Technical Applications of VipyDone Polymers
Introduction

Lambson is a UK company with world class manufacturing expertise and an enviable reputation for high quality research and development. We are a people focused business, organised around our customer’s needs and markets. With over 40 years track record of high quality manufacture and innovation we cover hi-tech, fast moving markets such as Beverage, Cosmetics, Pharmaceutical, Automotive, Surface Coatings, Adhesives, Printing Inks and Detergents.

To further enhance our customer service we have developed long term partnerships with Universities and Research Institutes, enabling us to react efficiently to our clients’ requirements. When working with our multi lingual technical support and sales teams, Lambson is guided by the following principles:

**Partnership** – working with our clients to improve existing processes or to overcome problematic formulations and products

**Teamwork** – to assist production or product development teams with our expertise and knowledge

**Innovation** – to provide high quality, unique products to our customers.

We are regarded as pioneers in the UV industry and continue to produce innovative, high performance solutions to our clients worldwide.

Our Personal Care division has over 70 years combined experience and expertise in a wide range of formulation types including hair styling, hair care, sun care and skin care.

Our Encapsulates division offers innovative functional encapsulation solutions, specifically engineered for your product and targeted to a wide range of applications, taking your product to another level by offering stabilisation, controlled delivery and improved efficacy, along with differential aesthetics.

Our VipyDone range of vinyl pyrrolidone homo- and co-polymers have a long-established track record of usage in a variety of technical applications. With a range of polymers, differentiated by molecular weight, hydrophilicity, and solubility, we can offer solutions to meet your specific product requirements in a number of functional areas.
Vinylpyrrolidone Polymers and Copolymers

Polymers of Vinylpyrrolidone (VP) have been known since the 1930’s, when Dr Walter Reppe first completed the synthesis from acetylene. By the 1940’s, commercial production had started and the wide functionality of VP polymers was starting to be understood.

The homopolymers of VP (Polyvinylpyrrolidone, PVP) have a unique combination of properties. They are soluble in water and polar organic solvents, have the ability to complex with a number of different types of molecules such as dyes, exhibit strong film forming properties with good adhesivity to a number of different substrates including plastics and glass, and above all have extremely low toxicity. They are available in a variety of different molecular weights, in powder or aqueous solution.

The properties of the homopolymers can further be varied by introducing comonomers, most notably vinyl acetate (VA). The resulting PVPVA copolymers have a variety of properties depending on the relative ratio of VP to VA, ranging from hydrophilic to hydrophobic, water soluble to alcohol soluble, tacky vs. non-tacky, etc.

PVP can also be cross linked with itself to form an insoluble, yet hydrophilic polymer, Polyvinylpolypyrrolidone (PVPP). This polymer retains the complexing abilities of the uncrosslinked variant, but in an insoluble, filterable form. Upon exposure to moisture, particulate PVPP absorbs water rapidly and swells, acting as a fast disintegrant for tablet or granule applications.

[Further copolymers and terpolymers are available in the Vida-Care Personal Care range. For more details contact your Lambson representative.]

VipyDone PVP Homopolymers

<table>
<thead>
<tr>
<th>Property</th>
<th>K15P</th>
<th>K15W30</th>
<th>K30P</th>
<th>K30W30</th>
<th>K60P</th>
<th>K90P</th>
<th>K90W20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>White to off-white powder</td>
<td>Pale yellow aqueous solution</td>
<td>White to off-white powder</td>
<td>Pale yellow aqueous solution</td>
<td>White to off-white powder</td>
<td>White to off-white powder</td>
<td>Pale yellow aqueous solution</td>
</tr>
<tr>
<td>% Active</td>
<td>&gt;95</td>
<td>~95</td>
<td>&gt;95</td>
<td>~95</td>
<td>&gt;95</td>
<td>&gt;95</td>
<td>~20</td>
</tr>
<tr>
<td>MW (approx.)</td>
<td>10,000</td>
<td>10,000</td>
<td>60,000</td>
<td>60,000</td>
<td>350,000</td>
<td>1,300,000</td>
<td>1,300,000</td>
</tr>
<tr>
<td>Residual VP monomer (ppm)</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
</tr>
<tr>
<td>pH</td>
<td>3-7 (10% aq.)</td>
<td>5-9 (10% aq.)</td>
<td>3-8 (10% aq.)</td>
<td>4-9 (10% aq.)</td>
<td>4-9 (10% aq.)</td>
<td>4-9 (10% aq.)</td>
<td>5-9 (10% aq.)</td>
</tr>
</tbody>
</table>

