**NZQA**

**Approved**

Achievement standard: 91169 Version 2

Standard title: Demonstrate understanding of physics relevant to a selected context

Level: 2

Credits: 3

Resource title: Fibre optics for high speed broadband

Resource reference: Physics VP-2.2 v2

Vocational pathway: Manufacturing and Technology

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| Quality assurance status | These materials have been quality assured by NZQA.  NZQA Approved number A-A-02-2015-91169-02-8214 |
| Authenticity of evidence | Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material.  Using this assessment resource without modification may mean that learners’ work is not authentic. Assessors/ educators may need to change figures, measurements or data sources or set a different context or topic to be investigated or a different text to read or perform. |

Vocational Pathway Assessment Resource

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Learner instructions

# Introduction

This assessment activity requires you to demonstrate your understanding of how physics relates to fibre optics.

You are going to be assessed on how you demonstrate comprehensive understanding of physics relevant to the context of fibre optics.

The following instructions provide you with a way to structure your work so you can demonstrate what you have learnt and achieve success in this standard.

Assessor/educator note: It is expected that the assessor/educator will read the learner instructions and modify them if necessary to suit their learners.

# Task

The New Zealand government wants to introduce ultra-fast internet connections for all schools and households by 2015. It intends to do this by installing fibre optic cables. Resource A describes fibre optics, which is the latest technology used by the telecommunications industry.

You are to research the physics behind fibre optic cables.

Working independently, research the physics of fibre optics. You may like to look at the websites listed in Resource B. Then use your research information to prepare a report in which you use physics principles to explain how fibre optics works.

Your report could include these ideas:

* the materials that are used to construct fibre optic cables and why these are chosen
* the physics of how signals are transmitted along fibre optic cables, such as internal reflection, refraction, losses of energy
* the special properties of laser light that make it useful for fibre optic communication
* worked examples that demonstrate how internal reflection for fibre optics works
* worked examples that show the physics of how laser light can be used to transmit so much data along a single glass fibre
* comparing and contrasting the physics and advantages of using fibre optics with other forms of transmission such as wire cable or satellites for long distance communication.

All sources of information, images, diagrams, and data must be acknowledged and referenced in a format that allows them to be easily traced.

Decide on the format of your report in consultation with your assessor/educator. This could be:

* a written report (with illustrations, diagrams, and graphs, if appropriate)
* a poster (with annotations or supporting notes)
* an oral presentation (with written references)
* a project booklet
* multimedia (for example a video or web page with embedded video, graphics, and text).

You will be assessed on how well you describe the relevant physics and integrate this into the context of fibre optics. In your report, you should aim to elaborate, justify, evaluate, compare and contrast, or analyse the physics underpinning fibre optics.

# Resource A

## What is fibre optics?

Fibre optics (optical fibres) consist of long, thin strands of very pure glass with the diameter of a human hair. These are arranged in bundles called optical cables and used to transmit light signals over long distances.

If you look closely at a single optical fibre you will see that it has the following parts:

* a core, the thin glass centre that the light travels through
* cladding, the outer optical material surrounding the core
* buffer coating, the plastic exterior that protects the fibre from damage and moisture.

Hundreds of these optical fibres are arranged in bundles called optical cables. The bundles are protected by the cable's outer covering, called a jacket.

# Resource B

Useful websites**:**

<http://www.howstuffworks.com/fiber-optic.htm>

<http://www.britannica.com/EBchecked/topic/205837/fibre-optics>

<http://uw.physics.wisc.edu/~timbie/P325/Wiseman_fiber_optics.pdf>

[http://www.physicsplanet.com/articles/fibre-optics](http://www.physicsplanet.com/articles/fiber-optics)

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Assessor/Educator guidelines

# Introduction

The following guidelines are supplied to enable assessors/educators to carry out valid and consistent assessment using this internal assessment resource.

As with all assessment resources, education providers will need to follow their own quality control processes. Assessors/educators must manage authenticity for any assessment from a public source, because learners may have access to the assessment schedule or exemplar material. Using this assessment resource without modification may mean that learners' work is not authentic. The assessor/educator may need to change figures, measurements or data sources or set a different context or topic. Assessors/educators need to consider the local context in which learning is taking place and its relevance for learners.

Assessors/educators need to be very familiar with the outcome being assessed by the achievement standard. The achievement criteria and the explanatory notes contain information, definitions, and requirements that are crucial when interpreting the standard and assessing learners against it.

# Context/setting

This activity requires learners to undertake research and prepare a report demonstrating their comprehensive understanding of the physics of fibre optics.

# Conditions

Confirm the format of the report with learners, for example:

* a written report (with illustrations, diagrams, and graphs, if appropriate)
* a poster (with annotations or supporting notes)
* an oral presentation (with written references)
* a project booklet
* multimedia (for example a video or web page with embedded video, graphics, and text).

# Resource requirements

Learners will require access to information sources, including the internet.

# Additional information

None.

# Assessment schedule: Physics 91169 – Fibre optics for high speed broadband

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| Evidence/Judgements for Achievement | Evidence/Judgements for Achievement with Merit | Evidence/Judgements for Achievement with Excellence |
| The learner demonstrates understanding of physics relevant to a selected context by:   * providing the characteristics of, or an account of, the physics related to fibre optic cables   For example, the learner:   * + describes light as electromagnetic energy   + describes the special nature of laser light and why this makes it useful for fibre optic communications   + draws diagrams as part of an explanation for internal reflection   + describes how analogue signals are converted into data signals   + describes the materials and properties used for fibre optic cables.   *The above expected learner responses are indicative only and relate to just part of what is required.* | The learner demonstrates in-depth understanding of physics relevant to a selected context by:   * providing the characteristics of, or an account of, the physics related to fibre optic cables * providing reasons as to how and/or why the physics applies to fibre optic cables   For example, the learner:   * + provides worked examples to show why certain materials are selected as the coating for the glass fibre to optimise total internal reflection   + explains with the use of diagrams what happens to the quality of the light signal as it travels along an optic fibre   + explains physics ideas that demonstrate how so much data can be transmitted along a single fibre optic cable.   *The above expected learner responses are indicative only and relate to just part of what is required.* | The learner demonstrates comprehensive understanding of physics relevant to a selected context by:   * providing the characteristics of, or an account of, the physics related to fibre optic cables * elaborating on how and/or why the physics applies to this context * justifying and evaluating why the particular physics is well suited to this context, and/or comparing alternatives   For example, the learner:   * + compares the physics and advantages of fibre optic communication over other methods such as wire cables or satellite transmissions for long distance communication.   *The above expected learner responses are indicative only and relate to just part of what is required.* |

Final grades will be decided using professional judgement based on an examination of the evidence provided against the criteria in the Achievement Standard. Judgements should be holistic, rather than based on a checklist approach.