

Australian Standard[®]

Tap-changers

Part 2: Application guide



This Australian Standard® was prepared by Committee EL-008, Power Transformers. It was approved on behalf of the Council of Standards Australia on 29 November 2006. This Standard was published on 21 December 2006.

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 - Australian Chamber of Commerce and Industry
 - Australian Electrical and Electronic Manufacturers Association
 - Australian Institute of Petroleum
 - Energy Networks Association
 - Engineers Australia
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-

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STANDARDS AUSTRALIA

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OF

AS 60214.2—2006

Tap-changers

Part 2: Application guide

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NOTES

Australian Standard[®]

Tap-changers

Part 2: Application guide

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PREFACE

This Standard was prepared by the Standards Australia Committee EL-008, Power Transformers to supersede AS 2326.2—1991. *On-load tap-changers*, Part 2: *Application guide* on publication.

The objective of this Standard is to provide assistance for designers and users in the selection of tap-changers and to provide information about the different types of tap-changers.

This Standard has been reproduced from IEC 60214-2, Ed. 1.0 (2004), *Tap-changers—Part 2: Application guide*. An explanatory Note has been added to Clause 6.2.15. This Note is identified by shading (example).

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CONTENTS

	<i>Page</i>
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Symbols and abbreviations	2
5 Types of tap-changer	2
5.1 General.....	2
5.2 On-load tap-changers	2
5.2.1 General.....	2
5.2.2 Resistor-type on-load tap-changers.....	2
5.2.3 Reactor-type on-load tap-changers	7
5.3 Off-circuit tap-changers.....	9
5.4 Liquid-immersed tap-changers	9
5.4.1 General.....	9
5.4.2 Liquid immersed on-load tap-changers.....	9
5.4.3 Liquid-immersed off-circuit tap-changers.....	10
5.5 Dry-type tap-changers.....	10
5.6 Other types.....	11
5.6.1 General.....	11
5.6.2 Electronic tap-changers	11
5.7 Protective devices.....	12
5.7.1 General.....	12
5.7.2 Increase of pressure within diverter or selector switch liquid compartments	12
5.7.3 Switching under excessive overload or short circuit conditions.....	14
5.7.4 Excessive liquid temperatures.....	14
5.7.5 Increase of pressure within separate tap selector liquid compartments	14
5.7.6 Tap-change supervisory circuit and phase unbalance protection	15
6 Selection of tap-changers	15
6.1 General.....	15
6.2 On-load tap-changers	16
6.2.1 Insulation level.....	16
6.2.2 Current and step voltage.....	16
6.2.3 Breaking capacity.....	17
6.2.4 Short-circuit current	17
6.2.5 Number of tap positions	17
6.2.6 Change-over selector recovery voltages.....	17
6.2.7 Coarse fine regulation leakage induction switching (resistor type tap- changers only)	18
6.2.8 Transformers and phases out-of-step condition.....	18
6.2.9 Enforced current splitting (paralleled selectors/diverters on same phase).....	18
6.2.10 On-load tap-changers for application in special transformers with non-sinusoidal currents (for example, HVDC converter transformers).....	19
6.2.11 On-load tap-changers for phase-shifting transformers (PST)	19
6.2.12 Contact life.....	20
6.2.13 Tap-changer mechanical life	

