



Integrated Solutions and Services

I MIRALECH

Company Overview Headquarters: Tulsa, OK, USA Manufacturing: (4) North America/(4) International Certifications: QS9001:2015/TS14001/ATEX/DNV/SIRA/USDA

(III) MIRALECH



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MIRATECH Group

- Natural Gas & Diesel Reciprocating Engine Exhaust Aftertreatment & Noise Solutions
- Oxidation & 3-Way System Solutions
- Diesel Particulate Filters (DPF)
- Selective Catalyst Reduction System (SCR)
 - Natural Gas
 - Diesel
- Engine Exhaust Sound Attenuation Reduction to 60 dBA



Exhaust Silencers

e EmeraChem.

Catalyst Manufacturing

VAPORPHASE

Exhaust Waste Heat Recovery

- Industrial, OEM, Engine, Rail and Marine Acoustic Solutions
- High Performance Engine Exhaust Silencers to 60dBA Attenuation
- Vent Silencers (Gas and Steam)
- Intake Silencers
- Blowdown Silencers
- Positive Displacement Blower Silencers
- Centrifugal Blower & Fan Silencers
- Vacuum Truck Silencers
- Custom OEM Silencer Solutions
- Complete Range of Exhaust System Accessories

- Natural Gas & Diesel Reciprocating Engine & Gas Turbine Catalyst Solutions
- Oxidation & 3-Way Catalyst
- Custom & OEM Specific Catalyst
- Custom Formulations for OEM Engines
- Custom Substrates for Specific Applications
- Catalyst Testing & Reconditioning
- Gas Turbine Catalyst Support Structures

- Reciprocating Engine Exhaust Waste Heat Recovery Systems
- Steam System
 Low Pressure
 High Pressure
- Cogeneration or Combined Heat & Power (CHP) Engineered Solutions
- Hot Water System
- Integration with Emissions and/or Silencing Solutions

Engineered to Perform[™]

Markets Served













Products

- Catalytic Solutions
- Emission Housings & Silencers
- Engine Silencers
- Process Silencers
- Heat Recovery Silencers
- Integrated Emissions Systems
- System Components



Capabilities

- Global Sales Support
- Engineering
 - Research & Development
 - Design & Application Engineering
- Aftermarket

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- Technical Support
- Parts and Service
- Field Service/Commissioning
- Catalyst Service Centers



Power Generation

Emission reduction, sound attenuation and exhaust gas heat recovery for emergency, prime power and demand response engines.

- OEM Engine Dealer Network
- End-users (Financial Institutions, Critical Care Facilities, Data Centers, Universities etc.)

Gas Compression

Emission control solutions for natural gas compression stations in transmission pipeline systems.

- Original Equipment Integrators and Packagers
- NG Midstream, Processing and Pipeline Companies
- Engineering & Construction Companies

Industrial/OEM

Solutions for mobile and stationary engine applications and industrial exhaust systems.

- OEM and First-fit Engine Exhaust Applications
- Industrial Silencing for Process
 Industries

Marine

Solutions for commercial, research and recreational ships and off-shore applications.

- Shipyards
- Naval Architects
- Offshore O&G Production
 Applications



1



System Solutions for Power Generation Applications

Your Experienced Catalyst & Silencer Partner

MIRATECH is the expert in providing fully integrated, proven, innovative emission solutions.

Reciprocating engine power plants have cleaned up their emissions with MIRATECH catalysts and controls. Environmentally conscious engine owners around the world increasingly specify our products for the Best Available Control Technology (BACT) exhaust emission solutions, which often include not only reduced exhaust emissions but also better noise abatement.

Our engineering specialists have a comprehensive knowledge of regulations, including:

- Tier 4 Interim and Final
- RICE NESHAP
- California Air Resources Board (CARB)
- Ozone Changes Within National Ambient Air Quality Standards (NAAQS)
- U.S. State Implementation Plans
- Canadian Province Standards
- World Bank Standards
- T.A. Luft Standards

Consulting specifying engineers and developers contact MIRATECH directly to learn how their project becomes a reality. MIRATECH field representatives and distributors provide one-on-one guidance with customers who are developing the catalyst/silencer/control system solutions for any size project. In concert, customers receive support from the design stage to commissioning to ongoing operations—whatever it takes.

