BEYOND MEASURE

SCION INSTRUMENTS

Reference Manual

Transformer Oil Gas Analyzer

SCION Instruments HQ
Suite 34, Livingston Business Centre,
Kirkton Road South, Livingston,
EH54 7FA, Scotland, UK.
Tel: +44 1506 300 200
sales-eu@scioninstruments.com
www.scioninstruments.com

SCION Instruments NL BV
4462, Goes,
Stanleyweg 4.
The Netherlands
Tel: +31 113 348 926
sales-eu@scioninstruments.com
www.scioninstruments.com

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SECTION CONTENTS

INTRODUCTION

Certain faults in electrical transformers may result in the production of gases, which remain dissolved in the transformer fluid. The transformer fluid and insulating materials will break down into a few easily identifiable by-products when subjected to fault conditions.
Identification and quantification of these gases can provide an early indication of developing problems in the equipment.

The ASTM method D3612 Method B describes the analysis of dissolved gases in electrical insulating oils using a stripper column. The Transformer Oil Gas Analyzer is based on this principle but has an extra feature which is based on backflushing of the oil and unwanted components to vent.

The oil sample is injected by means of two 10 port gas sampling valves both equipped with a sample loop onto two stripper columns. Each stripper column extracts the dissolved gases from the oil and flush these gases to two different channels. One channel equipped with two molecular sieve wide bore column separates the lighter gases like hydrogen, oxygen, nitrogen, while the other channel equipped with two porous polymer columns separates the other carbon gases, including CO and CO2. A methaniser-FID combination ensures that the carbon oxide gases are detected at low ppm levels.

After extraction the oil and the components of non-interest are backflushed

The components of interest in the extracted gas are typically hydrogen, oxygen, nitrogen, carbon monoxide, carbon dioxide, methane, ethane, ethylene, acetylene, propane and propylene.

For a real understanding of the flow scheme, see also the **states of operation** (STEP BY STEP) at page 13 of this manual.

The instrument is tuned during Final Test to its proper settings. Do not change any flow or pressure settings unless it is requested.

INSTRUMENT SPECIFICATIONS

Every instrument is fully tested; the results of the tests, as well as the methods used during these tests, are presented as part of this manual (refer to section 1).

START UP.

At initial START-UP as well as after a longer idle period, follow the instructions below:

- **Connect all the gases to the instrument.**
- **Switch on the power.**
- **Load appropriate method.**
- **Check the flow settings.**
- **Do not make any changes to the methods**
- **The system is ready for injections.**

For a new system there is no need to do any flow measurement or flow tuning before power-up.
The instrument is tuned and tested in our Factory in Goes.

INSTALLATION OF COLUMNS, SYRINGE PUMP, FLOW AND PRESSURE SETTING

Tuning of the analyzer is only necessary in case new columns are installed or after flow of pressure settings have been changed. Before new columns may be installed, they need to be preconditioned!!

Make sure, the instrument is connected to the minimum gas supply conditions as indicated in the 456-GC Pre-installation Requirements.

For more detailed information concerning the configuration of the instrument, please, refer to the drawing section (section 6 of this manual). The factory drawing indicates which flow and pressure controls are being used. The drawing also outlines the way the analyzer channel has been incorporated into the gas chromatograph

Regularly check and replace filters maintaining the supply quality as described in the pre installation requirements.

Replacement columns:

RT19721	-	15 mtr x 0.53 mm fs Molsieve 5A
RT19741	-	10 mtr x 0.53 mm fs Rt-Q Bond
RT19750	-	30 mtr x 0.53 mm fs Rt-U Bond df = 20 µm
Rt10083	-	Restriction

Syringe Pump

Introduction of transformer oil can be performed using the syringe pump.
This pump can be programmed by a contact closure command in the sample delivery table so that during the run of the GC the oil is introduced into the sample loops.
See also the sample delivery table at page 8.

In order to refill the sample loops it is necessary that the pump delivers at least 1 ml of oil from the syringe.
For instructions how to operate the syringe pump, please read the instruction manual provided with it.

Tuning the TOGA

Tuning is only necessary when new columns have to be installed or by malfunctioning of the GC.

Connect the columns according the flow schematics given in Section 6 and adjust the pressures (if necessary) at an oven temperature of 30°C.

Take very good care not to create any dead volume!

