PMI

POSITIVE MATERIALS IDENTIFICATION

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INTRODUCTION

- Positive Material Identification (PMI) is a quick and non-destructive method used to check the composition of materials. Using tools like X-ray or optical analyzers, PMI helps identify the elements in a material, ensuring it meets required standards. This process is important in industries like construction, oil and gas, and manufacturing to avoid mistakes, ensure safety, and maintain quality.

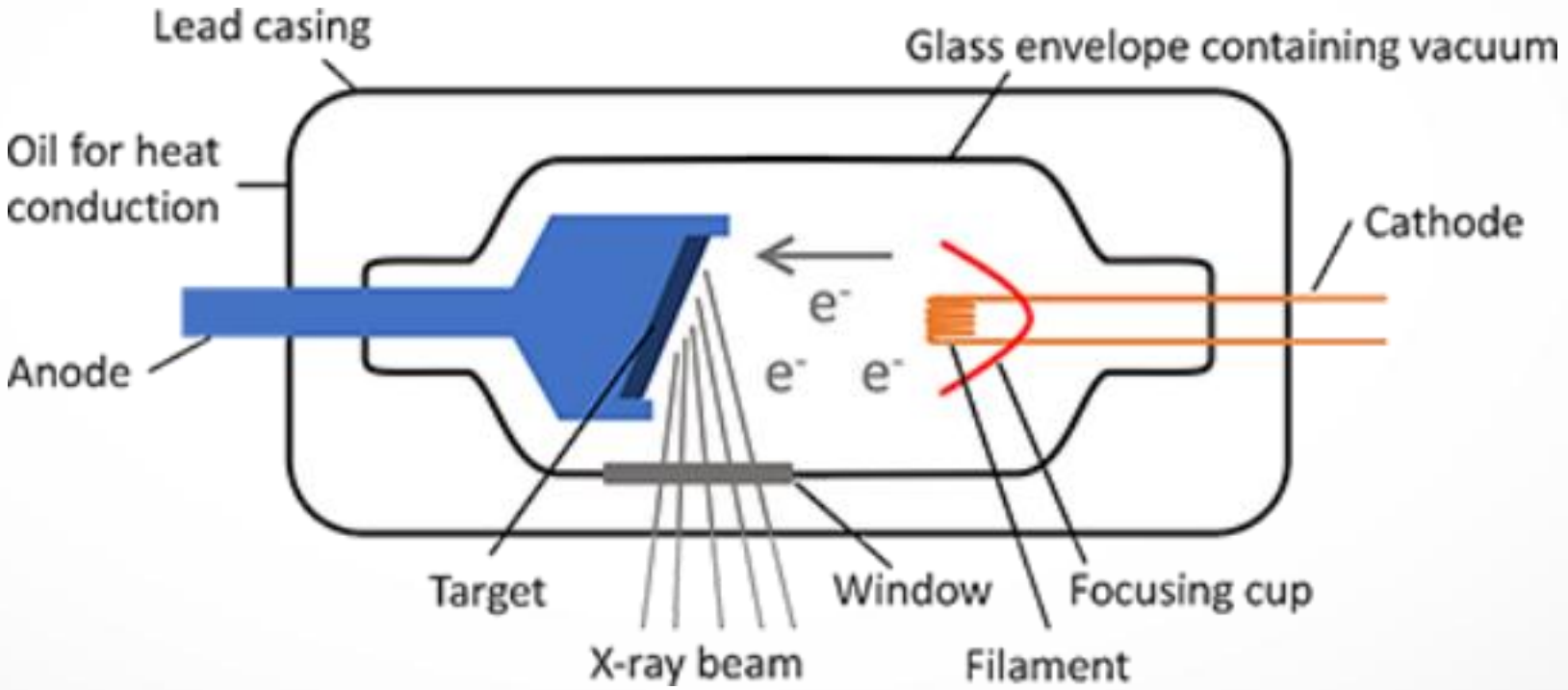
STANDARD

- ASME Sec II Part A Edition 2023
- ASME Sec II Part C Edition 2023
- ASME Sec I NONMANDATORY APPENDIX B
- ASME Sec IX

What is XRF

- XRF → X - Ray fluorescence
- X-ray fluorescence is a non-destructive analytical technique that uses the interaction of X-rays with a material to determine its elemental composition by measuring the fluorescent (or secondary) X-rays emitted when a sample is excited by a primary X-ray source.