System Integration

MIRATECH provides total exhaust system integration, including emissions controls, exhaust heat recovery, silencing and interconnecting piping. As a single-source supplier, we take responsibility for total system back pressure, acoustic performance, emissions performance and optimum layout for the space available.

Since we design and manufacture the catalyst, heat recovery, silencer and piping components, we can optimize the system for the best performance and value for the customer. No matter how simple or complex, we can be the complete exhaust system supplier, from turbo to rain cap.

Engineered Catalyst & Silencer Emission Systems: Single-Point, Complete Solutions Done Right

Customers come to MIRATECH for the best catalyst and silencer technology available to the industrial engine business today. The lowest cost of total ownership and best uptime performance is a result of our expertise, engineering skills and product craftsmanship.

MIRATECH systems can reduce regulated exhaust stream pollutants to failsafe, first-step compliance levels for any stationary reciprocating natural gas, diesel or dual-fuel gas engine.

These pollutants include:

- Oxides of Nitrogen (NOx)
- Carbon Monoxide (CO)
- Hazardous Air Pollutants (HAPs)
- Unburned Hydrocarbons (THC)
- Volatile Organic Compounds (VOCs/NMNEHC)
- Particulate Matter (PM)





MIRATECH[®] AT-IV[™]

Active Tier 4 Final Compliant

Designed for mission critical applications

- Reduces NOx, CO, VOC and PM to Tier 4 Final or better
- Active DPF regeneration technology works regardless of exhaust temperatures
- Active self-regenerating DPF technology by Rypos. Compact design fits in engine room or on generator enclosures
- Integrated silencing 25dB(A) with options for higher attenuation

MIRATECH[®] LTR[™]

CARB Level 3+ Verified Diesel Particulate Filter System

Best in class LTR[™] (Low Temperature Regeneration) – regenerates as low as 500%260° C

- Designed for maximum reduction of particulate matter (PM) from engine exhaust - up to 97%
- · Single housing assembly contains a DOC and a passive DPF
- Reduces CO, HC, VOC, HAP and PM
- Designed for emergency backup and prime power generators
- Designed to accommodate engines sized from 37 kW to 4 MW
- Provides critical grade noise reduction, eliminating the need for a separate silencer in most applications
- Can be fitted on Tier 1 and newer engines

MIRATECH[®] Monitoring & Control Systems

In-house designed and built

- SCR Controls ACIS3
- Catalyst Monitoring Systems MIRA-MONITOR
- DPF Monitor

Control/Monitoring systems available with communications to Customer SCADA/BAS and remote diagnostics



MIRALECH

MIRATECH[®] MIRA-CUBE[™]

Tier 4 Final Compliant

Designed to offer an integrated prepackaged solution

- Compact design fits in engine room or on generator enclosures
- Efficient design offers simplified installation
- Meets U.S. EPA Tier 4 Final/Euro Stage V/T.A. Luft or better emission limits
- Can be supplied as SCR-only or DPF-only additional catalysts may be added later in order to meet future requirements
- Utilizes proven LTR[™] (Low Temperature Regeneration) DPF very low regeneration temperature (500°F/260°C)
- Integrated silencing of 30-35dBA attenuation (higher attenuations are available)





System Solutions for First-fit Gas Compression Applications

Engineered Solutions

When applications have unique or strict compliance standards, customers turn to MIRATECH for a solution. Our field-tested designs and skilled engineering staff are familiar with a range of applications from standard stock engine installations to tighter total site emissions and sound regulated projects. MIRATECH's seasoned staff works alongside our customer's engineering, applications and environmental personnel to understand their goals and challenges in order to provide the best solution for the application.

MIRATECH's standard fleet and custom engineered total exhaust system designs can integrate emissions controls, silencing, work platforms, backfire relief and interconnecting piping. As a single-source supplier, MIRATECH can take responsibility for total system back pressure, acoustic performance, emissions performance and layout for the available solution footprint.

Since we design and fabricate the catalyst, silencers and piping components ourselves, we strive to optimize each system solution to achieve the best performance and optimum value for the customer. No matter how simple or complex, we can be your complete exhaust system supplier.

