1. **Introduction**

This article has two main aims. The first is to present a technical word list of a trade, Fabrication (Welding), developed using multiple approaches including written and spoken corpora, consultation with experts, and extensive checking of technical dictionaries, and how a tutor has integrated it into his practice. This work is important because the vocabulary of the trades has not been the subject of much research prior to this study. The second aim is to consider how this technical vocabulary might fit into conceptualisations of knowledge in the trades, in particular, Vaughan, Boone and Eyre’s (2015) *vocational thresholds*.

* 1. ***Background and context***

Over the last 20 years there has been a particular focus in Aotearoa/New Zealand on developing literacy and numeracy for adults. This focus has been partly in response to the Adult Literacy Survey (IALS) of 1996 (OECD, 1997) which suggested that a proportion of the working age population in New Zealand had low literacy levels. A range of strategies have been implemented since this time, including the development of a literacy and numeracy framework, the creation of national literacy testing tools and the benchmarking of learner literacy levels. The NZQA literacy framework consists of the four strands of listening, speaking, reading and writing. Vocabulary is an aspect of literacy that is common to all four literacy strands and one of the benchmarks of literacy is that learners need to achieve involves understanding and using more specialised words. The Tertiary Education Strategy 2014 – 2019 (Ministry of Education and the Ministry of Business, Innovation and Employment, 2014) and the Strengthening Literacy and Numeracy: Theoretical Framework (Tertiary Education Commission, 2009) have influenced the development of language and literacy in vocational and trades training context. Recent research has identified some challenges in vocational literacies (Edwards, Minty and Miller, 2013), and the tensions between the complexities of language and literacy and embedding these into vocational training (Bak & O’Maley, 2015). Although neither of these studies have focused specifically on the specialised words of vocational training, they do offer some insights into the variety and demands of tasks that trainee trades students are faced with (e.g. Edwards, Minty & Miller, 2013).

The present research is part of a project called the Language in the Trades Education (LATTE) project (Parkinson, Coxhead, Demecheleer, Mackay, Matautia, McLaughlin & Tu’amoheloa, 2017). One of the aims of the project was to identify specialised vocabulary in four trades; two in construction (Carpentry and Plumbing) and two in engineering (Fabrication and Automotive Engineering). These four trades are offered at Weltec, a polytechnic in New Zealand, and these courses range from level two foundation type programmes through to level three and four programmes, which are pre-degree. These levels are part of the New Zealand Qualifications Authority (NZQA) (n.d.) framework. Levels 1 and 2 constitute basic introductions to Fabrication, and Levels 3 and 4 are more operational and theoretical.

In this article, we focus on the Fabrication course which is part of the Level 3 New Zealand Certificate in Mechanical Engineering, along with welding and machining. Classes are typically made up of approximately 16 learners, predominantly young male European New Zealanders from a range of educational backgrounds. After completion of this programme, learners typically move onto an apprenticeship programme, where they work in the industry in the day and complete evening and block courses outside of their working hours. Possible careers involving fabrication include welding, fitting and turning, and structural sheet working. A key aspect of learning in this context is the importance of the practical and ‘hands on’ nature of the courses. Trades-based students are practically-oriented learners, as one of the Fabrication tutors, who we will call Seth, put it, “[The] learners are like me, by the time we get through school we just want to use our hands and I don’t mean for writing.” This point is important because learners in the Fabrication course see themselves as students in a trades course and not students in a language course, which means that any language-focused instruction needs to be carefully integrated into the trades programme (McLaughlin & Parkinson, 2018).

It is also important to note that while the research site was New Zealand, the vocabulary of fabrication is not specific to this context. Rather, it is used wherever people in the trades communicate with others in speaking or writing, or when they are reading technical documents. There is diversity in vocational education over the globe (Billett, 2011) from secondary school-based learning through to polytechnic education and apprenticeships. In Tonga, for example, trades education in schools uses English and draws on resources that are published in Australia and New Zealand (Coxhead, Parkinson & Tu’amoheloa, 2017).

1. **Technical vocabulary**

Technical vocabulary has many names, such as specialised or semi-technical vocabulary, depending on the purpose or intent of a researcher. This vocabulary has several features which mark it apart from general vocabulary in English. Firstly, knowing the technical vocabulary of a field and being able to use it appropriately is an indication that someone also understands the content of that field. Content knowledge and specialised lexical knowledge are closely related (Woodward-Kron, 2008). Gamble (2016) divides knowledge in the trades into the categories of *situated* and *formal*. Situated knowledge involves two kinds of knowledge: procedural or ‘how to’ knowledge which is not usually written down; and craft knowledge, which involves visual images. Formal knowledge, on the other hand, involves codified systems which are written down, and scientific knowledge, which focuses on understanding abstract or symbolic principles. Vaughan, Boone and Eyre (2015) (see also Vaughan (2017) propose the concept of *vocational thresholds* which suggests a major shift in a learner’s development as they develop their understandings of their field:

Vocational thresholds are transformational learning experiences that show learner-practitioners the big picture of their field of practice and their role in it. Vocational thresholds help learner-practitioners connect their field’s theory to its practice. Once someone has crossed a vocational threshold, they see their work and its purpose in a new light. They are likely to move to a new level of capability and vocational identity that integrates what they know, what they can do, and how they are as practitioners

Vaughan, Boone and Eyre (2015, p. 2)

Vocational thresholds, according to Vaughan et al. (2015), contain an element of identity for the learner. Technical vocabulary also has a core element of identity, which Parkinson & Mackay (2016, p. 40) refer to as *trades talk*, which they define as “…technical language that reveals the depth of knowledge of the trade of its speakers.” Vaughan et al. (2015) emphasise that vocational thresholds are based in ‘authentic practice’ as opposed to learning in classrooms, and that there may well be numerous thresholds in the journey of a learner/practitioner as knowledge develops. Parkinson, Demelcheleer and Mackay (2017) document changes in the personal and less precise language use in diaries kept by carpentry students to less personal and more precise language use as they develop their professional and mature identities as carpenters. Research which explores exploring apprenticeship and learning in a vocational environment has found that learners build identities in new workplaces (Chan, 2011; 2013; Holmes & Woodhams, 2013). This means that knowing and using the technical vocabulary of a field signals belonging to a group, and this vocabulary, for some learners, could well contribute to or constitute a vocational threshold.

