TOA User Help
TOA Basic Features

1. About TOA

Transformer Oil Analyst 4.0 (TOA) is a software product developed and marketed by Delta-X Research Inc. TOA provides state-of-the-art computerized interpretation of dissolved-gas analysis (DGA) and insulating fluid test results for power transformers and other liquid-filled high-voltage equipment. Its main purpose is to help you process test data and identify abnormal results quickly so that investigation or corrective action can be initiated promptly to prevent unscheduled outages, avoidable equipment failure, and safety hazards.

Whether TOA is installed on a single computer or on a network, its user interface is a web browser. If installed on a network, TOA is accessible by users on that network in the same way that a web site would be. TOA Online is a subscription-based service providing TOA's data management, analysis, and reporting via the public Internet.

2. TOA Disclaimer

There are many unusual circumstances that can affect dissolved-gas analysis (DGA) and other oil test results, and no computer software can possibly handle all of them reliably and economically. For this reason, competent human involvement in data interpretation is essential. TOA's automatic data interpretation is intended to assist, not replace, the equipment expert.

TOA results must always be reviewed by a person qualified to interpret the data, who can judge the correctness and applicability of the results in each case and decide upon follow-up action if required. The criteria upon which TOA results are based must also be subjected to review and control by a qualified person.

Although we do our best to ensure that TOA employs up-to-date and proven analysis methods, Delta-X Research Inc does not claim or guarantee that TOA's automatically generated data interpretation is complete or correct. It is only offered as an aid to a qualified person, who would in most cases want to perform a similar type of analysis before deciding whether further investigation or alternative interpretations are required. Delta-X Research is pleased to reveal and discuss the details of TOA's diagnostic calculations with any qualified TOA user.

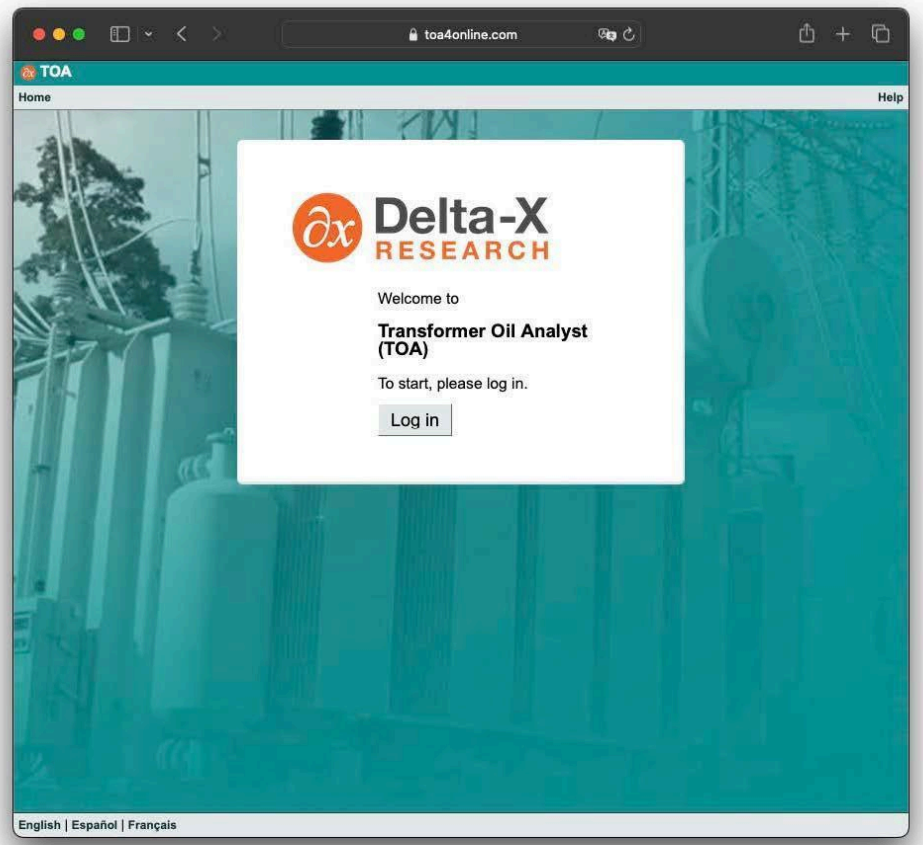
It is also important to be aware that, although DGA is an extremely important tool for early detection of equipment faults, it is far from perfect. According to insurance company statistics, generally only about one-third of all transformer failures are avoidable by means of annual screening DGA, and only about two-thirds of all transformer failures are avoidable by means of continuous online monitoring.

3. Find TOA Online

TOA Online is TOA software acting as a web site on the public Internet. To find it, point your web browser to this home address: https://www.toa.online.com/toa/
There are two special things to note about this address.

- First, it starts with "https" instead of the more usual "http". This signifies that a special high-security protocol is used which encrypts all information exchanged between your browser and the TOA Online server.
- Second, it ends with "/toa". This is a security feature. If you forget the "toa/" part and try to use the basic dot-com address, your browser will tell you that the requested web page does not exist.

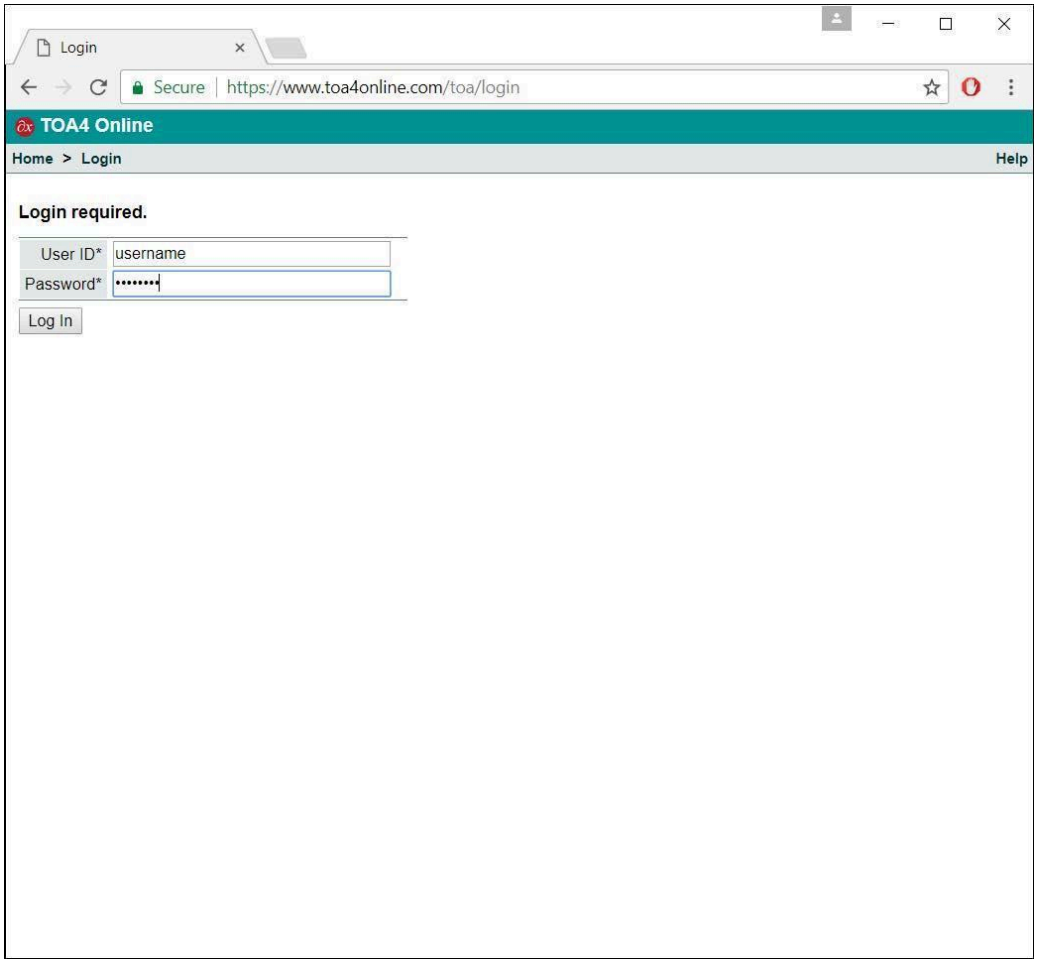
We suggest that you create a "bookmark" for the TOA home address. In Internet Explorer, this is the same as adding the TOA Online home address to your "favorites". Below is what you see when your browser first connects with TOA Online.



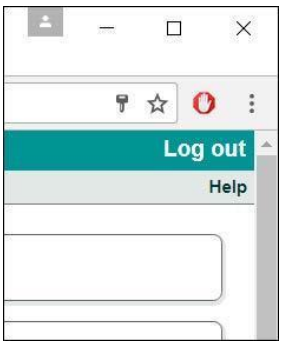
4. Log In and Out

Each user must log in to TOA before using it. The user login ID's and initial passwords are assigned by your TOA Administrator.

To log in, click “Log in” in the TOA home page or try to access any of TOA’s features other than the home page or Help. A login dialog box is presented.



Your login ID and password are case-sensitive.
When you are finished using TOA, it is a good idea to log out. Click the "Log out" link at the right end of the title bar at the top of any TOA web page.



5. TOA User Security Roles

Every TOA login ID is associated with a security role which defines what data and operations are available to a user with that ID. There are two classes of login ID's - FULL and RESTRICTED. "Restricted" login ID's are issued with a particular security role which is permanent. The security role of a "Full" login ID can be changed (within a certain range) by a TOA administrator. Details are shown below.

FULL user security roles

unauthorized	View the home page and use Help.
authorized	Read-only access to equipment, test data, norms, lists.
operator	Import/edit equipment, unreviewed test data, lists.
supervisor	Import/edit/delete equipment, data, and norms. Review test data.
administrator	Like supervisor. Also edit user profiles and set passwords.

RESTRICTED user security roles

authorized	Read-only access to equipment, test data, norms, lists.
data-provider	Upload and view data files, download equipment.
rpc-user	Execute RPC commands (automation interface to TOA).

6. Access Control Groups

In some cases it may be necessary or desirable to allow certain users access to only a subset of the equipment in a TOA database. For example, there may be several different departments or power plants, each with its own equipment, where the employees at each location should be able to see and work with information about only their equipment. In the same situation, there may also be equipment experts who need to be able to review and edit equipment information from multiple locations, and administrative users usually need to have access to everything in the database.

TOA's access control groups feature provides a way to handle this kind of requirement.

Example
Power Short Corp. has two subsidiaries, Nuke Power Co. and Big Smoke Co., each of which has several TOA login ID's. At corporate headquarters, there is a lab, a group of equipment experts, and an I.T. person who takes care of TOA administration and database maintenance.

The administrator creates two access control groups, respectively called "NUKE POWER" and "BIG SMOKE". The users at those sites are put into the group for their site. The lab user and the equipment experts are put into both groups. It does not matter whether the administrator is included in the groups or not, because an admin user always has access to the entire database.

