SOLUTION SHEET

# StreamLine Pro CTA system

## Research grade hotwire anemometer for turbulence investigations

### High performance anemometer system for the most demanding applications

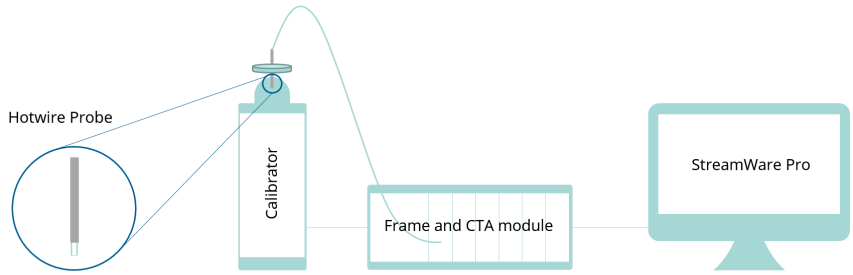
The Dantec Dynamics StreamLine Pro system is the next generation CTA based on the popular StreamLine system. Using the latest developments in signal processing technology, the StreamLine Pro provides the highest Signal-to-Noise Ratio and widest bandwidths of any commercially available CTA system. Some of the additional improvements in this new design include higher accuracy of gain and offset settings, and new software features running on the latest Windows OS. For fundamental fluid dynamics and turbulence research, these significant improvements are critical to successful results especially in the most challenging measurement applications.

### Key benefits

- High temporal resolution: Fluctuations up to 450 kHz can be measured
- High spatial resolution: Eddies down to fractions of a mm can be resolved
- High dynamic range: from a few cm/s to supersonic
- Real-time continuous output signal: Provides full information in the entire frequency range
- Application software supports set-up, automatic calibration, data acquisition and data reduction
- Turbulence statistics in both amplitude and frequency domain based on velocity time series

## The StreamLine Pro solution in brief

Constant Temperature Anemometer (CTA) technology is a well-established technique for the measurement of velocity in gas and liquid flows. The measurement principle uses King's law and the cooling rate of small heated sensors placed in the flow. As the name suggests, the sensor temperature is kept constant and is one arm of a Wheatstone bridge. The output voltage from the anemometer is digitized and converted to velocity based on the probe calibration.
Even though CTA technique is intrusive it is still the only solution for high frequency turbulence investigations; i.e. the accurate determination of high frequency flow fluctuations, boundary layer diagnostics, simultaneous multi-point velocity and temperature measurements.




*A typical StreamLine Pro configuration.*

Using the StreamLine Pro CTA system is made easy with our StreamWare Pro software. This comprehensive software package interfaces with the electronics to set the probe overheat, automatically balances the bridge, provides data acquisition, and data analysis of the results. The system combines the advantages of the high quality hot-wire anemometer, high accuracy A/D converters and graphical user interface. The system comprises:

- Frame with controller and temperature monitor
- CTA anemometer modules
- Optional temperature module
- Automatic probe calibrator
- Hotwire and fiber-film probes with supports
- Analog to digital converters
- StreamWare Pro application software

*Frame with controller and three CTA modules*

## System components

### *Frame with controller*

The StreamLine Pro frame contains 6 power supplies, a controller and slots for 6 modules (CTA or temperature modules). Three frames can be combined in one CTA measurement system allowing for up to 16 simultaneous measurement channels.
The CTA modules are state-of-the art electronics containing three bridge configurations, two 1:20 bridge ratios with 20 ohms and 10 ohms top resistors, and one 1:1 bridge ratio, selectable from the software. The 1:1 configuration is useful especially in situations where high bandwidths and longer cables are required.

### *Automatic Calibrator*

As the sensor response depends on velocity, a calibration is required for accurate CTA measurements. The StreamLine Pro Automatic Calibrator can provide in situ air velocity calibrations to assure high accuracy.
The StreamLine Pro Automatic Calibrator is designed for calibration of wire and fiber-film probes in air at velocities from a few cm/s up to > 300 m/s.

*Automatic Calibrator*

The probe is placed in a free jet with a flat, low-turbulent velocity profile during calibration. The calibrator is connected to a computer via USB or Ethernet and the calibration process is controlled from StreamWare Pro.

The calibrator is delivered with a certificate including the calibration data of the internal transducers (traceable to accredited laboratories) and a verification of the jet velocity in three points over the velocity range.
For water flow measurements, a water calibration system is also available.

### *Automatic Directional Calibrator*

Hot-wire sensors have velocity, temperature and directional sensitivity. Multiple sensor probes are used to perform 2- and 3- component velocity measurements using information about the directional sensitivity.

Although it is possible to use typical (default) k and h factors for the calculation of angular velocity, for the most accurate measurement, directional as well as magnitude calibration is required. We offer both a manual as well as high precision automatic (motorized) directional calibration modules.