A second feature of technical vocabulary is that it tends to occur mostly in the area of specialisation and people outside the field generally do not know these words (Nation, 2013). In Fabrication, for example, *polyurethane*, *scalars*, *crosspein* and *rutile* are words that might be very familiar to welders but these words are not common outside the field. This means learners need to focus on learning both the content of their course and its technical vocabulary at the same time. Coxhead, Demecheleer and McLaughlin (2016) found that technical vocabulary in carpentry places high demands on learners’ memory and requires attention and concentration, according to student responses in interviews and questionnaires. Students in that study reported that there was a large amount of technical words to learn in carpentry, and they struggled at times with making the connection between how the words sound and their spelling. The combination of large amounts and intense listening in class and on the building site in carpentry courses, as well as new technical vocabulary, was challenging.

Another feature of technical vocabulary is precision in use and meaning. In Aviation English, for example, vocabulary is prescribed and quite tightly controlled. Aviation English consists of particular phraseology and plain English (Moder, 2013), and clear communication is clearly important for safety reasons. Estival (2016, p. 39) gives examples of words which can cause confusion in Aviation English, such as *request*, meaning ‘I should like to know or wish to obtain’ and *require* meaning ‘this is an operational requirement’.

Technical vocabulary is also important because it can make up a large proportion of a technical text. Chung & Nation (2004) compare methods for identifying specialised vocabulary. One of these methods is a semantic rating scale. Chung & Nation (2003) used such a scale to identify and categorise the vocabulary of an Anatomy textbook. The four-point scale began with words that have no specific relationship to the field through to words which only occur in Anatomy and are therefore highly specialised. They found that one word in three in a line of text in the Anatomy textbook was technical (around 30% of the text) and one word in five in an Applied Linguistics text (around 20% of the text) was technical. McLaughlin and Parkinson (2018) found that both Carpentry learners and tutors in Weltec

were keenly aware of the importance of technical vocabulary. Tutors used strategies such as drawing attention to specialised words and aspects of those words that learners need to know, developed and used glossaries.

A final point to make about technical vocabulary is that everyday words can have technical meaning (Coxhead, 2018). Some examples from Fabrication include *line*, *beam*, *blind*, *solution* and *point.* The general meanings of these words are likely to be known by learners, but the technical meaning needs to be learned. These words are kind of a ‘silent menace’ in that they are present in texts but are perhaps not attended to by learners in a way that words which are clearly technical and unknown (for example, *crosspein*) might be. Little is known about technical vocabulary in Fabrication, and this article aims to address this gap in the field.

* 1. ***Technical word lists***

One way to help learners and teachers identify which words might be technical and therefore useful is to develop a technical word list. Nation, Coxhead, Chung and Quero (2016) suggest that specialised word lists can help gauge the size of a technical vocabulary in a field, and support teachers and students in guiding decisions on which words to learn, why, and also, in some cases, how. In the trades, textbooks and learning materials tend to rely on glossaries for identifying technical vocabulary, but in our experience, these glossaries often contain words which do not actually appear in the texts themselves (see also Sinclair & Renouf, 1988), and conversely, words in the texts that may need defining are not always in the published glossaries.

Initially, there was a plan in the LATTE project to develop a trades-based word list, but while there was evidence of lexical overlap between some of the trades in the project, such as Plumbing and Carpentry, it became clear that there was also substantial differences in technical vocabulary as well. Also, learners in these trades tend to focus on their specific courses. The technical word list of Carpentry (Coxhead, Demecheleer & McLaughlin, 2016) contained just over 1,400 words (for example, *timber*, *roof*, *underlay*, and *cleat*), and has supplementary lists of 104 abbreviations and 28 proper nouns. Coxhead and Demecheleer (under review) found that their technical word list of Plumbing contained just over 1460 words and covered over 30% of the words in a written corpus of Plumbing; a similar finding to Chung and Nation (2003) but using a different methodology. The coverage over spoken texts in Plumbing was much lower, at just over 11% (Coxhead & Demecheleer, under review). These findings are important because they suggest that learners need a large amount of vocabulary to learn in their field, particularly for reading. A technical word list in Fabrication might well be a similar size and have similar coverage over texts.

These lists have been translated into Tongan (Coxhead, Parkinson & Tu’amoheloa, 2017). This research revealed five categories in technical vocabulary in Tongan: words with a Tongan equivalent; words which have been Tonganised; English words which are used in Tongan; words which need to be glossed; and words which have one word in Tongan but several synonyms in English. High frequency technical vocabulary are more likely to be Tonganised than low frequency technical vocabulary.

Developing a technical word list of Fabrication based on the texts that students read and what they hear in their classrooms is an important step in identifying the vocabulary of that trade. That said, it is vital that word lists are integrated into curricula, because such tools are only really useful when they are fully used and evaluated. Nation (2016, 131-132) provides a framework for critiquing a word list, using the following key points: focus, purpose, unit of counting, corpus, main word lists, other lists, making the lists, self-criticism, and availability. This framework is used to set out the specifications of the Fabrication word list.

There are four research questions for this study:

Research questions

1. What vocabulary is identified as specific to Fabrication?
2. What is the coverage of the pedagogical Fabrication word list, abbreviation and proper nouns lists over the written and spoken Fabrication corpora?
3. What is the coverage of these lists over academic written texts and fiction texts?
4. How did a Fabrication tutor make use of the technical word list?
5. **Methodology**

A mixed method approach was used for the development of the specialised word list, similar to the other word lists in the LATTE project in Carpentry (Coxhead, Demecheleer & McLaughlin, 2016) and Plumbing (Coxhead & Demelcheleer, under review). A corpus-based analysis of the vocabulary in written texts collected at Weltec was carried out as the first step in the development of the word list. The Fabrication written corpus contains 185570 running words (tokens), and is made up of 17 booklets collected at Weltec from the Level 3 New Zealand Certificate in Mechanical Engineering. The selection criteria for the written analysis drew on Nation’s BNC/COCA (2012; 2016) frequency lists, using Heatley, Nation & Coxhead’s (2002) Range program. The BNC/COCA lists are frequency lists in English, developed using large corpora of British and American English. Items which occurred only in our Fabrication corpus and not in Nation’s lists were kept aside in a ‘Fabrication’ file. Items which occurred in the Fabrication corpus and had word families in Nation’s existing lists were added to the BNC/COCA lists. Examples of such words include *thicknesses* and *workings*, which were added to the word families of *work* and *thick* respectively. Abbreviations (e.g. *GMAW*, *GTAW*), proper nouns (e.g. *Newton*, *Pascal* and *Allen*), and transparent compounds (e.g. *forklift*, *screwdriver*) were added to Nation’s existing lists for these categories of words. Once all the words in the corpus were identified, the process for selecting items for the pedagogical word list of Fabrication began.