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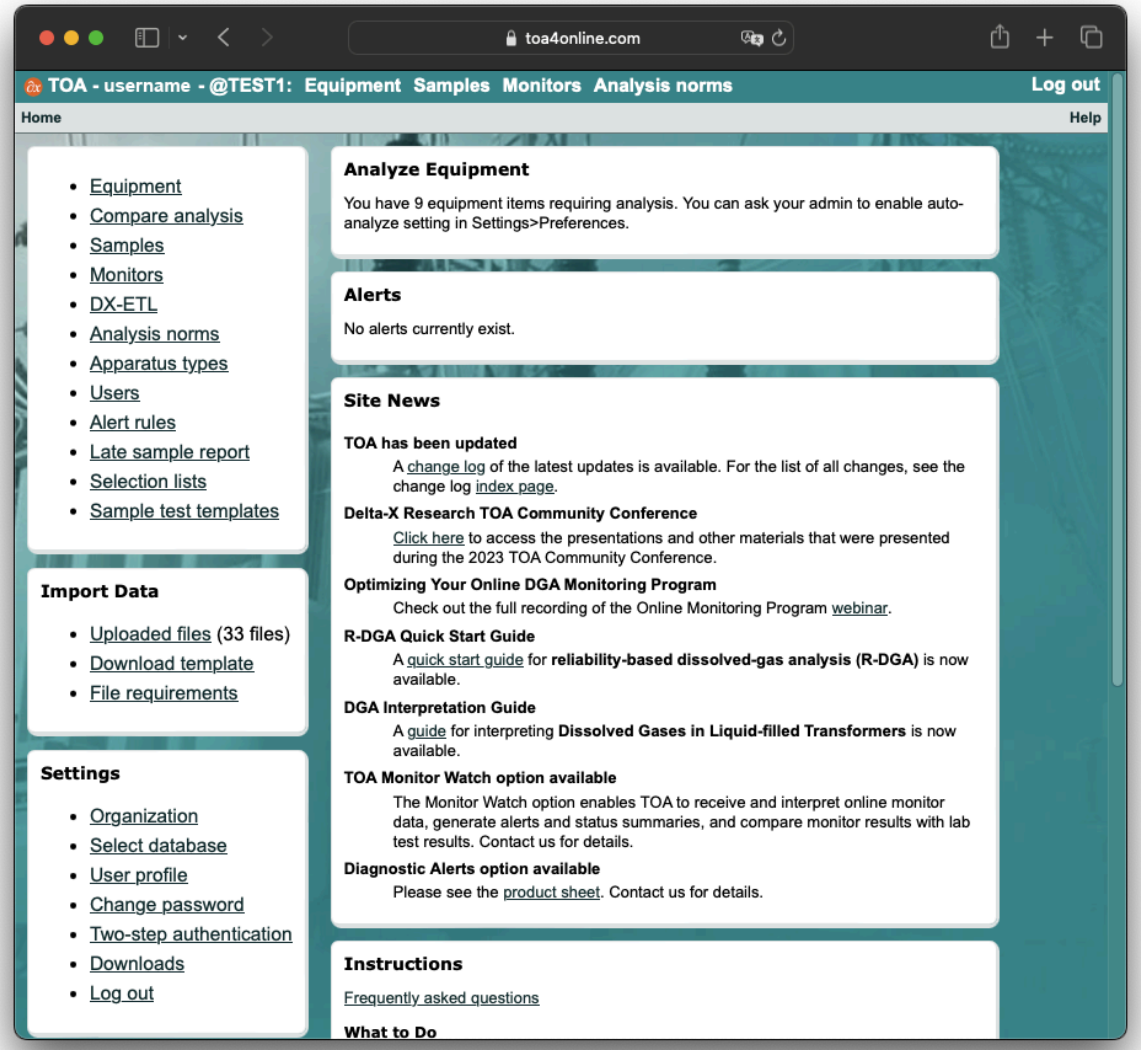
The administrator edits the equipment or does an equipment update import to set the group_name of each equipment item to NUKE POWER or BIG SMOKE.

For details, see “Access Control Groups” under “Reference Information” in TOA Help.

7. The TOA Home Page

After you log in, the TOA home page contains links to important features, What’s New notices, and very basic pointers for new users. What exactly is visible to you on the home page (and other pages) depends on the “security role” assigned to your TOA Online login ID. If you are a supervisor-level user, for example, some extra links are provided for uploading, editing, and deleting data and analysis norms.



The “user profile" link under Settings allows you to record your contact information so that your TOA administrator can contact you when necessary.

The “change password" link allows you to set your own password. By default, TOA requires a password to meet certain length and complexity standards. The password requirements can be customized by your TOA administrator. If you forget your password, your TOA administrator can set a new one for you.

8. Use Bookmarks

Since TOA Online is a web site, you can bookmark any page or report that you would like to return to in the future. For example, you might bookmark the Equipment page of a transformer which requires special attention. You could bookmark a Help page which contains information that you refer to often. It is handy to bookmark major pages such as Equipment and Analysis Norms to avoid using menus to find them.

9. Copy and Save

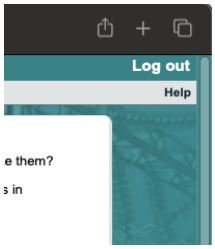
When viewing text or images in TOA, you can use the copying and saving features of your web browser to transfer information to a separate file or to a word processing document or a spreadsheet.

Copying text
Highlight some text on a TOA page. Click on it with the right mouse button. In the context menu that appears, choose “Copy.” The text can now be “pasted” into a word processing document, spreadsheet, or notepad file in a different window. If you highlight and copy a table, such as the test history shown in an analysis report, in most cases it can be pasted into a spreadsheet or word processing document as a similar table. If pasted into a notepad file or pasted as “plain text,” it will appear as tab-separated text. To copy a large table, if not all rows are displayed in the current page, change “Rows to show” (near the top of the page) so that it is the same as “Records” and click the Go button. Even if the table contains hundreds of records, the page - with a table containing all those rows - should be redisplayed very quickly. Now you can highlight the entire table, copy it, and paste it into a document or file.

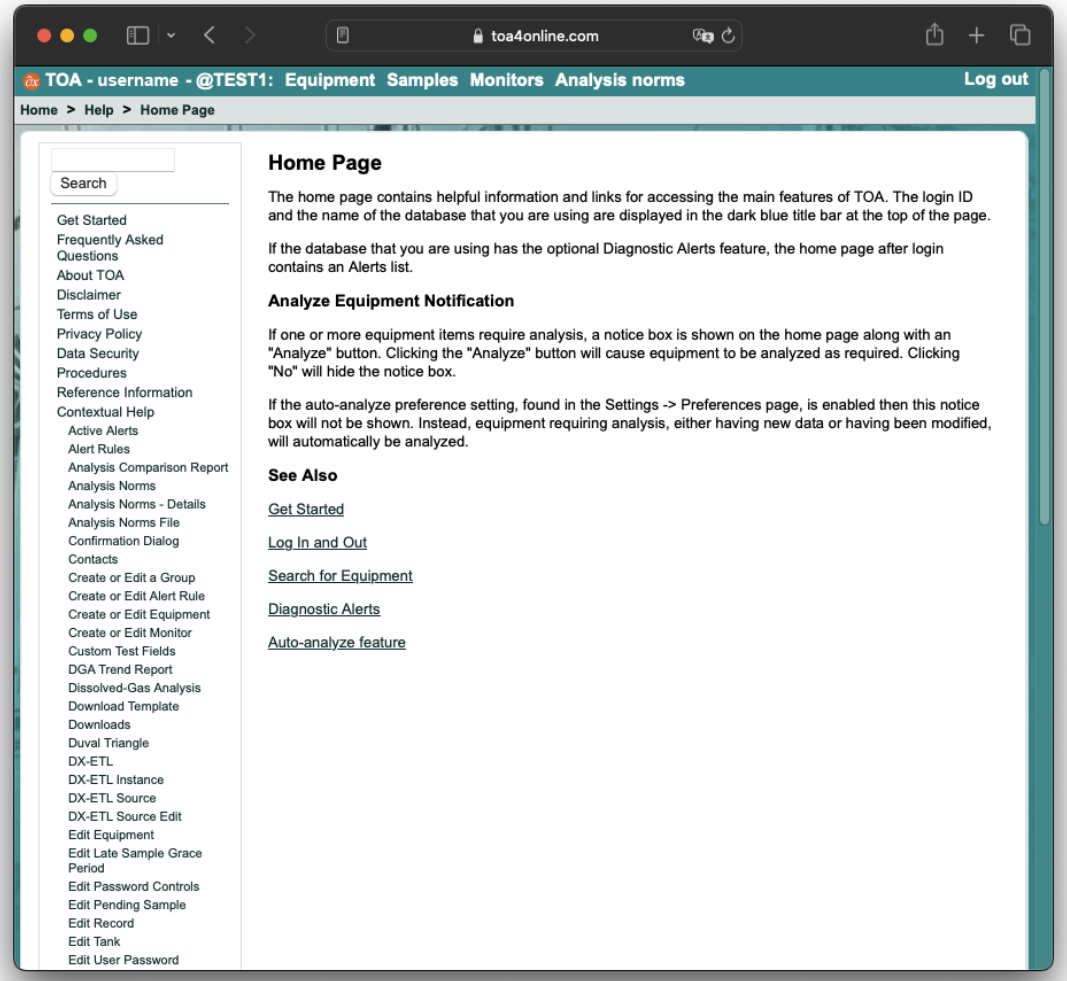
Copying or saving images
Every graph, triangle chart, or other image displayed in a TOA page can be saved to a file or copied and then pasted into a document. Simply click on the image with the right mouse button and choose “Save As” or “Copy” (depending on what you wish to do) in the context menu that appears.

10. Get Help

Most TOA web pages have a "Help" link in the upper right for displaying help information relating to the page you are currently viewing.



Each help page has a navigation menu on the left side that allows you to look up other information.



11. Equipment List

The equipment list displays basic information about equipment items and serves as a starting place for finding more detailed information about each equipment item. Above the equipment list is a set of controls which can be used to filter and sort the list in various ways and to scroll back and forth in the list, if it contains more items than those displayed.

11.1 Special List Columns

New
The number of new, un-analyzed samples for each equipment item is shown in the New column.

Total
The total number of oil sample records for each equipment item is shown in the Total column.

Last Sampled, Last DGA/FQ/moisture Sample

The date when the latest DGA or fluid quality (FQ) or moisture-in-oil sample was drawn is shown in a column named Last Sampled or Last DGA Sample, etc.

Next DGA, Next FQ
The suggested date when the next DGA or fluid quality (FQ) sample should be drawn is shown in the Next DGA or Next FQ column.

DGA, FQ, Moisture
The latest result codes for dissolved-gas analysis, fluid quality, and moisture content are shown in the DGA, FQ, and Moisture columns, respectively. The result code is a number:
0: Un-analyzed, or no data
1: No abnormality detected
2: May require retesting or extra attention
3: May require urgent attention
4: May require extremely urgent attention or action

Diagnosis
If the DGA, FQ, or Moisture result code is greater than 1, indicating the detection of an abnormal or faulty condition, a diagnostic code of the relevant type can be displayed indicating the most likely type of fault corresponding to the evidence found. For brevity, the DGA diagnosis is identified by a short code.