- HP solutions from 20 to 20,000+
- Sound attenuation from 15 to 60 dBA
- Emissions reductions:
 - NOx up to 99% with SCR
 - CO up to 98%
 - HAPs up to 99%
 - VOCs up to 85%
- Up to three-year guaranteed emissions reductions with the MeC-BEAST[™] catalyst integration
- Custom engineered mounting orientations to fit your application

Platforms, Piping and Accessories

- Custom work platform fabrication capabilities and modular pre-engineered work platform system availability
- Carbon and stainless-steel exhaust and intake piping fabrication to fit your package layout
- Exhaust expansion bellows
- Engine exhaust backfire relief solutions
- Engine intake air-silencing solutions
- Exhaust thermal and personal protection insulation solutions

MIRATECH's high-performance catalysts and silencers are reliable with superior mechanical and thermal durability. Exhaust pipe components provide singlesource ordering and system integration. From consulting engineers and new equipment packagers to end-users who specify and purchase from MIRATECH again and again, our customers typically have a unique mixture of project concerns with their applications due to:

- Extreme Wind Speeds and Shears
- Altitude
- Ambient Temperature Swings
- Tight Noise Requirements
- Seismic Location and Codes
- Humidity Variations
- Space Limitations
- Air Permit Requirements

Our MIRATECH sales team believes that "we bring unmatched value to projects and superior industry and solution knowledge on extreme applications." End-users know this to be true as well and rely on MIRATECH's consulting sales team when questions arise.







MIRATECH® F-Line – Fleet Solution

Full turnkey low-cost solution designed for the gas compression markets' most prevalent requirements:

- Hit common emissions reduction targets
- CO reductions: minimum 93%
- HC reductions: minimum 60%
- CH2O reductions: minimum 76%
- Design for four acoustic targets:
- Industrial grade: 10-20 dBA
- Critical grade: 22-29 dBA
- Hospital grade: 27-35 dBA

System options include exhaust piping, insulation, bellows and work platforms.

MIRATECH® Quad-Tuned Silencers

Field tested up to 60 dBA attenuation; outperforms the competition.

- Designed to meet the sound attenuation market needs for high sound requirement applications
- Patent-pending innovative chamber design employs quadruple-tuned reactive components that effectively control sound
- Allows for higher sound attenuation than multiple silencers in a series and reduces risk of exhaust leaks
- Design algorithm allows tuning of the muffler to match a specific engine's environment and application for optimal performance
- Can be applied to both horizontal and ground access designs
- Each system is customized to meet the specific needs of each application

MIRATECH® Z-Flow Emission Solution

The MIRATECH ZX Series[™] (ZCS[™], ZHS[™] and ZES[™]) is an exceptional catalyst housing with an innovative design that addresses applications with higher emissions reduction targets and customer needs for site HP growth.

- Paralleled single-layer catalyst design improves exhaust flow and lowers back pressure
- Specifically designed to function with lean burn natural gas engines ranging from 1,400 to 5,000 HP

Noise control:

- ZCS: 22-25 dBA
- ZHS: 27-35 dBA
- ZES: 45-52 dBA
- Customizable for all inlet and outlet configurations

MIRATECH® Selective Catalytic Reduction (SCR) Solutions

- Reduces NOx up to 99% on NG LB reciprocating engines
- Can assist in keeping emissions under Title V limits
- Meets and can exceed new GP-5a emissions regulations
- Engineered for both emissions and sound reductions
- Customer engineered to your specific project requirements
- Systems can be designed to support multiple engines





System Solutions for Gas Compression Aftermarket Applications

The MeC-BEAST[™]

The MeC-BEAST catalyst combines the innovative technologies of two industry leaders, MIRATECH and EmeraChem, to create unprecedented emissions-control capability. For superior performance and durability, plus the industry's best warranty, you need the MeC-BEAST.

