

CatTracker® Catalyst Tracking System
Daily Thermetrics Product Advantages



REACTOR THERMOMETRY

CatTracker® Catalyst Tracking System



DAILY
THERMETRICS

UNLEASH YOUR REACTOR'S with the CatTracker® Catalyst Temper

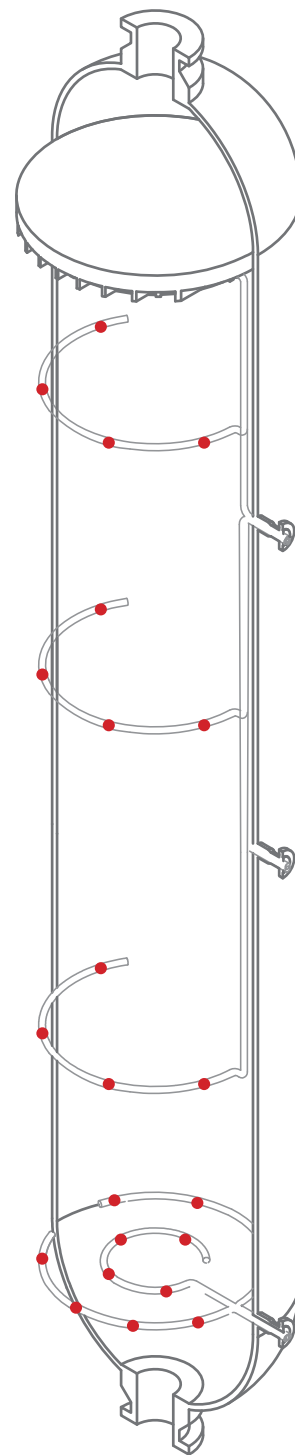
MOST ADVANCED TRACKING TECHNOLOGY

The **CATTRACKER® CATALYST TEMPERATURE TRACKING SYSTEM**, patented by Daily Thermetrics and first introduced commercially in 2001, is a proven technology with superior operational service over five continents profiling hundreds of reactors, regenerators, and fractionating columns.

The **CatTracker®**, employing patented aerospace thermocouple technology, offers the process industry the most rugged yet **flexible** temperature probes designed to be in direct contact with the process. CatTracker® temperature sensors are engineered to withstand the harshest environments and the most strenuous temperature demands.

Each CatTracker® probe consists of a mineral insulated (MI) cable which can sense temperature along its length at various predetermined locations. The CatTracker®'s multiple temperature sensing points are each independent and isolated from one another, while remaining ungrounded from the sheath. The CatTracker®'s patented design eliminates any possibility of signal interference (*due to the fact that there is **no common leg***) and provides **unsurpassed reliability** for the most demanding applications.

No currently available system can equal the CatTracker®'s performance record.



CATALYST MANUFACTURERS/PROVIDERS

ALBEMARLE
EXXONMOBIL

AXENS
HALDOR TOPSOE

CRITERION
JOHNSON MATTHEY

CHEVRON
UOP

Identified as a *Catalyst Complementary Technology* by all leading catalyst manufacturers, the **CatTracker®** precisely identifies acceptable and unacceptable temperature trends in relation to catalyst activity.

In optimizing performance, it is highly important to accurately monitor **catalyst utilization and condition**. Reliance on inadequate or poor temperature instrumentation can have a severe adverse effect on the bottom line. **Today's high activity catalysts require temperature operating tolerances that simply cannot be met with out-dated reactor profiling systems.**

Only with the most advanced, up-to-date equipment can a refiner expect to get the most from the processing unit. Employing advanced techniques and technologies give the modern refiner **an edge on productivity** as margins become an **increasing concern for profitability**.

Regardless of the type of catalyst used, the CatTracker® serves to protect the end user's investment by notifying operators of dangerous or undesired process phenomena such as hot-spots, maldistribution, and channeling.

Red Dots Indicate
CatTracker® Temperature Sensors

FIGURE 1:

Sample layout for illustration purposes only.
Type of vessel and/or sensor arrangement
may vary according to application.

NOTE: Sensor density and layout arrangement options are virtually limitless.



