on customer input

## Traceability System Requirements

Traceability Element	Information Captured	System	Retention Period
Raw Materials	Supplier, lot #, analysis, receipt date	ERP System	7 years
Production Batches	Recipe, parameters, operators, equipment	MES System	7 years
Quality Testing	Test results, analyst, equipment, dates	LIMS	10 years
Finished Product	Batch records, packaging, shipping	ERP System	7 years
Customer Complaints	Investigation, root cause, corrective action	Quality System	10 years
Calibration Records	Equipment, standards, frequency, results	Calibration System	Equipment life + 3 years



# Product Catalog & Technical Specifications

## Standard Product Portfolio

Product Code	Description	Application	Key Specifications	AWS Classification
FeCr	Ferro-Chromium	Stainless and hardfacing flux	Cr 60-72%, C 0.03-8.0%, Si 1.5% max...	FeCr
FeCrC	High-Carbon Ferro-Chrome	Hardfacing and wear-resistant flux	Cr 60-70%, C 6-8%, Si 2% max, Fe ba...	FeCrC
FeMn	Ferro-Manganese	SAW flux deoxidizer and alloying	Mn 65-82%, C 0.1-7.0%, Si 0.5-2.0%,...	FeMn
FeMo	Ferro-Molybdenum	High-temperature steel welding	Mo 60-70%, C 0.1% max, Si 1.0% max,...	FeMo
FeNb	Ferro-Niobium	HSLA and pipeline steels	Nb 60-70%, C 0.1% max, Si 3% max, A...	FeNb
FeNi	Ferro-Nickel	Corrosion-resistant welding	Ni 15-35%, C 0.03-2.0%, Si 0.5-3.0%...	FeNi
FeSi	Ferro-Silicon	SAW flux deoxidizer and silicon addition	Si 72-78%, C 0.1-0.5%, Al 1.5% max,...	FeSi
FeSiMn	Silico-Manganese	Combined deox and alloying	Mn 65-68%, Si 16-21%, C 1.5-2.5%, F...	FeSiMn
FeTi	Ferro-Titanium	Deoxidizer and grain refiner	Ti 25-75%, C 0.1% max, Al 4% max, F...	FeTi
FeV	Ferro-Vanadium	High-strength steel welding	V 50-80%, C 0.1-0.5%, Si 1.5% max, ...	FeV

## Product Categories & Applications

**Standard SAW Flux Products:** FluxGen manufactures a comprehensive range of SAW flux products designed for various welding applications and base metal combinations.

**Basic Flux (F6XX Series):**

- Applications: General structural welding, ship building
- Base metals: Carbon and low alloy steels
- Characteristics: Good slag detachability, smooth bead profile
- Typical chemistry: CaO-SiO<sub>2</sub> based system



**Low Hydrogen Flux (F7XX Series):**

- Applications: Pressure vessels, critical structures
- Base metals: Medium to high strength steels
- Characteristics: Low diffusible hydrogen, excellent toughness
- Typical chemistry: CaF<sub>2</sub>-CaO-SiO<sub>2</sub> system

**Neutral Flux (F6A2 and similar):**

- Applications: Multi-pass welding, build-up operations
- Base metals: Various carbon and alloy steels
- Characteristics: Minimal weld metal dilution
- Typical chemistry: SiO<sub>2</sub>-MnO based system

**Specialty Alloy Products:**

- Weather-resistant steel flux for Corten applications
- Stainless steel flux for corrosion-resistant applications
- High-strength steel flux for offshore and arctic applications
- Custom formulations for specific customer requirements

**Typical Mechanical Properties**

Property	F6A2-EM12K	F7A2-EM12K	F7A4-EM12K	Test Method
Tensile Strength (min)	70 ksi	80 ksi	90 ksi	AWS A4.2
Yield Strength (min)	58 ksi	68 ksi	78 ksi	AWS A4.2
Elongation (min)	22%	20%	18%	AWS A4.2
CVN Impact @ -29°C	27 J	40 J	35 J	AWS A4.2
Diffusible Hydrogen	<8 ml/100g	<4 ml/100g	<4 ml/100g	AWS A4.3
Slag Removal	Excellent	Good	Good	Visual assessment
Bead Appearance	Smooth	Smooth	Smooth	Visual assessment

