



# CALDON LEFM 380Ci Gas Ultrasonic Flowmeter

Integrating experience, proven technology,  
and innovation





The CALDON\* LFM 380Ci Series eight-path gas ultrasonic flowmeter combines world-leading flow measurement technology with one of the lowest costs of installation and operation of any flowmeter on the market today for the natural gas industry.

The LFM 380Ci flowmeter design addresses the needs of the natural gas industry by eliminating the need for flow conditioning, providing a smaller meter installed footprint, reducing the risk of corrosion and/or contamination of internal meter surfaces, and improving safety for technicians servicing the meter.

As a world leader in transit-time ultrasonic technology applications, we have integrated our eight-path, dual-plane flowmeter design with new technology to introduce the LFM 380Ci gas ultrasonic flowmeter for use in natural gas applications, including but not limited to, custody-transfer metering, fiscal metering, city gate metering, check metering, and transfer of product to and from underground storage facilities.

#### **Features and benefits**

- The LFM 380Ci flowmeter has been designed to reduce the cost of installation, reduce yearly maintenance and operating costs, and increase personnel safety.
- Savings realized in installation, maintenance, and operating costs can result in a payback of up to three times the initial cost of the meter over the life of operation.
- The unique eight-path, dual-plane, cross-path design of the LFM 380Ci flowmeter is insensitive to velocity profile asymmetry and swirl.
- Transducer assemblies are inserted into transducer housings sealed into the meter body. The transducer housings are pressure boundaries isolating the transducers from the process. This eliminates the need to shut down flow and depressurize the pipeline if a transducer should ever need to be replaced.
- Optional proprietary internal coating significantly reduces the risk of corrosion and/or contamination of the internal meter surfaces.

# Product Features

## Dual-plane, eight-path configuration

The LEFM 380Ci gas ultrasonic flowmeter features our eight-path, dual-plane, cross-path flowmeter design. Cameron has conducted extensive research and testing to develop, validate, and refine the eight-path configuration for accurate measurement of flow containing both asymmetry and swirl.

Fluid velocity measurements are averaged over the eight chordal paths of the two combined planes. Swirl effects in one plane will be equal but opposite in magnitude to the effects in the second plane. Averaging the velocity measurements has a net result of resolving any effects due to swirl on the overall measurement.

## Sealed transducer housing design

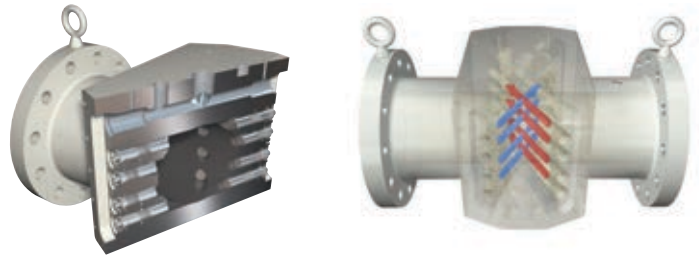
The LEFM 380Ci gas ultrasonic flowmeter has transducers that are installed into Inconel transducer housings, similar to how a resistance temperature device (RTD) inserts into a thermowell. The transducer housing is a pressure boundary between the transducer assembly and the process. This feature is common in our liquid flowmeters, but is a first for an ultrasonic natural gas flowmeter.

The operator does not have to block and depressurize the meter if an LEFM 380Ci transducer should ever need to be replaced. A transducer can be replaced safely with gas flowing in the meter. The design does not require any special tools or extraction devices for transducer replacement.

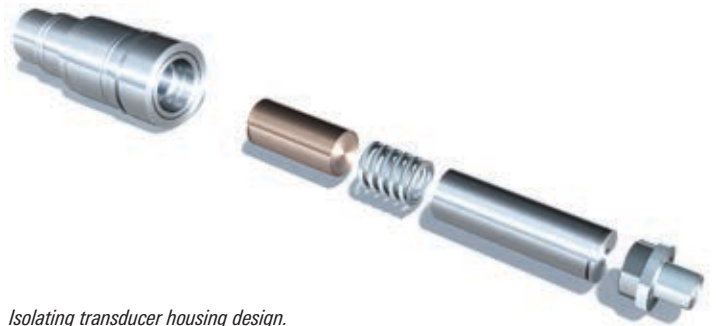
## Proprietary coating

Corrosion and contamination of the flowmeter and adjacent piping can be problematic in regards to meter performance. The LEFM 380Ci gas ultrasonic flowmeter has a proprietary internal coating that significantly reduces or eliminates the risk of corrosion and/or contamination. This coating was selected based on our experience with buildups that can occur in liquid applications. It has good anti-corrosion properties, high thermal stability, chemical inertness in aggressive environments, and superior anti-stick properties.

