

NGTS 3.2.7

Issue 1

September 92



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**National Grid
Technical
Specification**

**NGTS 3.2.7
Issue 1
September 1992**

**Bushings for the
National Grid System**

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Authorised for Issue by:

A handwritten signature in black ink, appearing to read "M B Humphries". The signature is written in a cursive, flowing style.

**M B Humphries
General Manager
Technology and Science Division**

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BUSHINGS FOR THE NATIONAL GRID SYSTEM

FOREWORD

This Specification defines the functional requirements for bushings of voltage rating 1000 V to a maximum of 420 kV for use on the National Grid Company (NGC) Transmission System. It supports the more general conditions defined in the documents NGTS 1, NGTS 2.2 and NGTS 2.3.

1 SCOPE

This is a functional specification for outdoor/indoor bushings for use in NGC substations.

2 REFERENCES

This document makes reference to, or must be read in conjunction with:

IEC 137 (BS 223)	Bushings for Alternating Voltages Above 1000 V
IEC 255-0-20	Contact Performance of Electrical Relays
IEC 517	Gas Insulated Metal Enclosed Switchgear for Rated Voltages of 72.5 kV and Above
NGTS 1	Overview, National Grid System
NGTS 2.1	Substations
NGTS 2.2	Switchgear for the National Grid System
NGTS 2.3	Transformers and Reactors for use on 132, 275 and 400 kV Systems
NGTS 2.6	Protection
NGTS 3.3.3	Co-ordinating Gaps

3 GENERAL REQUIREMENTS

In addition to the requirements of NGTS 1, NGTS 2.2 and NGTS 2.3, the following clauses apply:

3.1 Requirements For All Bushings

3.1.1 Bushings shall be designed for a minimum service life of 40 years as detailed in NGTS 2.2 clause 3.1.1.

3.1.2 Bushings shall comply with IEC 137 (BS 223).

3.1.3 External porcelain insulation and insulation co-ordination shall be in accordance with NGTS 2.2.

3.1.4 Bushings of the capacitance graded type shall be provided with a test tap as defined by clause 2.33 of IEC 137 (BS 223).

3.1.5 The continuous current rating of the bushing shall be selected so as to be appropriate to the associated equipment including overload ratings as required.

3.2 Additional Requirements for Transformer Bushings

3.2.1 The oil end of transformer bushings shall be suitable for accommodating current transformers in accordance with NGTS 2.3 clause 3.10.

3.2.2 Oil/SF₆ transformer bushings (completely immersed type), one end of which is intended to be immersed in SF₆ to form a direct GIS connection shall be selected to facilitate interchangeability of transformer spares in accordance with NGTS 2.3 clause 3.7.3.

3.2.3 Oil/SF₆ transformer bushings shall be provided with an insulating spacer between the bushing flange and the transformer connection to prevent circulating currents between the GIS busbar trunking and the transformer tank to the substation earthing system.

3.2.4 Oil/SF₆ transformer bushings of the oil impregnated paper type shall be fitted with a suitable pressure gauge and switch to give indication and alarm facilities in the event of:

- (i) Leakage of SF₆ gas from the GIS enclosure into the self-contained bushing oil
- (ii) Loss of oil from the bushing.

The switch (or switches) shall be capable of giving an alarm at abnormally low or abnormally high operating pressures of the internal bushing oil. The switches shall comply with IEC 255-0-20, Category III. Alarm pressure settings shall be appropriate to the bushing design and application.

3.2.5 Oil/SF₆ transformer bushings shall comply with the operating temperature requirements specified in IEC 517.

3.2.6 Oil/air transformer bushings which are intended for operation with phase isolated busbar systems shall be suitable for operation at a maximum air temperature of 75°C and a maximum oil temperature of 80°C.

3.2.7 Provision shall be made for co-ordinating gaps in accordance with NGTS 3.3.3.

4 PERFORMANCE REQUIREMENTS

4.1 Requirements for All Bushings

All bushings shall comply with the requirements of IEC 137 (BS 223) for the relevant rating requirements detailed in NGTS 1, NGTS 2.2 and NGTS 2.3.

4.2 Additional Requirement for Transformer Bushings

The assembled insulating joint of clause 3.2.3 shall be capable of withstanding a power frequency voltage of 2.5 kV rms for 1 minute.

5 TESTING REQUIREMENTS

5.1 Type Tests

5.1.1 Bushings shall be type tested to IEC 137. The following tests are also required:-

(i) For bushings of the capacitance graded type, chopped lightning impulse tests to IEC 137 clause 22 (note 2) shall be performed as follows:-

(a) Transformer bushings of rated voltage 132 kV and above shall be subjected to 5 impulses of negative polarity. The peak voltage level shall be 115% of the full wave value. The time to sparkover of the chopping gap shall be between 2 μs and 6 μs.