Table 1: Commercially available standard grades of VipyDonePVP – other grades can be available on request
K-Value and Viscosity

VipyDone PVP homopolymers are available in several molecular weights, as powders and/or aqueous solutions. The polymers are characterised by their K-values, which are related not just to the polymer’s molecular weight, but also the degree of polymerisation and the intrinsic viscosity of the polymer. K-values are calculated by the Fikentscher equation, and are calculated from relative viscosity measurements.

\[
\frac{\log_{10}(\eta_{\text{rel}})}{c} = \frac{75 \cdot k^2}{1 + 1.5 \cdot k \cdot c} + k
\]

Where \(c\) is concentration in g/100ml, and \(k\) is the Fikentscher parameter. Solving for \(k\) then gives rise to the commonly reported K-value, where \(K = 1000k\)

VipyDone PVP homopolymers are readily soluble in water, with the concentration achievable limited by viscosity alone. Viscosity of aqueous solutions is of course a function of concentration, however it should be noted that the lower K-value polymers have a much less marked concentration effect compared to the high molecular weight polymers, and at lower levels this effect is virtually negligible. Hence for applications where higher viscosities are intended, the higher K-values are indicated.

The solution viscosity is broadly stable across the range of pH from 2-10, but in strong acid (eg: HCl) the viscosity will increase substantially, and in high pH systems (eg high caustic) the polymer will precipitate out, but redissolve on dilution.

VipyDone PVP homopolymers are soluble at 10% minimum in a number of solvents, including many alcohols, glycols, organic acids, etc. The homopolymers are essentially insoluble in most hydrocarbons and chlorinated hydrocarbons, ethers and esters. However, solutions of PVP in eg; mineral oils or hydrocarbons can be achieved by first dissolving the PVP in a cosolvent such as butanol or N-methylpyrrolidone.
When dissolved in a suitable solvent, the viscosity of the resulting polymer solution is heavily dependent on the solvent itself, and suitable testing must be performed to show not just solubility but also impact on viscosity when selecting solvents and co-solvents.

<table>
<thead>
<tr>
<th>Solvent</th>
<th>PVP Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2%</td>
</tr>
<tr>
<td>1,4-Butanediol</td>
<td>101</td>
</tr>
<tr>
<td>Butyrolactone</td>
<td>2</td>
</tr>
<tr>
<td>Ethylene Glycol</td>
<td>24</td>
</tr>
<tr>
<td>Diethylene Glycol</td>
<td>39</td>
</tr>
<tr>
<td>Propylene Glycol</td>
<td>66</td>
</tr>
<tr>
<td>Ethanol</td>
<td>2</td>
</tr>
<tr>
<td>Isopropanol</td>
<td>4</td>
</tr>
<tr>
<td>Glacial Acetic Acid</td>
<td>2</td>
</tr>
<tr>
<td>Glycerol</td>
<td>480</td>
</tr>
<tr>
<td>N-methylpyrrolidinone</td>
<td>2</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>1</td>
</tr>
<tr>
<td>Monoethanolamine</td>
<td>27</td>
</tr>
<tr>
<td>Triethanolamine</td>
<td>156</td>
</tr>
</tbody>
</table>

Table 2: Kinematic Viscosity of PVP K30 in Organic Solvents / cSt (Ref 2)

**Film Formation / Adhesivity**

VipyDone PVP Homopolymers will form films when dried. These films are transparent, glossy, hard and brittle in their unmodified forms, but may be plasticised with a variety of compatible plasticisers without significantly impacting the clarity or gloss. In addition, moisture absorbed from the atmosphere may also act to plasticise films of PVP.