Status
When new test data are imported for an equipment item, its status is shown as UNREVIEWED until a supervisor or administrator designates each new test record belonging to that equipment as REVIEWED.

11.2 Batch Processing Buttons

The batch processing buttons (located below the equipment list) initiate operations which affect only the equipment items selected by the current filter settings. For example, if you filter on a specific substation, an analysis operation will process only data belonging to equipment at that substation.

Analyze new data
When some equipment items have recent un-analyzed data, the “Analyze new data” button is displayed. If the analysis is activated, the equipment with un-analyzed data is processed, typically at a rate exceeding 200 data records per second. Test data records marked as REVIEWED are not modified by the analysis. A message is displayed when the analysis is complete.

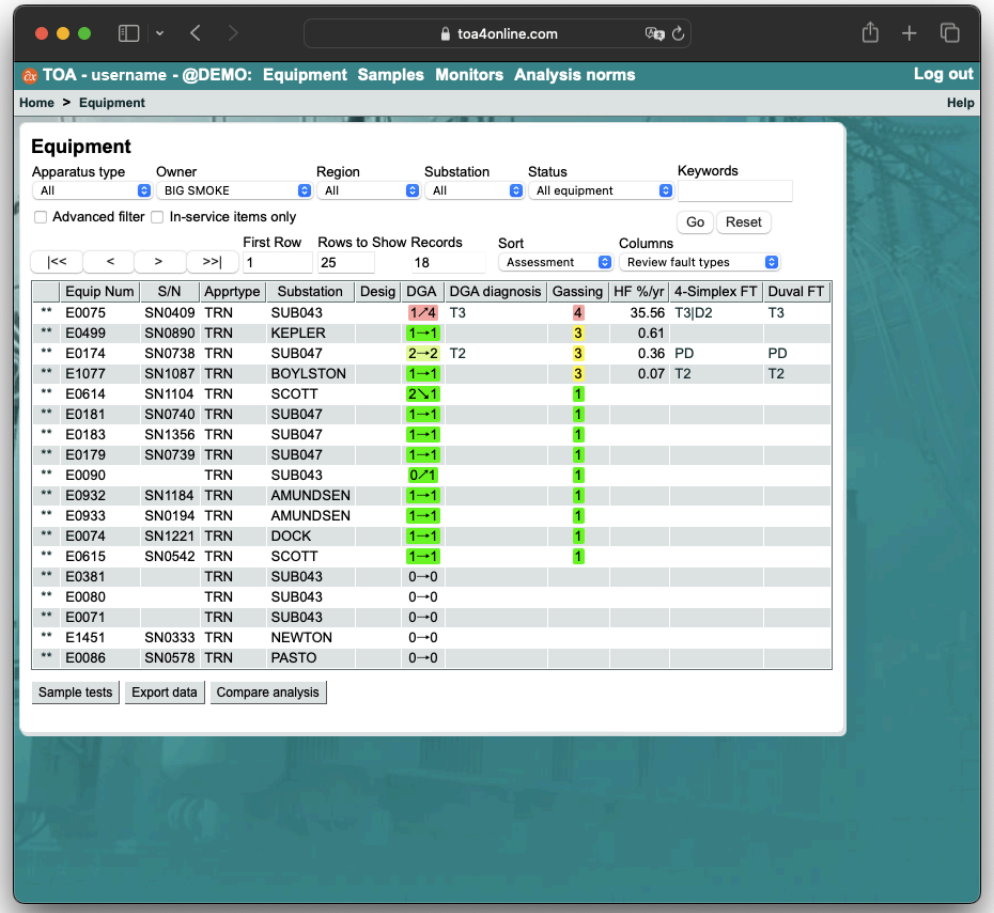
Analyze unreviewed
The “Analyze unreviewed” button is provided so that an analysis can be run even if there are no un-analyzed records. This will analyze all new data and also all UNREVIEWED data. Note that any reviewer edits and comments which may have been made on the UNREVIEWED items will be overwritten by this analysis. Test data records marked as REVIEWED are not modified, though. A message is displayed when the analysis is complete.

Delete
Deletes all equipment that is selected by the current filter, along with all the associated test data.

Review
The “Review” button is displayed when some test data records have been analyzed but are still UNREVIEWED. When Review is clicked, a confirmation dialog is presented explaining that UNREVIEWED

test data with no evidence of abnormality (i.e., with all result codes < 2) will be marked as REVIEWED. After “Review” has been used, that button is hidden. Equipment with abnormal results which are still UNREVIEWED may be found by filtering the equipment list for Abnormal or Unreviewed status.

Import
The “Import” button displays the Upload File page.



12. Equipment List Filters

Just under the title of the Equipment page there is a row of selection lists for filtering the equipment list. To the right of the filter selection lists is a textbox for entering search text. At the extreme right of that row are a Go button and a Reset button. The filters, including the keyword search, act jointly. To remove all filters, click the Reset button.

12.1 Apparatus Type

Apparatus type designates a generic type of equipment, such as transformers, oil circuit breakers, and so on. The available apparatus types are generally subscriber-defined.

12.2 Owner

Owner is intended to designate the company, organization, or department to which an equipment item belongs. For an electric utility, owner might be TRANSMISSION, DISTRIBUTION, or GENERATION, or it might identify a subsidiary. For a lab or electrical service company, owner would usually identify the customer who owns the equipment.

12.3 Region

Region is intended to designate a geographical territory, but in some situations it might be used to identify a large facility, such as a refinery, containing several substations.

12.4 Substation

Substation normally identifies an electrical substation or similar group of equipment at one physical location.

12.5 Status

The status selections are as described here:

All equipment	Show all the equipment items.
Abnormal	Show all equipment with a DGA, FQ, or moisture code greater than one.
Unanalyzed	Show all equipment with unanalyzed test data.
Unreviewed	Show all equipment whose most recent test data is UNREVIEWED.
Reviewed	Show all equipment whose most recent test data is REVIEWED.

12.6 Keywords

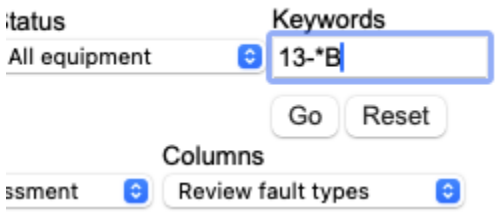
The Keyword Search feature for finding equipment is located on the Equipment List page. Just under the page title there is a row of selection lists for filtering the equipment list by apparatus type, owner, and so on. At the right end of that row is a text box for entering search text. The equipment search feature operates in combination with the filter selection lists to restrict the contents of the equipment list according to criteria that you choose.

To filter the equipment list according to the search text that you have typed (and also the other filter selections you have made), press Enter or click the “Go” button after typing the search text.

A text or numeric expression typed in the Keyword Search box must be matched exactly unless a “wildcard” character (asterisk “*”), representing any number of anonymous characters, is found in the

expression. The search looks at all the text attributes of all equipment for matches; these attributes include the equipment number, serial number, substation name, designation, owner name, manufacturer, model, description, apparatus type, year manufactured, kV rating, MVA ratings, current rating, fluid type, and cooling type.

For example, enter the name of a set of analysis norms to produce a list of all the equipment using those norms. A search for “03-001234” might display a single equipment item with that particular equipment number or serial number. Searching for “03-*” would display all the equipment having an attribute (probably equipment number or serial number, in this case) starting with “03-”. Searching for “03-*B” would display all equipment having an attribute starting with “03-” and ending with “B”.



13. Equipment List Display Controls

Between the row of filter controls and the top of the equipment list, there is a row of widgets for scrolling the list, controlling the number of rows displayed, and choosing different combinations of columns to show.

13.1 VCR Buttons

The "VCR buttons" at the left side are for showing different parts of the list:

|< <	Beginning of list.
<	One page back.
>	One page forwards.
> >|	End of list.

13.2 First Row

The First Row textbox shows which row of the equipment list (as currently filtered) is at the top of those displayed. To jump directly to a particular row, enter its number in the box. If the page size or number of rows in the list do not allow the designated row to be shown at the top, the number in the First Row textbox may change to a different value than the one you entered.

13.3 Rows to Show

The Rows to Show textbox controls the page size, i.e., the maximum number of rows displayed at one time. For some purposes you may wish to expand or shrink the page size to display exactly a particular set of rows. It is also possible to enter a large number and cause all the equipment in the list (as filtered) to be displayed at once, even if there are several thousand rows.

13.4 Records

The Records text box shows the number of rows present in the equipment list as filtered. This number is not editable.

13.5 Sort

The Sort selection list provides several different ways to sort the equipment list as currently filtered. Some sort options are available only with certain selections of columns.

Assessment	Combination of DGA, FQ, moisture condition codes. Worst at the top.
Equipment	Equipment No. / Serial No., in alphabetical order
Last sampled	Date of latest sample, with most recent dates at the top.
Next DGA/FQ	Recommended next DGA (or FQ) sample date, earliest at the top.
Oil test status	Reviewed/Unreviewed status. Reviewed at the top.
Substation	Substation, in alphabetical order.

13.6 Columns

The Columns selection list provides several different combinations of columns to show. All views include the equipment identification (Equipment No., Serial No., Apparatus Type) and location (Owner, Region, Substation, Designation). Additional columns shown in each case are:

Analysis Norms	Manufacturer, kV rating, Norms.
Basic info	Manufacturer, kV rating, Amps rating, Cooling, Fluid type.
DGA status	New samples, Total samples, Last DGA, Next DGA, DGA result, DGA diagnosis, Oil test status.
FQ status	New samples, Total samples, Last FQ, Next FQ, FQ result, FQ diagnosis, Oil test status.
Moisture status	New samples, Total samples, Last moisture sample, moisture result, moisture diagnosis, Oil test status.

