

## **Powerful Tool for Detection of Ultra-Low Sulfur and full elements in Gasoline and Diesel**

### **—Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometer DUBHE-1630**

#### **Application:**

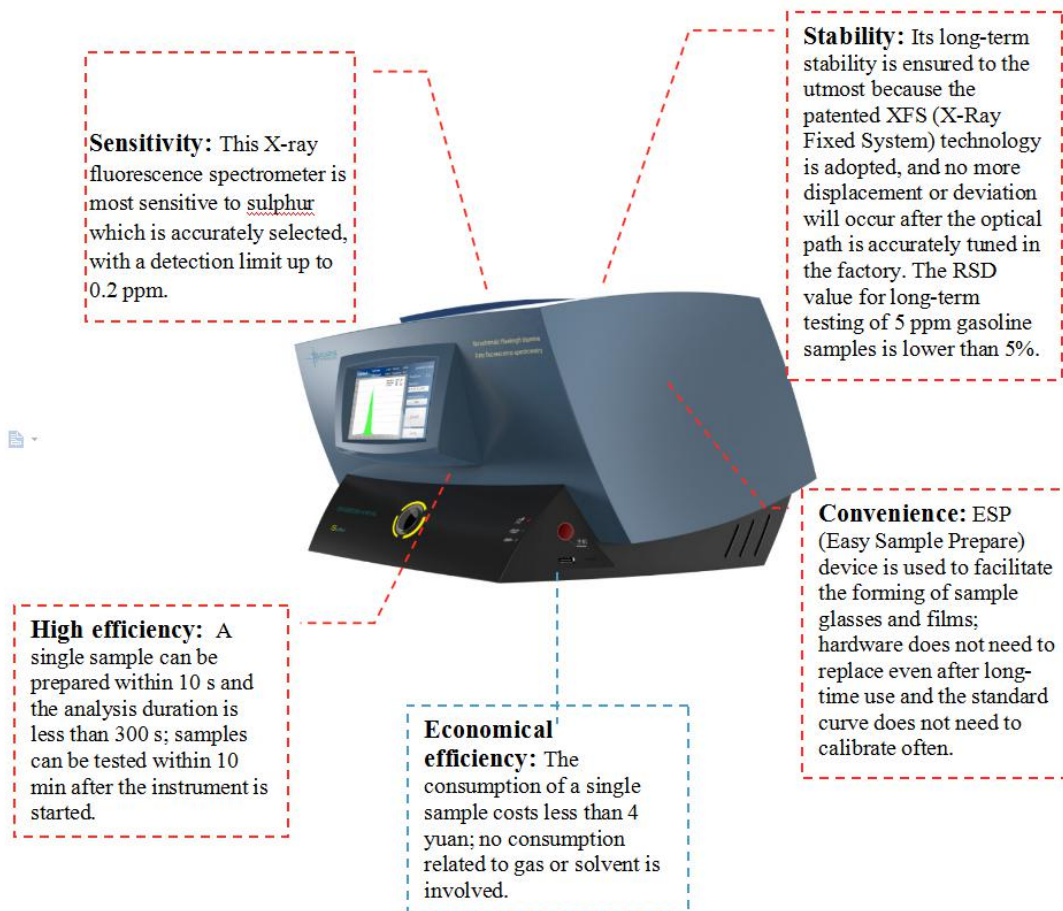
It is widely used in analysis of sulfur and other required elements content in gasoline, diesel, kerosene, lubricants, naphtha and reformat, analysis of ultra-low sulfur content in gasoline and diesel as well as in production quality control of oil refineries and petrochemical enterprises, quality inspection in oil storage and transportation, and inspection by Quality Control Department and Industry and Commerce Departments on gasoline and diesel in market.

The monochromatic wavelength dispersive X-ray fluorescence spectrometer, a high-selectivity and high-sensitivity detection method, can provide a detection limit of sulfur content in oil products up to 0.2ppm and features efficient detection, low cost, good repeatability, convenient operation and on-line monitoring.

Through years of efforts, SKYRAY INSTRUMENT has developed the monochromatic wavelength dispersive X-ray fluorescence spectrometer DUBHE-1630 for detection of sulfur content in diesel.