Features and Benefits

Turbulent Foil Geometry

- Eight optimized turbulent zones maximize destructive performance while reducing engine backpressure
- Maximizes HAPs exposure to catalyst substrate
- Added performance helps unit stay within permit limits longer
- For certain applications, less catalyst volume may be required to achieve the same reductions
- Optimized turbulent design reduces ash fouling and cleaning frequency
- Increased catalytic reactions provide greater potential for HAPs reductions, even in higher-BTU gas environments

Resistance Welding and Diffusion Bonding

- Gives catalyst greater mechanical stability over the thermal cycling life of the element
- Preserves the oxidized foil surface, for excellent coating adhesion (unlike brazing) and longer performance life

Increased Catalyst Surface Area and Coating Durability

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• Greater catalyst masking tolerance, for longer performance

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- Equivalent of 55 football fields of catalytic surface area on every cubic foot of catalyst
- Thermally stabilized wash coat provides greater resistance to sintering during prolonged operation at high temperatures

Increased Precious Metals Durability

- Higher tolerance to contaminants found in engine exhaust, lube oil and coolants
- Proprietary form of Pt yields super-high dispersion on the catalyst surface, for better performance and longer service life
- Advanced form of Rh, for greater service life and regenerative responsiveness to catalyst washes
- Three-year end-of-life warranty

Catalyst Service Centers

Located in major natural gas producing regions of North America: Cypress, TX; Gillette, WY; Knoxville, TN; Midland, TX; Pittsburgh, PA; Tulsa, OK.



Localized Inventory

Catalysts come in a wide variety of shapes, sizes and formulations to match a broad range of engine sizes, application and site conditions. MIRATECH has a large network of distributors and owned facilities throughout the world and maintain a large inventory of many of our catalysts.

Catalyst Performance Testing

How much performance life is left in your catalyst? Will chemical washing restore the performance?

Ask MIRATECH. Our Catalyst Service Centers feature the patented Multi-Lambda Catalyst Testing System (MLCTS). Real-world testing on your elements ensures successful operations in the field. Our dealers make this service easy to access.

Washing Stations

A precious metal catalyst is a valuable piece of equipment and deserves first-rate maintenance. Every MIRATECH-authorized dealer operates a state-of-the-art catalyst chemical washing system. Catalyst washing is a carefully controlled chemical process, and you can feel confident knowing that our process is the product of two decades of catalyst development and know-how. Before you replace your old catalyst, find your local MIRATECH dealer and insist on MIRATECH's chemical washing and regeneration process for your precious metal catalyst.

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Precious Metal Reclaim

At the end of the catalyst's service life, precious metals such as platinum, palladium and rhodium can be reclaimed and recovered, and used to manufacture replacement catalyst or redeemed for their monetary value.

Drop off or schedule a pick up from our local dealer to receive a core credit for your spent catalyst.



7

Silencer Technologies for Industrial, Process and Marine Applications



Controlling noise, especially in industrial equipment or process manufacturing plants, is not easy. Machinery such as industrial fans, large or small, high-speed positive displacement blowers, low-pressure vents, centrifugal compressors, gas turbine engines, centrifugal blowers, vacuum pumps, etc., require noise control measures to meet a facility's sound abatement requirements.

MIRATECH leads the way in high-performance acoustic solutions for these types of equipment. We are a recognized leader in the field of acoustic engineering with expertise in designing, engineering and fabricating solutions that address each customer's unique application needs.



MIRATECH manufactures an advanced range of intake and discharge silencers for blower and vacuum applications. Sized according to blower capacity and acoustic performance desired, MIRATECH silencers are designed to balance back pressure, acoustics, dimensions and cost to create optimum selections for a wide variety of blower flow and speeds.

Vent

MIRATECH also manufactures a broad range of noise reduction options for pressure gas flow required in industrial processing. Using controlled expansion and stabilization of flow, MIRATECH industrial process vent silencers can be applied to HRSG safety and pressure relief valves, boiler process or GT start up valves as well as blow down tanks where steam flows are combined before releasing to atmosphere. Whether you are an EPC, utility, processing plant or boiler OEM, we are here to help.



Marine Silencers

MIRATECH is one of the largest suppliers of exhaust silencers and accessories to the marine market offering the EM[™] and Cowl[™] brand silencer products and accessories. MIRATECH provides a broad range of exhaust silencers for each marine application, and we have solved a great number of acoustic requirements for new and repowered vessels. We work with naval architects all the way to the end-user vessel owners. You can be assured MIRATECH's marine silencers are made of the highest quality and performance guarantees. Our silencers are designed and manufactured to the highest standards and are DNV- and SIRA/ATEX-certified. MIRATECH understands that there is limited space on some vessels and its unique Cowl[™] spiral silencer solves a lot of packaging issues.

