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Australian STANDARD®

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Quantum technology — Reference guide to quantum computing



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How to read this Standard

This page explains the meaning of the language and structure of this Standard.

Refer to Standards Australia's Standardisation Guide 006 for more details about drafting rules.

Australian and Australian/New Zealand Standards are voluntary unless they are referenced in legislation or called up in contracts.

Requirements

To conform to a Standard, all requirements in the Standard need to be met.

A requirement is any statement in the Standard which uses the word "shall".

Recommendations, permissions and possibilities

The following words are commonly used in Standards, but statements using them do not have to be followed to conform to the Standard:

(a) "should" means that something is recommended.

(b) "may" means that something is permitted.

(c) "can" means that something is possible.

Structure of Standards

A Standard always has the following parts:

(i) The Preface states who developed the Standard, what the Standard is aiming to do, and how it relates to other documents.

(ii) The Scope states what the Standard is about, what it covers and what it does not cover.

(iii) The Normative references clause lists other documents that are referenced in the Standard as part of requirements.

(iv) The Terms and definitions clause defines important terms to help with understanding the Standard.

A Standard may also include other parts, such as the following:

(1) A normative appendix sets additional requirements that need to be conformed to.

(2) An informative appendix provides additional information or guidance. They usually do not contain requirements. If an informative appendix does contain requirements, the Standard will explain when those requirements apply.

(3) A Bibliography lists documents referenced in the Standard but not as part of requirements.

Many Standards include notes. Notes provide recommendations and/or guidance only. They never contain requirements.

Preface

This Standard was prepared by the Standards Australia Committee PC-006, Quantum Technology.

The objective of this document is to specify a hierarchical description of concepts in the field of quantum computing and provide guidance on preparing guidelines for due diligence related activities.

This document aims to facilitate accurate, aligned and realistic engagement between quantum businesses and quantum industry stakeholders. It aims to foster long-term investment relationships with quantum businesses through improved alignment of client-provider expectations, realistic timelines and benchmarking for target outcomes, and improved understanding of technology capabilities.

This document was developed with the support of the Department of Industry, Science and Resources with the goal of this national publication being adopted as an international standard or equivalent.

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Introduction

The quantum technology industry is experiencing rapid expansion across the world. Both private equity investment and sovereign investment into quantum computing, quantum communications and quantum sensing systems have seen almost exponential growth in the past 10 years. Australia has a particularly rich history in these fields, with federal and state government investment stretching back to the late 1990s, and new investment in the Australian quantum industry by both government and private funders is only growing.

NOTE 1 For further information, refer to Standards Australia's 2023 research reports *At the Intersection Between Scalable Quantum Computing and Standardization* and *At the Intersection between Quantum Communication Networks and Standardization*.

Amid the ongoing development of quantum technology initiatives, various stakeholders are faced with the challenge of navigating the complexities inherent in this emerging field. Gaining a comprehensive understanding of the present state of quantum technology, its anticipated evolution over the next 10 or 20 years, the interconnectedness between its core technologies (computing, communications and sensing), its utility across diverse domains, and the expected timeline for economic benefits, will be essential — both for informing effective funding and investment activities, and for supporting advancements in both the public and private sectors of the quantum industry in Australia.

A significant challenge facing this goal is the conceptual complexity of many quantum technology applications, and the "quantum mystique" which often shrouds their operating principles and makes the quantum industry especially vulnerable to hype. As a result, those who are motivated to invest in quantum technologies either by need or interest often have limited understanding of the concepts needed to target their investment sensibly, conduct necessary due diligence, or assess project success. This creates a substantial quality assurance risk for Australia's quantum industry, ultimately also feeding into a significant risk of loss of public licence.

NOTE 2 For further information, refer to Standards Australia's 2023 research report *Quantum Education, Training and Literacy: Laying Good Foundations for the Future Quantum Industry*.

The aim of this document is to provide information and guidance for quantum industry stakeholders who are not quantum computing domain experts to better navigate client-provider transactions with quantum businesses. These elements form a framework that aims to empower a diverse range of stakeholders within the Australian quantum landscape, from government agencies and policy makers to research institutions, industry players, and investors. Specifically, the framework is designed to support stakeholders to —

(a) translate high-level strategic goals into robust, evidence-based, and expert-informed quantitative targets, terms of references, deliverables, and success metrics;

(b) identify how their strategic goals connect to fundamental research and development in both quantum hardware and software; and

(c) align expectations and foster clear communication across disparate stakeholders, from research and educational institutions to industry and end-users.

This document focuses on the key quantum technology pillar of quantum computing.

Section 2 provides a hierarchical classification of conceptual areas within quantum computing (a Concept Hierarchy). This structured classification both elucidates the broad range of topics that lie within and are relevant to quantum computing and describes how they are (or are not) related to each other. This provides quantum industry stakeholders with a high-level map to the field and presents the connections between different domains of activity and capability within the field. This hierarchy also underpins the classification of subconcepts that are included or not included under any concept within it.

For concepts within the top three tiers of the Concept Hierarchy, this document also provides high-level, accessible, informative Concept Summaries. These can serve as a reference for or a brief introduction into key concepts within quantum computing, or as resource text to support quantum industry stakeholders

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to assemble accurate, expert-informed background summaries or briefing documents that may be the basis for funding and investment guidelines or other due diligence related activities.

Section 3 provides guidance on how to shape a “guidelines” document to most suitably guide and govern a prospective client-provider process in which a stakeholder (the “client”) is seeking to approach quantum computing researchers or businesses (potential “providers”) to deliver an outcome of interest. This guidance provides recommendations regarding —

(i) clearly identified, realistic objectives;

(ii) relevant topical scope;

(iii) appropriate and realistic timelines;

(iv) relevant, proportionate and concrete success benchmarks;

(v) robust consultation with relevant domain experts; and

(vi) embedded expertise for coordination.

This guidance is designed to build on and incorporate information from the Concept Hierarchy classification and informative Concept Summaries from Section 2.

While this document focuses on quantum computing, the framework is designed to be applicable across other quantum technology pillars, including quantum communications and quantum sensing.

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