PRODUCT MANUAL FOR
HALOGEN FREE FLAME RETARDANT (HFFR) CABLES FOR WORKING VOLTAGES UPTO AND INCLUDING 1100V
ACCORDING TO IS 17048: 2018

This Product Manual shall be used as reference material by all Regional/Branch Offices & licensees to ensure coherence of practice and transparency in operation of certification under Scheme-I of Bureau of Indian Standards (Conformity Assessment) Regulations, 2018 for various products. The document may also be used by prospective applicants desirous of obtaining BIS certification licence/certificate.

1.	**Product**	:	IS 17048: 2018	
	Title	:	Halogen Free Flame Retardant (HFFR) Cables for working voltages upto and including 1100V	
	No. of Amendments	:	Nil	
2.	**Sampling Guidelines:**			
a)	**Raw material**	:	Annealed, bare or tinned high conductivity copper wires Aluminium wires	IS 8130
b)	**Grouping guidelines**	:	Please refer ANNEX – A	
c)	**Sample Size**	:	(i) 5 meters Copper/Aluminium wire (before stranding) (ii) 100 g Cu wire (for copper purity test) (iii)50 meters HFFR Cable/ Cord	
3.	**List of Test Equipment**	:	Please refer ANNEX – B.	
4.	**Scheme of Inspection and Testing**	:	Please refer ANNEX – C.	
5.	**Possible tests in a day**	:	Please refer ANNEX - D	
6.	**Scope of the Licence:** Halogen Free Flame Retardant (HFFR) Cables/ Cords, Circular/Flat, with Rigid/Flexible Copper (Bare/Tinned)/Aluminum Conductor, Class 1/2/5, Insulated [Type HFI-TP 70 (thermoplastic)/ HFI-XL 70 (Crosslinked thermoset)/HFI-XL 90 (Crosslinked thermoset)], Unsheathed/ Sheathed (HFS-TP 70/HFS-TP 90/ HFS-XL 70/HFS-XL 90), Category 01/02/03/04, for working Voltages upto and including 1100 V, for the following varieties: a) Single Core for Sizes upto and including ….. b) Multi-core upto and including …. Cores, Sizes upto and including ….. mm^2			

ANNEX A

Grouping Guidelines

I. 1(a). Samples of each variety of Cable shall be tested considering the following:

i. Material for Conductor – Aluminium, Copper

ii. Type of Conductor – Rigid (Class 1, 2) , Flexible (Class 5)

iii. No. of Cores (Single Core, Multi-core)

iv. Type of Insulation (HFI-TP 70/ HFI-XL 70/ HFI-XL 90)

v. Type of Sheath (HFS-TP 70/ HFS-TP 90/ HFS-XL 70/ HFS-XL 90)

vi. Category of Cable (01, 02, 03, 04)

1(b). The following relaxation may be given when a variety is tested for all the requirements:

Variety Tested	**Additional Variety that may be covered**
Tinned Copper	Bare Copper
Stranded (Class 2)	Solid (Class 1)
Multi-core	Single Core
Type HFI-XL-90 Insulation	Type HFI-XL-70 Insulation
Sheathed	Unsheathed
Type HFS-TP 90 Sheath Type HFS-XL 90 Sheath	Type HFS-TP 70 Sheath Type HFS-XL 70 Sheath
(a) Category 04 (b) Category 02	(a) Category 03 (b) Category 01
Flat Cable	Circular Cable

2. Cable with any size (Nominal Cross-Sectional Area of Conductor) and no. of cores, (preferably the largest) intended to be covered in the Licence shall be drawn for testing.

3. The Firm shall declare the Varieties and Sizes of various Cables they intend to cover in the Licence. The Scope of Licence may be restricted based on the Manufacturing and Testing capabilities of the Manufacturer.

4. During the operation of the Licence, BO shall ensure that all the Varieties covered in the Licence are tested in rotation to the extent possible.

5. 2 samples (1 FS + 1 MS) shall be drawn in a year for complete testing. Samples shall be sent to OSL for the following tests:
    - Assessment of halogen on Insulation and sheath
    - Ozone resistance on Insulation and sheath
    - Flame retardance and smoke density test

    For all other tests, separate sample shall be sent to BIS lab (presently only NROL has test facilities for FR tests).