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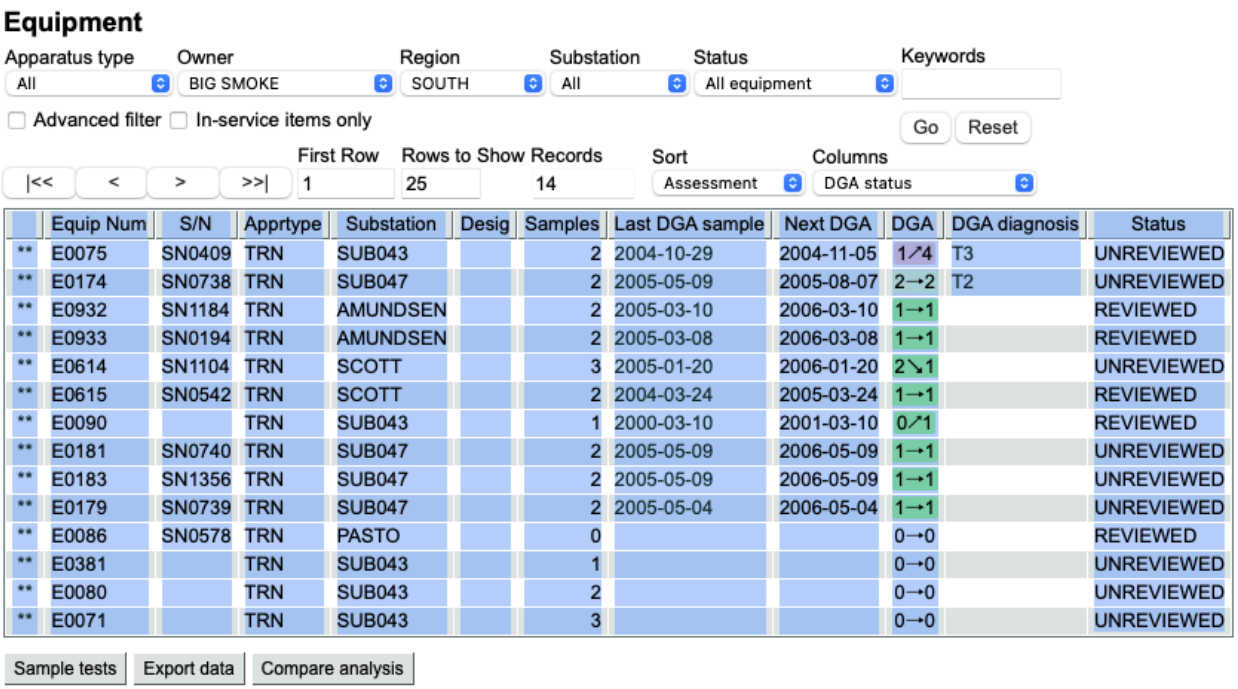
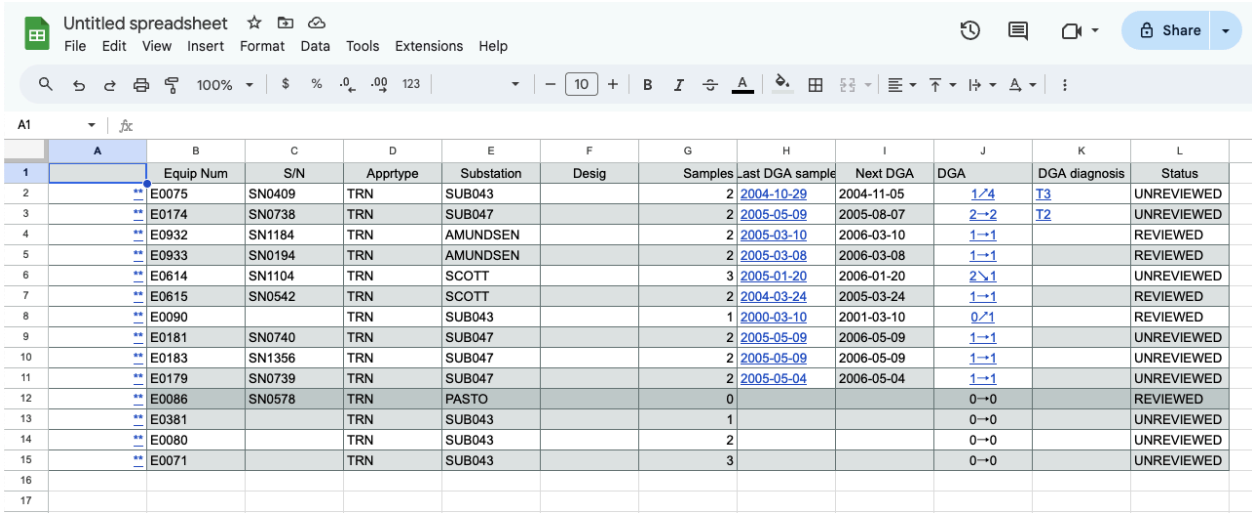
Review new data — New samples, Total samples, Last sample, DGA result, FQ result, moisture result, Oil test status.

14. Copy a Table and Paste to a Spreadsheet

To copy a large table, if not all rows are displayed in the current page, change “Rows to show” (near the top of the page) so that it is the same as “Records” and click the Go button. Even if the table contains hundreds of records, the page - with a table containing all those rows - should be redisplayed very quickly. Now you can highlight the entire table, copy it, and paste it into a document or file. Use “Paste Special” and select “Plain Text”.



	Equip Num	S/N	Apprtype	Substation	Desig	Samples	Last DGA sample	Next DGA	DGA	DGA diagnosis	Status
**	E0075	SN0409	TRN	SUB043		2	2004-10-29	2004-11-05	1↗4	T3	UNREVIEWED
**	E0174	SN0738	TRN	SUB047		2	2005-05-09	2005-08-07	2→2	T2	UNREVIEWED
**	E0932	SN1184	TRN	AMUNDSEN		2	2005-03-10	2006-03-10	1→1		REVIEWED
**	E0933	SN0194	TRN	AMUNDSEN		2	2005-03-08	2006-03-08	1→1		REVIEWED
**	E0614	SN1104	TRN	SCOTT		3	2005-01-20	2006-01-20	2↘1		UNREVIEWED
**	E0615	SN0542	TRN	SCOTT		2	2004-03-24	2005-03-24	1→1		REVIEWED
**	E0090		TRN	SUB043		1	2000-03-10	2001-03-10	0↗1		REVIEWED
**	E0181	SN0740	TRN	SUB047		2	2005-05-09	2006-05-09	1→1		UNREVIEWED
**	E0183	SN1356	TRN	SUB047		2	2005-05-09	2006-05-09	1→1		UNREVIEWED
**	E0179	SN0739	TRN	SUB047		2	2005-05-04	2006-05-04	1→1		UNREVIEWED
**	E0086	SN0578	TRN	PASTO		0			0→0		REVIEWED
**	E0381		TRN	SUB043		1			0→0		UNREVIEWED
**	E0080		TRN	SUB043		2			0→0		UNREVIEWED
**	E0071		TRN	SUB043		3			0→0		UNREVIEWED

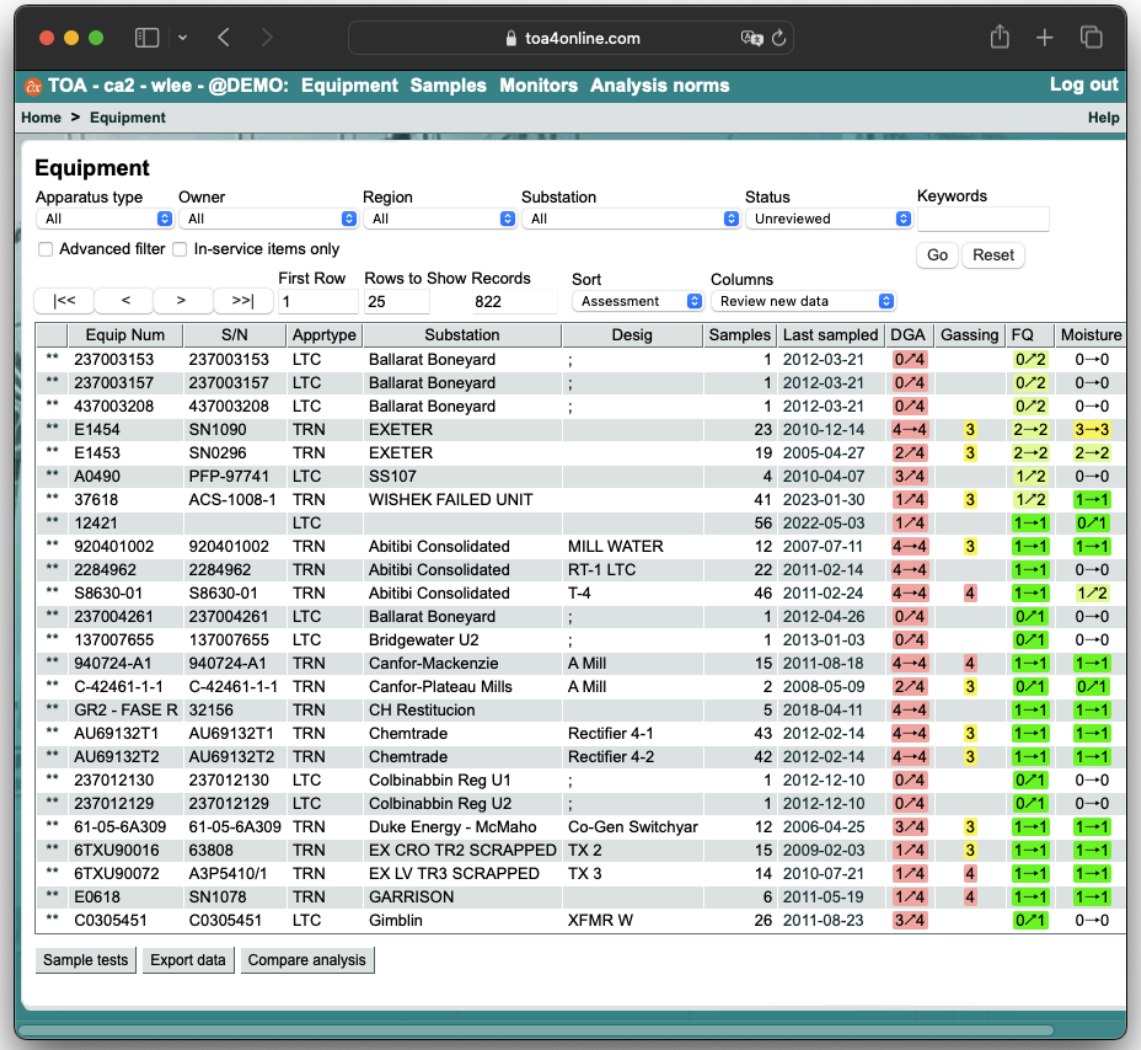


	Equip Num	S/N	Apprtype	Substation	Desig	Samples	Last DGA sample	Next DGA	DGA	DGA diagnosis	Status
**	E0075	SN0409	TRN	SUB043		2	2004-10-29	2004-11-05	1↗4	T3	UNREVIEWED
**	E0174	SN0738	TRN	SUB047		2	2005-05-09	2005-08-07	2→2	T2	UNREVIEWED
**	E0932	SN1184	TRN	AMUNDSEN		2	2005-03-10	2006-03-10	1→1		REVIEWED
**	E0933	SN0194	TRN	AMUNDSEN		2	2005-03-08	2006-03-08	1→1		REVIEWED
**	E0614	SN1104	TRN	SCOTT		3	2005-01-20	2006-01-20	2↘1		UNREVIEWED
**	E0615	SN0542	TRN	SCOTT		2	2004-03-24	2005-03-24	1→1		REVIEWED
**	E0090		TRN	SUB043		1	2000-03-10	2001-03-10	0↗1		REVIEWED
**	E0181	SN0740	TRN	SUB047		2	2005-05-09	2006-05-09	1→1		UNREVIEWED
**	E0183	SN1356	TRN	SUB047		2	2005-05-09	2006-05-09	1→1		UNREVIEWED
**	E0179	SN0739	TRN	SUB047		2	2005-05-04	2006-05-04	1→1		UNREVIEWED
**	E0086	SN0578	TRN	PASTO		0			0→0		REVIEWED
**	E0381		TRN	SUB043		1			0→0		UNREVIEWED
**	E0080		TRN	SUB043		2			0→0		UNREVIEWED
**	E0071		TRN	SUB043		3			0→0		UNREVIEWED

15. Prioritized List for Reviewing New Results

To get a list of equipment prioritized according to test results, with the worst cases at the top, choose “Review new data” in the Columns selection list and “Assessment” in the Sort selection list. Also choose “UNREVIEWED” in the Status selection list to restrict the list to equipment whose latest tests have not yet been reviewed. On the other hand, choose “REVIEWED” in the Status selection list to restrict the list to equipment whose latest tests have been reviewed.

