



PRODUCT STANDARD
SWITCHGEAR ENGINEERING DIVISION

SG 10409 Rev: 00

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SPECIFICATION OF SF₆ GAS AND CYLINDERS

1. GENERAL:

This specification governs the technical and statutory requirements of SF₆ gas filled and stored in cylinders.

2. APPLICATION:

For SF₆ circuit breakers and gas insulated power equipments.

3. COMPLIANCE WITH NATIONAL/INTERNATIONAL STANDARDS :

- a) **IEC: 60376 and IS -13072:** SF₆ (Sulphur Hexafluoride) gas shall conform to these standards.
- b) **ANSI: B57.1 or BS: 341 Part I or IS: 3224.** : The valves fitted to the cylinders shall conform to these standards.
- c) **IS: 4379:** Identification of the contents of industrial gas cylinders.
- d) **IS : 7311:** Seamless high carbon steel cylinders for permanent & high Pressure liquefiable gases. The cylinders shall also meet Indian Boilers Regulations. (Mandatory).
- e) **IEC 61634:** To establish appropriate health and safety practices and to determine the applicability of regulatory limitations prior to use. Also, disposal of these items should be carried out according to local regulations with regard to the impact on the environment. Every precaution shall be taken to prevent the release into the environment of sulphur hexafluoride as per this standard.

4. TECHNICAL SPECIFICATIONS :

- a) **Cylinder Capacity:** Preferred water capacity of the cylinders supplied shall be around 40 liters and weight of SF₆ gas in each cylinder shall be approximately 50kg.
- b) **Filling Ratio:** The filling ratio (The ratio of weight of liquefiable gas introduced in the cylinder to the weight of the water the cylinder will hold at 15 °C) shall be around 1.20.

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REV.		PRINTS TO:-	APPROVED –		
ALTD.			Issued online	HR Patel	
APPD.			PREPARED	ISSUED	DATE
DATE.			Sonali Sinha	VKD	06.09.2014



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5. TESTING

I) Purity Test

Content	Specification	Analytical methods (for indication only, not exhaustive)	Precision
Air	2 g/kg [note 1]	Infrared absorption method	35 mg/kg
		Gas-chromatographic method	3 – 10 mg/kg
		Density method	10 mg/kg
CF4	2 400 mg/kg [note 2]	Gas-chromatographic method	9 mg/kg
H2O	25 mg/kg [note 3]	Gravimetric method	0,5 mg/kg[note 5]
		Electrolytic method	2 – 15 mg/kg
		Dew point method	1 °C
Mineral Oil	10 mg/kg	Photometric method	< 2 mg/kg
		Gravimetric method	0,5 mg/kg [note 5]
Total acidity expressed in HF	1 mg/kg [note 4]	Titration	0.2 mg/kg

NOTE 1 2 g/kg is equivalent to 1 % vol under ambient conditions (100 kPa and 20 °C [1]).
NOTE 2 2 400 mg/kg is equivalent to 4 000 µl/l under ambient conditions (100 kPa and 20 °C [1]).
NOTE 3 25 mg/kg (25 mg/kg) is equivalent to 200 µl/l and to a dew point of –36 °C, measured at ambient conditions (100 kPa and 20 °C [1]).
NOTE 4 1 mg/kg is equivalent to 7.3 µl/l under ambient conditions (100 kPa and 20 °C [1]).
NOTE 5 Depending on the sample size.

Due to the maximum impurity levels that can be present in SF6, the SF6 amount in a container (measured in the liquid phase), shall be higher than 99.7 % in weight.

II) SF6 gas shall also be tested for dew point and hydrolysable fluorides contents other than those mentioned at SI No. I of Clause-5 as per IEC: 376, 376A & 376B and test certificates shall be furnished to BHEL indicating all test results as per IEC standards for each lot of SF6 gas.

6. DESIGN AND TEST PARAMTERS :

The cylinders shall have a minimum designed working pressure of around 130 kgf/cm² (gauge).

The test pressure for hydraulic stretch test shall be at least 210 kgf/cm² (gauge).



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7. STATUTORY REQUIREMENTS :

The chief Controller of Explosives, Department of Explosives, and Government of India is the statutory authority regulating the importation and use of SF₆ gas cylinders. A license has to be obtained by the users from this Authority for importation and use of SF₆ gas cylinders. Hence, the suppliers shall comply with the regulations of the above authority, as indicated in this specification and separately communicated from time to time.

8. STORAGE

Containers shall be used for storage and transportation of the SF₆. It is the responsibility of the supplier to provide gas in the appropriate containers, according to local regulations and international transport regulations.

Nevertheless, the containers shall have valves properly protected. The mass of sulfur hexafluoride (in kg) shall be stated on each cylinder by the supplier.

Attention shall be paid to the filling factor of the containers, taking into account their design pressure and the maximum ambient temperature to which they will be subjected.

