

# Thermo Scientific ARL OPTIM'X X-Ray Fluorescence Spectrometer



Minerals/Cement



Petrochemicals/Polymers



Environment



Slags/Hot Metal



Food



Academics



Glass

Packaging - Processing

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## ARL OPTIM'X

### Optimized Performance for your Application

The wavelength dispersive X-ray fluorescence (WDXRF) technique is one of the most versatile analytical methods for the chemical analysis of solids and liquids. Elements from beryllium to uranium can be analyzed in a wide variety of samples with accuracy, precision and reliability. The technique and the analytical methods are mature enough to establish clear qualitative and quantitative characterization of diversified materials. Modern technological developments have helped to include WDXRF into reference methods for analytical laboratories (ASTM and ISO norms for example) by virtue of its simplicity, flexibility, affordability and reliability. The cost per analysis is clearly advantageous over many traditional wet chemical and other spectroscopic methods.

#### A compact and independent WDXRF instrument

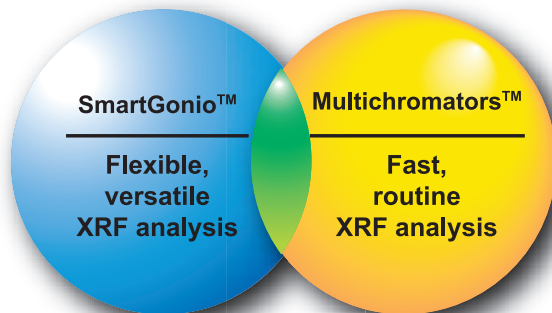
Continuing its tradition of innovation and leadership in WDXRF, Thermo Fisher Scientific presents a compact instrument, the Thermo Scientific ARL OPTIM'X, with the following salient analytical features:

- Unique WDXRF platform with sequential and/or simultaneous capabilities
- Element coverage from fluorine to uranium, depending on configuration
- Closely coupled optics for increased intensity (210 % higher than conventional geometry)
- Multichromators™ for fast analysis;
- Unique compact SmartGonio™ for sequential analysis
- Sequential-simultaneous configuration blending speed to analytical flexibility
- High precision (short term and long term repeatability) thanks to temperature regulation of spectrometer and crystals
- Superior spectral resolution from low Z elements to heavy elements (~15 eV at CaK $\alpha$ )

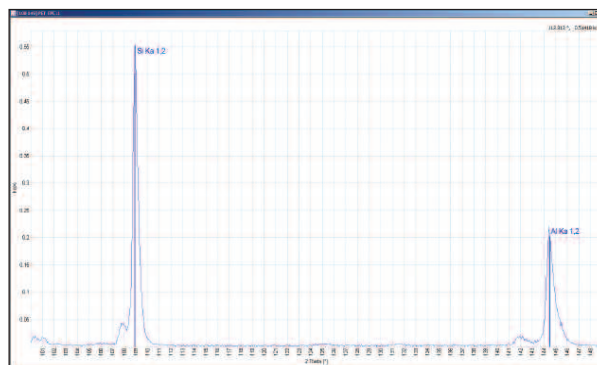
- Optimum configuration for specific applications with simplified operation (ISO or ASTM standards compliance)
- Stand alone and autonomous operation without water cooling
- No gas supply required (depending on the configuration)
- Direct and simple introduction of the sample
- Automatic analysis of batches with sample changer
- Small footprint.

#### Configuration for speed and flexibility

- Up to 8 elements simultaneously using 4 Multichromators™
- Sequential analysis with the SmartGonio™
- Sequential-simultaneous analysis: SmartGonio™ and 2 elements simultaneously on one Multichromator™



Configuration selected according to application needs



Excellent resolution: Si and Al peaks are free from any interference despite the presence of 55 % of Mg in this magnesite sample