X - Ray

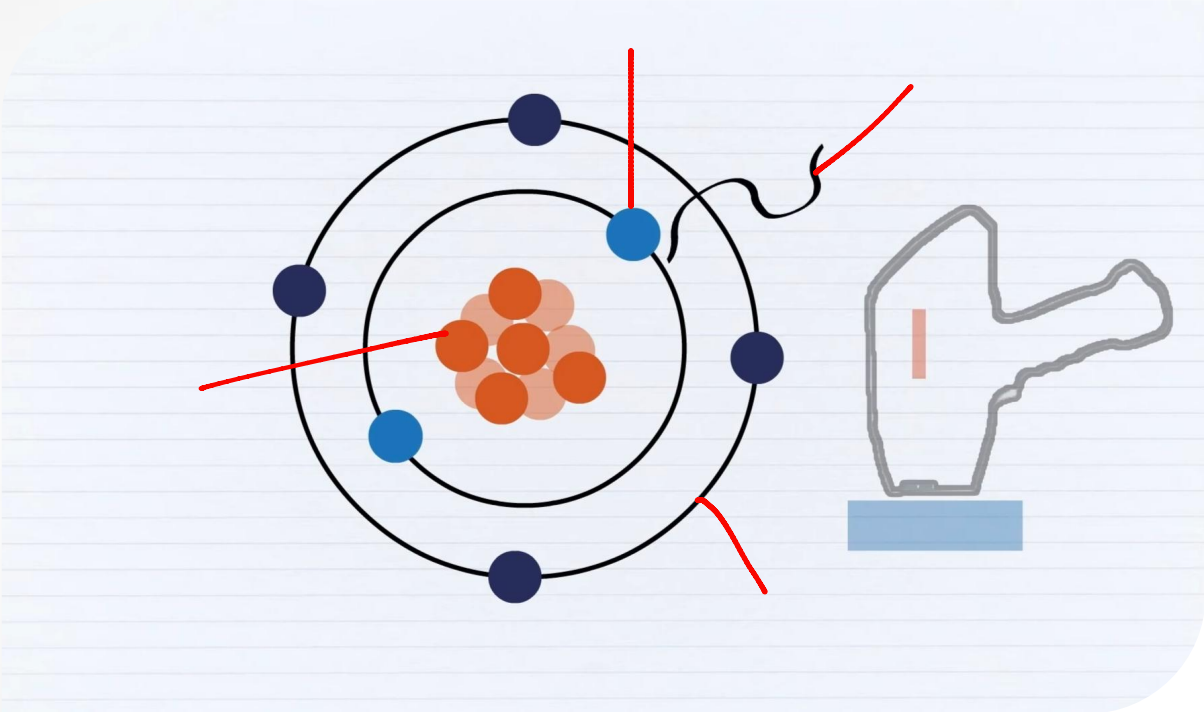

Lead casing
Glass envelope containing vacuum
Oil for heat conduction
Cathode
Anode
e-
e-
e-
Target
Window
Focusing cup
X-ray beam
Filament