- Program the oven temperature at 30 °C and methaniser at 400 °C and the COC injector (these is actually the stripper column oven, configured as a COC) at 90 °C.
- Set valve 1 and 2 in the (+) position.
- While measuring the flow at the exit of the FID, adjust the Aux Middle EFC-24 until there is 10 ml/min He.
- Adjust the hydrogen flow for the methanizer at 15 ml/min.
- Set the make-up for the FID at 20 ml/min.
- Set the Hydrogen for the FID at 15 ml/min.
- Set the Air for the FID at 300 ml/min.
- Set the Aux Front EFC-24 flow (flow over the Molsieve and restriction column) until there is 5 ml/min Ar coming out the exit of the TCD.
- Set the TCD make-up flow at 3ml/min
- Set TCD reference flow at 9 ml/min.
- Switch valve 1 and 2 to the (-) position.
- Set Middle EFC-24 and Front-EFC24. Flow at vent 1 (Solenoid V-3 deactivated) approx. 40 ml/min. Flow at vent 3 (Solenoid V-4 deactivated) approx. 35 ml/min.
- Switch valve 1 and 2 again to the (+) position.
- Activate VLV's 3 and 4. Adjust the needle valves A and B giving flows of approx 20 ml/min out of Vent 2 and Vent 4
- Program the method as given in the OPERATION section.

Check all connections for leakage. If big leaks are detected it may advisable to repeat flow tuning.

After stabilization of the TCD and FID signal the system is ready for injection of a gas mixture.

OPERATION

Operational method is preloaded in the instrument. The method shown below displays settings for the injection of oils sample, including a Temperature Program for the stripper columns and the operation of the Syringe Infusion Pump via the valve table.

Listed below is an example method; settings determining the application may be different.

Stripper column oven (COC):

	Temp(°C)	Rate(°C/min)	Hold(min)	Total(min)
Initial	90		9.00	9.00
	120	20	9.00	19.50
	90	20	3.5	24.50

Column Oven:

	Temp(°C)	Rate(°C/min)	Hold(min)	Total(min)
Initial	30		3.60	3.60
	150	20.0	8. 40	18.00
	30	20.0	0.50	24.50

Stab time 0.50 min
Coolant OFF

Methanizer oven:

Temp 400(°C)

Detector (front TCD):

Temp 120 °C
Range 0.05
Time cons: slow
Fila temp: 250 °C
Fila max: 390 °C
Polarity: Positive
Carrier gas: Ar

DEFC-14: Make-up flow: 3 ml/min(Argon)
Reference flow: 9 ml/min(Argon)

Detector (middle FID):

Temp: 200 °C
Electronics: ON
Time cons: slow
Range: 12

DEFC-11: Make-up flow: 20 ml (Helium)
Hydrogen flow:15 ml/min
Air flow: 300 ml/min

Flow/Pressure (Helium carrier gas)

Front EFC 24:
program: Initial: 16.0 psi (example)
Total Flow: 60 ml/min

Aux Front EFC 24:
program: Initial: 13.0 psi (example)
Total Flow: 40 ml/min

Flow/Pressure (Argon carrier gas)

Middle EFC 24:
program: Initial: 20.0 psi (example)
Total Flow: 60 ml/min

Aux Middle EFC 24:
program: Initial: 13.0 psi (example)
Total Flow: 40 ml/min

Sample delivery (example)

	Inj/Bf valve 1	Inj/Bf valve 2	EventA	EventB	EventC	EventD	Remarks
Initial	-	-	-	-	-	-	
0.10	+	+	+	+	-	-	Injection on both channels
5.00	+	-	+	+	-	-	BFL of TCD channel
5.01	+	-	+	-	-	-	
6.40	-	-	+	-	-	-	BFL of FID channel
6.41	-	-	-	-	-	-	
19.00	-	-	-	-	-	+	
19.01	-	-	-	-	-	-	Start Syringe Pump
21.00	-	-	-	-	-	+	
21.01	-	-	-	-	+	-	Stop Syringe Pump

Refer to section 1 for the actual method(s), whenever the instrument has combined channels.

Never interrupt an analytical run. The complete cycle has to finish!

For testing TCD/FID channel: use a gas sample containing the relevant Transformer Gases. The resulting chromatogram should look like Fig 1 and 2.

The system is shipped with a programmed backflush time enabling elution of both the C3 components Propylene and Propane.
The retention times for the components during oil analysis will be shifted to slightly later times. This is because the extraction takes some time; because of oil transportation, flow rates inside the system change somewhat.
Fig 3 and 4 are typical oil patterns.