6.2.14	Motor-drive mechanism	20
6.2.15	Pressure and vacuum tests	20
6.2.16	Low-temperature conditions	20
6.2.17	Continuous operation	21
6.2.18	Preventive autotransformer circuit (reactor type tap-changers only)	21
6.3	Off-circuit tap-changers.....	21
6.3.1	Insulation level.....	21
6.3.2	Rated through-current	22
6.3.3	Overload current	22
6.3.4	Rated step voltage	22
6.3.5	Short-circuit current	22
6.3.6	Paralleling off-circuit tap-changers	22
6.3.7	Number of tap positions	22
6.3.8	Mechanical life	22
6.3.9	Motor-drive mechanism.....	22
7	Location of liquid immersed tap-changers	23
7.1	Tap selectors	23
7.2	Diverter and selector switches	23
8	Fittings.....	23
8.1	Valves, air release vents and liquid-sampling devices	23
8.2	Liquid level gauges	23
8.3	Low liquid level alarms.....	23
8.4	Nameplate and other plates	24
8.5	Devices to aid maintenance	24
8.6	Dehydrating breathers	24
9	Field service (operation, maintenance and monitoring).....	24
9.1	Operation.....	24
9.1.1	Parallel operation	24
9.1.2	Contact erosion and liquid contamination	24
9.1.3	Overheating of selector contacts when operating on fixed tap position	25
9.1.4	Discharges during the operation of changeover selectors.....	25
9.2	Maintenance	26
9.2.1	Liquid replacement.....	26
9.2.2	Contact resistance measurement	26
9.3	Monitoring in service.....	26
9.3.1	DGA of mineral oil.....	26
9.3.2	Other liquid testing	26
9.3.3	Non-invasive monitoring techniques	27
9.3.4	Invasive monitoring techniques	27
9.3.5	Commercial monitoring systems.....	27
10	Information to be provided by the transformer manufacturer.....	27
10.1	Information required at the enquiry or order stage for an on-load tap-changer.....	27
10.2	Information required with enquiry or order for off-circuit tap-changers	29
10.2.1	General	29
10.2.2	Only for rack or slide-type design off-circuit tap-changer	30
10.2.3	Small off-circuit tap-changers.....	30
10.3	Documentation.....	30
11	Protection and safety	30
11.1	Protection	30
11.2	Safety aspects	30

11.2.1 Gases	30
11.2.2 Operation of an on-load tap-changer	30
11.2.3 Manual operation of an off-circuit tap-changer.....	31
11.2.4 Pressure-relief devices.....	31
11.3 Immersing medium.....	31

Figure 1 – External separate selector and diverter compartments (for mounting on the end or side of the transformer)	3
--	---

Figure 2 – External mounted selector switch tap-changer (for mounting on the end or side of the transformer)	4
--	---

Figure 3 – External mounted in-tank with separate barrier board	5
---	---

Figure 4 – In-tank separate selector and diverter switch	6
--	---

Figure 5 – In-tank selector switch tap-changer	7
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INTRODUCTION

The recommendations in this application guide represent advice to the tap-changer manufacturer and purchaser.

It is stressed that the responsibility for the correct application of the fully assembled tap-changers in connection with the transformer lies with the manufacturer of the transformer.

STANDARDS AUSTRALIA

Australian Standard

Tap-changers
Part 2: Application guide

Any table, figure or text of the international standard that is struck through is not part of this standard. Any Australian/New Zealand table, figure or text that is added is part of this standard and is identified by shading.

1 Scope

This part of IEC 60214 is intended to assist in the selection of tap-changers designed in accordance with IEC 60214-1 for use in conjunction with the tapped windings of transformers or reactors. It is also intended to assist in understanding the various types of tap-changers and their associated equipment available. The application guide covers on-load tap-changers (resistor and reactor types) and off-circuit tap-changers.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 60076-1:1993, *Power transformers – Part 1: General* —
Amendment 1(1999)¹~~

AS 60076.1, *Power transformers, Part 1: General*

IEC 60076-3:2000, *Power transformers – Part 3: Insulation levels, dielectric tests and external clearances in air*

IEC 60076-5:2000, *Power transformers – Part 5: Ability to withstand short circuit*

~~IEC 60076-11:2004, *Power transformers – Part 11: Dry-type transformers*~~

AS 60076.11, *Power transformers, Part 11: Dry-type transformers*

~~IEC 60214-1:2003, *Tap-changers – Part 1: Performance requirements and test methods*~~

AS 60214.1, *Tap-changers, Part 1: Performance requirements and test methods*

IEC 60296:2003, *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*

~~IEC 60354:1991, *Loading guide for oil-immersed power transformers*~~

AS 2374.7, *Power transformers, Part 7: Loading guide for oil-immersed power transformers*

¹ ~~There exists a consolidated edition 2.1 (2000) that includes edition 2.0 and its amendment.~~
www.standards.org.au

IEC 60599:1999, *Mineral oil-impregnated electrical equipment in service – Guide to the interpretation of dissolved and free gases analysis*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60214-1 apply.