PERFORMANCE

ature Tracking System



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PROCESS LICENSORS & REACTOR INTERNALS PROVIDERS

AXENS	EMRE	KBR TECHNOLOGY
CDTECH	GTC TECHNOLOGY	PETROBRAS
CLG	HALDOR TOPSOE	SHELL GLOBAL SOLUTIONS
DUPONT	IMP	UOP

Unsurpassed in reliability and precision for real-time monitoring and controlling of temperature variations within a catalyst bed, the CatTracker® is now an integral part of the latest reactor design packages. More specifically the CatTracker® is approved and/or endorsed by the licensors specified above, **and is becoming mandatory in select applications.**

Within the past decade, process licensors and reactor internals providers have made significant advancements in distributor tray designs. The resulting performance improvements have enabled end users and operators to **increase throughput** of a uniform, in-spec product. In order to maximize product and effectively operate the quench systems, licensors now require a much more thorough, complete understanding of reactor bed temperatures.

With the advances made by Daily Thermetrics in thermocouple technology, the CatTracker® enables process licensors and reactor internals providers to ensure the performance guarantee that is expected by the industry.

END USERS & OPERATORS

BP	GAZPROM	PETROBRAS	SINOPEC
CHEVRON	INDIAN OIL	PETROCHINA	TOTAL
CHINESE PETROLEUM	P66	PTT AROMATICS	TUPRAS
EXXONMOBIL	PDVSA	REPSOL	VALERO
FORMOSA	PEMEX	SHELL	YPF

++ Above is a **partial list** of end users who are enjoying the benefits of peak reactor performance by implementing the CatTracker® technology.

With today's high activity catalyst and high performance distribution tray technologies, upgrading reactor thermometry is critical to the refiner's ability to maximize profitability and safety of the operating unit. To stay competitive in today's market conditions, getting the most out of existing reactors and maximizing asset utilization is a top priority.

Optimal operating conditions vary from process to process and even within processes depending upon variables such as the type of catalyst and internals selected. More than ever, ideal reactor performance is achieved within specific temperature ranges. The *Ultra High Precision™* CatTracker® enables users to achieve these tighter operational envelopes.

End users around the world recognize that the CatTracker® is a key component in implementing a fully comprehensive revamp solution.

CATTRACKER® FEATURES:

- Certified SIL 3 Capable
- 10 Year Warranty*
- Patented Aerospace Technology
- Ultra High Accuracy™*
- Ultra High Precision™*
- True Redundancy™*
- Limited Space™* Design
- Secondary Containment Chamber
- Designed and Installed by Experienced Engineers

CATTRACKER® ADVANTAGES:

- Tightest Control of Reactor Performance
- Highest Reliability Rating
- Achieve Maximum Point Density
- Eliminate "Second-Guessing" of Bed Temperatures
- Optimize Inlet and Outlet Bed Temperatures
- Maximize Catalyst Utilization
- Maximize Catalyst Volume
- Fastest Installation**

CATTRACKER® BENEFITS:

- Highest Return on Investment
- Maximize Profitability
- Maximize Safety
- Minimize Costs
- Peace of Mind

*Terms and Conditions Apply

**Typically 1/3 the time of traditional flexible reactor thermocouples

CatTracker® is a registered trademark of Daily Instruments Corporation.
PLEASE NOTE THAT DAILY THERMETRICS' CATTRACKER® IS PATENT-PROTECTED BY U.S. PATENT #s 6,550,963 AND 6,599,011, AND CANADA PATENT #s 2449074.

CatTracker® Catalyst Temperature

BLOCK VALVE

PURPOSE: TO ALLOW FOR REMOVABILITY/REPLACEMENT OF PRESSURE INDICATOR

- Rated to design pressure and temperature of reactor vessel

BLEED VALVE

PURPOSE: IN THE EVENT OF PRESSURIZATION OF THE SECONDARY/SAFETY CONTAINMENT CHAMBER, THIS VALVE CAN BE OPENED TO ANALYZE THE CONTENTS

SECONDARY/SAFETY CONTAINMENT CHAMBER

PURPOSE: TO CONTAIN PROCESS IN THE EVENT OF BREACH IN PRIMARY SEAL(S) AND ALLOW CONTINUED NORMAL OPERATION

- Rated to design pressure and temperature of reactor vessel
- Pressure Equipment Certifications Available (e.g., "U" Stamp, CE/PED, etc...)