MIRATECH also provides a wide range of exhaust system accessories and piping components available to complete your system. From turbo-to-raincap; MIRATECH standard and custom product include: Engine flex connections, expansion bellows, wall thimbles, piping, tube, thermal insulation as well as a complete range of tube connections and piping flange hardware.



Silencer Solutions for Power Generation, Gas Compression and Off-highway Equipment

Exhaust systems and acoustics for reciprocating engines have their own specific set of challenges. MIRATECH has the product, tools, technology and experience to create effective solutions for your project requirements.

Compact and Low-profile

MIRATECH's compact disk and oval silencers combine high performance and compact heights.

- Critical- to extreme-grade acoustic performance
- Available in custom configurations, materials, connections, and acoustic or pressure drop requirements
- · Internally insulated to assist with overall attenuation and reduced thermal load
- · Designed specifically for genset enclosures or applications where overhead space is limited

Cowl[™] Silencers

Renowned for its compact size, maximum performance and extreme durability, the COWL silencer is optimized to suit the most demanding applications.

- Compact and lightweight design
- High insertion loss
- Configurable inlet/outlet positions
- Excellent for off-road equipment, marine or packaged engine assembly

Cylindrical and High-performance Silencers

MIRATECH has a full range of cylindrical and high-performance silencers to suit a wide variety of engine applications.

- Industrial- to extreme-grade acoustic performance
- Available in custom configurations, materials, connections, and acoustic or pressure drop requirements
- Heavy-duty steel fabrication

Silencer Sizing Tool

The MIRATECH exhaust system design and selection tool takes online support to a new level. Designed entirely in-house by MIRATECH's resident software team, the new silencer selection tool incorporates exhaust system design flexibility with the added feature of allowing users to generate sizing reports detailing acoustic performance and system back pressure. This also includes silencer and accessory drawings with the full commercial proposal document. This may sound simple, but it's a big task—so much so that MIRATECH is the only company currently operating in this space with such a complete user interface.





@EmeraChem.

Oxidation Catalyst for Gas Turbine Applications

Since 1992, we have supplied over 300 successful catalyst systems totaling over 40 gigawatts of generation capacity, including installations for:

- Utility power generation
- On-site distributed generation
- Gas compression stations

Our catalysts are custom-designed and manufactured to perform durably and economically for your application with features such as:

- High reductions of CO, VOCs and formaldehyde
- Platinum coatings for durability and poison-resistance
- Low-tempature HRSG operation
- Substrates bonded for strength
- Low back pressure
- Support structures and catalyst from 5 MW to >5,000,000 pounds-per-hour of turbine exhaust
- Performance warranties of 3 to 7 years

MIRATECH also offers catalyst maintenance services to reduce your life-cycle cost.



Custom Catalytic Solutions

MIRATECH has over 26 years of developing, patenting, commercializing, and manufacturing catalyst and nanophase surface chemistry products, including:

- Emission catalyst for reciprocating engines, turbines and industrial boilers
- Wide range of fuels—gases, liquids, waste byproducts
- Fuel reforming catalysts
- Products with set BACT, MACT and LAER
- Patents in North America, Europe and Asia

We also develop custom substrates to meet special customer requirements that include:

- Custom dimensions
- · Custom cell geometries, including turbulent foils
- · Custom back pressure requirements
- Custom flanges and accessories

MIRATECH has developed advanced substrates and catalysts for special customer applications then installed them in the field within a couple of weeks. That's what we can do for you.



Engine Exhaust Heat Recovery Silencers

Cogeneration or Combined Heat & Power (CHP) systems utilize waste heat streams that would otherwise be lost. As much as 30% of the energy input to an engine is lost through the exhaust. Recovering that energy in the form of hot water or steam can increase the overall efficiency of an engine plant to over 80%. Designed for years of service, MIRATECH's Vaporphase Exhaust Heat Recovery Silencers have the following features:

- Bare fire tube design is similar to standard fired boiler design. This makes the units easy to service and maintain by any qualified boiler shop. Units are easily cleaned with a flue brush or water wash.
- Two-pass design puts the exhaust connections at the same end of the unit, simplifying piping layout. Removable end covers provide easy access for tube cleaning/inspection.
- Available in horizontal or vertical configurations. Horizontal units are supplied with mounting saddles. Vertical units are supplied with support legs.
- Available with an internal or external bypass with either manual or automatic actuators. Automatic bypass can trim heat recovery during periods of low demand.