Please note that the latest test results don’t get calculated until someone clicks the “Analyze new” button.



	Equip Num	S/N	Apprtype	Substation	Desig	Samples	Last sampled	DGA	Gassing	FQ	Moisture
**	237003153	237003153	LTC	Ballarat Boneyard	;	1	2012-03-21	0↗4		0↗2	0→0
**	237003157	237003157	LTC	Ballarat Boneyard	;	1	2012-03-21	0↗4		0↗2	0→0
**	437003208	437003208	LTC	Ballarat Boneyard	;	1	2012-03-21	0↗4		0↗2	0→0
**	E1454	SN1090	TRN	EXETER		23	2010-12-14	4→4	3	2→2	3→3
**	E1453	SN0296	TRN	EXETER		19	2005-04-27	2↗4	3	2→2	2→2
**	A0490	PFP-97741	LTC	SS107		4	2010-04-07	3↗4		1↗2	0→0
**	37618	ACS-1008-1	TRN	WISHEK FAILED UNIT		41	2023-01-30	1↗4	3	1↗2	1→1
**	12421		LTC			56	2022-05-03	1↗4		1→1	0↗1
**	920401002	920401002	TRN	Abitibi Consolidated	MILL WATER	12	2007-07-11	4→4	3	1→1	1→1
**	2284962	2284962	TRN	Abitibi Consolidated	RT-1 LTC	22	2011-02-14	4→4		1→1	0→0
**	S8630-01	S8630-01	TRN	Abitibi Consolidated	T-4	46	2011-02-24	4→4	4	1→1	1↗2
**	237004261	237004261	LTC	Ballarat Boneyard	;	1	2012-04-26	0↗4		0↗1	0→0
**	137007655	137007655	LTC	Bridgewater U2	;	1	2013-01-03	0↗4		0↗1	0→0
**	940724-A1	940724-A1	TRN	Canfor-Mackenzie	A Mill	15	2011-08-18	4→4	4	1→1	1→1
**	C-42461-1-1	C-42461-1-1	TRN	Canfor-Plateau Mills	A Mill	2	2008-05-09	2↗4	3	0↗1	0↗1
**	GR2 - FASE R	32156	TRN	CH Restitucion		5	2018-04-11	4→4		1→1	1→1
**	AU69132T1	AU69132T1	TRN	Chemtrade	Rectifier 4-1	43	2012-02-14	4→4	3	1→1	1→1
**	AU69132T2	AU69132T2	TRN	Chemtrade	Rectifier 4-2	42	2012-02-14	4→4	3	1→1	1→1
**	237012130	237012130	LTC	Colbinabbin Reg U1	;	1	2012-12-10	0↗4		0↗1	0→0
**	237012129	237012129	LTC	Colbinabbin Reg U2	;	1	2012-12-10	0↗4		0↗1	0→0
**	61-05-6A309	61-05-6A309	TRN	Duke Energy - McMaho	Co-Gen Switchyar	12	2006-04-25	3↗4	3	1→1	1→1
**	6TXU90016	63808	TRN	EX CRO TR2 SCRAPPED	TX 2	15	2009-02-03	1↗4	3	1→1	1→1
**	6TXU90072	A3P5410/1	TRN	EX LV TR3 SCRAPPED	TX 3	14	2010-07-21	1↗4	4	1→1	1→1
**	E0618	SN1078	TRN	GARRISON		6	2011-05-19	1↗4	4	1→1	1→1
**	C0305451	C0305451	LTC	Gimblin	XFMR W	26	2011-08-23	3↗4		0↗1	0→0

If you are one of the expert reviewers, see the Analyze and Review help page for a suggested procedure. Look in the navigation menu of any Help page under the top-level heading Procedures.

16. Prioritized List for Sampling

To get a list of equipment arranged according to DGA sampling priority, with the most urgent items at the top, choose “DGA status” in the Columns selection list and “Next DGA” in the Sort selection list. Normally you would also choose "UNREVIEWED" in the Status selection list to restrict the list to equipment whose latest tests have been reviewed. To create a working list for DGA sampling, change “Rows to show” to a number large enough to display all the items that you want to include in the list. Then use the Copy a Table and Paste to Spreadsheet procedure described above to transfer those items to a spreadsheet.

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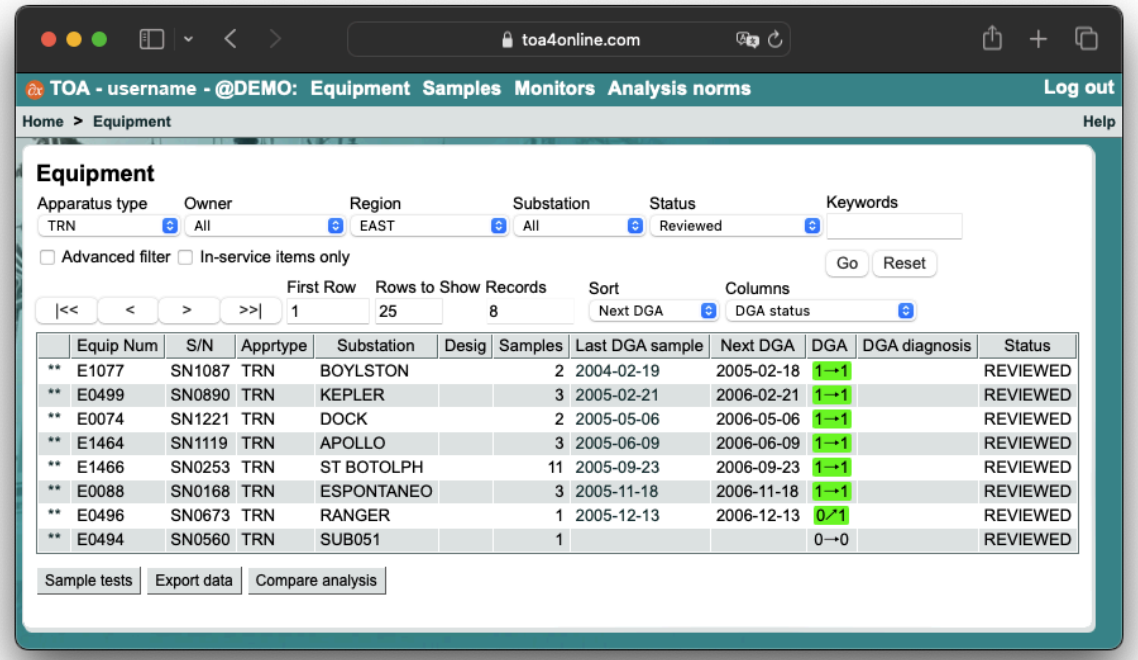
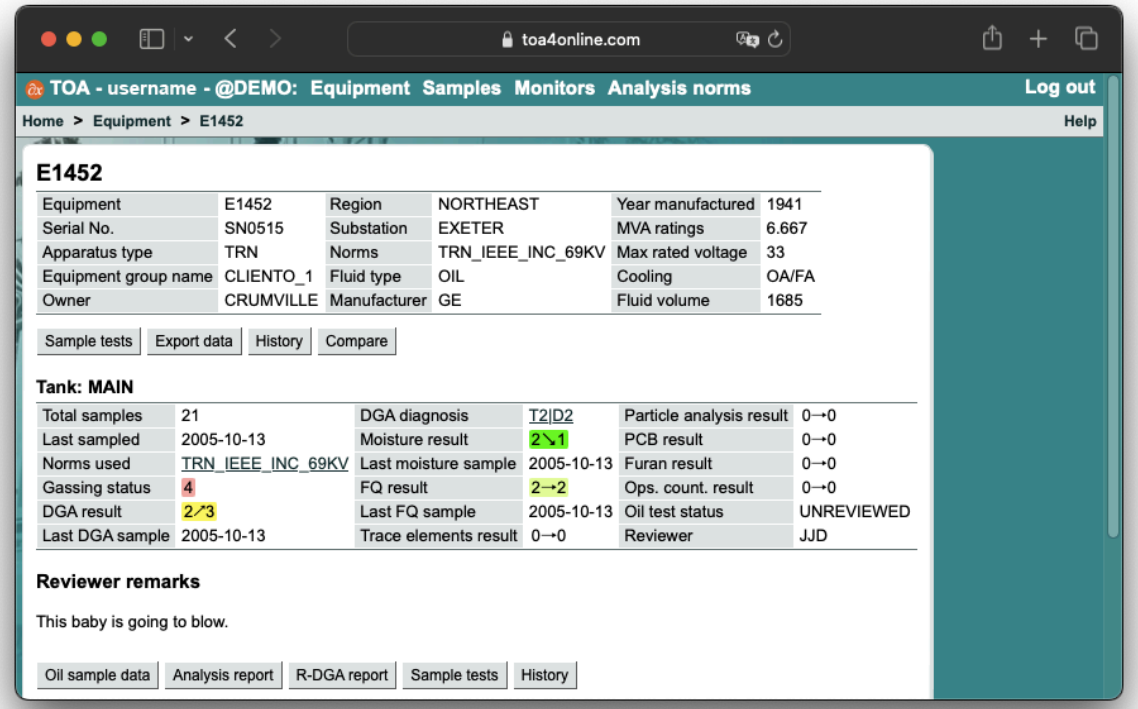


17. Equipment Detail

Click any equipment item in the Equipment List to view a page containing detailed information about that equipment, plus a summary of test results for each “tank” that is defined for it.

If you have a sufficiently high security role in TOA, there are buttons below the equipment information for editing or deleting the equipment and for reanalyzing the equipment’s test data.

The Compare button generates a report (see separate writeup below) comparing this equipment’s latest test results to the corresponding test results of similar equipment. Under the summary information for each “tank,” there are buttons for viewing the oil test data (as a list of records), the latest analysis report, and the latest trend report. If your security role is high enough, and if the latest results are still unreviewed, there may also be a Review button which opens an edit form for entering reviewer remarks for the latest test results.



18. Equipment Comparison Report

Click the Compare button in the detail page of any equipment item to display an Equipment Comparison Report, showing the available information about the selected equipment and a side-by-side comparison of that equipment's latest test data with corresponding statistics from all the equipment in your database which uses the same analysis norms.

18.1 Equipment Information

The top section of the report identifies the equipment and shows all the nameplate and other static information provided for it. The standard buttons are provided for editing the equipment information, re-analyzing the equipment's test data, or deleting this equipment item from the database. Hyperlinks below the buttons enable you to download this equipment's test data in text files.