9. TRANSPORTATION

Transport of SF₆ shall be carried out in accordance with national and international regulations. However, it is recommended to legibly mark the containers at the valve end and preferably on the cylindrical part of the body.

Specific labeling of containers shall be effected in accordance with the mode of transport and the national and international regulations.

Cylinders can be shipped on the deck in conformance with shipping regulations.

10. DOCUMENTS TO BE SUPPLIED BEFORE SHIPMENT:

- a. Documents necessary for obtaining the approval of the chief controller of Explosives for License to import the SF₆ gas cylinders shall be supplied at the appropriate time. If the chief controller of Explosives asks for additional information or suggests any change in the cylinders or valves, the same shall be complied by the supplier.
- b. The supplier shall not ship the cylinders filled with SF₆ gas until we obtain the license from the chief controller of explosives and the same is communicated by us in writing.
- c. A material safety data sheet (MSDS) shall be provided by the supplier.



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In case the gas is imported by the local representative and he has complied with above regulations, the supplier shall submit a copy of above document for ready reference of BHEL prior to supply.

11. GUARANTEE

- a. The supplier shall guarantee against faulty material.
- b. Supplier shall guarantee that the SF6 supplied is non-toxic, taking into account the local regulations and state-of-the-art knowledge.

12. ACCEPTANCE CRITERIA:

- a. Conformance to relevant IEC Standards/IS Standards as per Clause 3.
- b. Technical Specifications as per Clause 4 & 5.
- c. Packing and Marking as per clause 7.
- d. Routine Tests as per Clause 5 and test certificates shall be furnished to BHEL indicating all test results as per IEC standards for each lot of SF6 gas.

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ANNEXURE – A

List of approved manufacturers/inspection agencies of SF₆ gas cylinders.

Country	Manufacturer	Specification	Inspecting Agency
U.S.A.	HARRISBURG STEEL CO	DOT 3AA 2015 And above	R.W. HUNT CO.
U.S.A.	TAYLOR WHARTON	DOT 3AA 2015 And above	PITTSBURG TESTING CO.
U.S.A.	NATIONAL TUBE	DOT 3AA 2015 And above	T.H.COCHROME LAB
U.S.A.	MWALTER KIDDE	DOT 3AA 2015 And above	INDUSTRIAL ANALYSIS
U.S.A.	PRESSED STEEL TANK CO.	DOT 3AA 2015 And above	ARROW HEAD
U.S.A.	MORRIS THERMADOR	DOT 3AA 2015 And above	COLPY-CHRISTIE SCHOFIELD
U.S.A.	MARISON	DOT 3AA 2015 And above	LINDER CO.
JAPAN	SHOWA KOATSU KOGYO CO. LTD.	DOT 3AA 2015 (AND ABOVE) OR JIS B8241	KHK OR LLOYD'S OR BUREAU VERITAS
JAPAN	SUMIKIN KIKO CO. LTD	DOT 3AA 2015 (AND ABOVE) OR JIS B8241	KHK OR LLOYD'S OR BUREAU VERITAS
JAPAN	SUMITOMO METAL INDUSTRIES	DOT 3AA 2015 (AND ABOVE) OR JIS B8241	KHK OR LLOYD'S OR BUREAU VERITAS
JAPAN	NIHON KUATSU YOKI	DOT 3AA 2015 (AND ABOVE) OR JIS B8241	KHK OR LLOYD'S OR BUREAU VERITAS
JAPAN	TOTSKUKA HIGH PRESSURE GAS CYLINDER CO. TOKYO	DOT 3AA 2015 AND ANOVE	KHK OR LLOYD'S OR BUREAU VERITAS
JAPAN	KANTO KOATSU YOKI MANUFACTURING CO.LTD	DOT 3AA 2015 AND ANOVE	KHK OR LLOYD'S OR BUREAU VERITAS
JAPAN	TOKA, HIGHPRESSURE CYLINDER CO. LTD	DOT 3AA 2015 AND ANOVE	KHK OR LLOYD'S OR BUREAU VERITAS
WEST GERMANY	MANNESMANN	DOT 3AA 2015 AND ABOVE	LLOYD'S OR BUREAU VERITAS
WEST GERMANY	INDUSTRIE WERKE KARLSRUHE, AUGSBURG	DOT 3AA 2015 AND ABOVE	LLOYD'S OR BUREAU VERITAS
U.K.	CHESTERFIELD TUBE CO.	BS: 5045, Pt.I	LLOYD'S
ITALY	ACCIAIERIAE TUBIFICIO DI BRESCIA	DOT 3AA 2015 AND ABOVE	BUREAUVERITAS
INDIA	BHARAT PUMPS & COMPRESSORSLTD NAINI, ALLHABAD	IS: 7285	ISI / LLOYD'S

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