Working

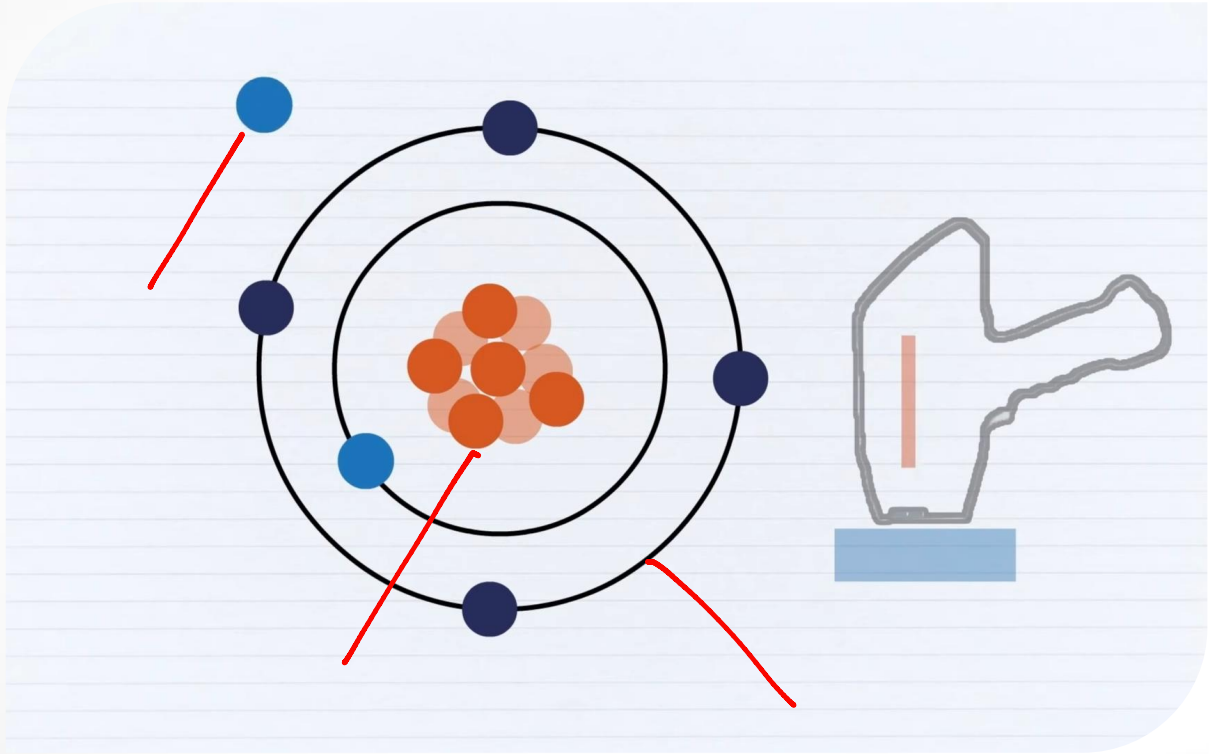
- ***Electron Generation (Cathode)***: In an X-ray tube, *a heated cathode (a filament) emits electrons and this process is called* thermionic emission.
- ***Electron Acceleration***: A high voltage (between 30-150 kV) is applied between the cathode and the anode. *This accelerates the electrons toward the anode*.

- ***Electron Collision (Anode)***: The accelerated *electrons strike a target material (usually tungsten) anode this cause deacceleration*. This sudden deceleration causes the electrons to lose energy, *emitting X-rays*.
- ***Photoionization***: When the X-rays interact with the atoms in a material (the sample), they eject electrons from the inner shells of the atoms (typically the K-shell). This is called photoionization.