**Certifications & Compliance Roadmap**

**Certification Timeline & Requirements**

Certification	Certifying Body	Phase	Target Date	Status	Cost Estimate
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WHMIS/MSDS Documentation	Health Canada	Phase 1	March 31, 2026	planned	CAD \$5,000.00
CWB Prequalification	Canadian Welding Bureau	Phase 1	June 30, 2026	planned	CAD \$15,000.00
AWS A5.17	American Welding Society	Phase 2	October 31, 2026	planned	CAD \$28,000.00
ISO 9001	ISO	Phase 2	December 31, 2026	planned	CAD \$35,000.00
AWS A5.23	American Welding Society	Phase 2	February 28, 2027	planned	CAD \$30,000.00
ISO/IEC 17025 Lab Setup	ISO	Phase 2	April 30, 2027	planned	CAD \$45,000.00
Lloyd's Register Certification	Lloyd's Register	Phase 3	October 31, 2027	planned	CAD \$30,000.00
DNV Certification	Det Norske Veritas	Phase 3	January 31, 2028	planned	CAD \$30,000.00
BV Certification	Bureau Veritas	Phase 3	April 30, 2028	planned	CAD \$28,000.00
ABS Export Certification	American Bureau of Shipping	Phase 3	August 31, 2028	planned	CAD \$32,000.00

## Regulatory Compliance Framework

### Product Certifications:

#### **AWS (American Welding Society) Certification:**

- A5.17 Specification for Carbon Steel Electrodes and Fluxes for SAW
- A5.23 Specification for Low-Alloy Steel Electrodes and Fluxes for SAW
- Product qualification testing and ongoing surveillance
- Certificate of Conformance for each product shipment

#### **CWB (Canadian Welding Bureau) Approval:**

- CWB W47.1 Certification of Companies for Welding
- Product approval for use in Canadian pressure vessel applications
- Quality system certification and periodic audits
- Canadian compliance for government and institutional projects

#### **ISO 9001:2015 Quality Management:**

- Third-party certification of quality management system
- Annual surveillance audits and continuous improvement
- Customer confidence and international market access
- Process standardization and documentation requirements

#### **Environmental Compliance:**

- Provincial environmental permits for manufacturing operations
- Air emissions compliance with Alberta Environment standards
- Waste management and recycling program implementation
- Environmental management system (ISO 14001 consideration)

**Workplace Safety:**

- Alberta OHS compliance and safety management system
- WHMIS training and hazardous material management
- Emergency response planning and equipment
- Regular safety audits and incident reporting systems

**Certification Implementation Timeline**

Milestone	Timeline	Activities	Dependencies
Facility Permits	Months 1-3	Building permits, environmental approvals	Site selection, design completion
Quality System	Months 4-6	ISO 9001 implementation, documentation	Staff hiring, training completion
Product Testing	Months 7-9	AWS qualification testing, approvals	Equipment commissioning, pilot production
Certifications	Months 10-12	Third-party audits, certificate issuance	Quality system maturity, test results
Market Entry	Month 12+	Customer trials, commercial sales	All certifications complete