ANNEX B

List Of Test Equipment

Major test equipment required to test as per the Indian Standard

S No	Test Equipment	Tests used in with Clause Reference	
		Cl. Ref.	**Tests**
1	Vernier Calliper	11.2,11.3, 12.2, 12.3, 13.2, 13.4, 13.5, 13.6, 14.2, 14.4, 14.5, 14.6, 15.2, 15.4, 15.5, Table 3 to 8	Measurement of thickness (insulation and sheath), diameter of core & Outer Dia
2	Steel Scale	4.2.4, 4.5.4,5.3	Flammability, Annealing and Elongation
3	Micrometer	11.2,11.3, 12.2, 12.3, 13.2, 13.4, 13.5, 13.6, 14.2, 14.4, 14.5, 14.6, 15.2, 15.4, 15.5, Table 3 to 8	Measurement of Wire Dia
4	Measuring Microscope	11.2,11.3, 12.2, 12.3, 13.2, 13.4, 13.5, 13.6, 14.2, 14.4, 14.5, 14.6, 15.2, 15.4, 15.5, Table 3 to 8, Table2 III (c) (vii), e(vi), (viii)	Measurement of thickness (insulation & sheath) and hot deformation test
5	Graduated Magnifying Glass		
6	Tensile Testing Machine	4.2.4, 4.5.4, Table 2 II (a), (f), 5.13	Tensile Strength, Elongation Test, Annealing Test & Water immersion Test
7	Dumbbell Cutting Machine with Die		
8	Hot Air Oven with thermostatic Temperature Controller	5.12, Table 2II (m), III(c)(vii), (xi); e(vi), (viii)	Hot Set Test, Hot Deformation
9	Hot Set Test Apparatus with grips for suspending test specimen, loads for hot set and loads for hot deformation test apparatus		
10	Thermal Ageing Oven with Thermostatic Temperature Controller, Air flow meter & Hour Meter	4.2.4, 4.5.4	Tensile Strength & Elongation after ageing, Loss of Mass Test

11	Water Bath with thermostatic temperature controller, stirrer & Hour Meter	5.1, 4.2.1 (Annex A)	Water Immersion AC & DC Test, Insulation Resistance Constant/Volume Resistivity Test
12	Megaohmmeter	Table 2 II(g), III (c) (iii)	Insulation Resistance Constant/Volume Resistivity Test
13	Smooth Metal Mandrels	5.15	Cold Bend Test
14	Low temperature Impact Apparatus with anvil, hammer and cylindrical pipe	5.16	Cold Impact Test
15	Physical weighing Balance with weights (LC- 0.1mg), Persulphate solution, Porcelain/Glass beaker, Nessler's Tube, Pipette, Volumetric Flask, Copper Sulphate and Ammonia Solution.	Table 2 II (c), III (a)(iii)	Persulphate Test for tinned Copper
16	Flame Retardance Test apparatus with vertical steel tube, rectangular ventilation openings, lid, conical tray, ethanol	5.11	Flame Retardant Test
17	Kelvin Double Bridge with galvanometer, DC Source	4.1.1(c)	Conductor Resistance Test
18	Flammability Test Apparatus with burner, Gas cylinder, Scale, Stopwatch & 0.71mm Coper wire	5.3	Flammability Test
19	Conditioning chamber & Refrigerator with Humidity Indicator	5.7, Table2III(c)(x), f(iii), (iv)	Cold Bend, Cold Impact & Conditioning of sample for assessment of halogens
20	AC Spark Tester	5.2	Spark Testing
21	DC High Voltage Test Set	5.1	DC High Voltage Test
22	AC High Voltage Test Set	5.1	AC High Voltage Test
23	Glass thermometer	4.1.1(c), Table 2(II)(g), III (c)(iii)	Conductor Resistance and Insulation Resistance Test
24	Balance Digital	5.3, 5.7	Flammability Test, Determination of halogens
25	Stop Watch		
26	Oxygen Index test apparatus with timer, thermocouple, Oxygen & Nitrogen Gas	5.4, 5.5	Oxygen Index & Temperature Index Test

