WHEN YOU NEED TO BE SURE

Determining Subsonic Air Flow

Version 5

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Version History

Version	Date	Revision Description
1	1/25/2016	Initial publication
2	8/23/2018	Format with SGS brand
3	4/9/2020	Retrofit to new template Remove REAL TIME FLOW EQUATIONS FOR SUBSONIC VENTURIES (SSV's) USED FOR CVS FLOW and publish separately.
4	12/13/2021	Removed `subsonic` usage content from *Section 3 Starting the Application* on page 3 and added hypertext linked cross-reference to its cyflex.com usage help.
5	6/16/2022	Updated all hypertext linked cross-references to cyflex.com usage help descriptions

Document Conventions

This document uses the following typographic and syntax conventions.

- Commands, command options, file names or any user-entered input appear in Courier type. Variables appear in Courier italic type.

  Example: Select the `cmdapp-`*`relVersion-buildVersion`*`.zip` file….

- User interface elements, such as field names, button names, menus, menu commands, and items in clickable dropdown lists, appear in Arial bold type.

  Example: **Type**: Click **Select Type** to display drop-down menu options.

- Cross-references are designated in Arial italics.

  Example: Refer to *Figure 1*…

- Click intra-document cross-references and page references to display the stated destination.

  Example: Refer to *Section 1 Overview* on page 1.

  The clickable cross-references in the preceding example are *1*, *Overview*, and on page 1.

CyFlex Documentation

CyFlex documentation is available at https://cyflex.com/. View **Help & Docs** topics or use the **Search** facility to find topics of interest.

Table of Contents

1 Overview

The `subsonic` command computes mass flow rate, Reynolds number and SCFM for a subsonic flow venturi.

The program is normally started in the `go.scp` startup script and is memory-resident from then on, computing the flow at the rate specified on the command line.

1.1 Computations

The computations performed by `subsonic` are defined by a paper by W.T. Martin entitled *Real Time Flow Equations for Subsonic Venturis (SSVs) used for CVS Flow*.

The paper has a section which calculates errors associated with the assumption of constant specific heat ratio. In this program, the ratio is continuously computed and updated. Note also, that an iterative computation of Reynolds number is not necessary for a real-time process if the previously computed mass flow is remembered as a starting point for the next process interval. This holds true as long as the computation rate is fast enough that the flow rate does not change drastically from one interval to the next.

2 Prerequisites

The computations performed by `subsonic` rely on properties of the air stream which are computed by the `gas_prop` program. The `gas_prop` program, in turn, relies on the existence of the composition and property variables associated with the fluid stream. The following example shows an example of launching those programs prior to the launch of `subsonic` in `go.scp`.

```
########################################################################
#
#  Example startup sequence in go.scp
#
########################################################################
#  "init_properties" and "init_composition" must precede
#  launching of “subsonic”

# init_properties creates the memory for composition and property
# variables

init_properties

# init_compositon reads /specs/properties/comp_specs.NNN and initializes
# the values of composition variables to the last value saved when running
# or those permanently defined by a comp.<STREAM> file

init_composition

# gas_prop computes the properties of the streams identified in
# prop_specs.NNN

gas_prop 12 1000 /specs/properties/prop_specs.305 &

subsonic 12 SLO /specs/subsonic &
```

Refer to `gas_prop` usage help on cyflex.com for supplemental information.

3 Starting the Application

Enter `subsonic` to start the application.

Refer to `subsonic` usage help on cyflex.com for command syntax.

Appendices

Appendix A. Subsonic Flow Venturi Specification File

The following is an example specification file used for subsonic flow venturi. All variables must be defined elsewhere in the system.

```
############################################################################

# barometer label – The ambient pressure to which the inlet_pressure is
# referenced
   barometer

# gas composition variable     gas property variable
   inlet_airC.                   inlet_airP.

# meter discharge coefficient as a function of Reynolds number
# Model options
#     TABLE_LOOKUP      - a CEESI table of Cd vs Re (list the filename)
#
#     SQRT              - Cd = C0 + C1/sqrt(Re)
#
#     POLY              - Cd = C0 + C1 * Re _+ C2 * Re**2 + ….

   POLY
   .9825

# venturi dimensions
# The diameters may be listed as a variable or a constant(with units)
# throat diameter               inlet diameter
   5[in]                       8[in]

#list the variables which measure the inlet conditions and the meter delta P
#inlet_pressure (gauge)        inlet_temp        meter_deltaP
   inlet_p                     inlet_t           meter_dp

#define the output variables
#mass_flow_rate   molar_flow_rate   volumetric_flow_rate SCFM     Reynolds#
   Mass_flow      molar_flow        volume_flow          std_vf   Reynolds
```

Appendix B. Subsonic Specification File

```
###############################################################################
#
#                            subsonic_spec.def
#
###############################################################################

#barometric label                 vapor pressure label
barometer                         CVSSSVVapP


#gas composition variable            gas property variable
CVSSSVAirC.                           CVSSSVAirP.

#meter characteristics (Cd as function of Re)
#calibration type
#
# options
#
#     TABLE_LOOKUP      - a CEESI table of Cd vs Re  (list the filename)
#                         (see //4/specs.def/venturi_cal.def for example)
#
#     SQRT              - Cd = c0 + c1/sqrt(Re)
#
#     POLY              - Cd = c0 + c1 * Re + c2 * Re**2 + ....
#
#

POLY

# c0        c1       ....
# These coefficients from a least squares 4th order polynomial curve fit
# to data for the calibration venturi S/N 20161 based on data collected
# by CEESI per order 17666 on 29 Oct 2004.  Used per Bill Martin.
#9.8779e-01  3.2336e-09  -1.5528e-14  9.8205e-21
9.5541e-01 1.6230e-07 -3.1209e-13 2.3620e-19 -6.2474e-26

#throat_dia    pipe_dia
CVSSSVThrDia   CVSSSVPipDia


#inlet pres (gauge)     inlet temp        meter_dp
CVSSSVInP               CVSSSVInT         CVSSSVDP


#mass flow       molar flow       act vol flow     std vol flow     Reynolds
number
CVSSSVMF         CVSSSVNF         CVSSSVAVF        CVSSSVSVF        CVSSSVR
```