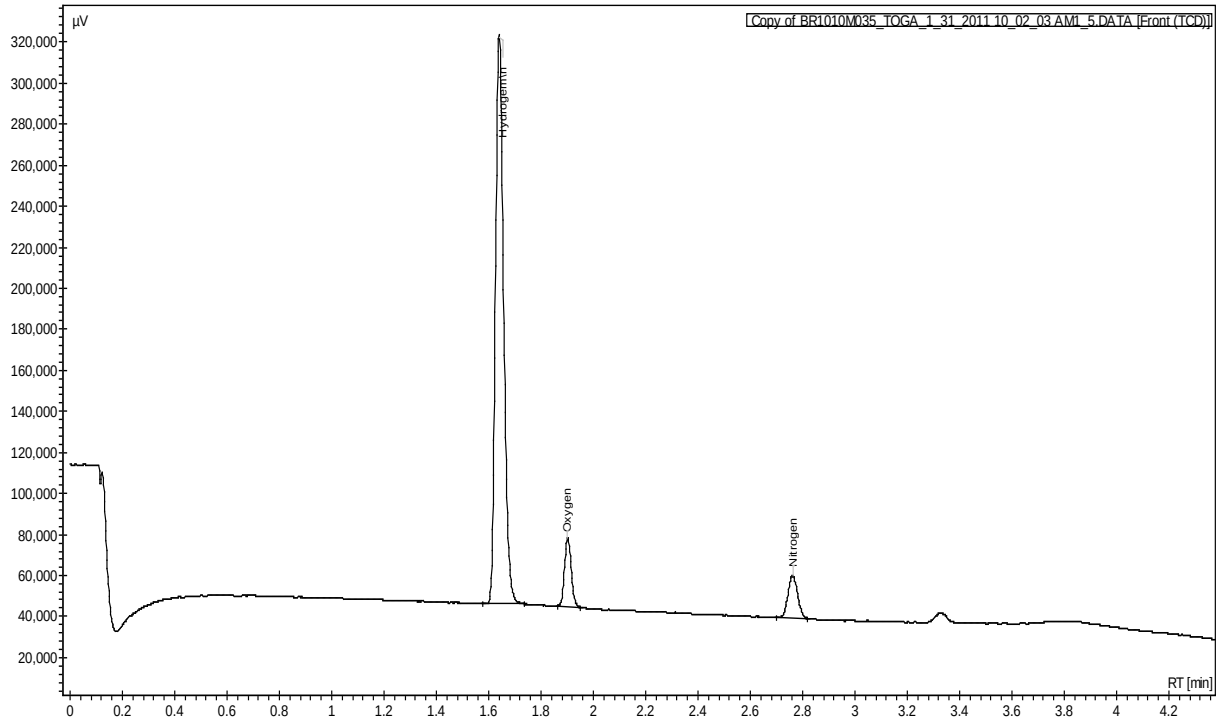


Fig 1.(Injection of TGA gas sample)

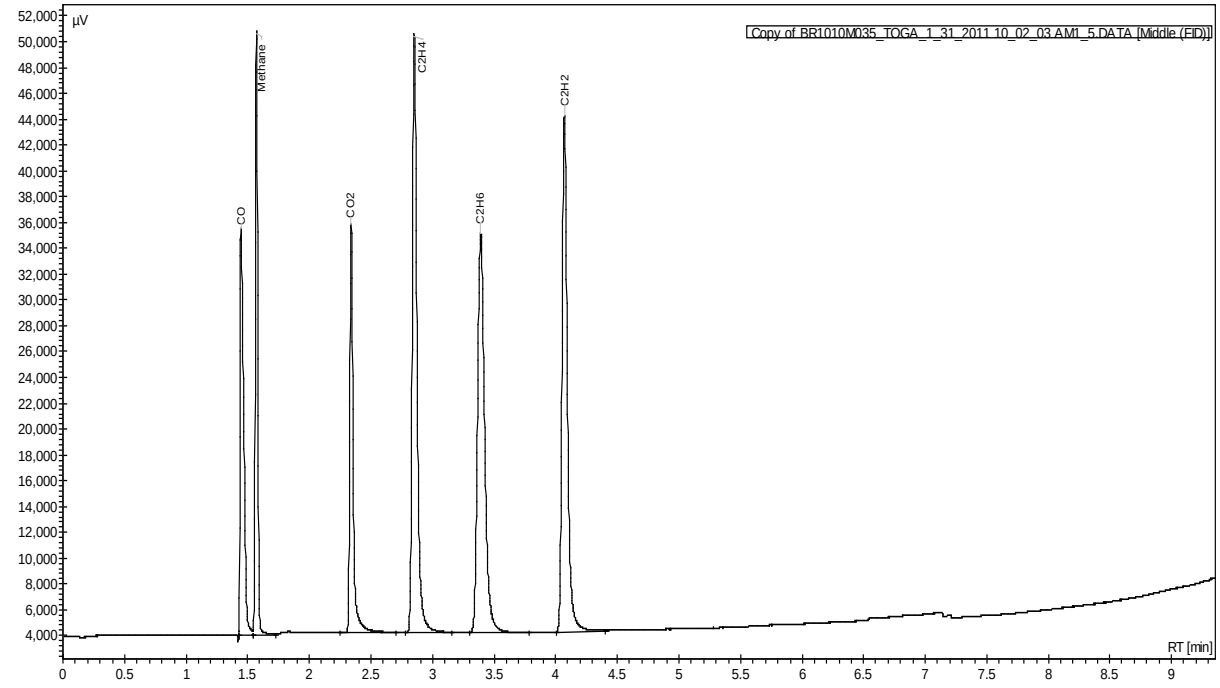


Fig 2 (Injection of TGA gas sample)

