THERMAL-LUBE'S PATENTED

COAT® System Analyzer

A unique fully integrated high-speed oil analysis system

Thermal-Lube's Model C-2 *Continuous Oil Analysis and Treatment* (**COAT**®) *System* is a robust, versatile, cost-effective package specifically configured for infrared oil analysis.

All **COAT**® System models operate on Thermal-Lube's powerful and user friendly **U.M.P.I.R.E. PRO**™ Software.

The **COAT® C-2** design and functionality allows the user to process up to 120 samples per hour using our unique 'Dilution Method' sample preparation. This novel and proven method:

COAT MODEL C-2

- Allows quick and easy sample analysis
- Requires only 10ml of product sample
- Eliminates sample viscosity restrictions
- Reduces cell wear and maintenance costs
- Produces accurate reproducible results
- Significantly reduces disposal costs
- Eliminates needle, tube, and cell cleaning between samples
- Avoids interferences commonly associated with competitive FT-IR oil analyzers

OIL ANALYSIS

FTIR technology provides a spectral snapshot of the targeted oil. Critical information depicted in the spectra can assess the condition of the lubricant.

Thermal-Lube's **COAT**® System analyzer, equipped with **U.M.P.I.R.E. PRO**™ software, is programmed with a variety of analytical tools and methods that will facilitate any used oil condition monitoring program.

The **COAT**® System supports two universally recognized analysis modes:
- Reference subtraction using a new or stored reference sample
- Direct analysis when reference samples are not available

IN-SERVICE CONDITION MONITORING

The **COAT**® System is pre-configured for used oil condition monitoring parameters established by JOAP-TSC and ASTM International New *Standard Practice D7418-07*. These condition monitoring parameters include the detection of:

- Water contamination
- Diesel fuel dilution
- Oxidation *(ASTM D7414-09)*
- Glycol contamination
- Nitration
- Incorrect lubricant
- Sulfate by-products *(ASTM D7415-09)*
- Antioxidant depletion
- Soot loading
- Phosphate antiwear *(ASTM D7412-09)*
- Ester Breakdown I & II

COAT MODEL C-1

Thermal-Lube's **U.M.P.I.R.E. PRO**™ software displays key oil condition monitoring parameters on screen along with programmable alarm limits, free-form message warnings, and allows the user to graphically trend results by each machinery component's history file. Results can be printed or exported for further trending or analysis.

In addition, the **COAT**® System is programmed with Thermal-Lube's proprietary Acid Content (AC), Base Number (BN) and Moisture Content (H_2O) *quantitative methods.* These novel methods are less time consuming and less costly than their ASTM titrimetric counterparts.

QUALITY CONTROL OF NEW LUBRICANTS

The **COAT**® System's **U.M.P.I.R.E. PRO**™ software is programmed with Thermal-Lube's "*starter-package*" spectral library database and search routine **QC Compare**™ based on Dendrogram Algorithms. This versatile and powerful functional search may be used for:

➢ Identifying an unknown (base oil) sample through spectral comparison of existing information stored in the library database.
- "Search Result"-*100%*
- "Search Result"-*Very High*
- "Search Result"-*High*
- "Search Result"-*Medium*
- "Search Result"-*Low*
- *No library match*

➢ Comparing the spectra of a known sample formulation with the spectrum of one that is stored in the library database. Essential for Quality Control of new lubricants.

Thermal-Lube Inc. offers customized support for building library databases and establishing search and acceptance criteria

U.M.P.I.R.E PRO™ *SOFTWARE*

U.M.P.I.R.E. PRO™ is the most comprehensive FTIR oil analysis software currently available. It is easily configurable to suit the needs of any oil condition monitoring program. **U.M.P.I.R.E. PRO™** software features:

- Easy to use sample input interface

- Password and hierarchy protection

- Data displayed on the screen is automatically archived

- Data may be exported in *.csv* and *.spc* formats.

