CyFlex® Fuel Air Total Computation

Version 4

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Developed by Transportation Laboratories

Version History

Version	Date	Revision Description
1	6/11/2020	Initial publication
2	12/8/2021	Revised *Section 1.2 Variables Updated by fa_total* on page 1 to add indexes from `perf_labels`. Revised *Section 2 Starting the Application* on page 3 to remove inline usage content for `fa_total` and add a hypertext linked cross-reference to its cyflex.com usage help.
3	6/14/2022	Updated all hypertext linked cross-references to cyflex.com usage help descriptions
4	2/21/2024	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

The overall purpose of the fuel air total application is to sum all the continuous air flow measurement devices and fuel flow measurement devices and output value for total air flow rate and total fuel flow rate. In addition to this, the value specified in `perf_labels` for dyno power calculates total fuel consumption, BSFC, air-fuel equivalence ratio, fuel-air equivalence ratio, and air fuel ratio. The `fa_total` application updates the fuel reading runtime variable. Refer to *Section 2 Starting the Application* on page 3.

1.1 Inputs

The following are the inputs to `fa_total`:

- fuel mass flow variable

  The continuous fuel flow rate output from flotron, AVL-735, gas flow meter, etc. For cells with multiple fuel flow measurement devices, there will be multiple entries.

- dry air flow variable

  The continuous dry mass air flow measurement variable. For cells with multiple air flow meters supplying air to the engine, there will be multiple entries.

- wet air flow variable

  The continuous wet mass air flow measurement variable. For cells with multiple air flow meters supplying air to the engine, there will be multiple entries.

If using an ultrasonic meter that outputs volumetric fuel rate, use the `gasfl` application to calculate dry air mass flow and wet air mass flow total variables to use as inputs to `fa_total`. Since `gasfl` uses the barometric pressure and vapor pressure as inputs, it does not require the `add_water` application.

If using a subsonic venturi or lfe, use the `lfe` application or `subsonic` application in conjunction with the `add_water` application to calculate dry mass air flow and wet mass air flow.

1.2 Variables Updated by fa_total

All variables updated by `fa_total` are specified in `perf_labels` and not in the `fa_total` spec file. All variables are continuously updated at the rate specified when initiating `fa_total`.

The index below from the top section of `perf_labels` will be used as an input to `fa_total` for BSFC calculations.

```
#index  label         units  format     initial hst_save  tolerance
#                                       value
5       Dyno_power    HP          1      -       OFF       5.0
```

The indexes below from the top section of `perf_labels` specify variables that are going to be updated by `fa_total`.

#index	label	units	format	initial value	hst_save	tolerance
6	Fuel_rate	LB/HR	1	-	ON	0.5
8	BSFC	LB/(HP-HR)	3	-	OFF	0.003
9	air_mtr0_mf	LB/MIN	1	-	OFF	1.0
11	phi	NONE	3	-	OFF	0.1
12	AF_ratio	NONE	1	-	OFF	1.0
25	lambda	none	2	-	ON	0.1
26	air_mtr0_mfd	lb/min	1	-	OFF	1.0

The index below from the 3rd section of `perf_labels` where only fuel reading data variables are specified shows the variable that will be updated for the fuel reading run time.

#index	label	units	format	initial value	hst_save	tolerance
17	FR_runtime	MIN	3	-	OFF	1.0

Below is a description for each of these variables:

`Fuel_rate`	total fuel consumption rate. This will be the sum of all the fuel flow entries specified in the spec file.
`BSFC`	brake specific fuel consumption.
`lambda`	air-fuel equivalence ratio.
`air_mtr0_mfd`	total dry mass air flow rate.
`air_mtr0_mf`	total wet mass air flow rate.
`phi`	fuel-air equivalence ratio.
`AF_ratio`	air fuel ratio.
`FR_runtime`	time duration of the fuel reading.

2 Starting the Application

Enter `fa_total` to start the application.

Refer to cyflex.com `fa_total` usage help for command syntax.

3 Specification File

The following is a `fa_specs` example spec file:

```
# Total fuel and air specification file used to support fuel rate
# measurements for continuous flow devices such as FLOTRON,
# AVL-735, gas flow meters, etc.
#
# This is an example specification for a natural gas engine
# which has a single air flow meter and a single gas flow meter.
#
#
# This is a specification file for the "fa_total" task as shown
# below:
#
#   fa_total 13 1000 /specs/fa_specs.414 &
#
# SECTION 1:   list all of the fuel mass flows supplying the engine
# These will be used as inputs
gas_mf_dry
$

# SECTION 2:   list all of the air flows supplying the engine (wet & dry)
# These will be used as inputs
Air_mf   Air_mf_dry
$
```