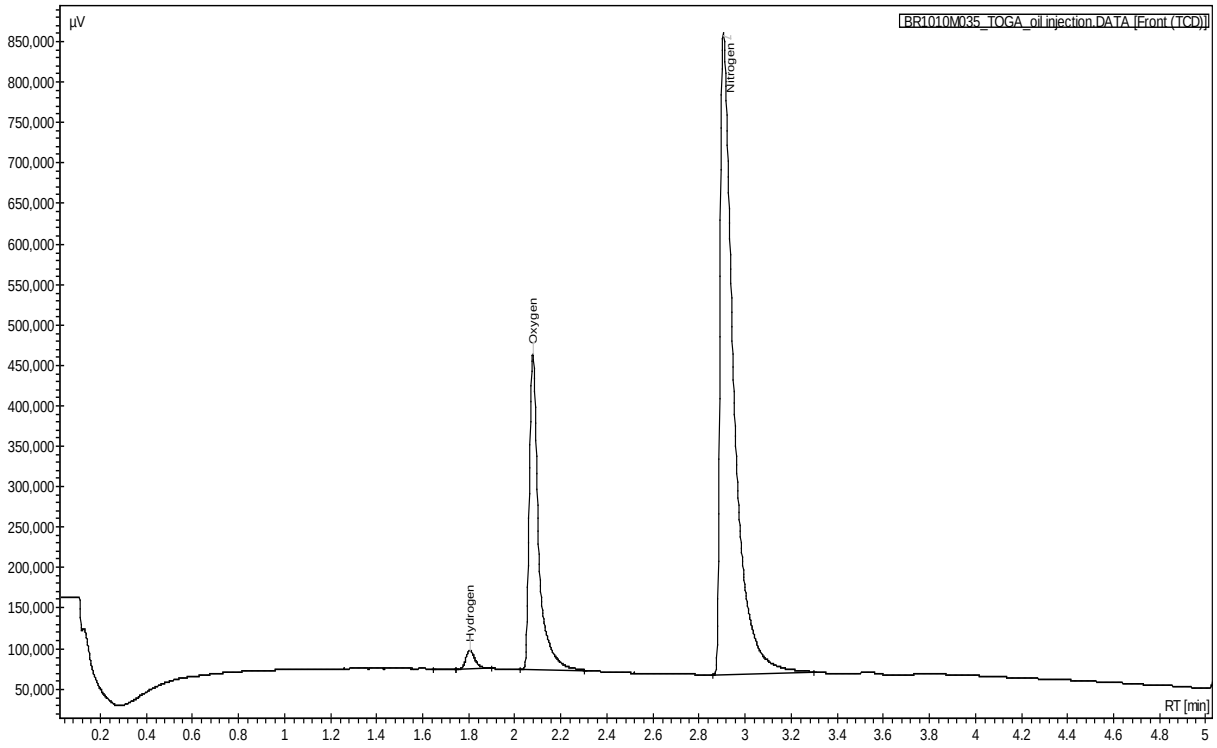


Fig 3. (Oil injection)