A frequency criterion was applied to the selection of items for the list. Words from the BNC/COCA lists had to occur with a frequency of ten or more in the corpus. Items from the Fabrication-only file had to occur four or more times. This lower threshold for Fabrication-only words was applied because these items have a very narrow margin of use. That is, they tend not to occur outside the trades. Other word lists, such as Coxhead’s Academic Word List (AWL) (2000) used range as a selection criterion because texts were gathered to represent academic disciplines. In the present study, the texts were collected in one trade only, and any attempt to divide the corpora into topics within the trade was thwarted by the repetition of topics throughout, such as *health and safety* and *regulations*. Another consideration was that the small corpora would become smaller if they were further divided to take range into account.

To decide whether an everyday word had a technical meaning in Fabrication, a four-step process was used. Firstly, all high frequency words from the most frequent words (the first 3,000 word families) of Nation’s BNC/COCA lists that occurred in the Fabrication written corpus were identified. Second, two experienced teachers of English to Speakers of Other Languages (ESOL) rated all the high frequency words as general or technical. Third, the same items from the list used by the ESOL teachers was given to three Fabrication tutors and they were also asked to decide whether a word was general or specific. Finally, any items that were identified as technical by everyone and that met the selection criteria were kept in the word list. Any items which were identified as general English were not selected for the list. Any items where there was uncertainty were checked in trade dictionaries and in the written Fabrication corpus.

Next, we carried out an analysis of our spoken corpus using the same process outlined above for the written corpus. The spoken corpus contains 19 recordings made over 26 hours, by four Fabrication tutors, and a total of 99,000 running words (Parkinson et al., 2017). Lexical items which met the selection criteria for technicality were added to the list. The written corpus was analysed first because it was ready first.

Finally, we interviewed Seth, a Fabrication tutor, on the ways in which he used the technical word list in his courses at Weltec.

1. **Results and discussion**
   1. ***What vocabulary is identified as specific to Fabrication?***

The pedagogical word list of Fabrication (Appendix A) contains 1079 families and has two supplementary lists; one for abbreviations (Appendix B) and the other for proper nouns (Appendix C). The list is divided into eleven sublists, with Sublist One containing the most frequent 100 word families, Sublist Two has the next most frequent 100 word families and so on. Appendix A is organised by words per family frequency, with each family arranged by its headword. The headword is the most frequent type in the professional writing corpus. If there are word family member with similar frequencies to the headword, they are listed with the headword. For example, *megapascal* and *megapascals* were both selected for the word list, so in the word types list, they are presented together like this: *megapascal(s)*. Other examples include *right-angle(d*), *cylinder(s),* and *tangent/tangential*. Table 1 has the top ten most frequent ‘words’ in the Fabrication list. This approach means that attention is drawn to high frequency specialised vocabulary through the headwords and to the most frequent items within a family group with technical meanings. Note that everyday words such as *work*, *material* and *source* are technical words in this trade.

**Table 1. The 20 most frequent words in the Fabrication word list.**

|  |
| --- |
| Items arranged by frequency |
| welding /weld(-s/-ed/-er/-ability) |
| work(-ing/-er(s)) |
| figure(s) |
| cutting / cutter(s) / cut(s) |
| tool(s) / tooling |
| material(s) |
| machine(s)/-ery/-ing/-ed/-ability |
| source |
| steel(s) |
| centre(s) |

The analysis began with the written corpus, followed by the spoken corpus analysis. The spoken corpus analysis brought 16 items into the word list. They were (Table 2) were added for several reasons. One reason was because words appeared in the spoken corpus but not in the written corpus (for example, *mil*, *helicoil*, and *t-joint*). In other cases, the experience of analysing and categorising the written corpus had sharpened our awareness of technical vocabulary in Fabrication. We therefore looked more closely at items that occurred frequently in the spoken corpus and that had not been identified as technical in the written analysis (e.g. *rule*) or had a low frequency in the written corpus which meant that it did not make the frequency cut off point (e.g. *tack*, *plasma* and *stone*).

**Table 2. Items from the spoken corpus analysis that were added to the Fabrication word list.**

|  |  |  |
| --- | --- | --- |
| Word | Frequency in the spoken corpus | Frequency in the written corpus |
| mil | 173 | 0 |
| tack | 46 | 4 |
| puller | 25 | 1 |
| helicoil | 24 | 0 |
| plasma | 24 | 3 |
| vise (American English) | 24 | 0 (1 = vice, British English) |
| gas-cutting | 22 | 7 |
| stone | 18 | 5 |
| t-joint | 17 | 0 |
| TPI | 16 | 0 |
| turning | 13 | 92 |
| m10 | 12 | XX |
| argoshield | 11 | 0 |
| lock-tight | 11 | 0 |
| rule | 11 | 73 |
| off-center | 10 | 0 |

The abbreviations list contains 57 items (see Appendix B) along with the meanings of these abbreviations, based on extensive corpus and dictionary checking. Table 3 contains some examples of these abbreviations and their meanings. Three abbreviations were added from the spoken corpus: *KPI - King pin inclination*, *MMHG - millimetre of mercury*, and *OTC - an oscilloscope brand*. The proper noun list contains nine items (*Allen, Brinell, Celsius, Kelvin, Newton, Pascal, Pythagoras, Vernier*, and *Weston*). Including these lists of abbreviations and proper nouns is important because these items are also technical in meaning (Coxhead, 2018).

**Table 3. Examples of technical abbreviations in Fabrication.**

|  |  |
| --- | --- |
| Abbreviation | Meaning |
| GMAW | Gas metal arc welding |
| GTAW | Gas tungsten arc welding |
| HAZ | heat affected zone |
| HERA | Heavy Engineering Research Association |
| HSE | Health and Safety in Employment (Act) |
| HSS | High Speed Steel |

Table 6 provides a summary of the specifications of the technical word list of Fabrication, based on Nation’s (2016) evaluation framework.