The second image on the following page is a view looking upstream through the downstream meter spool into an LEFM 380Ci flowmeter that was in service for six months. The downstream section shows signs of rust and corrosion, with markings indicative of liquid having run along the bottom of the pipeline. The coated LEFM 380Ci flowmeter body remained clean. Cameron can provide upstream and downstream pipe spools with this coating at the operator's preference.



*Ultrasonic eight-path configuration.*



*Isolating transducer housing design.*

A 24-in LEFM 380Ci gas ultrasonic flowmeter was installed in an application that needed a short footprint. The operator requested that the entire meter package (upstream piping, meter, and downstream piping) be no longer than 10 pipe diameters. This meter package was installed downstream of piping elements that could create asymmetrical flow profiles and swirl. After the LEFM 380Ci flowmeter was installed, we remotely monitored the meter using eCheck and was able to determine that up to 42% swirl was present. The flowmeter provided measurements well within the operator's expectations.





*flowmeter with proprietary internal coating*



*rust and corrosion in downstream section without proprietary internal coating after only six months in use*

### LEFM SystemLink G3

The LEFM SystemLink G3 user interface software technology allows access to real-time diagnostic data, historical data, and event logs from a G3 ultrasonic flowmeter by using an Ethernet/fiber optic modem connection. Historical data and event logs are stored within the G3 transmitter, thus allowing for later retrieval—giving operators ability to monitor and analyze critical diagnostics, helping prevent unplanned downtime.

LEFM SystemLink G3 features:

- Health overview report show the current meter status as well as meter process measurements including flow rate, temperature, and pressure
- Detailed charts and graphs present the meter diagnostic information in an easy-to-understand format with alarm limits that help identify issues
- User defined reference points are built using the meter's stored data. These reference points allow the user to graphically compare current meter performance against user defined reference points. For example, current performance can be compared against calibration or commissioning data.
- Export data as both predefined PDF reports or to customer defined excel spreadsheets.