#### Cassettes for manual loading of solids



#### Cells for liquids and loose powder analysis



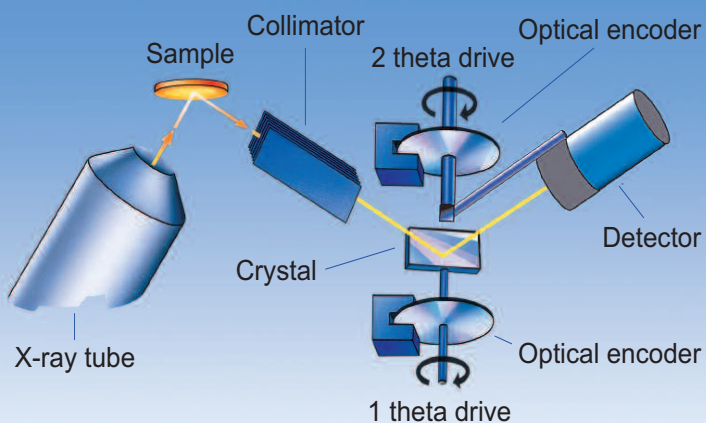
#### ARL OPTIM'X with its sample changer





### Exclusive SmartGonio™

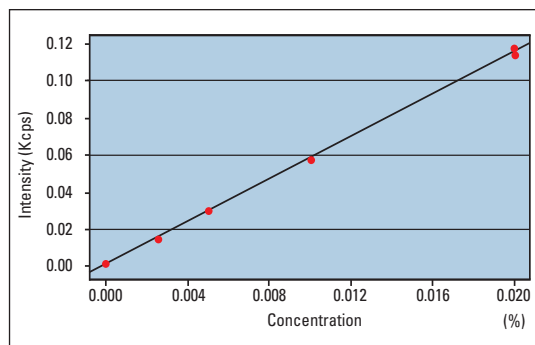
- Quantitative analysis of any element from F to Zn (with one detector fitted)
- Quantitative analysis of any element from F to U (with two detectors fitted)
- Angular positioning to ensure  $\theta / 2\theta$  relationship between crystal and detector is achieved through Moiré fringe optical encoders:
  - no friction
  - no wear!
- Temperature regulation of crystals for best analytical stability
- Closest coupling with X-ray tube provides optimized sensitivity



SmartGonio™  
principle of  
operation

**Optimized for specific applications**

- Petrochemical industry – analysis of S (ISO 14596 or ASTM D2622), Pb (ASTM D5059) or other elements in gasoline and oils  
 The calibration curve for sulfur in oils and gasoline can be easily obtained for concentrations ranging from ppm levels up to 5 % (see Fig. 1). The excellent limit of detection of 1.4 ppm in 100s (or 1 ppm in 200s) is achieved. This good result is proved by the reproducibility test shown in Table 1. Separate Application Notes AN41701 and AN41706 give additional details
- Major and minor oxides in raw materials such as limestone, sand, feldspar, bauxite, magnesite and other mining applications as well as clinker and raw meal. The ARL OPTIM'X shows excellent repeatability of analysis for such types of materials (see Table 2)  
 As the calibration curve (Fig. 2) proves, the analysis of Na can be carried out without problem either with the SmartGonio™ or with a fixed channel. Additional data can be found in separate Application Notes AN41702 and AN41705
- Major and minor oxides in products such as sanitary ceramics, refractories, slags and sinters (more details in separate Application Notes AN41703 and AN41704)
- Glass, paints, paper, ferro-alloys, silicon, metal sheets and other products where a few major and minor elements need to be monitored (more details in separate Application Note AN41708)
- Food industry for major and minor nutrients and other regulated elements. Typical concentration ranges and the excellent limits of detection in milk powders are listed in Table 3 below



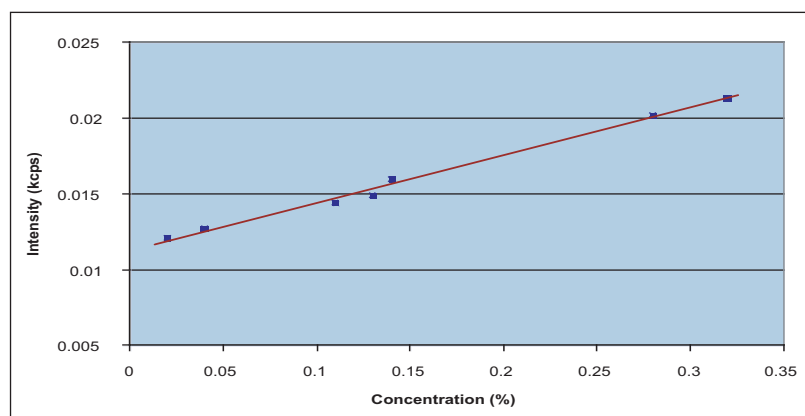
**Fig 1: Calibration curve for S in oils and gasoline (zoom on the low concentration level range)**

