



# On-Site Testing of

# E H V C A B L E S



HIGH VOLTAGE  
Systems | Testing | Calibration

✉ [info@samgor.in](mailto:info@samgor.in)

🌐 [www.samgor.in](http://www.samgor.in)

# About Samgor India

- A leading, quality-oriented and only company having all assets & technical expertise for GIS up to 765kV class
- Having experienced Engineers, Equipment's and Expertise in different disciplines of GIS & EHV Cables
- Have the highest number & highest capacity of on-site HV test systems
- Up to 400kV cables tested. Also tested 220kV EHV cable of 6kms length
- Present around the world, We are Global!!

## Abilities that Represent Us

### GIS



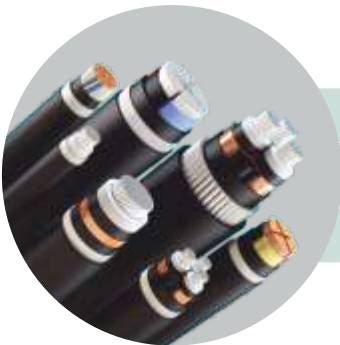
INSTALLATION & SF6 HANDLING

ALL COMMISSIONING TESTS

HV & PD TESTING

REPAIR & MAINTENANCE / AMC

### CABLE



PRE-COMMISSIONING TESTS

VLF HV/PD/TD TESTING

POWER FREQ. HV & TD TESTING

### REPAIR & MAINTENANCE



REPAIR / AMC / SPARES SUPPLY

EMERGENCY FAILURE ACTIVITIES

PREVENTIVE CARE (PMP)

### TEST SYSTEMS & CALIBRATION



HV TRANSFORMER & IMPULSE TEST SYSTEM

ISO/IEC 17025 ACCREDITED CALIBRATION LAB

SF6 STD CAPACITORS & HV DIVIDERS

# EHV Cable Life-Cycle Services



## Installation & Commissioning

- Drum Test
- Pre-Comm Test
- HV Test
- PD Test

## Periodic Maintenance Diagnostics

- Tan Delta
- VLF Test
- Online PD Test

## Failure Event Services

- Fault Location
- Burn Out
- HV Test
- PD Test

M	Cables are tested in factory already, and do not need re-testing at site	IEC standards specify voltages and durations for both factory test and post-installation site test. Cables per se cannot be used without joints and terminations, and these are the main parts assembled at site, that need testing.	F
Y	Joints and terminations are done by skilled technicians deputed by joint/termination OEMs, and have years of experience	Site conditions in India are not even near to the specified conditions by OEM for making the joint/termination. However best a jointer may be, the work is subject to vagaries of hostile working environment & unskilled support labors	A
T	Sheath testing was done on cable, and had passed the test. Cable insulation also passed DC 30kV test	Sheath testing is not for the XLPE insulation, it is instead for the outer jacket. <b>Refer IEC62067:2022 latest edition, and it reads at 16.1 as follows "The use of VLF and DAC waveforms for on-site tests are not recommended..."</b>	C
H	VLF test / DC test can be done on the cable with relatively ease at site, and should suffice.	DC test is not recommended for XLPE cables due to space charge creation. VLF testing is better than DC testing, in a way because it is varying DC with both polarities. But, VLF cannot create the same problematic patterns that AC Power Frequency can do, hence subtle issues in cable insulation can remain unidentified.	T
S	Soak testing for 24hrs at Uo was the norm since long time, and has worked most cable right.	"Imagine qualifying an asset in 24hrs that would be otherwise expected to be used at same voltage for min 24yrs!!" Uo testing does not check the cable insulation enough to withstand aging effects, switching & lightning impulses, and heating effect on insulation.	S