(b) Bushings for gas insulated switchgear shall be subjected to 5 impulses of negative polarity, chopping of the impulse being made by means of an air insulated gap. The peak voltage level shall be 100% of the full wave value. The time to sparkover of the chopping gap shall be between 1 μ s and 6 μ s.

(c) Bushings for gas insulated switchgear shall be subjected to 30 impulses of both positive and negative polarities with a chopping gap immersed in SF₆ and located adjacent to the SF₆ end of the bushing. The peak voltage level shall be 60% of the full wave value. The time to sparkover of the chopping gap shall be between 1 μ s and 6 μ s.

(ii) Temperature Rise - The thermal time constants of the bushing shall be determined on both rising and falling temperature.

5.1.2 Representative routine test measurements shall be made before and after all type tests. No significant changes between these results shall be permitted.

5.2 Routine Tests

All bushings shall be routine tested to IEC 137.

6 APPROVAL PROCEDURE

The requirements for bushing approval are detailed in NGTS 2.2. Where required, Appendix A of this document shall be completed by the supplier in support of approval. Approval of bushings shall be limited to tests which demonstrate compliance with this specification and such approval does not relieve the contractor from his responsibility with respect to the correct selection and application of bushings in the primary equipment.

APPENDIX A

INFORMATION TO BE SUPPLIED BY THE TENDERER

A1 GENERAL DETAILS

1	Manufacturer	
2	Type reference Drawing reference (s)	
3	Description of bushing	
4	Production commencement date	
5	Type test report number (s)	
6	Test specification (s)	
7	Category and date of approval	

A2 GENERAL TECHNICAL DATA

1	Nominal voltage (U_N)	kV	
	Maximum operating voltage (U_m)	kV	
2	Rated current (I_N)	A	
3	Rated thermal short-time current (I_{th})	kA	
	Rated dynamic current (I_d)	kA	
4	Capacitance	pF	
	Dielectric dissipation factor ($\tan \delta$)		

(b) Bushings for gas insulated switchgear shall be subjected to 5 impulses of negative polarity, chopping of the impulse being made by means of an air insulated gap. The peak voltage level shall be 100% of the full wave value. The time to sparkover of the chopping gap shall be between 1 μ s and 6 μ s.

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3	Rated thermal short-time current (I_{th})	kA	
	Rated dynamic current (I_d)	kA	
4	Capacitance	pF	
	Dielectric dissipation factor ($\tan \delta$)		

5	Maximum angle of mounting (to vertical)	°	
6	Power frequency withstand voltage (dry/wet)	kV	
	Lightning impulse withstand voltage, full wave	kV	
	Lightning impulse withstand voltage, chopped wave	kV	
	Switching impulse withstand voltage (dry/wet)	kV	
7	Admissible static load	kN	
	Admissible dynamic load	kN	
	Cantilever test load	kN	
	Porcelain breaking strength	kNm	
8	Insulation test tap (Yes/No)		
	Test tap power frequency withstand voltage	kV	
9	Porcelain insulator creepage distance	mm	
	Porcelain insulator arcing distance	mm	
10	Primary insulation:		
	(a) Insulating medium		
	(b) Quantity	m ³	
	(c) Type of insulating oil (if applicable)		
	(d) Gas insulation (if applicable)		
	(i) Maximum operating pressure	MPa	
	(ii) Minimum operating pressure	MPa	
(iii) Normal operating pressure	MPa		
(iv) Leakage rate	torr l/s		
(v) Max permissible dew point temperature	°C		
11	Total weight	kg	



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	Lightning impulse withstand voltage, full wave	kV	
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7	Admissible static load	kN	
	Admissible dynamic load	kN	
	Cantilever test load	kN	
	Porcelain breaking strength	kNm	
8	Insulation test tap (Yes/No)		
	Test tap power frequency withstand voltage	kV	
9	Porcelain insulator creepage distance	mm	
	Porcelain insulator arcing distance	mm	
10	Primary insulation:		
	(a) Insulating medium		
	(b) Quantity	m ³	
	(c) Type of insulating oil (if applicable)		
	(d) Gas insulation (if applicable)		
	(i) Maximum operating pressure	MPa	
	(ii) Minimum operating pressure	MPa	
	(iii) Normal operating pressure	MPa	
(iv) Leakage rate	torr l/s		
(v) Max permissible dew point temperature	°C		
11	Total weight	kg	

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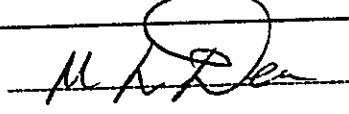
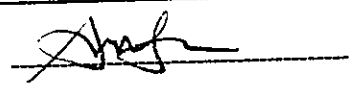
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