



SF₆ Gas Field Reference

Handling, Analysis, and Gas Management

A practical reference for substation and switchgear maintenance professionals responsible for SF₆ gas management programs.

Test Equipment + Field Services + Technical Advisory
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Why SF₆ Gas Condition Matters

Sulfur hexafluoride (SF₆) serves two critical functions in high and medium voltage equipment: it insulates energized components from ground, and it quenches the arc when a circuit breaker interrupts fault current. It is used in gas-insulated switchgear (GIS), SF₆ circuit breakers, gas-insulated transformers, and ring main units throughout the utility and industrial power infrastructure.

When SF₆ is in good condition, it performs both functions reliably. When it degrades, the consequences are serious: reduced dielectric strength raises the risk of internal flashover, and decomposition products damage gaskets, contacts, and insulators. Left unmanaged, degraded SF₆ is both a safety hazard and a reliability threat.

A well-run SF₆ gas management program monitors three things: moisture content, gas purity, and the presence of decomposition products. Each tells you something different about the condition of the equipment and the gas inside it.

Why This Matters Now

SF₆ has a global warming potential (GWP) of 23,500 times that of CO₂ over a 100-year period (IPCC AR5). Utilities and industrial operators face increasing regulatory pressure under EPA requirements to minimize atmospheric release. Proper gas management means testing, not venting.

What to Test and When

The Three Critical Parameters

Every SF₆ gas management program must track these three measurements:

1. **Moisture (Dewpoint):** Water in the gas phase reduces dielectric strength and reacts with decomposition products to form hydrofluoric and sulfurous acids, which attack metal surfaces and gaskets. Measure as dewpoint in degrees Celsius at operating pressure.
2. **SF₆ Purity:** Measures the percentage of SF₆ in the gas mixture. New SF₆ should be greater than 99.9% pure. Contamination with air (N₂/O₂) reduces insulating performance and can indicate leakage.
3. **Decomposition Products (SO₂, H₂S):** When SF₆ is exposed to an electrical arc, it breaks down into sulfur-based compounds. SO₂ is the primary marker for arcing. H₂S indicates decomposition with moisture present. Concentrations above threshold values indicate the equipment has experienced a fault or severe arcing.

When to Test

- New equipment commissioning: Verify gas quality before energizing. Check dewpoint, purity, and pressure. Document baseline readings.
- Routine maintenance intervals: Per IEC 60480 and manufacturer guidance, typically every 3-5 years for switchgear not subject to frequent switching.
- After switching operations or fault events: Any time the breaker has interrupted a significant fault current, test for decomposition products before re-energizing.
- After suspected or confirmed leaks: Test purity and moisture before returning to service.

- Annual monitoring for high-duty-cycle equipment: Breakers performing frequent switching should be monitored more often.

Field Note

Do not wait for a visual inspection to identify gas quality problems. SF₆ deterioration is invisible. By the time you smell decomposition products, you already have a significant problem. Test on a schedule, not on instinct.

Understanding Your Readings

The table below reflects IEC 60480 (2004) guidelines for SF₆ in service. Always cross-reference with your equipment manufacturer's specifications, as some OEMs set tighter limits.

Parameter	Acceptable	Marginal	Action Required
Moisture (Dewpoint)	< -36°C at 20°C	-36°C to -25°C	> -25°C at 20°C
SF ₆ Purity (%)	> 97%	90% to 97%	< 90%
SO ₂ (Decomp.)	< 12 ppmv	12 to 50 ppmv	> 50 ppmv
H ₂ S (Decomp.)	< 5 ppmv	5 to 15 ppmv	> 15 ppmv
HF (Decomp.)	< 25 ppmv	25 to 75 ppmv	> 75 ppmv
CF ₄ (Impurity)	< 500 ppmv	500 to 1000 ppmv	> 1000 ppmv

What to Do Based on Results

4. **All readings acceptable:** Document results, return to service, schedule next test per your program interval.
5. **Moisture in marginal range:** Investigate the source. Recheck after 30 days. If trending upward, plan to dry or replace the gas.
6. **Moisture in action range:** Remove from service. Recover gas using certified recovery equipment. Dry or recycle. Inspect internal components for corrosion before returning to service.
7. **Decomposition products above threshold:** Do not re-energize without thorough inspection. Recover gas, inspect contacts and insulators, test contact resistance, and document findings.
8. **Low purity (< 90%):** Check for leaks. Recover gas, test the recovered gas, recycle or replace as appropriate.