## Recommended Stage-wise Tests - As per DEWA

- Sheath Integrity Test
- Insulation Resistance Test

### Drum Test

### Cable Laying

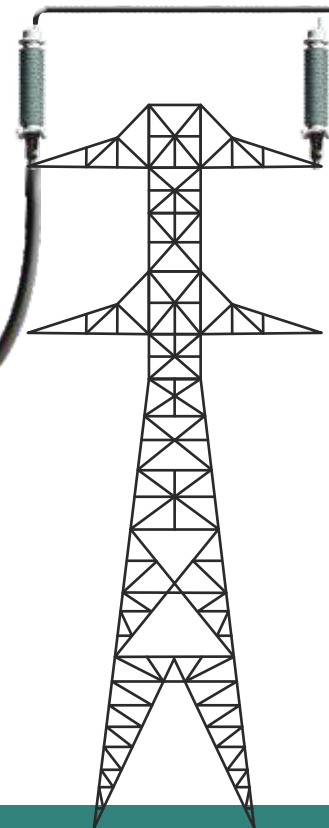
- Insulation Resistance Test
- Sheath Integrity Test
- Sectional Phasing

### Cable Jointing

- Shield Break Test
- SVL Integrity Test
- Joint Bay Earth Resistance Test
- Link Box Contact Resistance Test
- Conductor Phase Verification Test
- Sheath Phase Verification Test

### Final Commissioning

- Sheath Integrity Test (End to End)
- Conductor Resistance Test
- Cross Bonding Test
- Positive & Zero Sequence
- Impedance Test
- High Voltage AC Power Freq Test
- Partial Discharge Test
- Tan-Delta Test



## Recommended tests and test systems for different kV Class and lengths

kV Class	Length				U <sub>0</sub>	Test Voltage & Duration	Referred Std
	< 100 mtr	> 500 mtr	500 mtr – 2.5 kms	2.5 - 5 kms			
11 kV	VLF 28	VLF28	VLF28+TD	VLF28+TD+PD	7 kV	19kV / 15 min	IEEE 400.2
33 kV	VLF 60	VLF60	VLF60+TD	VLF60+TD+PD	20 kV	39kV / 15 min	IEEE 400.2
66 kV	135kV 1A	300kV 3A	300kV 20A	300kV 40A	36 kV	72kV / 60 min	IEC 60840
132 kV	300kV 3A	230kV 4.5A	600kV 20A	300kV 60A	76 kV	132kV / 60 min	IEC 60840
220 kV	300kV 3A	230kV 9A	300kV 60A	300kV 60A *	127 kV	216kV / 60 min	IEC 62067
400 kV	460 kV 4.5 A	600kV 20A	300kV 60A *	300kV 60A *	220 kV	374kV / 60 min	IEC 62067

\*Can work for shorter test duration of about 5 mins or with reduced voltage as per previous IEC edition

## Test Standards

### As per IEC 60840

1	2	3	4 <sup>a</sup>	5 <sup>a</sup>	6 <sup>a</sup>	7 <sup>a</sup>	8 <sup>a</sup>	9 <sup>a</sup>	10 <sup>b</sup>
Rated voltage U	Highest voltage for equipment U <sub>m</sub>	Value of U <sub>0</sub> for determination of test voltages U <sub>0</sub>	Value test of 9.3 2.5 U <sub>0</sub>	Partial discharge test of 9.2 and 12.4.4 1.5 U <sub>0</sub>	Tan measurement of 12.4.5 U <sub>0</sub>	Heating cycle voltage test of 12.4.6 2 U <sub>0</sub>	Lightning impulse voltage test of 10.12, 12.4.7 & 13.2.5 kV	Voltage test of 12.4.7 2.5 U <sub>0</sub>	Voltage test after installation of 16.3 kV
kV	kV	kV	kV	kV	kV	kV	kV	kV	kV
45 to 47	52	26	65	39	26	52	250	65	52
60 to 69	72,5	36	90	54	36	72	325	90	72
110 to 115	123	64	160	96	64	128	550	160	128
132 to 138	145	76	190	114	76	152	650	190	132
150 to 161	170	87	218	131	87	174	750	218	150

a. If necessary, these test voltages shall be adjusted as stated in 12.4.1.  
b. If necessary these test voltages shall be adjusted as stated in 16.3.