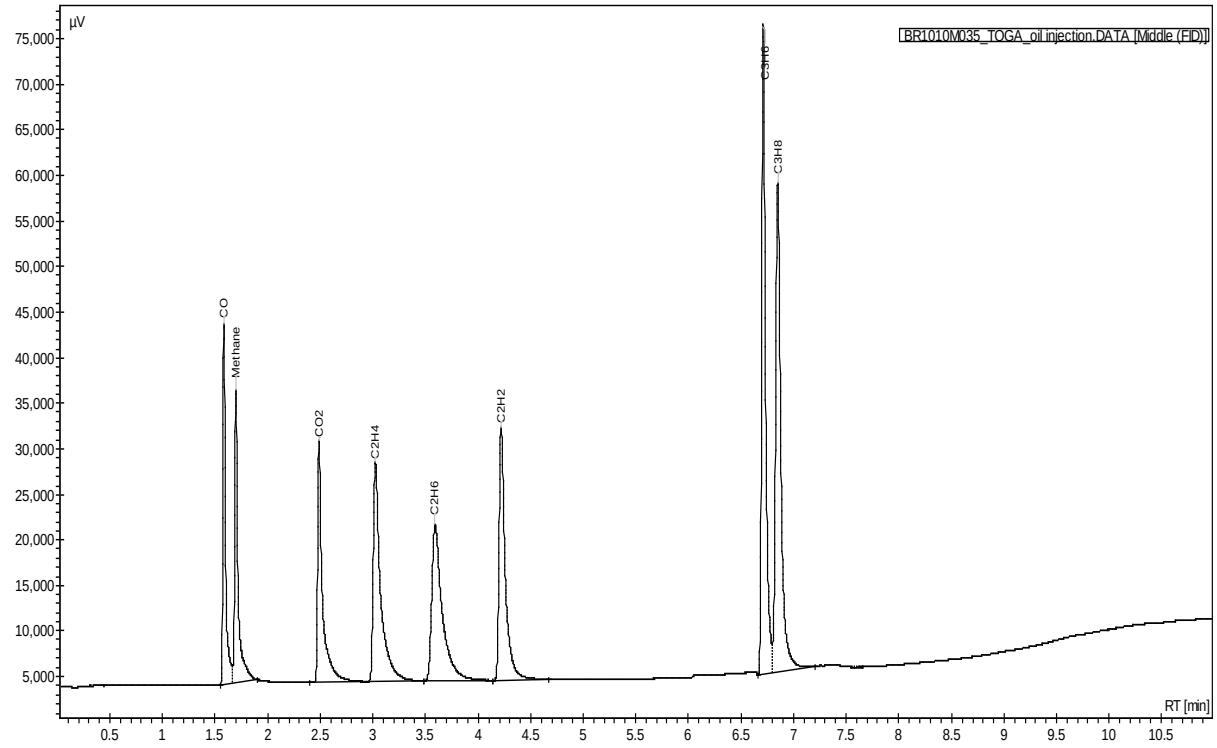


Fig 4. (Oil injection)

TROUBLE SHOOTING

For problems related to the basic hardware and electronics of the gas chromatograph, as well as injectors and detectors, refer to the 456-GC reference manual.

In case of any analytical problem, it is always advised to record an analysis using a reference sample. The result, including full details can be submitted to your local Scion Instruments service department to judge performance.

In case of decreasing retention times of the Molecular Sieve column, this column needs reconditioning. Conditioning needs to be done in a different oven under nitrogen or helium at a temperature of 300 °C overnight. Sometimes conditioning overnight of the Molsieve columns in the GC oven at 180 °C will be sufficient. Check the status of the humidity filter in case of conditioning is needed. The origin might be saturation of this filter.

In case of replacement of the Rt-U Bond column, conditioning in the GC oven can be done. However, it is mandatory to disconnect the column from the methaniser.

MAINTENANCE TOGA Analyzer

Standard maintenance.

Daily Iso-octane flush (at the end of the day).

After analyzing a set of samples, the sample injection system should be flushed with iso-octane and then purged with Air to remove the remaining oil from the system and help to keep it clean and free of grit which can score the valve rotors. Overnight, park the oven at low temperature:30°C.

Make a blank run at the start of the day, or a series of analyses.

Column bake-out:
After successive analyses, heavier components such as C4's and C5's may accumulate on the FID channel. A regular bake-out at 150°C for at least one hour is recommended.

Regular change the frit filters in the bulk-head unions of the sample line. This assures trouble free movement of the sample.