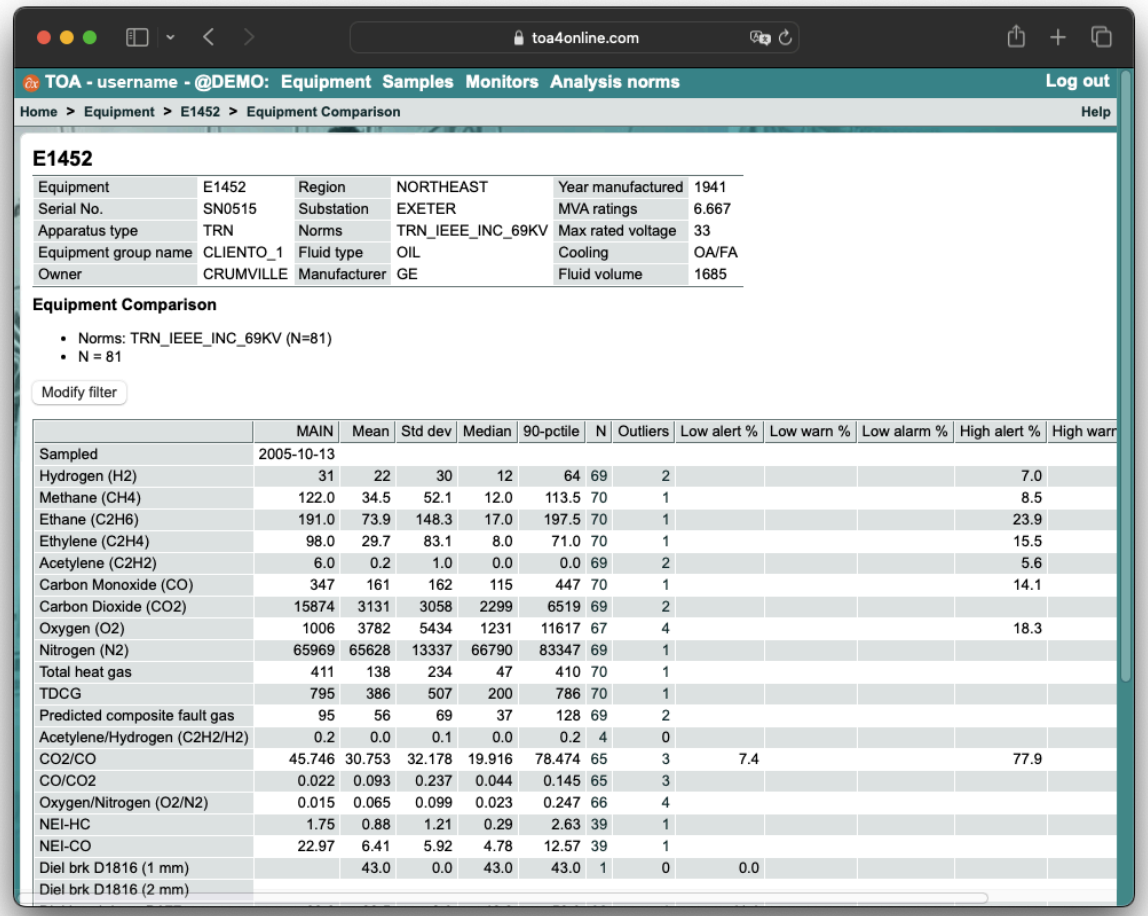
18.2 Equipment Comparison

The Equipment Comparison table shows the equipment's latest test results in the leftmost column(s), followed by several columns of statistical information derived from the latest test data for all equipment sharing the same analysis norms as the selected equipment. If no analysis norms are specified for the selected equipment, then the comparison is with all equipment of the same apparatus type.

Each row of the table represents one test variable which was either measured or calculated as of the sample date shown. The value is given, followed by statistics such as the mean, standard deviation,

median, and 90-th percentile. The N statistic is the number of equipment items involved in calculating the statistics for each variable. The number of outliers (values so extreme that they are omitted from the calculations as invalid) is also shown; outliers are identified by a standard statistical rule known as Chauvenet's Criterion.

If analysis norms are specified for the selected equipment, there are additional columns summarizing how those norms classified the data for all the relevant equipment. For example, if the "High alert %" column contains 4.5 for hydrogen, it means that, of all the hydrogen values reported for the latest samples for all the equipment included in the comparison, 4.5% exceeded the High alert norm for hydrogen.



	MAIN	Mean	Std dev	Median	90-pctile	N	Outliers	Low alert %	Low warn %	Low alarm %	High alert %	High warn
Sampled	2005-10-13											
Hydrogen (H2)	31	22	30	12	64	69	2				7.0	
Methane (CH4)	122.0	34.5	52.1	12.0	113.5	70	1				8.5	
Ethane (C2H6)	191.0	73.9	148.3	17.0	197.5	70	1				23.9	
Ethylene (C2H4)	98.0	29.7	83.1	8.0	71.0	70	1				15.5	
Acetylene (C2H2)	6.0	0.2	1.0	0.0	0.0	69	2				5.6	
Carbon Monoxide (CO)	347	161	162	115	447	70	1				14.1	
Carbon Dioxide (CO2)	15874	3131	3058	2299	6519	69	2					
Oxygen (O2)	1006	3782	5434	1231	11617	67	4				18.3	
Nitrogen (N2)	65969	65628	13337	66790	83347	69	1					
Total heat gas	411	138	234	47	410	70	1					
TDCG	795	386	507	200	786	70	1					
Predicted composite fault gas	95	56	69	37	128	69	2					
Acetylene/Hydrogen (C2H2/H2)	0.2	0.0	0.1	0.0	0.2	4	0					
CO2/CO	45.746	30.753	32.178	19.916	78.474	65	3	7.4			77.9	
CO/CO2	0.022	0.093	0.237	0.044	0.145	65	3					
Oxygen/Nitrogen (O2/N2)	0.015	0.065	0.099	0.023	0.247	66	4					
NEI-HC	1.75	0.88	1.21	0.29	2.63	39	1					
NEI-CO	22.97	6.41	5.92	4.78	12.57	39	1					
Diel brk D1816 (1 mm)		43.0	0.0	43.0	43.0	1	0	0.0				
Diel brk D1816 (2 mm)												

19 Analysis Report

Click the Analysis button under a tank in the detail page of any equipment item to display an analysis report for that tank's oil samples. At the top of the report is equipment detail and tank summary information, possibly with edit buttons for a reviewer to use for editing the report and changing the report's status to REVIEWED.

For each test type for which data is provided - DGA, fluid quality, moisture, furans, particles, PCB - there is a table showing the latest several samples in right-to-left order by sample date, with some interpretive text underneath.

If there is more than one sample for this equipment, the bottom of the report contains a large assortment of history graphs.

If you print the report from your web browser, using the Print command in the browser's File menu, the report is reformatted for printing without all the web page widgets.

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TOA - username - @DEMO: Equipment Samples Monitors Analysis norms Log out

Home > Equipment > E1452 > MAIN > Fluid Analysis Report Help

Oil sample data | Analysis report | R-DGA report | Fault type | Gas events

Fluid Analysis Report

Equipment	E1452	Fluid volume	1685
Serial No.	SN0515	Tank	MAIN
Apparatus type	TRN	Norms used	TRN_IEEE_INC_69KV
Equipment group name	CLIENTO_1	DGA result	2↗3
Owner	CRUMVILLE	Moisture result	2↘1
Region	NORTHEAST	FQ result	2→2
Substation	EXETER	Trace elements result	0→0
Norms	TRN_IEEE_INC_69KV	Particle analysis result	0→0
Fluid type	OIL	PCB result	0→0
Manufacturer	GE	Furan result	0→0
Year manufactured	1941	Ops. count. result	0→0
MVA ratings	6.667	Oil test status	UNREVIEWED
Max rated voltage	33	Reviewer	JJD
Cooling	OA/FA		

Compare | Sample tests | History

Last Analysis Done On 2021-12-02

To ensure an accurate and up-to-date analysis report, re-analyzing the equipment may be required. Since the last analysis was done, one or more of the following was modified: equipment fields, norms, oil sample data. You can choose to auto-analyze all equipment as new data becomes available in Settings>Preferences.

Sample Remarks

Sampled	Reviewer remarks
2005-10-13	This baby is going to blow.

Dissolved Gas Analysis

Sample date	2005-10-13	2005-06-14	2005-04-27	2004-10-19	2004-06-02	
Sample temp			40		50	°C
Hydrogen (H2)	**31!**	16	16	41	51	µL/L
Methane (CH4)	**122.0*!**	90.0	82.0	**147.0***	**133.0*!**	µL/L
Ethane (C2H6)	**191.0*!**	**132.0*+**	**119.0***	**161.0***	**165.0*!**	µL/L
Ethylene (C2H4)	**98.0*!**	**73.0***	**75.0***	**94.0***	**114.0***	µL/L
Acetylene (C2H2)	**6.0*^**	0.0	**12.0***	**14.0***	**13.0*^**	µL/L
Carbon Monoxide (CO)	**347!**	214~	217~	341	322	µL/L
Carbon Dioxide (CO2)	15874	11429	11622	9943	9518	µL/L
Oxygen (O2)	1006	492	60	203	648	µL/L
Nitrogen (N2)	65969	72594	67585	85939	61480	µL/L
Total heat gas	411	295	276	402	412	µL/L
TDCG	795	525	521	798	798	µL/L
Equivalent TCG			0.320		0.603	%
Total partial press			72.7		64.2	% atm
Est. safe handling limit			7.9		7.1	%
Predicted composite fault gas	95	56	57	105	112	µL/L
Acetylene/Hydrogen (C2H2/H2)	0.2	0.0	0.8	0.3	0.3	
CO2/CO	45.746	53.407	53.558	29.158	29.559	
CO/CO2	0.022	0.019	0.019	0.034	0.034	
Oxygen/Nitrogen (O2/N2)	0.015	0.007	0.001	0.002	0.011	
NEI-HC	1.75	1.20	1.28	1.79	1.84	kJ/kL
NEI-CO	22.97	16.37	16.65	14.94	14.29	kJ/kL
DGA retest days	30	90	90	90	30	days
DGA retest date	2005-11-12	2005-09-12	2005-07-26	2005-01-17	2004-07-02	
DGA reference days	121.0	48.0	190.0	139.0	1227.0	days
DGA result	2	2	2	2	2	

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Dissolved Gas Analysis Remarks

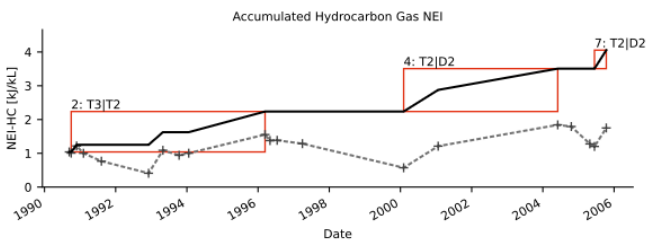
Sharp jump (!). Significant increase (^). High level (*). trn_oil_dga_t2|d2 Consider investigative sampling.