**Table 6. Specifications for the Fabrication word list.**

|  |  |
| --- | --- |
| Focus | Description of the list |
| Purpose | Technical vocabulary of Fabrication; learners in Fabrication courses at polytechnic; second language learners of English; learners with little technical knowledge of the field |
| Unit of counting | Types |
| Corpus | Written and spoken corpora of Fabrication; both corpora were meticulously checked for errors |
| Main word lists | Types list with headwords based on frequency; hyphenated forms were carefully checked in the corpus and in the results |
| Other lists | List of technical abbreviations; proper noun list |
| Making the list | Mixed-method: corpus-based with checking by experts and referring to the corpus qualitatively, technical dictionaries, and Fabrication sources; there was extensive checking of the lists; only frequency was used; no range. |
| Possible criticisms | No replication of the word list for validation; generalisability; small corpora; range measures were not included because of the small corpus sizes |
| Availability | See Appendix A; contact the first author; a website is being developed for the lists so they will be publicly available |
| Function words | Not included in the list |
| Homoforms | Checked as part of the technical analysis with tutors |

This technical word list contains everyday words which have technical meanings, such as *rule*, *surface*, and *power*, and a number of multi-word units (e.g. *martensite* and *thermosetting*). Word parts such as *over* (for example, *overhead, overload, breakover*), *up* (*upcut*, *buildup*, *cleanup*), *inter* (*intersection*, *interchangeable*), and *pre* (*prefix*, *precaution*) also feature in items in the list. The Fabrication list is smaller than the Plumbing (Coxhead & Demecheleer, under review) and Carpentry (Coxhead et al., 2016) lists, by about 400 words.

* 1. ***What is the coverage of the pedagogical Fabrication word list, abbreviation and proper nouns lists over the written and spoken Fabrication corpora?***

The term ‘coverage’ means what percentage of the words in the texts are in the word lists. To find the answer to this question, the Range programme (Heatley, Nation & Coxhead, 2002) was used. The total coverage of the two corpora by all three technical lists is almost 30.5% for written and nearly 9.2% for spoken (Table 4). The highest coverage of the Fabrication list is over the written corpus at nearly 29%. This is the corpus that the list was developed from. The coverage over the written corpus suggests that around one word in three in a line of text is technical; a similar result to Chung & Nation (2004) who used a semantic rating scale, as opposed to our mixed method study. The abbreviations list covers 1.54% of the written corpus, which means these items occur more in the written texts, than in the spoken texts.

The Fabrication list covers almost 9% of the spoken corpus. This figure means that the proportion of technical vocabulary in spoken Fabrication texts is around one third of the proportion of technical vocabulary in written texts; which suggests that the written texts have a higher load of technical vocabulary than the spoken texts. Similar results have been found in terms of higher amounts of specialised vocabulary in written than spoken texts (Coxhead & Demecheleer, under review; Dang, Coxhead and Webb, 2017)

**Table 4. Coverage of the technical lists of Fabrication, abbreviations and proper nouns (%).**

|  |  |  |
| --- | --- | --- |
| Technical list | Fabrication writing | Fabrication speaking |
| Fabrication list | 28.87 | 8.78 |
| Fabrication abbreviations | 1.54 | 0.37 |
| Fabrication proper nouns | 0.06 | 0.03 |
| Total | 30.47 | 9.18 |

Below are two examples from the corpora used in this study with words from the technical word list in **bold**. Figure 1 contains a sample from the spoken corpus (261 words) and the Figure 2 is from the written corpus (240 words). A total of 7.66% of the words in the spoken example are also in the technical word list, compared to 33.75% of the words in the written example. These figures are quite similar to those in Table 4, even with such short pieces of text.

Spoken example: (Transcription>

<151019\_0021 Steve Fabrication > <workshop session: drawing, working out dimensions & coordinates, cutting, pitching holes, hammering, drilling, etc)

<T:> <laughs> Well… there’s only one way to learn… That’s all right, isn’t it? Yeah. What you can… What you can do once you’ve **drawn** it carefully is go round and put a little centrepoint **mark** around the outside so you don’t lose the **line**. You only need to do it very lightly, it’s just so, you know, that you can actually see the **line** when you’re **cutting** it. Not everyone does it like that but…

<S:> That’s just a way of seeing it.

<T:> What you should do is… I usually put my hand on top, I put my **thumb** on the end and push it round with your **thumb**. You might need to change fingers a little **bit**, you know… Of course it depends how **sharp** your implements are… Wonderful… we’re getting about 10 **lines**, aren’t we?

<S:> Yeah…

<T:> Doesn’t matter. And then you’ve got other **diameters** here as well cos these **circles** go on a couple of what we call **PCD**s, which are **pitch** **circle** **diameters**. So where it says **PCD**, that just means that’s the **line** that those **holes** fall on, ok? So that one is 160, isn’t it? And that’s **diameter**… so 80 **radius**. You know the difference between 80... so you can take these down … if you do this, you can just take it down by hand, see… so that’s 80 there and I’m on 100 here, so go down to 80 and you just **spring** that down so you don’t waste time.

Figure 1: Example of a spoken text with Fabrication technical words in bold

Written example (National Certificate in Mechanical Engineering Level 2, Module 12 Workbook. First published: Edition 1, July 2012, by Competenz.)

Simple **Fabrication** **Shape**s

Simple **shape**s can be **constructed** using a wide range of **fabrication** **materials**, **tools** and **equipment**. Additional **material** to make and complete the different types of **joints** must be allowed for during the **material** planning, **layout** and **marking-out** stages. **Stakes** and **rolls** can be used to **form** **cylindrical** and **conical** **shape**s. **Formers**, folders and **benders** can be used to create **square**, **rectangular** and **pyramidal** **shape**s. **Framework** can be **constructed** using sections **cut** from lengths of common **engineering** **material**s, such as flat and round **bar** or **angle**.

**Cubes** or **rectangular** **shape**s can be **constructed** by creating a **series** of up to six **square** or **rectangular** **shape**s, which are **folded** or bent at 90ø along the mating **edge**s (shown in red).

The remaining **edge**s are **joined** after **folding**.

**Cylinders** can be **constructed** by creating two **circular** ends and a **rectangle**. The length of the **rectangle** 'L' is the equal to the **circumference** of the **circular** ends. The width of the **rectangle** 'W' will be the height of the **cylinder**. The **edge**s of the **cylinder** are **joined** after **rolling**.

**Truncated** Pyramids can be **constructed** by creating a **series** of four **truncated** **triangular** sides which are **folded** or bent at 90ø along the mating **edge**s (shown in red).

The length of the **joint** along the **face** of the **truncated** pyramid is governed by the length of **edge** 'F'.

The **square** **base** and smaller **square** top are **folded** over and the remaining **edge**s **joined**.

Figure 2: Example of a written text with Fabrication technical words in bold

* 1. ***What is the coverage of these lists over academic written texts and fiction texts?***

To find out whether the coverage of the pedagogical word lists over the Fabrication texts was similar to other kinds of texts or different, a comparison was made using an academic written corpus and a fiction corpus (see Table 5). The academic written and fiction corpora were chosen because they are very different from trades texts and they were both used in Coxhead’s (2000) AWL study. Using different corpora to investigate word lists was trialled by Coxhead (2000) and is recommended by Nation (2016). Table 5 shows that the Fabrication list had lower coverage over Fiction (2.16%) than over written academic English (7.07%). This academic written English coverage is only 1.71% lower than the spoken Fabrication coverage. High frequency words in the technical list which have general meanings (for example, *work* and *centre*) could be the reason for this similar coverage. Note that the abbreviations occur in the two comparison corpora but none of the proper nouns does.

