CyFlex® Computing Critical Air Mass Flow

Version 7

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Developed by Transportation Laboratories

Version History

Version	Date	Revision Description
1	1/25/2016	Initial publication
2	8/23/2018	Format with SGS brand
3	4/8/2020	Retrofit to new template
4	8/18/2020	Revised document title from *Computing Air Mass Flow* to *Computing Critical Air Mass Flow*.
5	12/9/2021	Revised *Section 3 Starting the Application* on page 3 to remove inline `critical_flow` usage content and add hypertext linked cross-reference to its usage help on cyflex.com.
6	6/16/2022	Updated hypertext linked cross-reference to cyflex.com usage for `critical_flow` in *Section 3 Starting the Application* on page 3
7	3/6/2024	Rebrand to TRP Laboratories

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

Run the `critical_flow` command to compute the air mass flow on a continuous basis when a critical flow venturi is being used.

The command is normally started in the `go` script that starts CyFlex.

2 Prerequisites

Prior to running `critical_flow`, several other programs must also be running or have run. They include `init_properties`, `init_composition`, `gas_prop`, and `add_water`. A sample startup sequence is shown below.

```
#####################################################################
#
#  Example startup for critical flow venturi meters
#
#######################################################################
#  "init_properties" and "init_composition" must precede the first
#  copy of "critical_flow" so that the gas composition variable will be
#  initialized
#
# init_properties creates the memory for composition and property
# variables - required for "critical_flow" & "gas_prop"

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 cfv gas stream

gas_prop 12 1000 /specs/properties/prop_specs.99 &
sleep 2

# add_water adds water vapor to the cfv gas stream

add_water 12 1000 /specs/properties/addwater_specs.99 &
sleep 2

# critical_flow is used to compute the mass flow rate based on a critical
# flow venturi

critical_flow   12   1000 /specs/cfv_specs.99 &
```

3 Starting the Application

Enter `critical_flow` to start the application.

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

Appendix A. Specification File

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

```
#
#  barometer label
#              required value - If this label as well as the
#              label for downstream pressure are defined, then the
#              ratio of outlet to inlet pressures will be calculated.
#
#  gas composition variable
#              required value - A composition variable must exist
#              that describes the gas flowing through the meter.
#
#  gas property variable
#              required value - A property variable must exist that
#              describes the gas flowing through the meter.
#
#  throat diameter and inlet diameter
#              required values - These may be values, variable labels,
#              or computed expressions.
#
#  downstream pressure (gauge)
#              optional value - If this label is defined, then the ratio of
#              outlet to inlet pressures will be calculated.
#
#  logical for sonic flow
#              optional value - If this label is defined, and labels
#              for downstream pressure and barometer are defined,
#              then the value will be set TRUE if the flow is
#              sonic through the device.
#
#  inlet compressibility value and logical use expression
#              optional values - Both may be values, variables, or
#              expressions.  If the logical variable is TRUE at the start
#              of the program, then the value for inlet compressibility
#              will be used.  If it is FALSE, then the program will
#              calculate a value.
#
#  specific heat ratio  and logical use expression
#              optional values - Both may be values, variables, or
#              expressions.  If the logical variable is TRUE at the start
#              of the program, then the value for specific heat ratio
#              will be used.  If it is FALSE, then the program will
#              use a value from the property variable
#
#  calibration values
#              required values - The values of a, b, and n are defined
#              in CFR1065 and are used to calculate the coefficient
#              of discharge for the meter
#
#  labels for intermediate values
#              optional values - If labels for intermediate values
#              are specified the values will be written on every
#              iteration.
```

```
#
#  labels for output values
#             mass flow is required and Reynolds number is optional -
#
#  labels for logical variables for compressibility and flow factor
#  convergence
#             optional values - If the labels are specified then a
#             value of TRUE or FALSE will be set depending on
#             whether or not the respective equations could be
#             solved within the tolerance of 0.01%
#
##############################################################################

#1 barometer label
   barometer

#2 gas composition variable     gas property variable
   vent_airC.                  vent_airP.

#3 throat diameter              inlet diameter
   0.000635[m]                 0.01905[m]

#4 downstream pressure (gauge)  logical for sonic flow
   downstream_P                cfv_sonic_flow

#5 inlet compressibility value  logical use expression
   Z0                          use_my_Z0

#6 specific heat ratio          logical use expression
   gamma                        use_my_gamma

#7 calibration values
#  a_1065        b_1065        n_1065
   0.80          3.00          0.50

#8 labels for intermediate values
#  inlet pressure       specific heat at const P      specific heat ratio
   cfv_inlet_press      cfv_Cp                        cfv_X0

#9 labels for intermediate values continued
#  inlet comp. factor   throat density                flow factor
   cfv_Z0               cfv_u_star                    cfg_Cf

#10 labels for intermediate values continued
#  diameter ratio       throat temperature
   cfv_B                cfv_T_star

#11 labels for intermediate values continued
#  throat to inlet pressure ratio      outlet to inlet pressure ratio
   cfv_r                               cfv_PR

#12 labels for output values
#  label for calculated mass flow      label for Reynolds number
   cfv_mass_flow                       cfv_Re

#13 labels for interation logicals
```

```
#  label for compressibility convergence  label for flow factor convergence
   cfv_z_converged                        cfv_r_converged
```