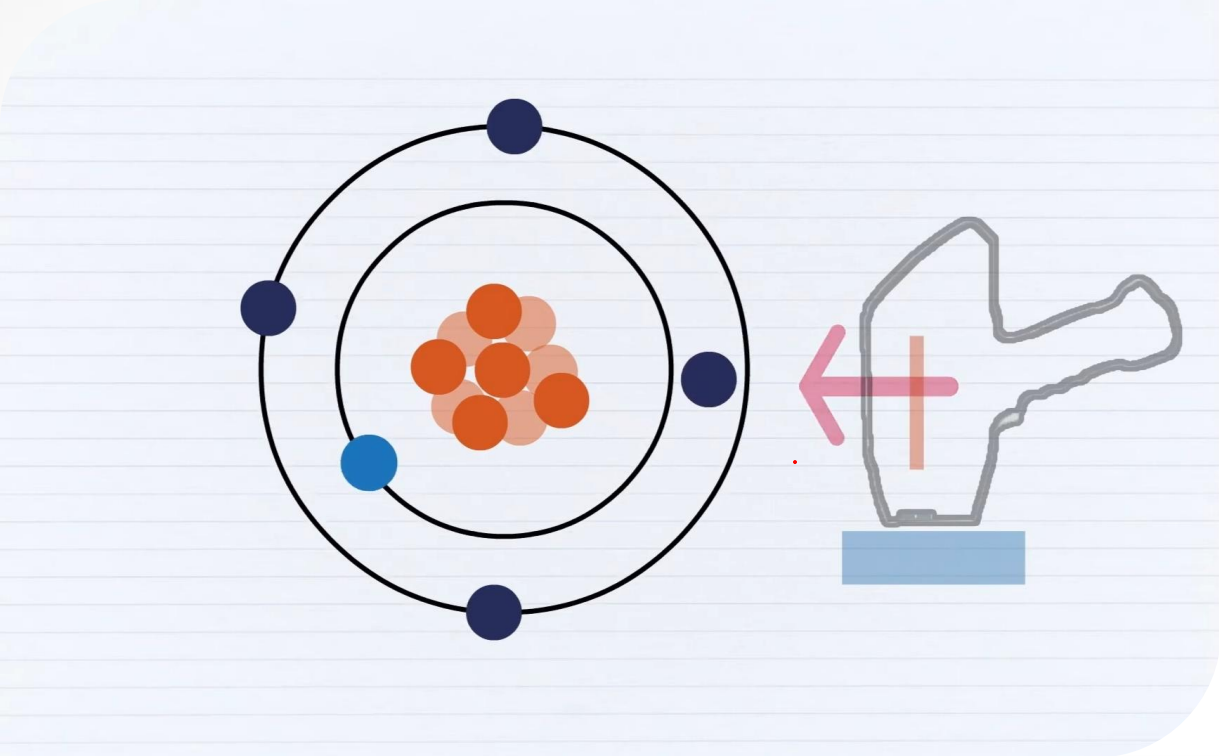
Working Principle



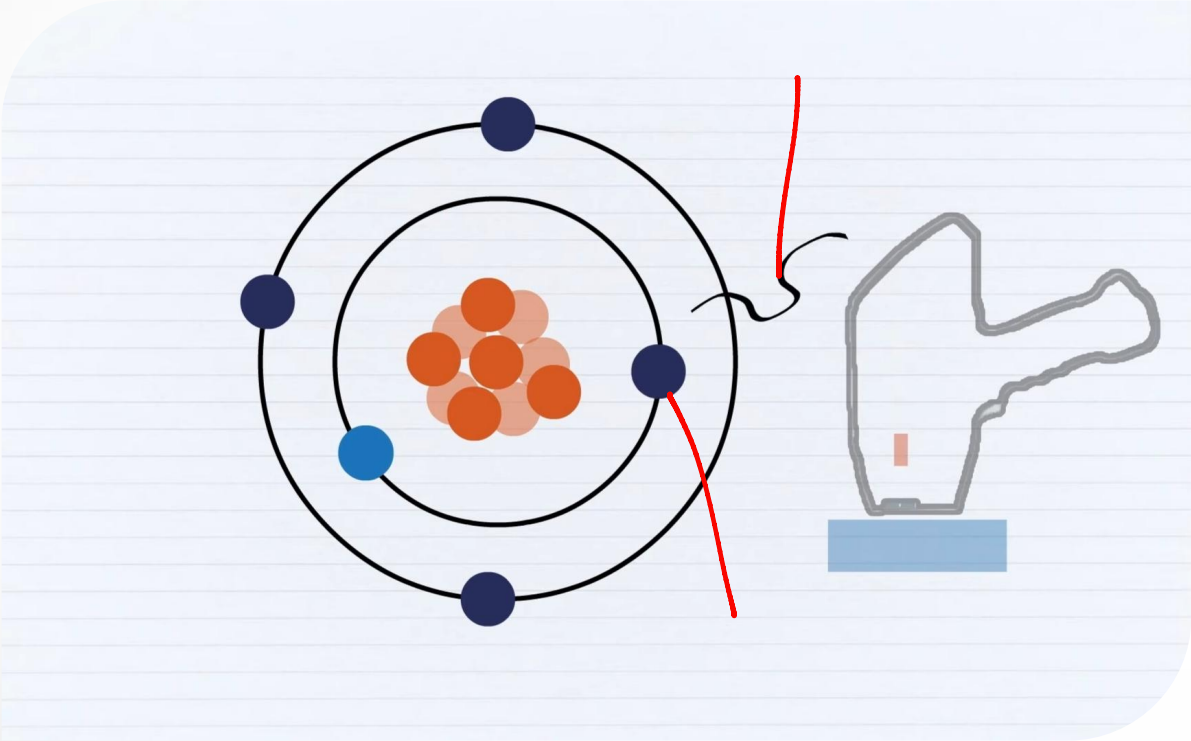
X-Ray Source: X-ray strike the electron in shell.