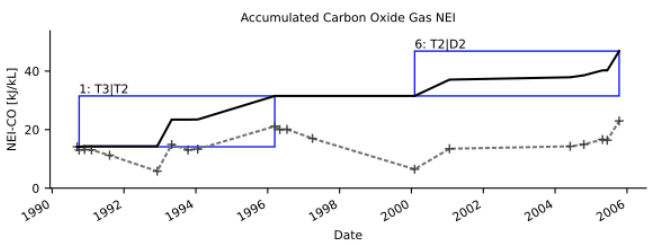
Dissolved Gas Analysis Summary

Variable name	Value	Units	Description
Hydrogen (H2)	31!	µL/L	Sharp jump.
Methane (CH4)	122.0*!	µL/L	Level alert (high 121). Sharp jump.
Ethane (C2H6)	191.0*!	µL/L	Level alert (high 66). Sharp jump.
Ethylene (C2H4)	98.0*!	µL/L	Level alert (high 51). Sharp jump.
Acetylene (C2H2)	6.0*^	µL/L	Level alert (high 3). Increment alert (3, 15, 30).
Carbon Monoxide (CO)	347!	µL/L	Sharp jump.

```
h2! ch4*! c2h6*! c2h4*! c2h2*^ co!
```

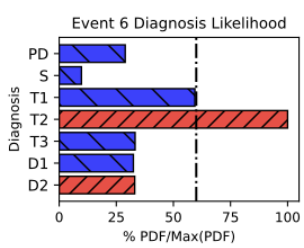
Gassing Events





Hover over an event to see its diagnosis likelihood.

4-Simplex Diagnosis



4-Simplex Remarks

A mixed fault type indicating a medium temperature thermal fault (300-700°C) with a region of high energy discharge. May be a simultaneous fault in two locations or a thermal hot spot that is showing evidence of arcing discharge. The relative proportions of the mixed fault are 75% T2 and 25% D2. More details can be found in the fault type report.

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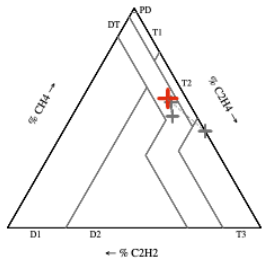
Duval Triangle Diagnosis



Triangle Diagnosis: DT

Thermal fault and electrical discharge.

Duval Triangle fault type determined using gas increments from NEI-based gassing events.

Moisture Analysis

Sample date	2005-10-13	2005-06-14	2005-04-27	2004-10-19	2004-06-02	
Sample temp			40		50	°C
Moisture (H2O)	26	**35***	28	21	18	mg/kg
Relative saturation			23		10	%
Dew point	4	10	5	-0	-3	°C
Moisture result	1	2	1	1	1	
Moisture diagnosis		WET-OIL				

Symbol legend: *: abnormal level

Moisture Remarks

The water content of the oil is acceptable.

Fluid Quality

Sample date	2005-10-13	2005-06-14	2004-10-19	2004-06-02	2000-02-03	
Sample temp				50	0	°C
Diel breakdown D877	33.0	**24.0***	40.0	31.0	52.0	kV
Acid number	0.140	0.130		0.130	0.070	mg KOH/g
Interfacial tension	**21.1***	**19.3***		**22.1***	**22.5***	mN/m
Color	3.5	3.5	3.5	4.0	3.5	
Oil quality index	6.6	6.7		5.9	3.1	
Fluid quality retest days			365			days
Fluid quality retest date			2005-10-19			
FQ result	2	2	1	2	2	
Fluid diagnosis	CONTAMINATED	CONTAMINATED		CONTAMINATED	CONTAMINATED	

Symbol legend: *: abnormal level

Fluid Quality Analysis Remarks

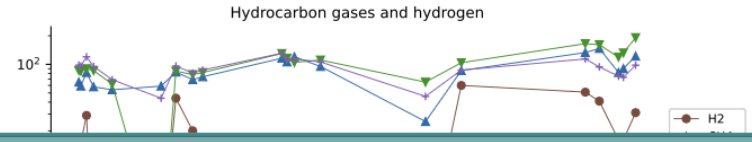
There may be polar contaminants or excessive moisture.

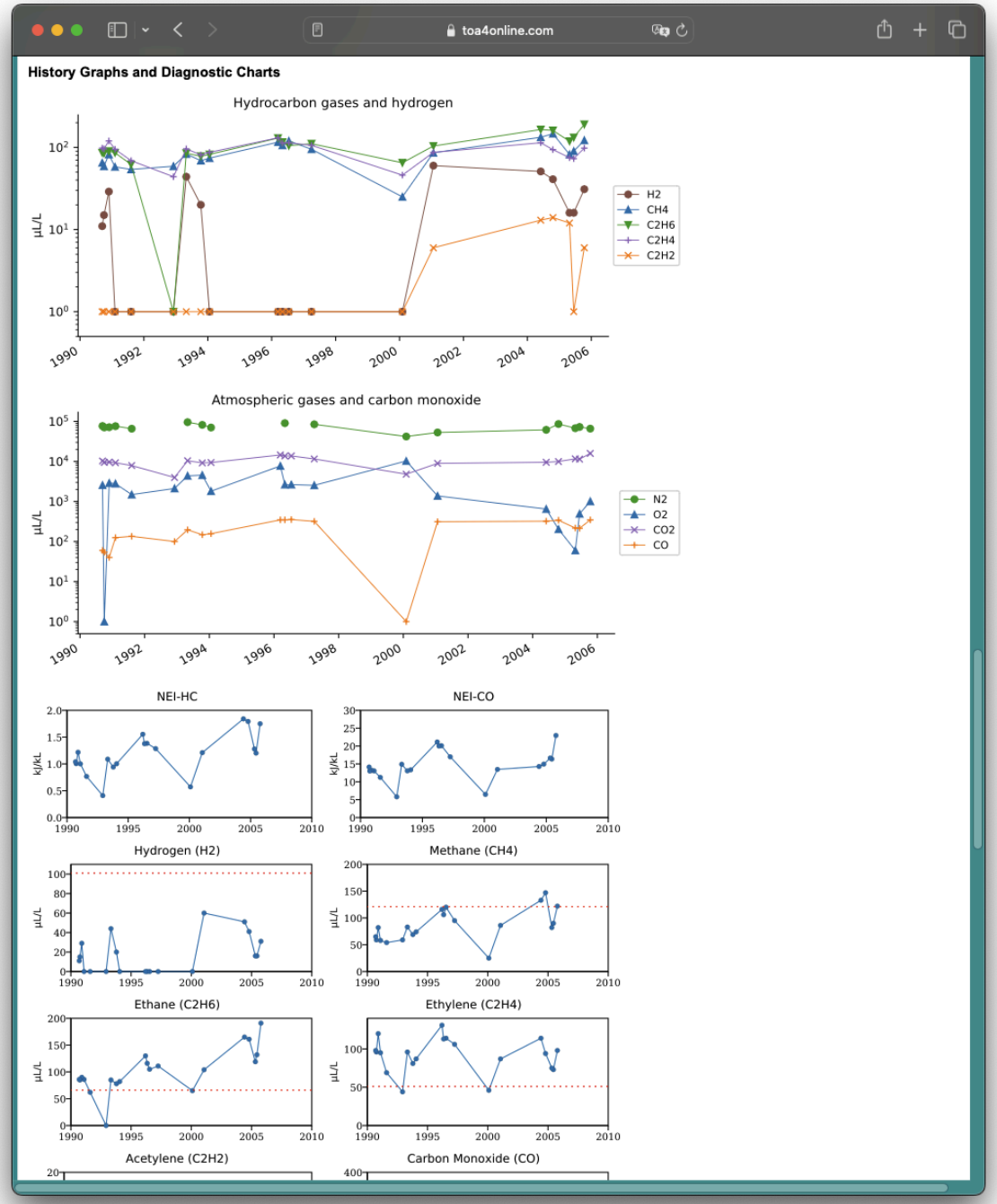
Fluid Quality Summary

Variable name	Value	Units	Description
Interfacial tension	21.1*	mN/m	Level alert (low 24, 16).

`ift*`

History Graphs and Diagnostic Charts

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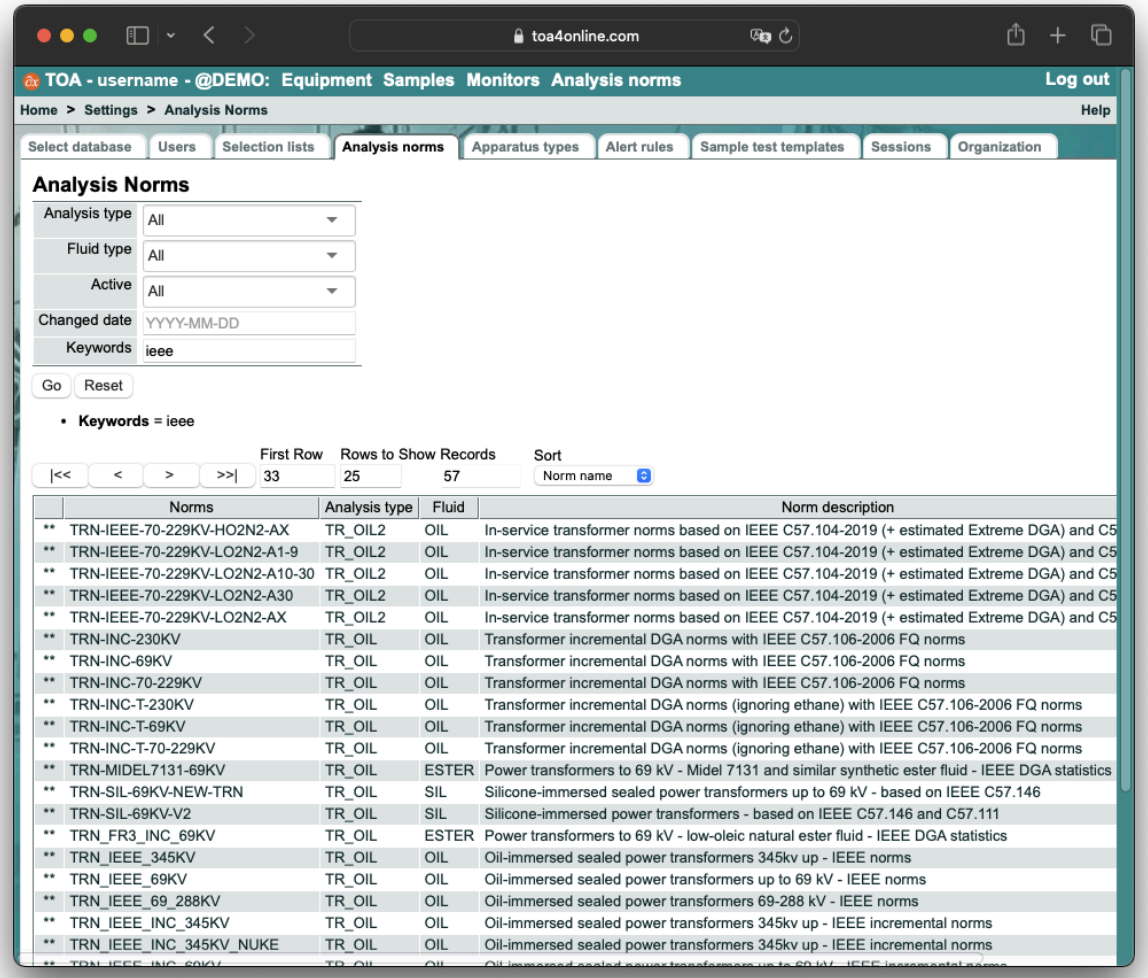
History Graphs and Diagnostic Charts
Hydrocarbon gases and hydrogen
µL/L
H2
CH4
C2H6
C2H4
C2H2
Atmospheric gases and carbon monoxide
N2
O2
CO2
CO
NEI-HC
NEI-CO
kJ/kL
Hydrogen (H2)
Methane (CH4)
Ethane (C2H6)
Ethylene (C2H4)
Acetylene (C2H2)
Carbon Monoxide (CO)

20 Analysis Norms

There is a list of analysis norms (limits and resampling intervals) used by the automatic data analysis which can be viewed by clicking the “Analysis norms” link under Settings in the TOA Home Page. Some of these norms are supplied by Delta-X Research as examples, and some may be norms developed for use at your site.