# Raw Material Requirements & Sourcing

## Raw Material Specifications & Sources

Raw Material	Specification	Monthly Usage (tons)	Primary Supplier	Backup Source
Silica Sand	SiO <sub>2</sub> >95%, 50-200 mesh	15-20	Western Canada Sand	US Silica
Dolomite	MgO 20-22%, CaO 30-35%	8-12	Graymont Ltd (BC)	Carmeuse (US)
Calcite	CaCO <sub>3</sub> >95%, low sulfur	5-8	Omya Canada	Mississippi Lime
Ferromanganese	Mn 75-80%, C <0.75%	2-3	Ferroglobe Canada	Eramet Norway
Ferrosilicon	Si 70-75%, low Al	1-2	Elkem Canada	Ferroglobe
Sodium Silicate	SiO <sub>2</sub> /Na <sub>2</sub> O ratio 3.2-3.4	1-2	PQ Corporation	Kapp-Chemie
Packaging Materials	Multi-wall kraft bags	2,000 bags	Mondi Bags Canada	International Paper

## Supply Chain Strategy

**Canadian Content Maximization:** FluxGen prioritizes Canadian suppliers to achieve 80-90% domestic content, supporting local economy and reducing supply chain risk.

**Supplier Qualification:**

- Technical capability assessment and quality system audits
- Financial stability evaluation and business continuity planning
- Logistics capability and delivery performance tracking
- Environmental and social responsibility compliance
- Long-term partnership potential and strategic alignment

**Inventory Management:**

- 30-45 day safety stock for primary raw materials
- 15-30 day inventory for secondary materials
- Seasonal purchasing for cost optimization
- Just-in-time delivery for packaging materials
- Strategic stockpiling for supply disruption mitigation

**Quality Assurance:**

- Certificate of analysis for every shipment
- Incoming inspection and testing procedures
- Supplier corrective action processes
- Alternative source qualification and approval
- Continuous monitoring of supplier performance

**Cost Management:**

- Annual supply agreements with price escalation clauses
- Volume commitments for preferential pricing
- Market intelligence and commodity price monitoring
- Transportation optimization and freight consolidation
- Waste reduction and material utilization improvement

## Technical Standards & Industry Compliance

### Applicable Technical Standards

Standard	Scope	Compliance Level	Testing Requirements	Certification Body
AWS A5.17	Carbon Steel SAW Electrodes/Flux	Full Compliance	Chemical, mechanical, radiographic	AWS
AWS A5.23	Low Alloy Steel SAW Materials	Full Compliance	Chemical, mechanical, impact	AWS
CSA W48	Filler Metals for Welding	Full Compliance	Performance qualification	CSA Group
ASME Sec II-C	Welding Rods/Electrodes/Filler	Full Compliance	Material properties	ASME
API 5L-X	Line Pipe Welding Materials	Selective Compliance	Sour service testing	API
ISO 14341	Wire Electrodes and Deposits	Reference Standard	Chemical analysis	ISO
EN 760	SAW Consumables	Reference Standard	European test methods	EN

### Performance Testing Protocols

**Welding Performance Testing:** All FluxGen products undergo comprehensive performance testing according to AWS A4.2 procedures:

- **Tensile Testing:** Ultimate and yield strength determination per ASTM A370
- **Bend Testing:** Root and face bend testing for ductility assessment
- **Impact Testing:** Charpy V-notch testing at specified temperatures
- **Hardness Testing:** Brinell hardness of weld metal and heat-affected zone
- **Chemical Analysis:** Weld metal composition verification
- **Radiographic Testing:** Weld quality and discontinuity assessment

**Special Testing Requirements:**

- **Hydrogen Testing:** Diffusible hydrogen measurement per AWS A4.3

- **Sour Service Testing:** For oil & gas applications per NACE MR0175
- **Low Temperature Testing:** Impact testing down to -46°C for arctic applications
- **Fatigue Testing:** Cyclic loading performance for dynamic applications
- **Corrosion Testing:** Salt spray and atmospheric exposure testing

**Process Qualification:**

- Welding Procedure Specification (WPS) development
- Procedure Qualification Record (PQR) testing
- Welder Performance Qualification support
- Pre-qualified joint design assistance
- Technical support for customer applications

**Documentation & Certification:**

- Material Test Reports (MTR) for each batch
- Certificate of Compliance with applicable standards
- Welding consumable data sheets with performance data
- Application guides and technical bulletins
- Welding procedure recommendations