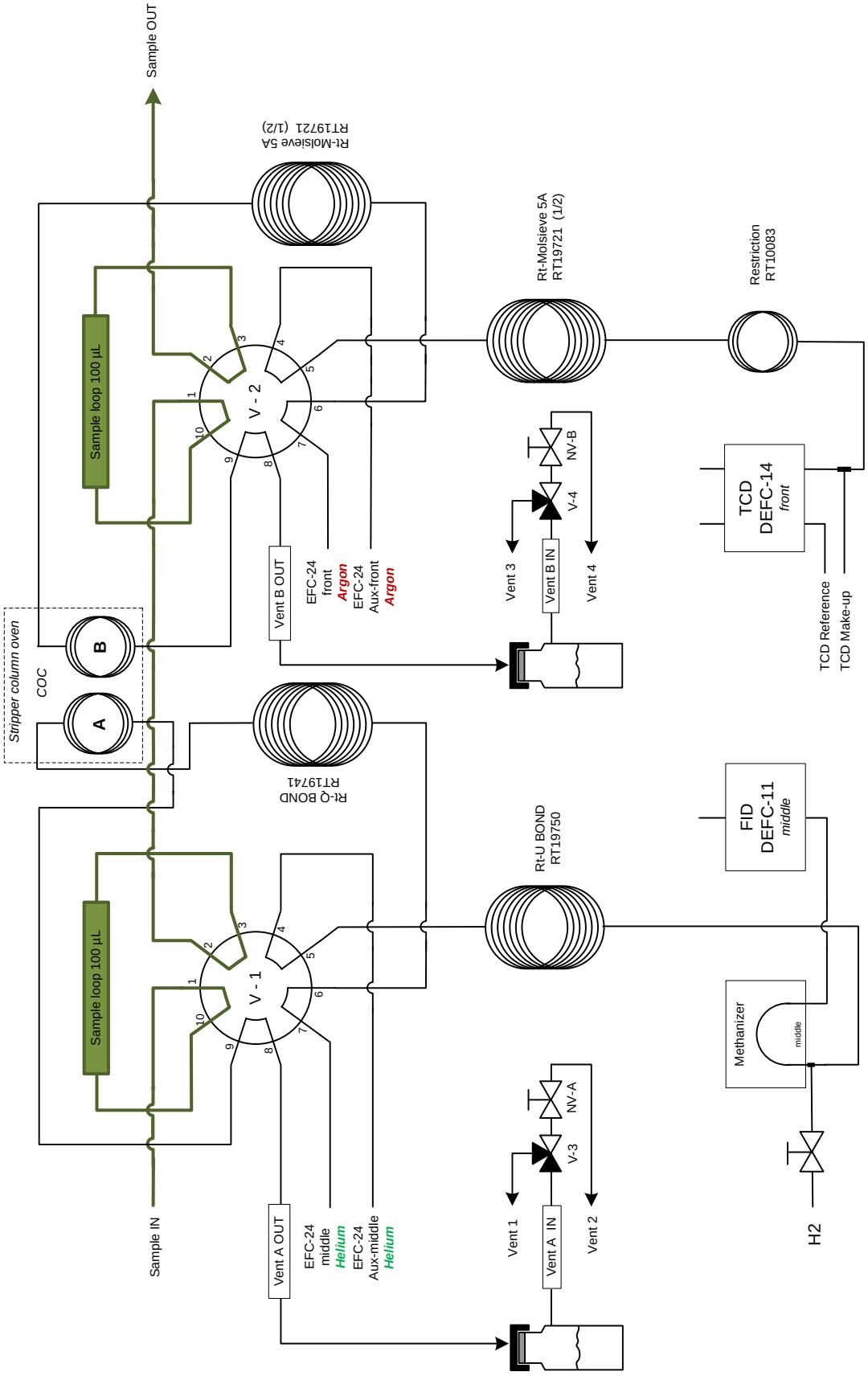
Rotor replacement, every 2000 injections (P/N VLSSAC10WE).
Stripper replacement is needed when the peak-shape deteriorates (P/N CP60025).