During the directional calibration, the probe is yawed and rolled around two axes, while it is exposed to a constant velocity. Measuring the probe response with the actual velocity on each sensor, StreamWare Pro software calculates the pitch and yaw factors for each individual probe. This calibration is stored in the software and is automatically referenced during data reduction.

*Automatic Directional Calibrator allows probe rotation around two axes.*

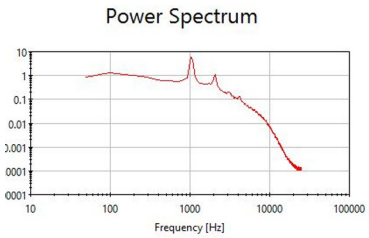
### *Completing the measuring chain - probes*

Dantec Dynamics hot-wire and hot-film probes cover most applications in flow measurements. Additionally, special probe and support designs for unique flow situations in accordance with customer's specifications can be offered upon request.  Examples of these include; 2-D/3-D probes with temperature sensor, 4-wire vorticity probes, extended length probe supports, 2-D high temperature probes, and more. Please contact your Dantec Dynamics representative and refer to the probe catalog for more details.

*Hot-wire and hot-film probes*

### *Software*

StreamWare Pro is a complete software package for Windows environment that helps the user to design, organize and document the measurements as well as post process the results. The complete system can be controlled by StreamWare Pro, which performs hardware set-up, automatic probe calibration, data acquisition, conversion and reduction. Raw and reduced data can be presented in StreamWare Pro or they can be exported to other applications (e.g. Excel and Tecplot®) for further analysis.



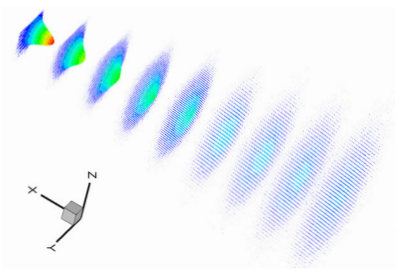

*Turbulence spectrum downstream of a cylinder in cross flow.*

### Turbulence Diagnostics in StreamWare Pro

CTA is the preferred technique for investigation of turbulence due to its unmatched frequency response. In the frequency domain, power spectra can be computed for analysis of the fluctuating flow characteristics.

### Data export and presentation

Based on time series acquired in one or several points in the flow statistics, mean velocity, turbulence intensity, Reynolds stresses and autocorrelation function can be calculated and displayed. Results can be displayed on StreamWare Pro or exported to other applications for further analysis or for advanced graphical presentation.



*Jet flow data exported to Tecplot.*

## Options

### *Temperature module for temperature fluctuations*

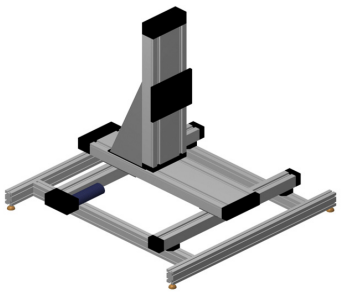
An optional temperature module is available for measurement of fast temperature fluctuations with wire probes of diameters down to 1 µm. It delivers a constant current adjustable between 0.1 and 5 mA through the wire and offsets, amplifies and filters the output voltage, which is a linear function of the flow temperature. The output is acquired by StreamLine Pro and can be analyzed individually or correlated with velocity fluctuations measured with an ordinary hot-wire.

### *Traversing systems*

Dantec Dynamics offers traversing systems that can move the probe in one, two or three directions with micrometer accuracy.

### *Probe Rotation Unit*

A motorized probe rotation unit is available which can also be mounted on a standard traverse mechanism. The accurate rotation is useful to obtain proper alignment of the probe with respect to the flow, or for obtaining two or three velocity components (non-simultaneously) from single slanted wire probe.



*Three-axis traversing system.*

### *System Computer*

The StreamLine Pro CTA system can be delivered with a system computer, which is preconfigured, tested and ready to use. All necessary hardware and software installation is performed before delivery.

All Dantec Dynamics systems with system computer have to pass a detailed system test procedure before shipment where test data is recorded on the system computer. The system test procedure ensures a smooth installation of the system on site and a quick start to actual research activities.

## Technical specifications

| Specifications | StreamLine Pro |
|---|---|
| Number of modules | Max. 6 per frame |
| Number of frames | Max. 3 per system |
| Number of channels | Max. 16 per system |
| Max. Frequency response | 450kHz (1:1 bridge, dedicated HF probe) |
| Equivalent Input Noise | Typical 1.8 nV/√Hz |
| Equivalent Input Drift | Typical 0.3 µV/°C |
| Communications | USB 2.0 and 10/100 Mbit LAN |
| Dimensions | 45 cm x 18.5 cm x 46.5 cm |

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