Different plasticisers can be used to modify the adhesivity and tackiness of films; for example carboxymethylcellulose and cellulose acetate will decrease tack while glycerine or diethylene glycol will increase tackiness. In general the higher K-value polymers give rise to stronger adhesive films.

**Complexation**

Although non-ionic in character, the pyrrolidone ring exhibits zwitterionic behaviour as a result of electron delocalisation across the N-C=O group. As a result, the pyrrolidone group is able to form complexes with a variety of other molecules, via a combination of interactions including dipole-dipole, hydrogen bonding and close range van der Waals interactions.

In aqueous solution, the O\(^-\) character is shielded due to hydrogen bonding of water molecules making the prevalent character to be that of the N\(^+\) moiety, making PVP behave as a semicationic molecule. Hence, in particular PVP homopolymers are known to form complexes with molecules which have predominantly anionic, hydrogen bonding, delocalised electron structures. Examples are some classes of dyestuffs, polyphenols, tannins, etc.
**Colloidal Stabilisation**

Emulsion, suspensions and dispersions can all be stabilised by solutions of relatively small amounts of PVP. The polymer adsorbs as a thin layer on the exterior of particles and thus prevents contact coalescence. Different types of particles are stabilised more effectively by different K-value grades; typically the lower K-value grades are more effective at stabilising particulate colloids in aqueous systems such as soils in detergent wash liquors, whereas higher K-value grades are more commonly used in viscous systems, and in suspension polymerisation where the grade and concentration of PVP can be used to modify the particle size of the resulting polymer.

**Cross linking**

VipyDone PVP homopolymers can be readily cross linked by a variety of means. The higher K-value polymers can be cross linked at temperatures of 70 - 90 °C in the presence of small quantities of a peroxides or persulphates in aqueous solution. Lower K-value polymers are more effectively cross linked at elevated temperature in aqueous solutions with pH at 11 or greater. PVP films can be cross linked by radiation curing methods (electron beam, gamma, X-rays) or by treatment with an initiator in the presence of UV light. Crosslinked PVP is insoluble in all solvents, but remains swellable in polar solvents such as water or ethanol, with the extent of swelling depending on crosslinking density.

Lambson offers cross linked PVP polymers as free flowing white powders under the VipyDone XL name.

**Storage and Handling**

Under normal storage conditions, PVP powders display high stability with little degradation. Low K-value polymers are particularly stable, while the higher K-value powders can suffer some loss of K-value on prolonged storage, particularly in higher temperatures. Extreme or prolonged high temperatures should be avoided where possible; the material is stable but can exhibit darkening upon prolonged exposure. Material should be kept in sealed containers at all times; PVP homopolymers are extremely hygroscopic and will absorb significant atmospheric moisture particularly in humid environments.

Solutions of PVP homopolymers are generally stable to moisture pick up and suffer from lower K-value degradation than their powder counterparts. However, as with all aqueous polymers, there is propensity for contamination with airborne moulds and yeasts and hence it is recommended that the product is stored in closed containers and that full containers are used where possible. Commercial grades of PVP solutions include suitable preservative systems.

Material is of extremely low toxicity; nevertheless it is recommended that usual hygiene and safety standards are followed. As with all powders, creation or inhalation of dusts should be avoided and sources of ignition excluded from areas where dusts may be created.
**VipyDone PVPVA Copolymers**

The copolymers of vinyl pyrrolidone with vinyl acetate are available in a variety of ratios. Due to their increasing hydrophobicity with increasing VA content, polymers with >50% VA content are delivered as alcoholic solutions, with ethanol or isopropanol offered as the carrier solvent. Polymers with <50% VA content are generally offered as solutions in water, ethanol and/or isopropanol. The 60:40 VP:VA variant is also offered in powder form.