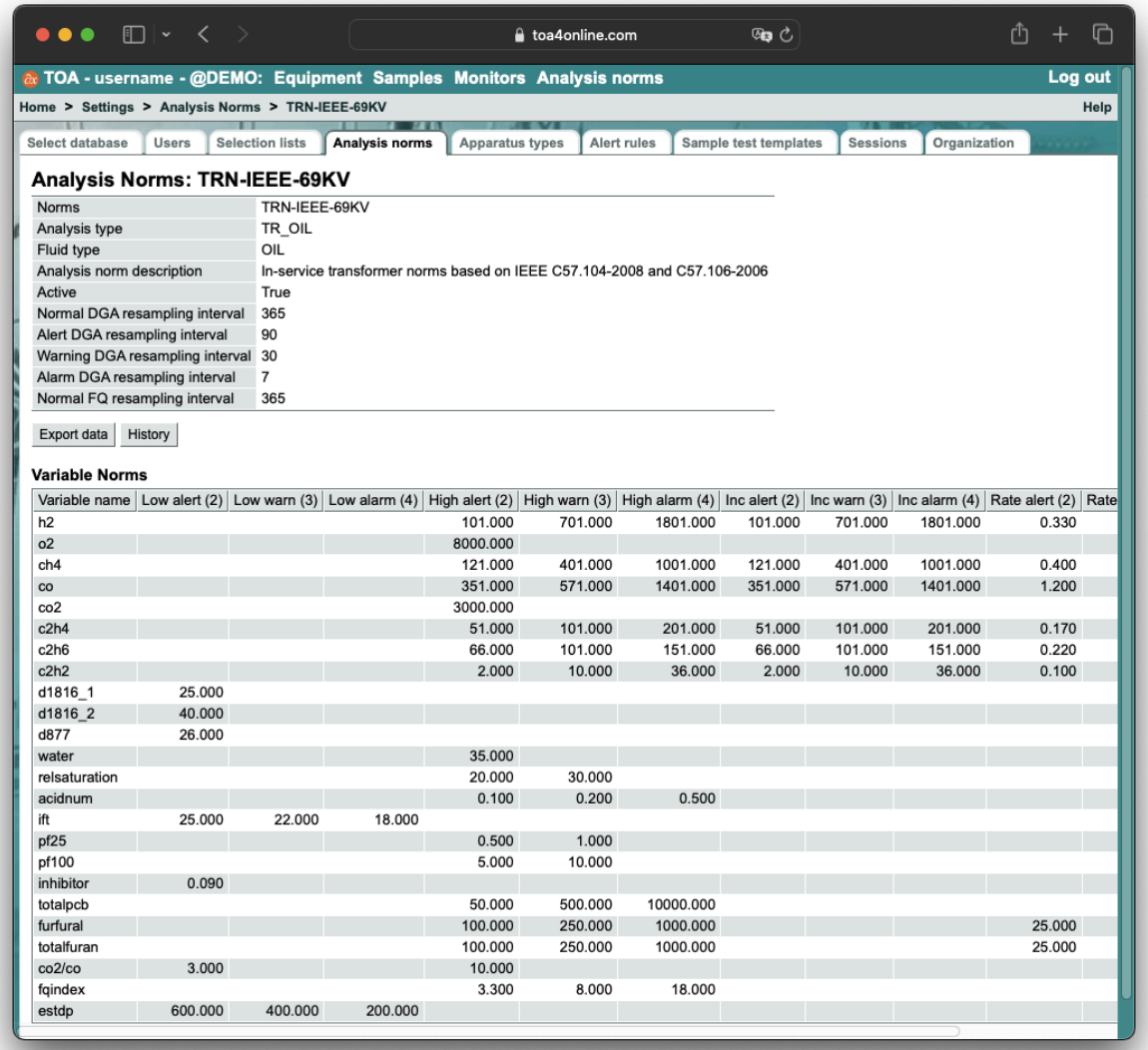


The links below the analysis norms list allow you to download the whole list in spreadsheet friendly format. The Upload norms button (visible only if you have a high enough security level in TOA) allows you to upload new or modified norms from the same kind of file.

See the Help information in the Analysis Norms help page for detailed information.

21 Analysis Norms Detail

Click any analysis norm in the analysis norms list to view its contents. The top section contains a name and description, plus a set of standard resampling intervals. The bottom section contains a table, each row of which defines various kinds of limits for the variable listed at the far left.



Analysis Norms: TRN-IEEE-69KV

Norms	TRN-IEEE-69KV
Analysis type	TR_OIL
Fluid type	OIL
Analysis norm description	In-service transformer norms based on IEEE C57.104-2008 and C57.106-2006
Active	True
Normal DGA resampling interval	365
Alert DGA resampling interval	90
Warning DGA resampling interval	30
Alarm DGA resampling interval	7
Normal FQ resampling interval	365

Export data History

Variable Norms

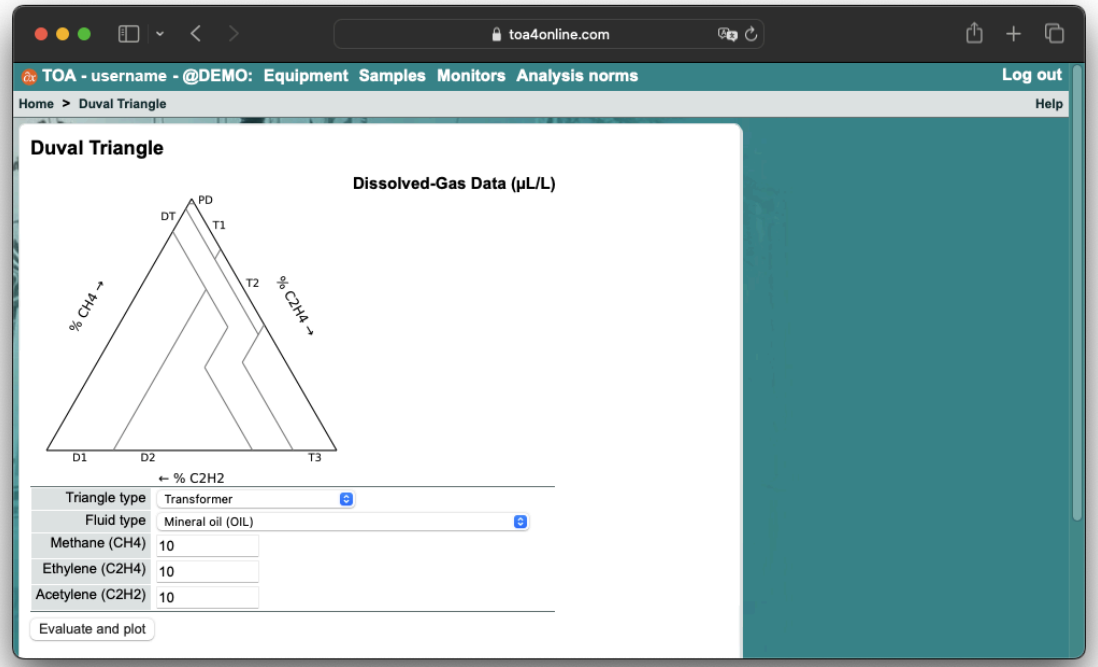
Variable name	Low alert (2)	Low warn (3)	Low alarm (4)	High alert (2)	High warn (3)	High alarm (4)	Inc alert (2)	Inc warn (3)	Inc alarm (4)	Rate alert (2)	Rate
h2				101.000	701.000	1801.000	101.000	701.000	1801.000	0.330	
o2				8000.000							
ch4				121.000	401.000	1001.000	121.000	401.000	1001.000	0.400	
co				351.000	571.000	1401.000	351.000	571.000	1401.000	1.200	
co2				3000.000							
c2h4				51.000	101.000	201.000	51.000	101.000	201.000	0.170	
c2h6				66.000	101.000	151.000	66.000	101.000	151.000	0.220	
c2h2				2.000	10.000	36.000	2.000	10.000	36.000	0.100	
d1816_1	25.000										
d1816_2	40.000										
d877	26.000										
water				35.000							
relsaturation				20.000	30.000						
acidnum				0.100	0.200	0.500					
ift	25.000	22.000	18.000								
pf25				0.500	1.000						
pf100				5.000	10.000						
inhibitor	0.090										
totalpcb				50.000	500.000	10000.000					
furfural				100.000	250.000	1000.000				25.000	
totalfuran				100.000	250.000	1000.000				25.000	
co2/co	3.000			10.000							
fqindex				3.300	8.000	18.000					
estdp	600.000	400.000	200.000								

1. The links at the bottom of the page allow you to download this one norm in spreadsheet friendly format.

   See the Analysis Norms - Details help page for detailed information.

22 Duval Triangle

The Duval Triangle is the main DGA diagnostic method applied in TOA, although by popular request the Rogers Ratio method is also shown alongside it for transformer DGA. TOA contains an interactive form for experimenting with the Duval Triangle, and there is also a Help page explaining how it works.



The DGA fault diagnostic codes used in TOA are adapted from IEC 60599 and the Duval Triangle:

PD	Partial discharge.
T1	Low-range thermal fault (below 300 C).
T2	Medium-range thermal fault (300-700 C).
T3	T3 High-range thermal fault (above 700 C).
D1	Low-energy electrical discharge.
D2	High-energy electrical discharge.
DT	Indeterminate - thermal fault or electrical discharge.

23 Find More Information

Go to any TOA help page and explore the navigation menu for information about many features not covered in this document.

The Delta-X Research web site at http://www.deltaxresearch.com/ contains information and external references about topics related to equipment diagnostics.

The TOA Tech Notes technical support "blog" is available at http://toatech.blogspot.com/.

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Document Revision Notes

Date	Version	Changes	Author
2007-02-15	1.2	Initial Draft	Jim Dukarm
2017-07-25	2.0	Updated format and screenshots	Steven Herchak
2017-11-30	2.1	Fixed minor typos	Steven Herchak
2024-11-05	3.0	Branding and screenshots	Delta-X Research Marketing
2025-04-08	3.1	Update password section	Matthew Milholm