4 Symbols and abbreviations

DGA Dissolved gas analysis

HVDC High-voltage direct current

PST Phase-shifting transformer

5 Types of tap-changer

5.1 General

Tap-changers are devices that will vary the turns ratio of a transformer and hence regulate the voltages of that transformer. Tap-changers that can perform this operation can broadly be divided into two fundamental types as follows:

- on-load tap-changers;
- off-circuit tap-changers.

5.2 On-load tap-changers

5.2.1 General

The on-load tap-changer is designed to change tap position and hence vary the turns ratio of the transformer whilst it is both energized and on load. It performs this function without any interruption of the supply. This is achieved with mechanically operated devices that will select the various tap positions and switch the load currents and step voltages.

On-load tap-changing can be employed by using various switching principles.

The two most common switching principles are:

- high-speed transition resistor type switching; and
- transition reactor (preventive autotransformer) type switching.

5.2.2 Resistor-type on-load tap-changers

5.2.2.1 General

Resistor-type on-load tap-changers can be divided into two distinctive types:

- external out-of-tank tap-changers (air environment), as described in 5.2.2.2;
- in-tank tap-changers (liquid environment), as described in 5.2.2.3.

The operating sequences of the different resistor type tap-changers are shown in IEC 60214-1, Table A.1.

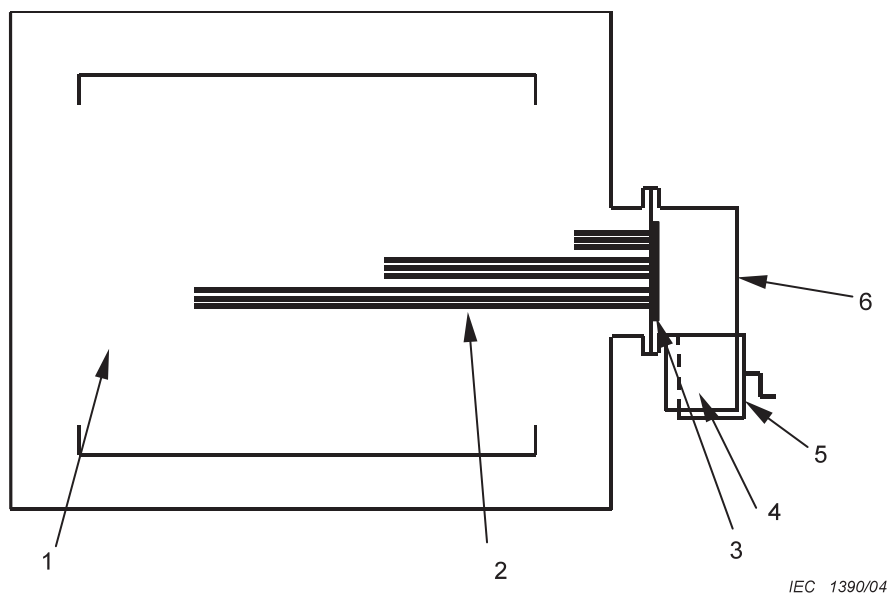
5.2.2.2 External resistor-type on-load tap-changers

5.2.2.2.1 General

These tap-changers are self-contained in their own tanks (except dry-type tap-changers) and mounted on the side or end of the transformer. Four types of tap-changer arrangements are considered, all employing the high-speed transition resistor switching principle.