Emmite the electron : When x ray strikes the K shell electron, it is escapes from shell.



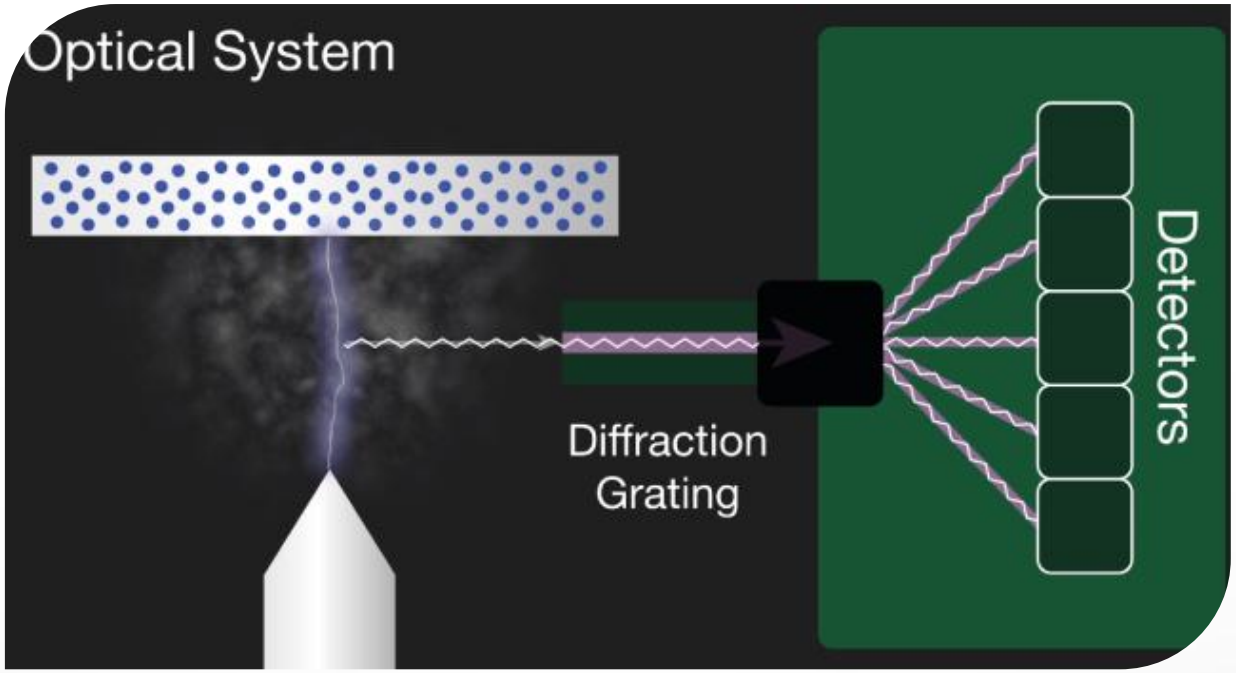
Electron Transition: Electrons from higher energy shells (like the L-shell or M-shell) fall to fill the vacancy created in the inner shell.



Detection and Analysis: The emitted X-rays are detected, and their energy is analyzed to identify and quantify the elements in the sample.