27	Cold Water Bath with De-ionized Water	5.13	Water immersion Test (effect of water on sheath of cable)
28	Smoke Density Test apparatus consisting of cubic enclosure 3000+-30mm with horizontal photometric system, ignition fluid (ethanol, methanol, water), table type fan, light source.	5.6	Smoke Density Test
29	Ozone Resistance Test apparatus (Test chamber with air flow meter, mandrels for bending, ozone generator)	5.14	Ozone Resistance Test
30	Tube Furnace, Quartz Combustion Tube, Porcelain/fused quartz/soapstone combustion boat, wash bottles, Glass Tubing and Silicon Rubber Stoppers, air flow meter, magnetic stirring bar and magnetic stirrer, Volumetric flask, thermocouple	5.7, Table 2 III c(viii), d(i), e(vii), Annex D	pH, conductivity, determination of Chlorine and Bromine
31	pH meter		pH
32	Conductivity meter		Conductivity
33	Equipment: Bunsen Burner, Glass test tubes of approximately 50mmx10mm, Test tube Holder, evaporating basin/mortar, wire gauge, Funnel, Filter Paper. Reagents: Sodium Metal, Nitric acid, Aqueous Silver Nitrate, Freshly prepared Zirconium-Alizarin red S reagent, Glacial Acetic Acid, pH Papers, Zirconium Nitrate, Hydrochloric Acid, Distilled Water	5.7, Table 2 III c(viii), d(i), e(vii), Annex D	Determination of Presence of Chlorine, Bromine and Fluorine

34	Apparatus: Oxygen Flask, Pipettes, Volumetric Flasks Reagents: Electrode filing solution as recommended by electrode manufacturer for Fluoride ion selective electrode method Or Alizarin fluorine blue reagent (Alizarin fluorine blue complex, Propanol, water), Standard Fluroide solution prepared from Sodium Fluoride, Dodecanol, Sodium Hydroxide Solution for Colorimetric method		Determination of Fluorine
35	Reagents: Sodium Hydroxide, Nitric Acid, Sodium Nitrate, Ammonium Thiocyanate, Ferric Ammonium Sulphate Solution, Potassium Hydroxide , Sulphuric Acid		Determination of Chlorine and Bromine
36	Air conditioner		For maintaining room temperature

ANNEX C

Scheme Of Inspection And Testing

1. LABORATORY - A laboratory shall be maintained which shall be suitably equipped (as per the requirement given in column 2 of Table 1) and staffed, where different tests given in the specification shall be carried out in accordance with the methods given in the specification.

1.1 The manufacturer shall prepare a calibration plan for the test equipment.

2. TEST RECORDS – The manufacturer shall maintain test records for the tests carried out to establish conformity.

3. LABELLING AND MARKING – In addition to the requirements of clause 9 and 10 of IS 17048: 2018, Identification in code or otherwise shall be either stencilled on reel/drum, packages of individual or contained in the label attached to the coil, in order that the date of manufacture and control unit can be traced back to factory records.

4. CONTROL UNIT – A cable/ cord of continuous length manufactured/ extruded under similar conditions of production for one nominal cross-sectional area and class of conductor shall constitute a control unit.

5. LEVELS OF CONTROL - The tests as indicated in column 1 of Table 1 and the levels of control in column 3 of Table 1, shall be carried out on the whole production of the factory which is covered by this plan and appropriate records maintained in accordance with paragraph 2 above.

6. REJECTIONS – Disposal of non-conforming product shall be done in such a way so as to ensure that there is no violation of provisions of BIS Act, 2016.

TABLE 1

(1) Test Details						(2)	(3) Levels of Control		
Cl.	Requirement	Test		Test Methods		Test equipment requirement R: required (or) S: Sub-contracting permitted	No. of Sample	Frequency	Remarks
		Clause	Ref	Pt	Ref				
Conductor									
4.1.1c	Resistance	7.3	IS 8130	5	IS 10810	R	One	Each Coil/bobbin of finished wire drawn or received	**
Table 2, II.a, b	Tensile strength (for Al, before stranding)	7.2.1(a)		2					
	Wrapping test before stranding (for Al)	7.2.2		3					
Table 2, III.a.ii	Annealing test (for Cu, before stranding)	7.1.2.1		1					
	Purity test (for Cu)	Table 4	IS 191	-	-	S		For each consignment	
Table 2, III.a	Tensile strength (for Al, after stranding)	7.2.1(b)	IS 8130	2	IS 10810	R	Two	Each Control Unit of 10,000 m or less	-
	Wrapping test after stranding (for Al)	7.2.2		3	-	R	-		-
Table 2, II.c	Persulphate test (For tinned Copper Only)	7.1.1	IS 8130	4	IS 10810	S	One	Once in a month	
4.1, 4.2	Material	4.1.1 (b), 4.2.2	IS 17048	-	-	R	Each Control Unit		
6	Core Identification	6							
14.3, 15.3	Assembly of cores	Sec 2 & 3							
4.2.3	Thickness of Insulation	Sec 2 & 3	IS 17048	6	IS 10810	R	Two	Each Control Unit of 10,000 m or less	-
4.5.3	Thickness of Sheath	Sec 3							
4.5.5	Overall dimensions	Sec 2 & 3, Table 3-8							
4.5.5.1	Ovality	Sec 3				R	Two		
Table 2, III.d	Assessment of halogen on Fillers / Dummy Cores and Binder Tapes/ Identification Threads	4.3, 4.4, 5.7 & Annex D	IS 17048	-	-	R	-	Cable/Cord of each size and type manufactured in a month from each consignment of such materials	#