PRIMARY SEAL WELD(S)

PURPOSE: TO MAINTAIN PRESSURE BOUNDARY AT FLANGE FACE

EXTERNAL WELD BEADS

PURPOSE: PERMANENT VISUAL AND TACTILE IDENTIFICATION OF CATTRACKER® TEMPERATURE SENSOR LOCATION.

NOTE: Temperature Sensor is located internally between Weld Beads.

PROCESS CONNECTION

- Typically RTJ or RF (Shown) flange
- Other Process Connection types available
- All pressure ratings available (150# - 2500#)
- Wide variety of materials available
- Pressure boundary at flange face

CATTRACKER® PROBE/SHEATH

PURPOSE: ENCLOSE AND PROTECT TEMPERATURE SENSORS

- Argon purged & *Thermocouple Clean* sheath
- Typical material to match or complement vessel internals (Wide variety of materials available)
- T/C sheath length to be determined by Daily Thermetrics such that requested temperature profile is achieved

SPECIFICATIONS FOR CATTRACKER® PROBES:

- Specifications for 16-POINT CatTracker®
 - Number of Sensors: Up to Sixteen (16) sensing points per probe
 - Sensing Points: Isolated, Independent
 - Junction Type: Ungrounded Junctions
 - Sheath Diameter: 0.500" (= 12.7mm) OD
 - Wall Thickness: HEAVY (.07" or 1.778mm - minimum)
- Specifications for 9-POINT CatTracker®
 - Number of Sensors: Up to Nine (9) sensing points per probe
 - Sensing Points: Isolated, Independent
 - Junction Type: Ungrounded Junctions
 - Sheath Diameter: 0.500" (= 12.7mm) OD
 - Wall Thickness: HEAVY (.07" or 1.778mm - minimum)
- Specifications for 4-POINT CatTracker®
 - Number of Sensors: Up to Four (4) sensing points per probe
 - Sensing Points: Isolated, Independent
 - Junction Type: Ungrounded Junctions
 - Sheath Diameter: 0.375" (= 9.525mm) OD
 - Wall Thickness: HEAVY (.07" or 1.778mm - minimum)

NON DESTRUCTIVE TESTING (NDT)

- Insulation Resistance (IR): Pass/fail criteria for IR moisture content is 10 GΩ minimum at ambient temperature (10x Industry Standards)
- T/C Calibration Test: Calibrated at 427°C (800°F) per ASTM E 220
- T/C Insulation Resistance Test: All thermocouples to be tested for insulation resistance (IR) per ASTM E 608/E 608M
- T/C Continuity Test: Per ASTM E 839
- T/C Compaction Density Test: Per ASTM D 2771, Method B
- Dye Penetrant Test (PT): Per ASME Section V, Article 6; ASTM E 165
- Ultrasonic Testing (UT): Per ASME Section V, Article 4; ASTM E 164
- Positive Material Identification: Positive Material Identification (PMI) per ASME Section II, Parts A & B; ASTM E 1085 & E 1086
- Hydrostatic Pressure Test: Per ASME Section VIII, Division 1
Note: Internal hydrostatic pressure test of secondary containment chamber tests all primary and all secondary seal welds.
- Radiographic Examination (RT): To be performed on all CatTracker® probe tip welds, junction welds, and transition housings, per ASME Section V, Article 2; ASTM E 94; ASTM E 839
- Helium Leak Test: ASME Section V, Article 10

Tracking System

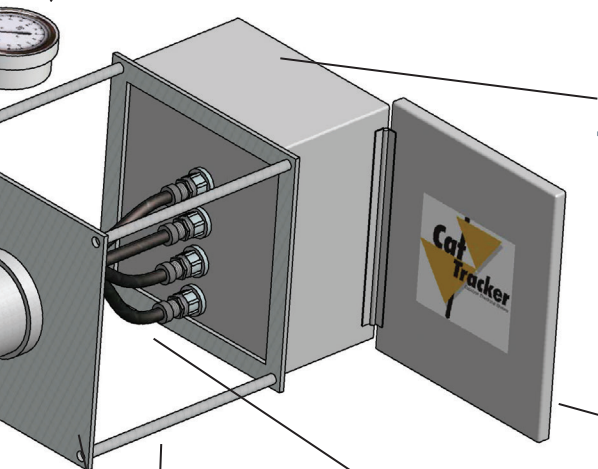


PRESSURE GAUGE

PURPOSE: TO ALLOW FOR INDICATION OF CURRENT PRESSURE OF SECONDARY CONTAINMENT CHAMBER

- Pressure range determined by application and/or client
- All pressure units of measurement are available