MIRATECH can provide the complete integrated system of emissions control waste heat recovery silencer, bypass, additional silencing (when required) and piping—turbo to rain cap.









Catalyst Testing



Staying on the cutting edge of catalyst technologies requires a full array of tools and facilities. MIRATECH has them all, and the technical team to apply them to today's challenges and create next-generation technologies.

Every day we are testing catalysts from the atomic level all the way up to performance on actual engines. Whether you have a rich-burn or lean-burn engine, gas- or diesel-fueled, oxidation, three-way, SCR, or DPF, MIRATECH has the tools and facilities to support you and lead you to strong technical solutions.

Knoxville, TN, is home to MIRATECH's catalyst manufacturing plant and catalyst technology center. We're situated in one of the great science centers of the U.S.—home to the Department of Energy's Oak Ridge National Laboratory, the University of Tennessee, the Tennessee Valley Authority, and numerous supporting technical businesses. MIRATECH has access to the most advanced analytical laboratories available anywhere, and we collaborate with these laboratories to bring benefits and value to our customers. This is where we examine the physical and chemical properties of new and used catalysts down to the atomic level.

At our Knoxville facility, we also have advanced catalyst test reactors. These computercontrolled systems non-destructively test full-size catalyst elements of all types and geometries. Only a gaseous test reactor can control and explore the effects of temperature, flow rate, gas composition and lambda independently, across a wide operating envelope. With FTIR and other advanced gas analyzers, we measure catalyst performance down to the parts-per-billion level. These test reactors are essential for developing new formulations and evaluating catalysts coming from the field. In the hands of our engineers and scientists, these reactors reveal performance details that can only be seen under carefully controlled conditions.



At our Tulsa, OK, facility you'll find MIRATECH's Innovation Center. The Center is equipped with four reciprocating engines—a lean-burn gas engine, a rich-burn gas engine, a diesel engine and a dual-fuel engine. They are outfitted with instrumentation and emissions reduction equipment such as oxidation catalysts, three-way catalysts, SCR systems and diesel particulate filters. Here, we reproduce a wide variety of engine operating conditions and evaluate catalyst performance. Our engineering team compliments these capabilities with modeling and design capabilities, including sound attenuation, CFD (Computational Fluid Dynamics) and FEA (Finite Element Analysis). The Innovation Center also serves as a resource for MIRATECH's customers and other end-users who want to duplicate and diagnose field issues.

World-class Services and Support

MIRATECH is a team of talented professionals who design and deliver quality solutions to complex emission and acoustic problems. By consistently delivering results and exceeding customer expectations, MIRATECH has become an industry leader worldwide.

MIRATECH's total customer experience management begins with well-engineered, field-proven solutions and extends throughout the lifecycle of the product, including maintenance and metal reclaim. From design and application engineering to field services and online customer support, we strive to give customers an exceptional end-toend experience.

Our passion **to do it right** guides every customer relationship. We build partnerships through performance based on one-of-a-kind needs and ensure that your engine, job site and company continue to run at their best. No project or challenge is too large or small, and we pride ourselves on providing custom solutions to meet your needs.







Global OEM approach

Matching Global OEM requirements with:

- Global Account Management
- One-part Manufacturing Regionally Where Needed

OEM Product Range

- Silencers
- Accessories
- Thermal Insulation
- Catalyst
- Full-system Integration

OEM Support Teams

- Acoustics
- Engineering
- Quality
- Operations & Capacity Planning
- Global Certifications

Project Management

- Cradle-to-Grave Project Support
- Large- & Small-scale Projects
- Site Layout Installation
- Pre-construction Support
- Installation SupportWiring Interconnects & Layout
- Site Commissioning Services & Support

Technical Support

- Worldwide Service & Support
- Training/Education
- Spare Parts Planning
- Field Service Calls
- Service & Maintenance Contracts
- Warranty Support





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