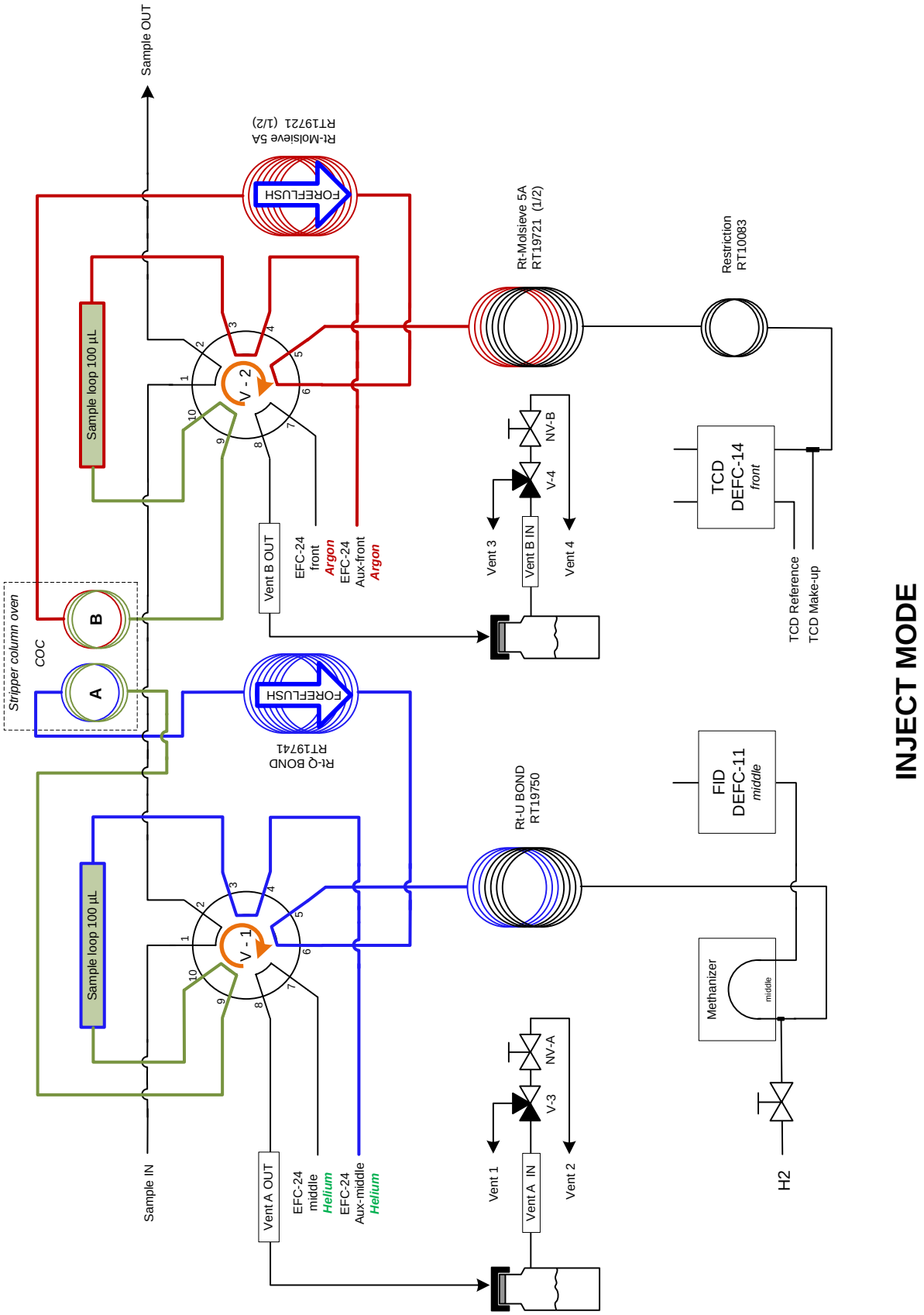
INCLUDED PARTS

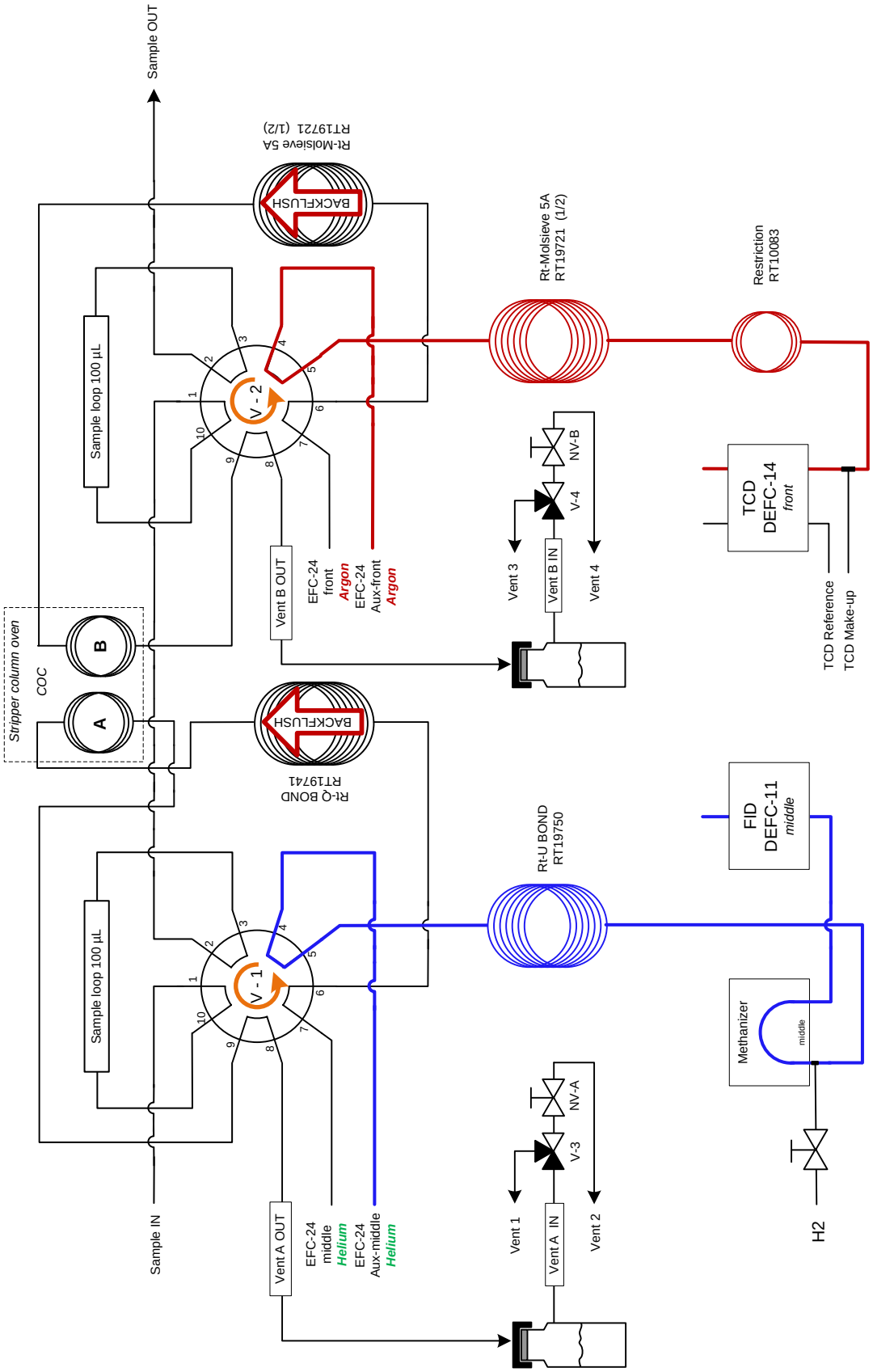
Part no	Description	Quantity
CP89405	Glass vial	2
CP4007	Stainless steel tubing (1/16” x 0.75)	1 mtr
CP4302	Nut brass 1/8”	10
	Plastic syringe	5
	Needle for plastic syringe	5
CP470101	Vespel ferrule, column 0.53 mm	2