**Table 5. Fabrication lists coverage over academic written and fiction corpora (%).**

|  |  |  |
| --- | --- | --- |
| Technical list | Academic written corpus  (3,495,911) | Fiction corpus  (147,642) |
| Fabrication list | 7.07 | 2.16 |
| Fabrication abbreviations | 0.85 | 0.91 |
| Fabrication proper nouns | 0 | 0 |
| Total | 7.92 | 3.07 |

This section has focused on the development and evaluation of the technical word list of fabrication. The next section discusses ways to use this word list in fabrication teaching, based on curriculum developments by the second and third author, who are provide learning support in trades courses, based on discussions with a Fabrication tutor.

* 1. ***How did a Fabrication tutor make use of the technical word list?***

Seth was an early adopter and adapter of the technical word list. He used it primarily initially as a reference tool. In preparation for teaching, Seth scanned through the list and highlighted all words that were relevant to the topic of the week He then developed topic-based glossaries for his students to use throughout the course. The list also served to develop Seth’s awareness of his own use of technical vocabulary in class. He reported using that new awareness to think carefully about how he ensures that his students are actively learning the words in the list, through everyday classroom-based activities such as writing the words on the whiteboard and drawing attention to them during class. He also encouraged his students to personalise the technical word list by adding words that they think are important, based on their studies.

1. ***To what extent might technical vocabulary constitute a ‘vocational threshold’?***

There can be no doubt that technical vocabulary plays a major role in both the *situated* and *formal* (Gamble, 2016) knowledge of a trade. With over 1,000 words in a technical word list and supplementary lists of abbreviations and proper nouns, this vocabulary represents a substantial amount of learning. The more learners learn this vocabulary and learn to use this vocabulary in their trades, the more specialised and substantial their capacity to communicate clearly and professionally becomes. This vocabulary clearly contributes to the development of professional identity for learners in Fabrication, which is an element of vocational thresholds, according to Vaughan et al. (2015). Another element of the thresholds concept is that there are possibly multiple thresholds for learners (Vaughan et al., 2015), and the present research illustrates how the amount and kinds of encounters with technical vocabulary in trades talk and trades texts differs. Understanding the technical vocabulary of trades talk can be difficult for students (Coxhead, et al., 2016) so perhaps transformational moments might occur when learners realise that they are more able to follow the spoken instructions and content from their tutors in class. Another moment might arise when learners begin to recognise the technical vocabulary from spoken input and interaction in class with the lexis in textbooks and other written materials. Another potential threshold might be reached when learners begin to use this technical vocabulary in their own speaking, another when they begin to use it in their writing, and when the learners transition to workplace interaction.

That said, Vaughn et al. (2015) state clearly that vocational thresholds do not arise from activities that take place in classrooms. Perhaps the activities and approaches recounted here by Seth and in McLaughlin & Parkinson (2018) support the development of the knowledge learners need and draw on during transformational moments, but do not provide the actual momentum at the time. Perhaps also there has been little evidence or evaluation of so far of technical word lists such as the one presented in this study being used in curricula and classrooms.

1. **Implications for pedagogy**

It is clear from the model that technical vocabulary development for learners requires thought and planning. The technical word list presented in this article contains different kinds of words, and Coxhead et al. (2017) presented suggestions on ways to work with high frequency words, abbreviations, proper nouns and everyday words that have technical meanings in the trades for Tongan learners, based on the features of those words. Table 8 is an adaptation from Coxhead et al. (2017).

**Table 8. Suggestions for focusing on technical vocabulary, adapted from Coxhead et al. (2017).**

|  |  |  |
| --- | --- | --- |
| Category | Features of these words | The learners need to |
| High frequency technical words | They are mostly in the first few sublists of the Fabrication list | develop fluency in recognising these words in writing and speaking; develop fluency in using these words in listening and speaking; focus on any unknown high frequency words first |
| Everyday words with technical meanings | There are many everyday words with technical meanings in Fabrication | be exposed to the technical meanings of everyday words; to understand that some everyday words have technical meanings in their texts |
| Technical abbreviations | Some abbreviations occur very often in written texts, but not so often in spoken texts | learn the meanings of the commonly used abbreviations; recognise them when reading; use them in writing |
| Technical proper nouns | Might be known from everyday English but the technical meaning might not be known | be exposed to the technical meaning of these words |
| Words that include word parts | Include word parts (prefixes) such as *over*, *pre*, and *inter*; these prefixes carry means | focus on the meaning of prefixes in technical words; look at the word parts and how they might alter the meaning of the word |

This study illustrates that technical Fabrication vocabulary does not occur often in fiction and is less frequent in academic written texts than in trade-specific written and spoken texts. This means that to encounter the vocabulary of their trades, Fabrication students need to be talking and reading about their trades.

Work is underway to develop an online tool for identifying words in a word list in Fabrication texts. This tool will enable teachers such as Seth and learners to find the technical words from the Fabrication list in texts easily, so they can see how often these words are used and which words are used the most. They can use the results to find out whether the texts provide any support for learning these words, for example, through providing explanations or drawings to illustrate meaning.

1. **Limitations and future research**

There are clearly limitations to this study, as already outlined in Table 6. While the corpora are specific to Fabrication, they contain small amounts of words compared to much larger corpora which might be available for general academic English, for example. It is difficult to replicate this study without having access to another specialised corpus of written and spoken Fabrication texts, as Miller and Biber (2015) suggest would need to be done. There are also limitations on reporting on the pedagogical applications at one institution by two teachers and a tutor. It must also be noted that this is not an exhaustive list of technical vocabulary in this trade. There are many words which did not meet the selection criteria for the Fabrication word list, but these words will also be technical in nature.

Finally, generalisation of this study beyond the local context needs to be handled carefully. It became clear during the gathering of the written corpus that many institutions in New Zealand drew on the same materials. In the Tongan context, textbooks and materials from New Zealand are used in trades education, as we have already mentioned. The question, therefore, is whether Fabrication education exists in very different forms in other countries. If learners in other contexts are reading technical texts about Fabrication in English and learning in classrooms where content and specialised language of Fabrication are closely intertwined (Woodward-Kron, 2009), we would argue that this list could be very useful for many learners and teachers internationally. The development of this technical word list was carefully done, and the extensive checking carried out in this study ensures that these lexical items are indeed technical in nature. If there is uncertainty around the fit of these lists for teaching and learning in different contexts, then either replication studies could be carried out in those contexts and the results compared to our technical word list, or our list could be used to interrogate the written and spoken texts of Fabrication in other contexts.