#### **Monochromatic wavelength dispersive X-ray fluorescence spectrometer DUBHE-1630**

DUBHE-1630 is an ideal instrument capable of detecting ultra-low sulfur content and with multiple proprietary intellectual property rights such as high-flux all doubly-curved crystal (HF DCCS), X-ray fixed system (XFS) and Easy Sample Prepare (ESP). It is applicable to production quality control of oil refining and petrochemical enterprises, quality inspection for oil storage and transportation, inspection of gasoline and diesel products by the quality control authorities and Industrial and commercial administrative departments as well as determination of sulfur content in chemical and other products.



**Fig.1 Diagram for Characteristics of DUBHE-1630**

### **DUBHE-1630**

#### **Performance verification**

DUBHE-1630 is used for the linearity test of 0 – 500ppm standard solutions and the repeatability test of standard samples with ultra-low sulfur content of 2ppm for standard samples of American VHG gasoline (as shown in Fig.2). The long-time repeatability and stability tests of Beijing-V standard gasoline is carried out to verify the reliability of the instrument in testing actual oil products.

All tests are carried out with the same sample glasses and films as follows: 3.0 $\mu$ m Prolene film, 4ml sample glass and Easy Sample Prepare (as shown in Fig.3).

All tests are carried out in the same conditions: Cr-target X-ray tube, 4.5KV voltage, 1.1mA current and test time of 300s per sample.



**Fig.2 Standard Samples of Sulfur in Gasoline from American VHG Company (blank, 5ppm, 10ppm, 50ppm, 100ppm, 200ppm and 500ppm)**



**Fig.3 Easy Sample Prepare (ESP)**

(1) Linearity test of 0 – 500ppm standard solutions

DUBHE-1630 is used to determine the counting rates of blank, 1ppm, 2ppm, 5ppm, 10ppm, 20ppm, 50ppm, 100ppm, 200ppm and 500ppm samples and establish a relation curve between the concentration and the counting rate, as shown in Table 1 and Table 2.

Table 1 Linearity of 0 – 50ppm Low-concentration Standard Solutions (gasoline)

Concentration (ppm)	CPS
0	0.72
1	1.07
2	1.39
5	2.28
10	3.94
20	7.02
50	16.5

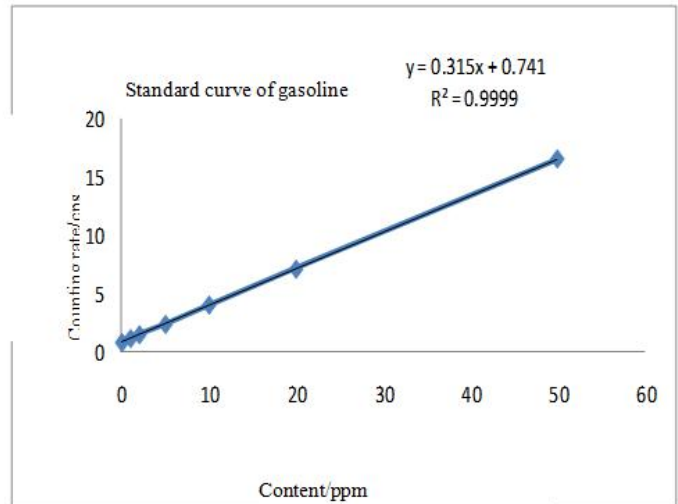
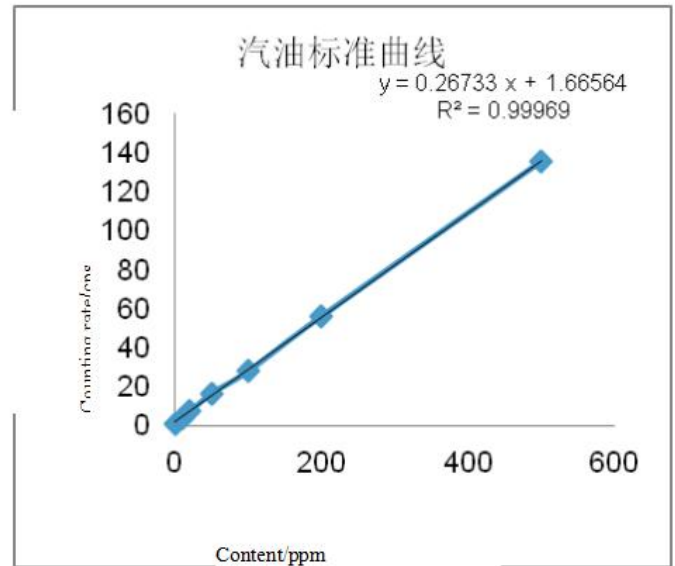