Safety and Regulatory Compliance

Handling Hazards

- SO₂ (sulfur dioxide) is toxic at low concentrations. OSHA PEL is 5 ppm (8-hour TWA).
- SF₄, SOF₂, and HF are produced during arcing. HF (hydrofluoric acid) causes severe burns with delayed symptoms.
- Decomposed SF₆ mixtures have a distinctive pungent odor. If you smell this when opening equipment, treat it as a toxic atmosphere.

Safety Rule

Never open an SF₆ compartment after a fault without proper PPE: supplied-air respirator or SCBA, chemical-resistant gloves, and face shield. Allow gas to fully recover using certified equipment before any internal inspection.

Regulatory Requirements

- Section 608 of the Clean Air Act prohibits knowingly venting SF₆ to the atmosphere during maintenance, service, repair, or disposal of electrical equipment.
- EPA GHG reporting rules (40 CFR Part 98, Subpart DD) require many utilities to report SF₆ emissions annually.
- Track gas quantities received, stored, used, and recovered. Document all handling events. Never vent to atmosphere.

Equipment Overview

Gas Analysis Instruments

Measurement Need	Field Instrument	Lab/Bench Instrument
Dewpoint/moisture only	Portable chilled-mirror hygrometer (RH Systems field units)	RH Systems 973-SF6 (lab reference standard)
Purity (SF ₆ %)	Thermal conductivity sensor field unit	Gas chromatograph
Decomp. products (SO ₂ , H ₂ S)	Electrochemical sensor portable unit	Gas chromatograph / mass spec
Full analysis	Multi-parameter portable analyzer	RH Systems 973-SF6

Gas Recovery and Recycling

- **Recovery:** Extracts SF₆ from equipment and stores in a transport/storage cylinder. Required before any work that opens a gas compartment.
- **Recycling/Purification:** Recovered gas passes through filters and dryers to restore it to specification. Far more economical than disposing of degraded gas.
- **Recovery efficiency:** Per EPA requirements, certified recovery equipment must capture gas to 99% or better.

Synecom recovery systems are designed for SF₆ handling in utility and substation environments. Models range from compact single-cylinder units for switchgear maintenance to high-capacity systems for large GIS installations.

Building Your Gas Management Program

9. **Inventory:** Know how much SF₆ is in each piece of equipment, in storage, and how much you buy and recover each year. This is the foundation of EPA compliance reporting.
10. **Testing schedule:** Assign test intervals to each piece of SF₆ equipment based on voltage level, age, duty cycle, and last test results. Put it in your CMMS.
11. **Calibrated instruments:** Gas analysis instruments must be calibrated against known reference standards. Annual calibration is standard practice.
12. **Documentation:** Record date, equipment ID, gas quantity, all measured parameters, and technician name for every test and every gas handling event. Keep records for at least five years.

Need Help With Your SF₆ Gas Program?

ProgUSA supplies RH Systems precision gas analyzers and Synecom SF₆ recovery, recycling, and handling equipment to utilities, NETA firms, and industrial operators across the United States.

We help you select the right tool for your application, support commissioning and training, and provide U.S.-based calibration and repair from our Florida service center.

Equipment Selection Tell us your voltage class, equipment type, and whether you need field or lab capability. We'll help you find the right fit.	Calibration and Repair All instruments we supply are supported by our Florida service center. U.S.-based. No shipping to Europe.	SF₆ Training On-site and web-based training on SF ₆ handling, safety, and gas quality interpretation. Available for your team.
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