# WHITE PAPER

Hot Dip Galvanizing Fume Extraction and Filtration System

**Dueltron System Integration (Pty) Ltd**
Dust Extraction and Pressurisation Systems (DEPS)
Automation Systems (DAS)

**Project Title:** High-Efficiency Fume Extraction and Filtration System
**Client:** Confidential – Hot Dip Galvanizing Specialist
**Project Lead:** Dueltron System Integration (Pty) Ltd
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# Executive Summary

Dueltron System Integration (Pty) Ltd was commissioned to design, supply, install, and commission a complete fume extraction and air pollution control system for a newly commissioned Hot Dip Galvanizing (HDG) plant.

The objective was to effectively capture and treat aggressive white fumes generated during the galvanizing process, ensuring full compliance with the National Environmental Management: Air Quality Act (Act 39 of 2004), while delivering a reliable, energy-efficient, and low-maintenance system suitable for continuous industrial operation.

The engineered solution integrated a total enclosure extraction hood, a high-capacity baghouse filtration system, pre-lime dosing for acid gas neutralisation, and a variable-speed induced draft fan. Advanced automation and control were provided through an in-house PLC and VSD system engineered by Dueltron Automation Systems (DAS).

Post-commissioning emission testing confirmed exceptional performance, with particulate matter and hydrogen chloride levels significantly below legislated limits. This project reinforces Dueltron's ability to deliver compliant, high-performance, and production-ready environmental engineering solutions for demanding industrial processes.

# 1. Introduction

Hot dip galvanizing is a critical corrosion-protection process for steel, involving immersion in molten zinc at high temperatures. This process generates a visible white fume consisting of particulate matter and acidic gases, primarily hydrogen chloride (HCl).

Uncontrolled emissions present serious risks, including:

- Operator health hazards
- Corrosion of structural steel and equipment
- Non-compliance with environmental legislation

Effective control of these emissions requires precise airflow engineering, robust filtration technology, and reliable automation. This white paper outlines how Dueltron engineered and implemented a fully compliant fume extraction and treatment system for a new HDG installation.

# 2. Project Objectives

The system was engineered to meet the following key objectives:

1. Complete Fume Capture
   Capture galvanizing fumes directly at the zinc bath using a total enclosure extraction design.

2. Effective Filtration and Neutralisation
   Remove particulate matter and neutralise acidic gases prior to atmospheric discharge.

3. Regulatory Compliance
   Ensure full compliance with NEMA: Air Quality Act (2004), Subcategory 4.22.

4. Operational Efficiency
   Deliver a durable, low-maintenance system with reduced energy and consumable usage.

5. Turnkey Delivery
   Provide an integrated mechanical, electrical, and automation solution from design to commissioning.

# 3. System Design and Technical Specifications

Dueltron engineered a fully integrated fume extraction and filtration system designed for stable airflow, high capture efficiency, and long-term operational reliability.

The project was completed on time, within scope, and within budget, with positive client feedback regarding system performance and execution quality.

## 3.1 Fume Capture and Ducting

- Total enclosure extraction hood designed to maintain negative pressure over the zinc bath
- Hood geometry developed in collaboration with the client to allow safe operational access
- Ducting velocities maintained above 18 m/s to prevent particulate settling and condensation

Primary fume extraction ducting and access platforms servicing the galvanizing enclosure.

High-velocity ducting designed to maintain particulate transport and prevent condensation.

# 3.2 Baghouse Filtration System

- Filter Capacity: 400 high-performance filter bags
- Filter Media: Acid-resistant membrane suitable for hygroscopic and corrosive conditions
- Pulse-Jet Cleaning:
    - 40 × 2” Mecair pulse valves
    - Full-immersion header tanks delivering 25–30% increased pulse volume
- Cleaning Control:
    - Pulse-on-Demand system activated by differential pressure
    - Reduced compressed air consumption and extended filter life

Internal view of the baghouse filtration system showing installed high-performance filter bags.

Baghouse filtration unit designed for acidic, high-humidity galvanizing fumes.

## 3.3 Pre-Lime Dosing System

- Calcium hydroxide injected upstream of the baghouse
- Neutralises hydrogen chloride gas within the airstream
- Converts acidic gases into a stable solid captured by the filter media

## 3.4 Conveying and Discharge System

- Inline screw conveyor beneath baghouse hoppers
- Secondary screw conveyor at 90° incline
- Rotary vane feeder acting as an airlock to prevent air ingress and pressure loss

Screw conveyor system for controlled removal of collected particulate matter.

## 3.5 Extraction Fan and System Performance

- Fan Type: Backward-curved centrifugal fan
- Capacity: 19.64 $m^3/s$ at transport velocity of 18 m/s
- Motor: 90 kW, 4-pole
- Control: Variable Speed Drive (VSD)

The VSD reduces airflow during non-processing periods, delivering substantial energy savings while maintaining system stability.

## 3.6 Automation and Control

- System controlled by a DAS-engineered PLC
- In-house control panel design and build
- Real-time monitoring of system pressures, airflow, and drive speed
- Operator-friendly interface for setpoint control and diagnostics

Dueltron Automation Systems (DAS) control panel incorporating PLC and VSD control.

## 3.7 Stack and Access Platform

- 19-metre discharge stack for effective dispersion
- Mandatory stack sampling point installed at regulatory height
- Fully compliant OSH access system including stairs, walkways, and handrails

## 3.8 Corrosion Protection

- Internal surfaces coated with high-specification 3-part anti-acid coating
- External surfaces protected with coastal-grade paint system
- Designed for long-term resistance to aggressive galvanizing environments

# 4. Implementation

Project execution required close coordination between Dueltron's internal engineering teams:

- **DEPS:** Mechanical design, fabrication, and installation
- **DAS:** Electrical design, PLC programming, and VSD configuration

Installation and commissioning were completed efficiently with minimal disruption to plant commissioning activities.

# 5. Performance and Results

Independent stack emission testing confirmed outstanding system performance:

| Parameter | Legal Limit | Measured Result |
|---|---|---|
| Particulate Matter (PM) | 25 mg/Nm$^3$ | 5.09 mg/Nm$^3$ |
| Hydrogen Chloride (HCl) | 0.25 mg/Nm$^3$ | <0.14 mg/Nm$^3$ |

Performance Summary:

- Emissions significantly below regulatory limits
- Stable system operation under continuous load
- Reduced operating costs through VSD and pulse-on-demand cleaning
- High client satisfaction with system reliability and compliance

# 6. Conclusion

This hot dip galvanizing project demonstrates Dueltron's ability to engineer and deliver complex, regulation-driven industrial air solutions.

By combining robust mechanical design, advanced filtration technology, and intelligent automation, Dueltron delivered a system that ensures:

- Full environmental compliance
- Improved workplace safety
- Energy-efficient operation
- Long-term system reliability

Dueltron remains a trusted partner for dust extraction, fume control, and industrial air-engineering solutions across heavy industry.

## About Dueltron System Integration (Pty) Ltd

Dueltron delivers integrated automation and air-engineering solutions, including dust extraction, fume control, ventilation, electrical panels, and industrial automation systems. Our multidisciplinary teams engineer high-performance systems focused on safety, compliance, and reliability.

## Disclaimer

This document is provided for informational purposes only. System specifications, performance data, and regulatory limits are project-specific and may vary depending on application and operating conditions.