Tests on Insulation									
Table 2, III.c	i. Tensile strength & Elongation at break (before ageing)	Annex A	IS 17048	7	IS 10810	R	One	Cable/Cord of each size and type manufactured in a month from each consignment of insulating compound	#
	iii. Insulation Resistance			43		R			
	iv. Oxygen Index test	5.4		58		R			
	v. Temperature Index test	5.5		64		R			
	vi. Tensile strength & Elongation at break (after ageing)	Annex A		11		R			
	vii. Hot deformation			15		R			
	viii. Assessment of halogen	5.7 & Annex D	IS 17048	-	-	R	One		
	x. Cold impact	Annex A		21	IS 10810	R	One		
	xi. Hot Set test			30		R	One	Each Control Unit	
	xii. Ozone resistance test			13	IS 10810	S	One	Cable/Cord of each size and type manufactured in a month from each consignment of insulating compound	
	xiii. Flame retardant test	5.11		61		R	One		
Tests on Sheath									
Table 2, III.e	i. Tensile strength & Elongation at break (before ageing)	Annex B	IS 17048	7	IS 10810	R	One	Cable/Cord of each size and type manufactured in a month from each consignment of sheathing compound	#
	ii. Tensile strength & Elongation at break (after ageing)			11		R			
	iii. Oxygen Index test	5.4		58		S			
	iv. Temperature Index test	5.5		64		S			
	v. Ozone resistance test	Annex A		13		S			
	vi. Hot deformation			15		R			
	vii. Assessment of halogen	5.7 & Annex D	IS 17048	-	-	R	One		
	viii. Hot Set test	Annex B	IS 17048	30	IS 10810	R	One	Each Control Unit	

Tests on finished cable									
Table 2, III.f.	High Voltage at room temperature *or*	5.1	IS 17048	45	IS 10810	R	Each coil		-
	Spark test (as applicable)	5.2		44		R			
	Flammability test	5.3		53		R	One	Each Control Unit	-
	Cold Bend test	Annex A, B		20		S	One	Cables/ Cord manufactured from each consignment of insulating compound in a month	-
	Cold Impact test			21		S	One		-
	Flame retardant test	5.11		61	IS 10810	S	One		-
	Water Immersion Test (Effect of Water on sheath)	5.13		-		R	One	Cable/Cord of each size and type manufactured in a month from one consignment of insulating and sheathing compound	-
	Smoke density test	5.6		63	IS 10810	R	One		-

** No further testing is required if accompanied with Test Certificate or ISI marked.

In case of failure, marking of that type and size shall be stopped and reasons for failure shall be investigated. Marking shall be done only if the sample from the control unit of improved quality meets the specified requirements. The original frequency shall be restored only after five consecutive samples have passed the requirements.

Note-1: Sub-contracting is permitted to a laboratory recognized by the Bureau or Government laboratories empanelled by the Bureau.

Note-2: Levels of control given in column 3 are only recommendatory in nature. The manufacturer may define the control unit/batch/lot and submit his own levels of control in column 3 with proper justification for approval by BO Head.

ANNEX D

Possible Tests in a day

(a) Dimensions

- Maximum Conductor dia.
- Overall dimensions
- Ovality
- Thickness of sheath and insulation

(b) Annealing Test (for Copper wires)

(c) Tensile Test (for Al wires)

(d) Wrapping test (for Al wires)

(e) Conductor Resistance

(f) Tensile Test (before ageing) on Insulation and Sheath

(g) Hot Deformation

(h) Insulation Resistance Test

(i) HV Test (at Room Temperature)

(j) Cold Bend Test/ Cold Impact Test

(k) Flammability Test

(l) Flame Retardant Test

(m) Assessment of Halogens