Table 2 Linearity of 0 – 500ppm High-concentration Standard Solutions (gasoline)

Concentration (ppm)	CPS
0	0.72
10	3.94
20	7.02
50	16.5
100	27.84
200	55.89
500	135.0



The results show that DUBHE-1630 presents good linearity in the entire concentration range, including low concentration.

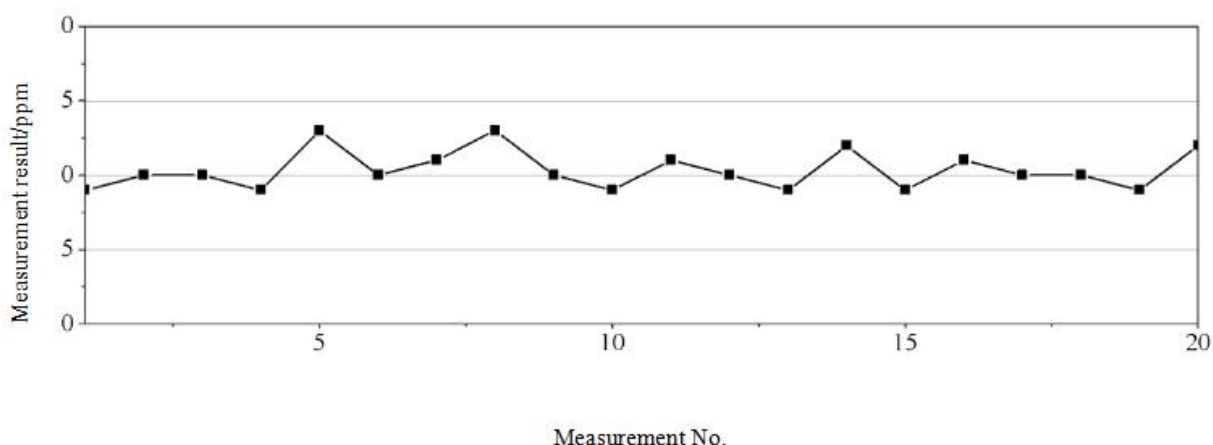
(2) Repeatability test of standard sample with ultra-low sulfur content of 2ppm

The 2ppm standard sample is tested for continuous 20 times, as shown in Table 3. According to the results (mean test value = 2.035, SD = 0.1309, and RSD = 6.43%), DUBHE-1630 presents extremely good repeatability in ultra-low sulfur detection.

Table 3 Results of Repeatability Test of 2 ppm Standard Sample

S/N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Measured value	1.9	2.0	2.0	1.9	2.3	2.0	2.1	2.3	2.0	1.9	2.1	2.0	1.9	2.2	1.9	2.1	2.0	2.0	1.9	2.2

Fig.4 Repeatability Test Results of 2ppm Standard Gasoline Solution



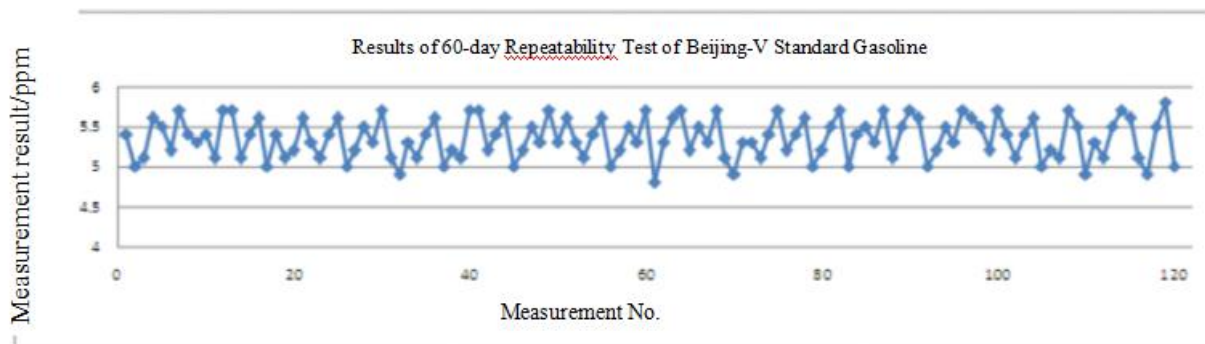
(3) Long-time repeatability and stability tests