OPTIONAL: Pressure Transmitter/Switch available in lieu of or in addition to pressure gauge



JUNCTION BOX

- Protective enclosure to house:
 - terminal blocks, or
 - temperature transmitters
- Wide variety of materials available
- All Area Classifications available
- Available both Direct Mounted (Shown) and Remote Mounted (Optional)

JUNCTION BOX COVER (Shown Open)

RALEXIAN™ THERMOCOUPLE/LEADWIRE TRANSITION

PURPOSE: TO ENSURE CATTRACKER® PROBES ARE HERMETICALLY SEALED

- X-ray Inspected to ensure against defects

MOUNTING/PROTECTIVE FRAME

PURPOSE: TO PROVIDE SUPPORT TO JUNCTION BOX AND ADD A PROTECTIVE BOUNDARY AROUND ELEMENT/LEAD TRANSITION

- Available for Standard Direct Mount (Shown) and Limited Space Direct Mount
- Mesh Protection Wrap available (Not Shown)
- Plate Protection Walls available (Not Shown)

CATTRACKER® TEMPERATURE SENSOR

SPECIFICATIONS FOR CATTRACKER® TEMPERATURE SENSORS:

- Thermocouple (T/C) ISA Type: Customer to specify (e.g., Type K, Type J, etc.)
- T/C Accuracy: Per IEC 60584-2 or JIS C 1602, IEC Tolerance Class 1 or better
- T/C Compaction Density: 88% minimum compaction density (vs. Industry Std. 70%)
- T/C Lead Wire: 20 AWG

PROPRIETARY TECHNOLOGIES DESIGNED INTO EACH CATTRACKER® SENSOR:

- Patented, Aerospace-Derived Technology
- Ultra High Precision™ Technology
Every CatTracker® Temperature Sensor is engineered and manufactured such that the temperature readings are within 1°C of each other at reference temperature (427°C).
- Anti-Drift™ Technology
Daily Thermetrics employs proprietary techniques to eliminate the known causes of drift and thermocouple error.

PROVEN CATTRACKER® APPLICATIONS

Alkylation Reactors
Aromatic Saturation Units
Butadiene Hydrogenation Units
BTL Reactors
CTL Reactors
GTL Reactors
CCR Catalyst Regenerators
Cumene Reactors
Deisobutenizer Vessels
Ethylene Reformers
EO Reactors
Fixed Bed Reformers
Flexicoker Scrubbers
Fluid Cat Cracking Units
Fractionator Columns
Hydrocrackers
Hydrotreaters, Cat Feed
Hydrotreaters, Dewaxing
Hydrotreaters, Distillate
Hydrotreaters, Gas Oil
Hydrotreaters, Gasoline
Hydrotreaters, Kerosene
Hydrotreaters, Naphtha
Hydro Naphtha Splitters
Isomerization Reactors
Iso-octene Reactors
Methanol Convertors
Oxidizers
Polishing Reactors
Steam Methane Reformers
Sulfur Recovery Units

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Latest CatTracker® Catalyst Tracking System Updates & Upgrades

After well over a decade of successful installations and operation in over 600 reactors, vessels and fractionators, Daily Thermetrics continues to lead the refining and petrochemical industries in **best-in-class reliability, accuracy, and precision** for real-time catalyst and reactor monitoring and control. Every CatTracker® Catalyst Tracking assembly now includes the following features, available only from Daily Thermetrics:

ULTRA HIGH ACCURACY™

Along with proprietary mechanical treatment of the thermocouple conductor wires, Daily Thermetrics is now sourcing the highest grade thermocouple conductor wire.

WHAT THIS MEANS FOR YOU:

CatTracker® accuracy is up to 4X that of off-the-shelf thermocouple technology.

BEST-IN-CLASS INSULATION RESISTANCE (IR) STANDARDS

Daily Thermetrics' pass/fail criteria for IR (insulation resistance) moisture content is now 10 GΩ minimum at ambient temperature. This is 10x the the industry standard of 1 GΩ.

WHAT THIS MEANS FOR YOU:

Moisture trapped in the thermocouple sheath negatively impacts thermocouple reliability, accuracy, and operational life. IR measures moisture content in all ungrounded thermocouples. A higher resistance reading indicates lower moisture content, which facilitates better performance and longer life.