5.2.2.2.2 External separate selector and diverter compartments

This type of tap-changer has two separate compartments, one for the pre-selection of the transformer taps called the tap selector compartment and the other for the on-load switching called the diverter switch compartment. The two compartments have separate liquid chambers and both are isolated from the liquid in the main transformer tank, although the tap selector compartment and the main tank may share the same conservator. The taps from the transformer are taken to the selector contacts through a liquid-tight barrier board. The tap selector compartment contains clean liquid enabling it to withstand the required higher voltages across the contacts. The diverter switch compartment isolates the carbonized liquid and gases. As can be seen from Figure 1, the tap-changer bolts on the side or end of the transformer. This arrangement is generally used for the larger MVA transformers.



Key

- | | | |
|------------------------|--------------------------------|----------------------------|
| 1 Transformer windings | 3 Liquid and gas tight barrier | 5 Drive mechanism |
| 2 Tap leads | 4 Diverter switch compartment | 6 Tap selector compartment |

**Figure 1 – External separate selector and diverter compartments
(for mounting on the end or side of the transformer)**

The switching can be by arc extinction in the liquid or by vacuum interrupters/power electronics.

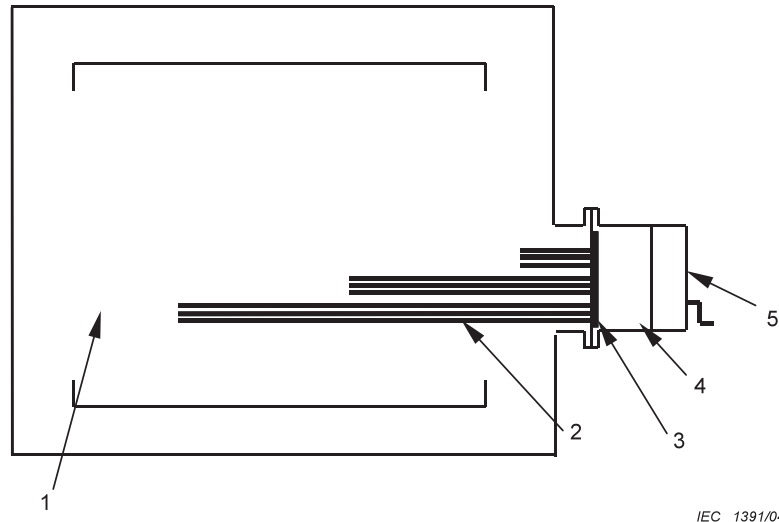
5.2.2.2.3 External mounted separate selector and diverter in single compartment

This type of tap-changer uses separate selector and diverter contact systems in a similar way to the double compartment arrangement in 5.2.2.2.2 but combines them in a single compartment.

The switching can be by arc extinction in the liquid or by vacuum interrupters/power electronics.

5.2.2.2.4 External mounted selector switch tap-changers

Selector switch tap-changers are contained in a single compartment, normally bolted on the side or the end of the transformer (see Figure 2). Again, the transformer taps are taken to the tap-changer contacts through a liquid-tight barrier board. The selection and switching are carried out using common contacts in the same liquid and chamber. These tap-changers tend to be used on the smaller MVA and voltage class transformers.



Key

- | | | |
|------------------------|--------------------------------|-------------------|
| 1 Transformer windings | 3 Liquid and gas tight barrier | 5 Drive mechanism |
| 2 Tap leads | 4 Selector switch compartment | |

**Figure 2 – External mounted selector switch tap-changer
(for mounting on the end or side of the transformer)**

5.2.2.2.5 External mounted in-tank with separate barrier board

By using an in-tank tap-changer in a separate pocket with a liquid-tight barrier board between the tap-changer and the transformer, it effectively becomes a separate bolt-on type of tap-changer. The liquid from the selector is totally isolated from the transformer although the selector compartment and the main tank may share the same conservator.

Figure 3 shows how this arrangement works and gives all the advantages of the separate tank tap-changer for the higher voltage classes.