Several studies could look further into the technical vocabulary of Fabrication, such as an analysis of multi-word units, and looking at the nexus of specialised vocabulary and visual elements of texts in Fabrication. Future research could also set evaluate the integration of this technical word list into courses of study such as at Weltec. It would also be extremely useful to investigate longitudinal development of learners’ development of technical vocabulary in any field, such as Fabrication.

1. **Conclusion**

Learning the technical vocabulary of any field is important for the development of expertise, identity, and content knowledge. Tools such as the technical word list of Fabrication presented in this article, along with lists of technical abbreviations and proper nouns, can serve as support for deciding which words to focus on during courses of study. They can help learners set goals for the development of their vocabulary. This research suggests that written technical texts have a high proportion of technical vocabulary in contrast to spoken texts, but still higher amounts than fiction or academic written texts. The technical word lists can also be used for independent learning by students before they start their studies or as they progress in their journey towards obtaining their qualifications and entering the workforce. They might even contribute in some ways towards vocational threshold moments for these learners on their journeys.

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**Appendix A: A technical word list of Fabrication.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Fabrication Sublist One:** | **Fabrication Sublist Two** | **Fabrication Sublist Three** | **Fabrication Sublist Four** | **Fabrication Sublist Five** | **Fabrication Sublist Six** |
| welding /weld(-s/-ed/-er/-ability) | bend(s) / bending | diagram | slip(-ping) | discs | jams / jammed |
| work(-ing/-er(s)) | plate(s) | teeth / tooth | manual | cycle | input |
| figure(s) | construction(s)/-ing/-ed | die(s) | hoist | moisture | root |
| cutting / cutter(s) / cut(s) | rate(-s/-d) | tip(s) | code | oblique | rungs |
| tool(s) / tooling | view(s) | mild | incident(s) | overhead | slag |
| material(s) | manufacturer(-ed/-ing) | torque | rod(s) | prior | zone |
| machine(s)/-ery/-ing/-ed/-ability | friction | relatively / relative | frame(s) | tee | damp |
| source | key(s) | chisel(s) | effective/effectiveness | hitch | gap |
| steel(s) | thickness(es) / thick | pipe(s) | imperial | elevation | guidelines |
| centre(s) | screw(s) | factor(s) | brittle | pencil | nozzle |
| hazard(-s) / hazardous | rolling / roll(-s/-er/-ers) | grip(-ping/-s) | grain(s) | valve | rack |
| metal(s) | mains | grade(s) | cable(s) | transmitted | timber |
| equipment / equipped | stress(es) | multiply/-ication/-ing | eliminate | durable / durability | solvents |
| check(-ed/-s/-ing) | chemical(s) | tensile | function(s) | ratio(s) | arising |
| angle(s) | block(s) | hook(s) | instrument(s) | crystals | mould |
| drill(-ing/-s/-ed) | blade(s) | calliper(s) | orthographic | overloaded /-ing | reeving / reeved |
| surface(s) | secure(d) | defects / defective | capacity | overalls | screwdriver |
| measuring/measure(ment(s)) | licensed / licence | depth | switch | saddle | elongation/-ate(d) |
| load(-s) / loading | thread(-ed/-s) | hose(s) | graph(s) | deterioration | blunt |
| line(s) | tighten / tight | weight | alignment / align(-ing) | sequence | chromium |
| point(s) | emergency | concrete | dip | fuel | conversion |
| drawing / draw(n) | distance | gun | rake | combustible | leadscrew |
| required/requirement(s) | radius / radii | quantity(-ies) | flammable | earth | fatigue |
| part(s) | spanner(s) | extinguisher(s) | tension | extrusion | powder |
| lifting / lift(s) | file(s) | bench | external | fusion | repetitive |
| permitted | assembly | internal | pitch | proportion | residual |
| assessment / assess(ed) | base(d) | volume | minimise | distortion / distort | hollow |
| power(ed) | jaw(s) | worksite(s) | magnetic | subtract | drag |
| area(s) | true | shear | extension | digital | torch |
| job(s) | milling | profile(s) | scriber | withstand | circlip(s) |
| hard(ness) / harden(ed/ing) | pressure | portable | knurling | tackle | tag |
| protective/protection | gauge(s) | potential | gear(s) | certificate | eyebolt(s) |
| force(s) | mechanical | guide | pictorial | gravity | drift(s) |
| arc(s) | heavy | formula / formulae | lubricant | certified | kilogram(s) |
| hole(s) | slot(s) | conductivity | forging | density | disconnect(ed) |
| electrical / electric(-ity/-ian) | datum(s) | stainless | brush(es) | generated | pad(-ded) /padding |
| wear (worn) / wearing | spindle | brass | tap | ignition / ignite | high-strength |
| form(s) | body | curved / curves | grease | assemble(d) | weld-pool |
| engineering / engineer(s) | sharpening / sharpen | rectangle | perpendicular | freehand | macro |
| table(s) | properties | balance(d) | shank | nickel | manganese |
| grinding / grinder(s) / grind | workshop(s) | melting / melt | decimal | electronic | nylon |
| sling(s) / slinging | wrench(es) | gloves | equation | pneumatic | reservoir |
| finish(es/ed) / finishing | metre(s) | dust | cone(s) | cemented | terminology |
| alloy(s) / alloying | substance(s) | hydraulic | millimetre(s) | appliance(s) | earmuffs |
| face(s) / facing | vertical(-ly) | shaft(s) | projection/project(ing) | absorbent | particles |
| edge(s) | sketch(es) | calibration/calibrated | filler | new-market | radiation |
| gas(es) | specification(s) | plug(s) | stretch | butt | flutes |
| heat / heating | dimension(s) | crane(s) | bronze | thermal | geometric |
| fire(s) | crack(-s)/ cracking | metric | synthetic | gearbox | neutral |
| circle(s) / circular | bar(s) | fluid(s) | toxic | monitor | coordinate(s) |
| square(s/-d) | lever(s) | value(s) | rag | oxide | clockwise |
| wire(s) | travel | pulley | mechanism | reels | crushed |
| position(s) | compressed (-ion/-ive) | entity / entities | setsquare | silicon | helmet(s) |
| joint(s) / jointing | workpiece | excessive / excess | exponent(s) | bore | litre(s) |
| strength | socket(s) | insert(s) | mixture(s) | quenching /quenched | installed/-ation |
| carbon | mass | template(s) | efficient / efficiency | transposing | dull |
| wheel(s) | structure(s) /structural | leaking / leak /leakage | magnesium | shifting | permission |
| component(s) | washer(s) | carbide | series | saw(s) / sawing | pool |
| accurate/accuracy | chain | technique(s) | fibre | molten | ram |
| mark(ed/s) / marking(s) | dividers / dividing | pliers | label | stickout | yield |
| shape(s) | ladder(s) | compass | convert | tungsten | severe |
| resistance | fault(s)/faulty | plane | rigidity / rigid | spray | wedge |
| bolt(s) / bolted | oil | beam(s) | tempered / tempering | inclined | division |
| calculate/-ions(s)/-or/-ing | rope(s) | shackle(s) | velocity | layout | thoroughly |
| feed(s) | box | intersect/ intersection | strain | caps | obstructions |
| method(s) | voltage / volts | scribe(d) / scribing | tank | clutch | burrs |
| fit(-ted) / fitting(s) | triangle(s) | zinc | micrometer | austenitic | diagonal |
| maintenance / maintain | copper | significant | tonne(s) | acid(s) | polymers |
| clear / clearance | spill(-s/-ed) / spillage | fasteners | headstock | annealing / annealed | revolution(s) |
| marking-out | impact | groove(s) | motion | dressing | specified |
| punch(es) | fume(s) | tangent / tangential | setup | flange | cubic |
| standard(s) | scale(s) | guards | shock | isometric | martensite/-itic |
| nut(s) | shielding / shield | circuit(s) | ventilation | scheme | tolerance(s) |
| clamping / clamp(-s/-ed) | parallel(s) | cord(s) | release | tailstock | expand |
| storage/stored | element(s) | ferrous | evacuation / evacuate | tin | extraction |
| diameter(s) | isolating / isolate(d) | axis | fixture(s) | axes | malleable |
| harm(ed) | confined | swarf | folded | complex | dispose(d) |
| Fabrication / fabricated | leg(s) | acceleration | evenly / uneven(ly) | technical | thermoplastic |