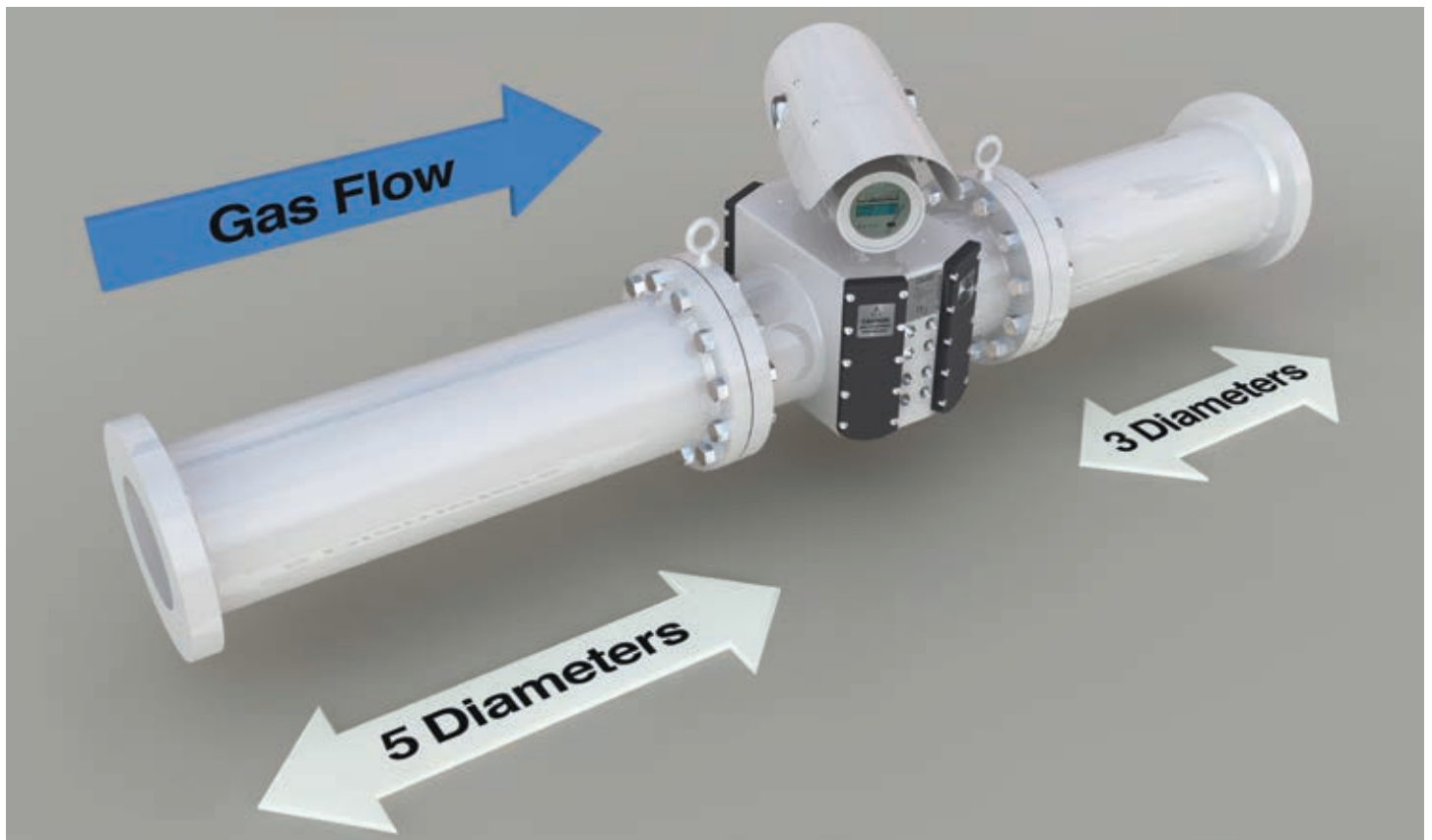


# Results You Can Measure

The LEFM 380Ci gas ultrasonic flowmeter is insensitive to velocity profile asymmetry and swirl. The general installation recommendation is based on our history with eight-path liquid ultrasonic flowmeters, LEFM 380Ci flowmeter field tests and third-party testing of the LEFM 380Ci, at independent labs in the USA and Europe. This recommendation meets or exceeds the the most stringent requirements of AGA Report 9, ISO 17089-1 Class 1 and OIML R137 Accuracy Class 0.5.

Having the smallest installed footprint means a compact installation and reduction in CAPEX by reducing the length of required upstream pipe and eliminating a flow conditioner. The ability to isolate the transducers from the flowing gas in the pipeline means increased safety for the technicians should a transducer ever need replacing, as well as a simplified, time-saving replacement procedure. The proprietary coating of the LEFM 380Ci flowmeter can provide higher accuracy of measurement over the months a flow metering section is being conditioned by corrosion and contamination of the process after it is installed, or fewer cleaning cycles for operators who may need to periodically remove the meter section for cleaning.

The LEFM 380Ci flowmeter has been designed to address technical and operational challenges associated with natural gas measurement. However, it also is a flexible design, which allows us to meet the specific local needs of operators, which is equally important. The LEFM 380Ci flowmeter is available in various materials of construction and has a design that is configurable to accept various end connections requirements. The transmitter can be integrally or remotely mounted from the meter body and has a wide range of input and output options.



# Count On Cameron

Cameron is constantly developing cutting-edge ultrasonic technology to better meet industry demands for custody transfer. LEFM multipath in-line ultrasonic flowmeters are backed by more than 40 years of experience and a history of technological firsts for their use.

We designed the LEFM 380Ci flowmeter based on feedback gathered from users of ultrasonic flowmeters for custody transfer of natural gas:

- Improve meter reliability over a wide range of application conditions
- Improve safety for technicians when replacing transducers
- Simplify installation and reduce the meter footprint and overall metering section weight
- Reduce maintenance

The LEFM 380Ci gas ultrasonic flowmeter represents the integration of three crucial design elements to create a truly unique meter to address the above concerns:

- Eight-path design creates a smaller installed footprint for custody-transfer measurement and reduces the weight of the metering section by eliminating a flow conditioner and reducing upstream piping; also delivers high redundancy, and thus, online availability
- Innovation makes the LEFM 380Ci flowmeter the first custody transfer gas ultrasonic meter with transducers that are fully isolated from the gas
- Proprietary coating effectively deals with the potential for corrosion and contamination from components in the gas stream

Our LEFM 380Ci gas ultrasonic flowmeter can significantly reduce installed cost and yearly operating cost while increasing personnel safety.

## LEFM Technological firsts

- 1965-70 First LEFM hydroelectric application
- 1970-75 First LEFM nuclear reactor coolant application
- 1974-75 First LEFM petroleum application
- 1994-99 First measurement uncertainty recapture uprate at nuclear facilities
- 1995 First LEFM MIL-SPEC
- 2003 First LEFM for custody transfer of liquid hydrocarbons
- 2005 First LEFM for custody transfer of LNG
- 2008 First LEFM for custody transfer of heavy, viscous crude oils up to 3000 cst
- 2010 First LEFM 380Ci flowmeters installed on natural gas pipelines with isolated transducers



Coraopolis, Pennsylvania facility

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[cameron.slb.com/ultrasonicmeter](http://cameron.slb.com/ultrasonicmeter)

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