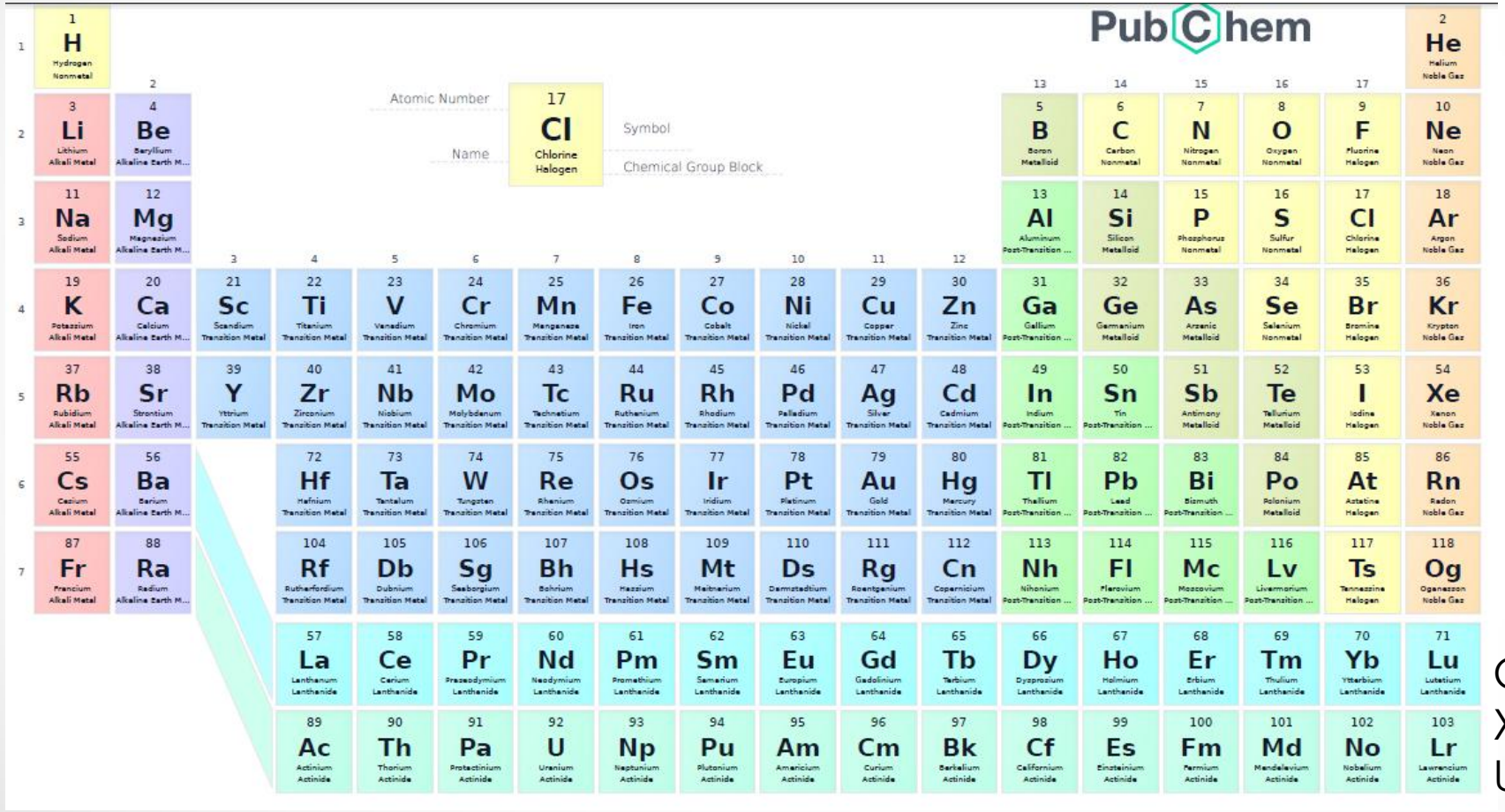
What is OES

- OES - Optical emission spectroscopy.



- Optical Emission Spectroscopy (OES), also known as atomic emission spectroscopy, is an analytical technique used to determine the elemental composition of a substance by analyzing the light emitted when it's excited, often by a spark or plasma.

Chemical Elements FOR XRF



Chemical elements analyzed by XFR range from Sodium (11) to Uranium (92)

CRM

- CRMs are standards with precisely known values, used as benchmarks in analytical procedures
- *Calibrate XRF instruments:* Ensuring accurate measurements by comparing the instrument's readings to the known values of the CRM.
- *Validate analytical methods:* Confirming the reliability and accuracy of the XRF analysis process.

- *Check product quality:* Ensuring that the elemental composition of samples falls within acceptable limits.
- *Monitor instrument performance:* Providing a baseline for routine analysis and identifying potential issues.

ACCEPTANCE VALUE OF PMI

BASE MATERIALS

- PMI test results showing presence of characteristic elements upto 10% less than the minimum specified value in the material specification and upto 10% more than the maximum specified value in the material specification shall be acceptable.

WELD MATAL

- The ± 12.5% variation in chemical composition for characteristic elements is more commonly found in welding consumable specification or welding procedure qualifications, which are usually governed by section IX rather than section I.