Sample	25 ppm	100 ppm
Cell 1	25.4	100.6
Cell 2	25.7	100.7
Cell 3	26.4	101.8
Cell 4	26	102.3
Cell 5	25	98.4
Cell 6	25.9	100.5
Cell 7	26.7	101.5
Average	25.9	100.8
Std. Dev.	0.58	1.27

**Table 1: Excellent reproducibility obtained for analysis of sulfur in oils (120s)**

Run nr	Al <sub>2</sub> O <sub>3</sub>	CaO	Fe <sub>2</sub> O <sub>3</sub>	K <sub>2</sub> O	MgO	P <sub>2</sub> O <sub>5</sub>	SO <sub>3</sub>	SiO <sub>2</sub>
1	0.329	50.41	0.303	0.116	2.76	0.014	0.036	2.68
2	0.328	50.44	0.303	0.117	2.77	0.015	0.036	2.68
3	0.328	50.45	0.304	0.116	2.74	0.014	0.036	2.68
4	0.324	50.41	0.305	0.117	2.76	0.014	0.036	2.69
5	0.326	50.36	0.301	0.117	2.75	0.014	0.036	2.68
6	0.327	50.38	0.301	0.116	2.74	0.014	0.035	2.69
7	0.327	50.41	0.302	0.116	2.74	0.014	0.036	2.68
AVG	0.327	50.41	0.303	0.116	2.75	0.014	0.036	2.68
Sd.Dev.	0.0015	0.029	0.0014	0.0005	0.011	0.0003	0.0003	0.005

**Table 2: Repeatability test for a limestone sample (pressed powder, 100 s counting time)**

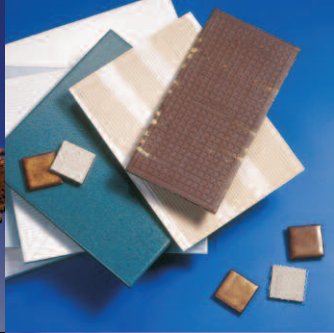


**Fig 2: Calibration curve for Na using fusion beads of oxides. Standard error of estimate is 0.011 % in a range from 0.02 % to 0.32 %**



**Table 3: Limits of detection (LoD) in milk powders prepared as pressed pellets (\*cumulated counting time of SmartGonio™ for Na and Mg)**

Element	Analytical device	Typical ranges	LoD (ppm in 60s)
Na	Fixed channel	0 – 0.03 %	20 ppm*
Mg	Fixed channel	0 – 0.12 %	11 ppm*
P	SmartGonio™	0 – 1.1 %	4.4 ppm
K	SmartGonio™	0 – 1 %	2 ppm
Ca	SmartGonio™	0 – 1.6 %	10 ppm
Fe	SmartGonio™	0 – 0.33 %	2.1 ppm
Cu	SmartGonio™	0 – 0.012 %	0.6 ppm
Zn	SmartGonio™	0 – 0.2 %	2 ppm
Cl	SmartGonio™	0 – 0.48 %	10 ppm
Mn	SmartGonio™	0 – 0.0023 %	1.2 ppm
Se	SmartGonio™	0 – 3.4 ppm	0.24 ppm



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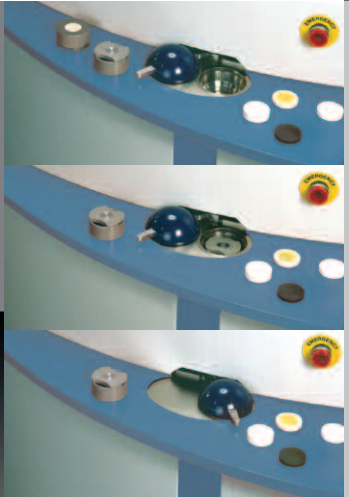
**LARGE VARIETY OF SAMPLES**  
 Many different types of samples can be analyzed on the ARL OPTIM'X: conductive or non-conductive solids, liquids, loose powders, pressed pellets, fusion beads, pastes. However the instrument configuration is optimized for your specific application.