A Beijing-V standard gasoline sample is tested for continuous 60 days (once in the morning and once in the afternoon respectively), during which the standard curve is not calibrated. The results are shown in Table 4.

The mean test value is 5.35 and the relative standard deviation (RSD) is 4.66%. It shows that DUBHE-1630 presents extremely good repeatability and stability in long-time use.

Table 4 Results of 60-day Repeatability Test of Beijing-V Standard Gasoline

No.	Measured value	No.	Measured value	No.	Measured value	No.	Measured value	No.	Measured value	No.	Measured value
1	5.4	21	5.6	41	5.7	61	4.8	81	5.5	101	5.4
2	5.0	22	5.3	42	5.2	62	5.3	82	5.7	102	5.1
3	5.1	23	5.1	43	5.4	63	5.6	83	5.0	103	5.4
4	5.6	24	5.4	44	5.6	64	5.7	84	5.4	104	5.6
5	5.5	25	5.6	45	5.0	65	5.2	85	5.5	105	5.0
6	5.2	26	5.0	46	5.2	66	5.5	86	5.3	106	5.2
7	5.7	27	5.2	47	5.5	67	5.3	87	5.7	107	5.1
8	5.4	28	5.5	48	5.3	68	5.7	88	5.1	108	5.7
9	5.3	29	5.3	49	5.7	69	5.1	89	5.5	109	5.5
10	5.4	30	5.7	50	5.3	70	4.9	90	5.7	110	4.9
11	5.1	31	5.1	51	5.6	71	5.3	91	5.6	111	5.3
12	5.7	32	4.9	52	5.3	72	5.3	92	5.0	112	5.1
13	5.7	33	5.3	53	5.1	73	5.1	93	5.2	113	5.5
14	5.1	34	5.1	54	5.4	74	5.4	94	5.5	114	5.7
15	5.4	35	5.4	55	5.6	75	5.7	95	5.3	115	5.6
16	5.6	36	5.6	56	5.0	76	5.2	96	5.7	116	5.1
17	5.0	37	5.0	57	5.2	77	5.4	97	5.6	117	4.9
18	5.4	38	5.2	58	5.5	78	5.6	98	5.5	118	5.5
19	5.1	39	5.1	59	5.3	79	5.0	99	5.2	119	5.8
20	5.2	40	5.7	60	5.7	80	5.2	100	5.7	120	5.0



### Test of Gasoline -V Standard

Source of No.92 gasoline: As gasoline is not sold in bulk in gasoline stations, we got a small amount of gasoline from a private car in a garage and sealed it in a glass bottle.

Sample glass and film: 3.0 $\mu$ m Prolene film, 4ml sample glass, Easy Sample Prepare

Test instrument: DUBHE-1630

Test conditions: Cr-target X-ray tube, 4.5KV voltage, 1.1mA current, test time of 300s per sample, standard curve established with standard gasoline from VHG Company

Test results:

Sample No.	1#	2#	3#	4#
Sulfur content	5.3	3.9	4.6	5.7

### Conclusion

A series of tests show that SKYRAY INSTRUMENT DUBHE-1630 is the optimum monochromatic wavelength dispersive X-ray fluorescence spectrometer for detection of ultra-low sulfur and other required elements content in gasoline and diesel, which features extremely high linearity, repeatability and stability, convenient operation and low cost. It can be applied to comply with the standards including ASTM D7039, D2622, GB11140, SH/T0842-2010, ISO20884 and etc.