| adjustable / adjust(ed/ing) | device(s) | hint | deformed /-ation | authorised | t-square |
| corrosion / corrosive | rivet(-s/-ing) | snips | high-speed | grit | criteria |
| workplace | rotating/rotate/-ion | adequate | circumference | inch | exits |
| cast / casting(s) | chipping / chip(s/-ped) | rust | bead | trolley | fulcrum |
| current | pin(s) | adhesive(s) | bruising | readout | housekeeping |
| level(s) | degree(s) | liquid(s) | flexible | revolving | lap |
| iron | cylinder(s) | hexagonal | lip | engage | pilot |
| procedure(s) | loose / loosen | permanent(ly) | register | respirator | titanium |
| aluminium | achieve(d) | abrasive | hacksaw | inductance | filter |
| electrode(s) | toughness / tough | dial | vector | accessories | glossary |
| coolant / cooling / cooled | joined / join(ing) | transformer | tube | sparks | relevant |
| chuck(s) | horizontal | symbol | approximate(ly) | vibration | solution |
| location(s) / located /-ing | mounted / mounting | mallet(s) | argon | flux | alert |
| activity (-ies) | bearing(s) | protractor(s) | oxygen | coefficient | apron |
| handle(s) / handling | lubrication/lubricate(d) | belt(s) | cylindrical | multiple | disadvantages |
| temperature(s) | hot | repair(s) / repaired | fillet | anchor(s) | liability |
| piece(s) | appropriate | flow | brazing | soldering / solder(ed) | primary |
| hammer(s) | rubber | ellipse | brackets | sufficient/insufficient | strands |
| supervisor / supervision | rough / roughing | spring | penetration | moulding | panels |
| vice(s) | insulation / insulator | precision | pump | bisecting / bisect | spinning |
| lathe(s) | taper(ed) | fraction(s) | explosion | inhaling /inhalation | transitions |
| sheet(s) | ductility / ductile | bit(s) | strike | overheat(-ing) | centreline(s) |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Fabrication Sublist Seven** | **Fabrication Sublist Eight** | **Fabrication Sublist Nine** | **Fabrication Sublist Ten** | **Fabrication Sublist Eleven** |
| stroke(s) | acetylene | molecular / molecule | parallax | octagon |
| anvil(s) | acute | snug(ly) | polyethylene | passivating |
| exerted | angular | tyre(s) | pulsed | suffocation |
| outline | backlash | bender(s) | radiata | wrists |
| pyramid | camlock | galvanised / galvanising | recurring | activation |
| radian(s) | caution | kink(s) | rutile | apertures |
| trigonometry /trigonometric | denominator | reflect / reflective | smear | braces |
| reaming / reamers | dresser | build-up | squat | chatter |
| recess(ed) | gantry | odd-leg | subjected | clips |
| cross-slide | handbook | pop-rivets | syndrome | coil |
| double-insulated | molybdenum | third-angle | thumb | dilute |
| right-angled | prick | adjacent | tirfor | flex |
| thermoset | spatter | applicable | vacuum | hinder |
| debris | theorem | apprenticeship | vanadium | infusion / infuses |
| feedback | derived | arithmetic | winding | keyway(s) |
| magnitude | elastomers | barrel | crowbar | propeller |
| newtons | porosity | batch | snap | rectified / rectifier |
| pearlite | stiles | collect | ultraviolet | slackness |
| retrieval | traverse | cosine | buckle | strap(s) |
| strictly | pallet | decibels | expired / expires | turbine(s) |
| stringer | vapours | dowel | fatal | automobile |
| subsequent | watt | hydrogen | float | overextended /-ing |
| vee | nick(s) | labour | hardwood | protrude / protruding |
| webbing | parameter(s) | petrol | kit(s) | sink(s) |
| casing | principle(s) | pillar | micron(s) | buffers / buffing /buffs |
| graduated | cropper(s) / cropping | plumb | nipple(s) | center-finder |
| pivot | weave / weaving | polypropylene | nitriding | cold-working |
| cabinet | buffs | radial | overtighten(ing) | end-mill |
| coarse | reinforced /reinforcing | rawhide | pits | first-order |
| interchangeable | seize(d) | rotary | resin(s) | high-carbon |
| joule | sticky / stickiness | sash | steam | purpose-built |
| serrated | vessel(s) | tang | thermometer(s) | second-order |
| designated | regulations / regulator | texture | transparencies/-y | self-lubricating |
| flame | vee-blocks | tray | arrowed / arrows | well-ventilated |
| chart(s) | dioxide | truncated | dam(s) | scalars |
| drum(s) | dovetail | tubular | dig | tinsnips |
| versatile / versatility | expansion | undercut | enclosing / enclosed | center-punch |
| jig(s) | handheld | workbench | flush | chip-breaker |
| seams | intervals | contamination | indentor / indentation | corrosion-resistant |
| tidy | masonry | epoxy | laminated / laminates | earth-leakage |
| layer(s) | negative | pein | loop(s) | feed-screws |
| verify(-ing) | pascals | tenons | trimming / trim | half-round |
| notching / notch(-es/-ed) | raw | bevel(s) | gouged / gouging | self-drilling |
| feed-shaft | spirit | blind | stiff | slide-ways |
| g-clamp | sulphur | clogged / clog | cross-sectional | slot-drill |
| abrasion | swivel | clutter | first-angle | soft-faced |
| analogue | universal | compact | full-size | star-wheel |
| cementite | artefact | degradation | heat-treatable | third-order |
| disclaimer | collet | draught | heavy-duty | zero-check |
| exclude | concentrate | nails | high-tensile | bainite |
| exhaust | crater | pastes | i-beam | breakover |
| output | diamond | phosphorous | no-go | eutectoid |
| oxyacetylene | displacement | satisfactory | self-tapping | oilstone |
| pertaining | embedded | shatter | work-hardening | tiedowns |
| phase | gaskets | symmetrical | acrylic | tierods |
| photocopying | overlap | trammels | aerospace | kilopascal |
| reproduced | plunger | vent(s) | appendix | arc-flash |
| slippery | stake | barrier(s) | barge | as-built |
| technology | suspended | channel(s) | baseline | carbide-forming |
| theory | trigger | charge | bob | fixed-wired |
| goggles | ducting | composition | cog | formed-type |
| mandrel | uniform | crackle / crackling | compulsory | four-arc |
| static | alternating /alternate | numeral(s) | conical | full-face |
| axle | digit(s) | polygon(s) | conjunction | go-no-go |
| ferrite | elasticity / elastic | rail(s) | convex | hand-pressure |
| jack | graphic / graphical | splice(s) | dee | monitored-earth |
| outlet | megapascal(s) | traceable | disperse | quick-change |
| choker | prefix(es) | compatible / incompatible | fan | shadow-board |
| electrocution | stud(s) | conveyor | firefighting | sheet-metal |
| lens | exceed(ed) | deposit | flats | straight-pein |
| lustre | relieving / relieve | drain(s) | foam | strain-hardening |
| sleeves | reverse / reversible | scrap / scrapped | formaldehyde | switchboard-mounted |
| collar(s) | tilting / tilted | slope(s) | formation | t-bar |
| configuration(s) | clean-up | oxidising / deoxidise | formers | test-tagged |
| core | ill-fitting | down-cut | foundations | vice-clamp |
| folder | self-centring | lint-free | frayed | wear-resistant |
| forklift(s) | alkalis | load-lifting | harsh | press-tools |
| rigging | chassis | low-carbon | inert | spot-welded |
| compound(s) | duration | spring-loaded | manila | ampere |
| stamp(-ed) / stamping | extent | t-slot | minimal |
| power-source | fabrics | try-square | numerator |
| ballpein | kinetic | amputation | offset |
| failure | muffs | apparatus | pedal |
| occupational | overall | automotive | polyurethane |
| precautions | pipework | aviation | practicable |
| thimble | planishing | binary | proximity |
| wrought | plywood | bubble | ratchet |
| carriage | presence | closefitting | runout |
| peripheral | scroll | concave | setback |
| straight-edge | sine | concentric | smother |
| transverse | upper | crosspein | sodium |
| adaptor | carburizing | equilibrium | straightforward |
| arbor | classification | framework | upcut |
| countersunk | globular | granite | warden |
| fracturing / fracture | extensively | housings | bushings |
| indexable / index | guillotine | isosceles | ceramic |
| brake(s) | retain | jobbing | composites |
| knock(ed) | scraping | multipurpose | dot |
| brand-name | conformity | nitrogen | foul |
| accordance | lug(s) | open-end | longitudinal |