Full automation with SMS-Omega loading system



Manual introduction of a solid sample placed in a cassette



**Instrument control and data handling: OXSAS - X-ray Fluorescence Analysis Software**

The powerful and user-friendly OXSAS software supports spectrometer operation and data handling. OXSAS is a very modern software platform that is designed to evolve to meet customer's needs with up-to-date solutions throughout the lifetime of the XRF instrument.

**Key features and benefits**

**See also the OXSAS Product Specification data sheet for more details.**

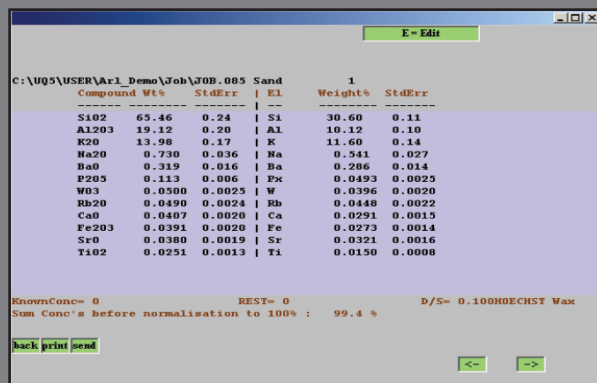
- State-of-the-art 32-bit software with very modern Graphic User Interface
- Complete and very rich functionality
- Mature software with many convenient features
- Ease of use, no matter what requirements are. From simple tasks to complex jobs, all are defined easily and performed quickly
- OXSAS allows performing rapid high quality analyses with templates leading through the analysis operation
- Simple definition and comprehensive operation of sample batches. With support of priority samples. Makes unattended analyses handy
- Integrated Analytical Assistant guides the creation or extension of methods with best analytical parameters for rapid and accurate analyses
- Fast calibration with multiple analyte curve display, instant base curve calculation, templates for edition and measurement of calibration standards. Calibration curve determination using multi-variable regression with a range of correction models and integrated theoretical alphas calculation
- Optional standard-less analysis packages: UniQuant, OptiQuant and the semi-quantitative QuantAS offer additional analysis versatility
- Display of multiple scans with graphical investigation tools

- Multi-purpose analysis display with wide-ranging optional data. e.g. the analysis calculation steps help the validation of methods
- Numerous customizable on-line processing functions, with manual or automatic application
- Comprehensive post-treatment of results, including direct export to Excel files (\*.xls)
- Real on-line integrated SPC
- SCT Manager: Status and history of Setting-up samples, Control samples and Type standards give the overview of the analytical capability of the instrument and of each method at any time.
- Easy to use: one click creation of a batch with all samples requiring analysis
- Effective monitoring and maintenance tools maximize the system uptime
- Very comprehensive contextual Help including "How-To" guides
- Integrated Microsoft® SQL Server 2005 Express relational database which stores your set up and analyses data

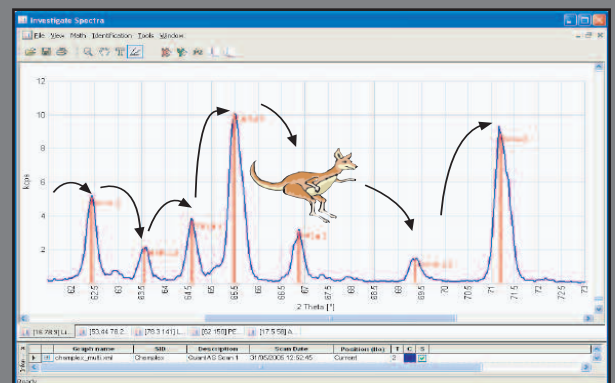
organic and ultralight elements. The OptiQuant™ optional package is fully calibrated and pre-installed in the factory using the SmartGonio™. Hence it is ready to be used right after installation of the instrument at the customer's site. Stable samples for setting-up and maintenance over time are included.