RALEXIAN™ TRANSITION

Daily Thermetrics' proprietary Ralexian™ transition design is now being utilized to prevent moisture ingress and improve the integrity of the conductor wire/extension wire connection.

WHAT THIS MEANS FOR YOU:

Moisture contributes to errant temperature readings and/or shortened thermocouple life. The Ralexian™ transition design (exclusive to Daily Thermetrics) is now a standard CatTracker® feature which prevents moisture ingress and acts as a true moisture barrier. Another important aspect of this design is to significantly improve the transition from conductor thermocouple wire to extension wire which is embedded in a complex epoxy structure.

ARGON PURGING

Daily Thermetrics' CatTracker® probes are now argon purged prior to final sealing. This standard practice was initiated in 2012 and displaces contaminants that could lead to corrosion.

WHAT THIS MEANS FOR YOU:

This contributes to the industry-leading performance and stability of the CatTracker® throughout its service life, resulting in an even more robust and reliable temperature measurement device.

HIGH PRECISION AUTOMATED WELDING

The majority of the critical welds are now performed via high precision automated welding stations.

WHAT THIS MEANS FOR YOU:

A high integrity instrument with the reliability and ruggedness necessary to withstand all the forces of a hydrocracker requires perfection and consistency throughout the manufacturing process. Incorporating automated welding throughout the production line reduces variances and enhances consistency.



**FOR A COMPLETE LINE OF
TEMPERATURE
INSTRUMENTATION
PRODUCTS,
PLEASE CONTACT YOUR
DAILY THERMETRICS SALES
REPRESENTATIVE**

DESIGN & ENGINEERING

- Engineering Departments dedicated to:
- Design • Production • Troubleshooting •
 - Field Installation & Operations Services •

Daily Thermetrics has established itself over the past 40 years as a global leader in engineering, designing, improving and producing high-performance technologies in temperature instrumentation for hydroprocessing applications. Paired with our manufacturing facility and active R&D group, no other temperature emphasized engineering company has the resources or experience to take temperature measurement to the advanced levels that Daily Thermetrics provides to the process industry.

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INSPECTIONS & TESTING

No less important than proper Design & Manufacturing is the verification of quality through extensive inspection.

Daily Thermetrics uses the latest techniques and equipment to guarantee every temperature sensor fabricated has been rigorously inspected to the strictest requirements of Daily Thermetrics, the technology licensor, and your refining facility.

- | | |
|---|-------------------------|
| On-Site State-of-the-Art X-ray Facility | ISO 9001:2008 Certified |
| In-House NDT Level II Inspectors | Ultrasonic Testing |
| Hydrostatic Testing | Calibration |
| Positive Material Identification | Helium Leak Testing |

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FIELD ENGINEERING SERVICES

Daily Thermetrics Field Engineering Services offers refiners on-site technical expertise to ensure confidence in the reactor's performance.

Daily Thermetrics understands that offering the best technology isn't enough. As experienced refining experts, we have engineered the **CatTracker® System** to not only provide the most accurate real-time information but also install in a fraction of the time of any previous generation hardware.

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GLOBAL SALES & SERVICE

Daily Thermetrics directly employs highly trained, experienced, technical personnel worldwide to provide unparalleled sales and technical support specializing in temperature instrumentation and integration within the process industry.

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MANUFACTURING & FABRICATION

Daily Thermetrics' products are manufactured by Daily Thermetrics, an ISO 9001:2008 Certified company.

REACTOR THERMOMETRY



REACTOR ACCESSORIES



HEATER/FURNACE TUBE SKIN
TEMPERATURE SENSORS



FIELD ENGINEERING SERVICES,
DIAGNOSTICS & INSTALLATIONS



THERMOWELLS,
THERMOCOUPLES & RTDS



Daily Thermetrics, a division of Daily Instruments Corporation, is internationally recognized for its excellence in designing, engineering, manufacturing, and installing superior products to the demanding needs of our customers. The engineering staff and personnel at Daily Thermetrics are highly trained and dedicated to solve the problems and meet the challenges presented by the Refining & Petrochemical Industry. Clients around the world have relied on Daily Thermetrics' experience and expertise for over 40 years. Daily Thermetrics' world headquarters is in Houston, Texas, USA.



DAILY
THERMETRICS

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