- Spectral data may be viewed at any time using the SPECTRAL VIEWER window

- Operations such as spectral addition, subtraction and derivative capabilities are easily accomplished

- Archived data can be easily retrieved for re-analysis using different criteria without having to rerun samples

- When using the TRENDING BY EQUIPMENT option, data is stored, charted, and trended using the EQUIPMENT MANAGER WINDOW

- **COAT**® System integrated diagnostics verify the condition of major hardware components
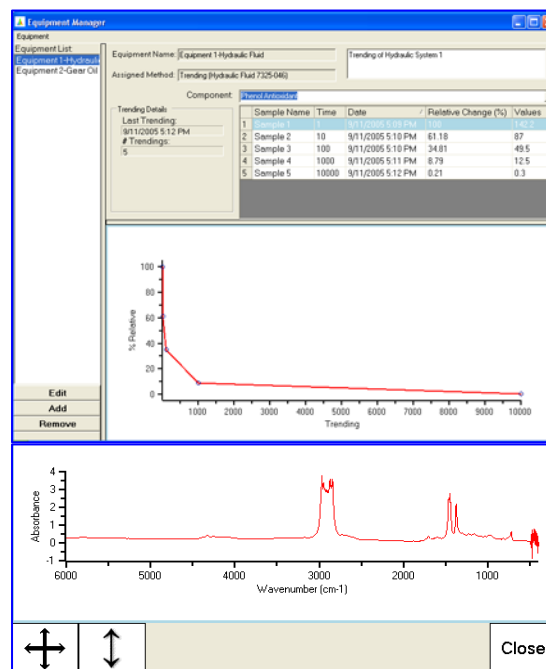
AUTOMATED ANALYSIS

The **COAT**® System's analytical methods are fully automated using Thermal-Lube's proprietary sample preparation Dilution Method. This allows viscous oil samples to be analyzed just as rapidly as low viscosity samples. The following features are available with automation:

- *Operator prompts that are customized for each method*
- *Automatic path length calculation and correction*
- *Cell fill check*
- *Air or empty cell background option*
- *Cell cleanliness check*
- *Ability to run multiple analysis methods in the same run using the same autosampler input screen*
- *Warning and alarm limits automatically displayed on screen during analysis*
- *Customized print output*
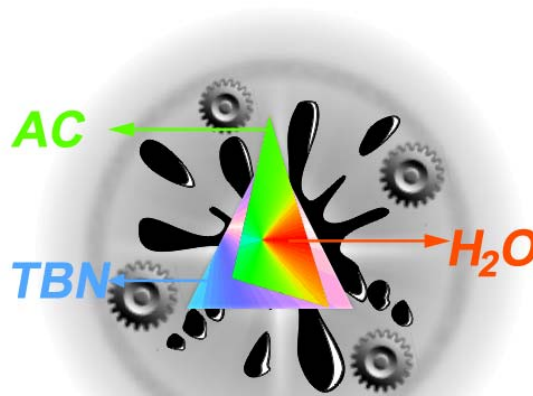
ANALYSIS SPECIFICATIONS

Parameter	Reproducibility (SD)	Units
Acid Content (AC)	0.10	Mequiv acid/g
Base Number (BN)	0.20	mg KOH/g
Moisture Analysis (H$_2$O)	50	ppm
Oxidation	0.10	AU/0.1mm
Nitration	0.06	AU/0.1mm
Sulfation	0.10	AU/0.1mm
Soot	0.12	AU/0.1mm * 100
Anti wear	0.10	AU/0.1mm
Antioxidant (phenol)	0.08	AU/0.1mm
Diesel fuel	0.84	(2 + AU/0.1mm) *100
Glycol	0.07	AU/0.1mm
Water (JOAP Pet. Lube)	0.48	AU/0.1mm

Additional information about these and other FTIR methods can be found on our website at www.thermal-lube.com or by contacting your Thermal-Lube Inc. representative for details.