**OptiQuant™**

- SPC-Full: On-line Statistical Process Control, full graphical package extension
- ARLcom: Software package for the transmission of results using network and serial communication
  - Network: result transmission solutions via Local Area Network to computer applications using TCP/IP or to files
  - Serial: result transmission solutions to computers, printers or terminals over serial RS-232 lines
- OEM Mode: Connection to an external process computer for automation purposes
- OptiQuant™: Adaptation of the renowned UniQuant® package to the ARL Optim'X spectrometer. OptiQuant™ provides "standardless" analysis for up to 73 elements when specific standards are not available, or when samples can only be obtained in small quantities or as irregular shapes. Additionally OptiQuant™ calculates the balance of unanalyzed elements present in the sample, e.g.



« Standardless » analysis through OptiQuant™



UniQuant and OptiQuant use "peak hopping" to acquire intensities for up to 133 line positions

### Fast qualitative analysis

Two forms of digital scanning are available. Step scanning provides precise definition of peaks with a resolution of 0.001°. For rapid qualitative analysis, continuous digital scanning allows fast acquisition of spectra at speeds up to 327° /min. Peaks identification is automatic.

### Quantitative analysis made easy

Analytical programs and calibrations are defined with the help of the on-line Analytical Assistant. Calibration curves are built using the Multi Variable Regression (MVR) program.

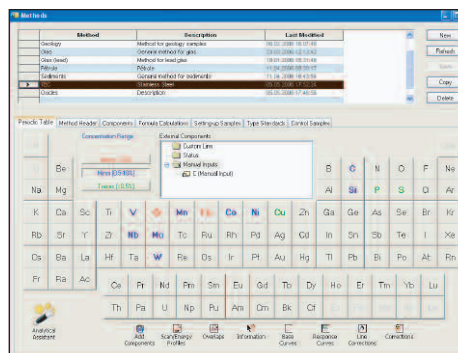
Correction models serve to minimize the influence of interfering elements in multicomponent matrices and achieve better accuracy of analysis. These models are:

- Line overlap correction
- Additive correction on intensities
- Additive correction on concentrations
- Multiplicative correction on intensities
- Multiplicative correction on concentrations
- Multiplicative and additive corrections on concentrations
- COverprehensive LChance (COLA) with 3 term alphas to be used with NBSGSC fundamental parameters program, which can simulate analytical calibrations for homogeneous materials. Interelement correction factors (theoretical alphas) are calculated and used as known coefficients in the MVR. This minimizes the number of standards necessary to produce calibrations and improves the accuracy of analysis

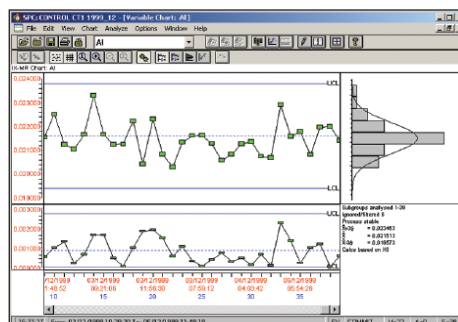
In addition, ex-works calibrations can be delivered for various materials:

- Oil industry products using Petroil Quant™ or ASTM/ISO methods
- Iron
- Copper, bronze and brass
- Various oxides through the General Oxide calibration
- Traces in soils and sediments
- Ferro-alloys
- Slags
- Cement

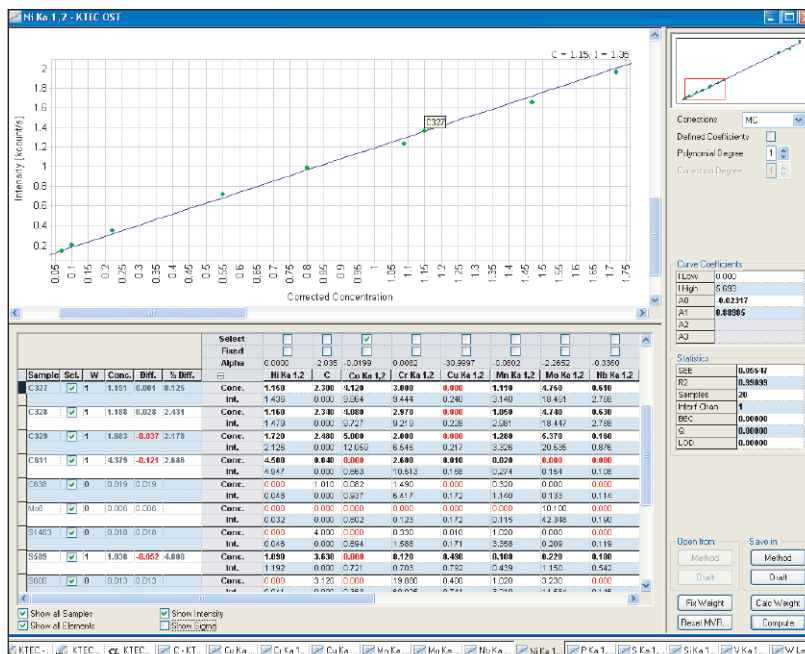
Analytical specifications are available on request for all these calibrations.