Appendix B: Common Fabrication Abbreviations and their meanings

Below are 57 common abbreviations from Fabrication with their meanings. They are organised alphabetically.

|  |  |
| --- | --- |
| AC | Alternating Current |
| Al | Aluminium |
| AMP | Ampere |
| Approx. | approximate / approximately |
| Ar  AS/NZS | Argon  Australian and New Zealand Standard |
| AWS | American Welding Society |
| BHN | Brinell Hardness Number |
| BS | British Standard |
| CC | cubic centimetres |
| CNC | Computer Numerical Control |
| CO2 | Carbon Dioxide |
| DC | Direct Current |
| DCEN | Direct Current Electrode Negative |
| DOL | Department of Labour |
| DRO | dial or digital readout |
| DTI | Dial Test Indicator |
| Fe | iron |
| GMAW | Gas metal arc welding |
| GTAW | Gas tungsten arc welding |
| HAZ | heat affected zone |
| HERA | Heavy Engineering Research Association |
| HSE | Health and Safety in Employment (Act) |
| HSS | High Speed Steel |
| ID | identification number |
| IN2 | square inch |
| ISO  kg | International Organization for Standardization  kilogram |
| kN | kilonewton |
| kPa | kilopascal |
| M2 | square metre |
| M3 | cubic metre |
| MIG  MM | metal inert gas  millimetre |
| MM2 | square millimetre |
| MMAW | manual metal arc welding |
| Mn | Manganese |
| MPa | megapascal |
| Nm | Newton metre |
| NZQA | New Zealand Qualifications Authority |
| OCV | open circuit voltage |
| Pa | Pascal |
| PCD | pitch circle diameter |
| pH | acidity or alkalinity of a solution |
| PPE | personal protective equipment |
| PTFE | Polytetrafluoroethylene |
| PVC | Polyvinyl Chloride |
| RCD | residual current device |
| Rev. | Revolution(s) |
| RPM | Revolutions per Minute |
| S2 | second squared |
| SAE | Society of Automotive Engineers |
| SI | International System of Units |
| SIN | Sine |
| SWL | Safe Working Load |
| TAN | Tangent |
| TIG | tungsten inert gas |
| WPS | Welding Procedure Specification |

**Appendix C: Common Fabrication proper nouns**

Here are 9 common abbreviations from Fabrication (organised by frequency).

|  |
| --- |
| Vernier |
| Newton |
| Pascal |
| Allen |
| Pythagoras |
| Celsius |
| Kelvin |
| Weston |
| Brinell |