### As per IEC 62067

1	2	3	4	5	6	7
Rated voltage U	Highest voltage for equipment U <sub>m</sub>	Value of U <sub>0</sub> for determination of test voltages U <sub>0</sub>	Preferred test voltage		Test voltage for special conditions (when use of the preferred test voltage of column 4 in notpossible, see 16.3.1)	
			Voltage test after installation of 16.3 -	Multiplier -	Voltage test after installation of 16.3 -	Multiplier -
kV	kV	kV	kV	x U <sub>0</sub>	kV	X U <sub>0</sub>
220 to 230	245	127	216	1,7	180	1,4
275 to 287	300	160	272	1,7	210	1,3
330 to 345	362	190	323	1,7	250	1,3
380 to 400	420	220	374	1,7	260	1,2
500	550	290	435	1,5	320	1,1

A threshold electrical stress of 27 kV/mm to 30 kV/mm should not be exceeded for some insulations (as specified by the manufacture) in order to avoid a possible weakening of the insulation.



## Site References

Customer	Site Location	Activity
TSTRANSCO	Srisaillam	400kV HV testing
Cobra Group	Ivory Coast	400kV HV testing
KEI Ltd	Hyderabad	220/132 kV HV & PD testing
Megha Engineering & Infrastructures Ltd (MEIL)	Hyderabad	220/132 kV HV testing & Online PD testing
Siemens Ltd	Hassan	66kV HV testing
SunEdison Infra Ltd	Bhilai	220kV HV testing
Steel Authority of India Ltd (SAIL)	Rourkela	220kV HV testing
The Ramco Cements Ltd	Tamil Nadu	110kV HV testing
Bharat Petroleum Corporation Ltd (BPCL)	Kochi	220kV HV testing
Tata Power	Basti	400kV Sheath test
Linxon (PGCIL)	Hiriyur	220kV HV & Sheath test
KEC International	Bhutan	220kV DC Hipot testing
NHPC	Kullu	400kV HV testing
Universal Cables	Chennai	220/132 kV HV testing
Refex Renewable	Bhilai	220kV HV & PD testing
Jyona Power (AMNS)	Hazira	220kV HV & PD testing
National Fertilizers	Nangal	66kV HV testing
Power Map Engineering	Barmer	220kV VLF testing
PGCIL	Pavagada	220kV HV testing
L&T	Vizag	220kV HV & PD Testing
Tan Transco	Chennai	220kV HV & Burn out test
Velan Infra	Alangulam	110kV Tan delta testing

## Testing Experiences

### 220kV XLPE Cable - Bhilai

- Insulation damage during sheath testing by inexperienced person

### 220kV XLPE Cable - Hyderabad

- Multiple failures at 3 different joints in same cable length, one after another

### 132kV XLPE Cable - Tangedco

- Burn out using ACRF. 3 times injection lowered breakdown vtg from 75kV to 9kV





## Available Resources

AC Resonant test system	:	400kV 10A 300kV 40A 300kV 60A 230kV 120A*
Insulation Resistance tester	:	10kV
DC High Voltage test set	:	120kV 20mA
3-ph Variable Autotransformer	:	150A
Contact resistance measurement kit	:	200A
Very Low Frequency (VLF) test kit with Tan-Delta measurement	:	28kVp, 60kVp
Line Impedance measurement kit	:	20mΩ – 5kΩ
Phase sequence identification kit	:	+/- 10, 20, 30 V
Clamp-meter, Multimeter, etc.	:	300A, 1000V
UHF PD measurement kit with HFCT	:	0.3 to 2.1 GHz
Power Analyzer	:	1000V, 30A, 3-Ph



***Most importantly, a team of experienced engineers & years of expertise in cable testing domain***

### VLF Test kit for LV / MV cable testing



VLF testing of solid dielectric cable is supported in IEC60502 (up to 35kV) and in IEEE 400.2 (up to 69 kV).

Acceptance test voltage are generally 2.5-3 times the line to ground system voltage .

VLF test should last between 15 and 60 minutes with a recommended minimum duration of 15 minutes.

***We are the only company having highest capacity (27MVar) on-site HV test system in India, for HV / EHV Power Frequency cable testing from 66kV to 400kV***



## Head Office

---

Block C, Anand Techno IT Park,  
Ambad MIDC, Nashik - 422 010,  
Maharashtra, India.

## Delhi Office

---

BHive 11, Office B6, B-2/11,  
Mohan Co-op Indl Estate,  
Badarpur, New Delhi – 110 044, India.

## Middle-East Office

---

PO Box 108479, Al Ghait Tower,  
Hamdan Street,  
Abu Dhabi, UAE.



+91 98237 26467  
info@samgor.in  
www.samgor.in