The Analytical Assistant helps definition of analytical programs, calibrations and instrument use



Statistical Process Control - Typical screen



MVR calibration curve: real concentration vs. intensities

## Specifications for the ARL OPTIM'X

Element range	Fluorine (Z=9) to uranium(Z=92)
Spectrometer environment	Vacuum or air for solids, helium for liquids and loose powders
Spectrometer design	Analysis devices contained in a vacuum chamber made of grey cast iron and temperature controlled
Spectrometer arrangement	X-ray tube inclined at 66 ° under sample
Spectrometer capacity	Simultaneous configuration: Four Multichromators™ Sim-seq configuration: One SmartGonio™ + one Multichromator™ Each Multichromator™ is composed of two fixed channels
X-ray excitation	Air cooled Rh anode end window tube with thin Be window (0.075 mm). 50 W power providing excitation similar to 200 W thanks to ultra close coupling and large solid angle irradiation. Other anodes available on request. Solid-state high frequency generator of maximum voltage 50 kV and maximum current 2 mA (combinations chosen to be less than 50W). Max. line voltage variation: 230 V -15 % to +10 %. Stability: ± 0.0002 % per 1 % variation
Multichromator™	Fixed channel using multiple curved crystal optics. Sealed detectors available for all elements from sodium (Z=11). Flow proportional or scintillation detectors also available depending on element. Dual pulse height integration to discriminate and correct for 2nd order peaks. A Multichromator™ is composed of two fixed channels, but some elements can only be fitted as single channel monochromator
SmartGonio™	Fully automatic, gearless, microprocessor controlled compact goniometer using optical encoders. Total angle range: 0°-150° 2θ (Flow proportional counter: 17°-150°, Scintillation counter: 0°-90°). Continuous digital scans: from 0.25° /min to 320° /min
Counting electronics	Multi-channel analyzer to discriminate peaks of higher energies. Digital Automatic Gain Control (AGC) for pulse shrinking correction. Automatic dead time correction ensures linearity of response up to 2 Mcps on flow proportional counter and 1.5 Mcps on scintillation counter
Sample loading	Basic: 1 position for cassette or liquid cell. Optional: 13 position autosampler and SMS-Omega full automation
Sample holders	Sample cassettes with maximum size of sample: height 26 mm, diameter 52 mm. Liquid cell: height 22 mm, external diameter 40 mm. Exposed opening: 29 mm diameter (basic). Rotation of sample holder in analysis position: 6 to 60 rpm
Dimensions and weight	H 126 cm, W 88 cm, D 82 cm with basic sample changer. System weight: approximately 250 kg
Laboratory information	Optional phone service support through modem connection
Power requirements:	1.5 kVA single phase
Safety standards:	Electrical and protection: IEC 1010-1, IEC 950 Radiation (fully protected system): ORaP (CH) 414.501 and BGB1.1. norms Electro-magnetic immunity: CENELEC EN 50081-2 + EN 50082-2 (industrial)

Thermo Fisher Scientific reserves the right to vary these specifications without prior notice

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Tap our expertise throughout the life of your instrument. Thermo Scientific Services extends its support throughout our worldwide network of highly trained and certified engineers who are experts in laboratory technologies and applications. Put our team of experts to work for you in a range of disciplines – from system installation, training and technical support, to complete asset management and regulatory compliance consulting. Improve your productivity and lower the cost of instrument ownership through our product support services. Maximize uptime while eliminating the uncontrollable cost of unplanned maintenance and repairs. When it's time to enhance your system, we also offer certified parts and a range of accessories and consumables suited to your application.

To learn more about our products and comprehensive service offerings, visit us at [www.thermo.com](http://www.thermo.com).

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