STEP BY STEP

Step by step drawings for the Transformer Oil Gas Analyzer Channel


Sample OUT
Rt-Molsieve 5A
RT19721 (1/2)
Rt-Molsieve 5A
RT19721 (1/2)
Restriction
RT10083
Sample loop 100 µL
V - 2
Vent B OUT
EFC-24
front
Argon
EFC-24
Aux-front
Argon
Vent 3
Vent B IN
Vent 4
NV-B
V-4
TCD
DEFC-14
front
TCD Reference
TCD Make-up
Stripper column oven
COC
B
A
Rt-Q BOND
RT19741
Rt-U BOND
RT19750
FID
DEFC-11
middle
Sample loop 100 µL
V - 1
Methanizer
middle
Sample IN
Vent A OUT
EFC-24
middle
Helium
EFC-24
Aux-middle
Helium
Vent 1
Vent A IN
Vent 2
NV-A
V-3
H2
FILL MODE


INJECT MODE
Sample OUT
Sample IN
Rt-Molsieve 5A
RT19721 (1/2)
FOREFLUSH
Rt-Molsieve 5A
RT19721 (1/2)
Rt-Molsieve 5A
RT19721 (1/2)
Restriction
RT10083
Sample loop 100 µL
V - 2
Vent B OUT
EFC-24
front
Argon
EFC-24
Aux-front
Argon
NV-B
V-4
Vent 3
Vent B IN
Vent 4
TCD
DEFC-14
front
TCD Reference
TCD Make-up
Stripper column oven
COC
B
A
FOREFLUSH
Rt-Q BOND
RT19741
Rt-U BOND
RT19750
FID
DEFC-11
middle
Sample loop 100 µL
V - 1
Vent A OUT
EFC-24
middle
Helium
EFC-24
Aux-middle
Helium
NV-A
V-3
Vent 1
Vent A IN
Vent 2
Methanizer
middle
H2


BACKFLUSH (FILL) MODE
Sample OUT
Rt-Molsieve 5A
RT19721 (1/2)
BACKFLUSH
Rt-Molsieve 5A
RT19721 (1/2)
Sample loop 100 µL
V - 2
Rt-Molsieve 5A
RT19721 (1/2)
Restriction
RT10083
NV-B
V-4
Vent 3
Vent B IN
Vent 4
Vent B OUT
EFC-24
front
Argon
EFC-24
Aux-front
Argon
TCD
DEFC-14
front
TCD Reference
TCD Make-up
Stripper column oven
COC
B
A
BACKFLUSH
Rt-Q BOND
RT19741
Rt-Q BOND
RT19741
Rt-U BOND
RT19750
FID
DEFC-11
middle
Sample loop 100 µL
V - 1
Rt-U BOND
RT19750
Methanizer
middle
NV-A
V-3
Vent 1
Vent A IN
Vent 2
Vent A OUT
EFC-24
middle
Helium
EFC-24
Aux-middle
Helium
Sample IN
H2