**Table 3: Commercially available standard grades of VipyDone PVPVA**

<table>
<thead>
<tr>
<th>Property</th>
<th>VA37E</th>
<th>VA37I</th>
<th>VA55E</th>
<th>VA55I</th>
<th>VA64W</th>
<th>VA64P</th>
<th>VA73E</th>
<th>VA73I</th>
<th>VA73W</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Clear, colourless to pale yellow solution</td>
<td>Clear, colourless to pale yellow solution</td>
<td>Clear, colourless to pale yellow solution</td>
<td>Clear, colourless to pale yellow solution</td>
<td>White to off white solution</td>
<td>White to off white powder</td>
<td>Clear, colourless to pale yellow solution</td>
<td>Clear, colourless to pale yellow solution</td>
<td>Clear, colourless to pale yellow solution</td>
</tr>
<tr>
<td>K-value</td>
<td>26-36 (1% EtOH)</td>
<td>22-31 (1% EtOH)</td>
<td>24-36 (1% EtOH)</td>
<td>22-32 (1% EtOH)</td>
<td>26-34 (1% EtOH)</td>
<td>26-34</td>
<td>28-38</td>
<td>24-34</td>
<td>22-32</td>
</tr>
<tr>
<td>% Active</td>
<td>48-52</td>
<td>48-52</td>
<td>48-52</td>
<td>48-52</td>
<td>48-52</td>
<td>&gt;95%</td>
<td>48-52</td>
<td>48-52</td>
<td>48-52</td>
</tr>
<tr>
<td>VP:VA ratio</td>
<td>30:70</td>
<td>30:70</td>
<td>50:50</td>
<td>50:50</td>
<td>60:40</td>
<td>60:40</td>
<td>70:30</td>
<td>70:30</td>
<td>70:30</td>
</tr>
<tr>
<td>Residual VP/VA monomer (ppm)</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
</tr>
<tr>
<td>Water Content %</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>~50</td>
<td>&lt;5</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>Film Flexibility</td>
<td>← Increasing ….. Decreasing →</td>
<td>← Increasing ….. Decreasing →</td>
<td>← Increasing ….. Decreasing →</td>
<td>← Increasing ….. Decreasing →</td>
<td>← Increasing ….. Decreasing →</td>
<td>← Increasing ….. Decreasing →</td>
<td>← Increasing ….. Decreasing →</td>
<td>← Increasing ….. Decreasing →</td>
<td>← Increasing ….. Decreasing →</td>
</tr>
<tr>
<td>Hygroscopicity / HLB</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
</tr>
<tr>
<td>Adhesivity</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
<td>← Decreasing ….. Increasing →</td>
</tr>
</tbody>
</table>

**Film Formation / Adhesivity**

All ratios of VipyDone PVPVA polymers function as primary film formers, showing good adhesivity to a variety of substrates including fibres such as textiles or papers, as well as smooth surfaces such as plastic or glass.

As the VA content increases, the resultant films show increased flexibility but reduced adhesivity with the strongest adhesive films being those with high VP content. Conversely the higher VA contents show more water resistance. Hence, selection of the appropriate VipyDone PVPVA copolymer or mix of copolymers, and suitable plasticisers, enables the formulator to tailor flexibility, adhesivity and water resistance/remoistenability to suit their specific application.

The VipyDone PVPVA copolymers are thermoplastic, with increasing Tg as VP content increases. Hence, hot melt adhesives can be formulated, most usually using the high VP copolymers. For reference; PVP homopolymers are also thermoplastic, but the Tg is typically too high to be of application use.
Impact of varying VP:VA ratio on Tg of VipyDone PVPVA Copolymers

<table>
<thead>
<tr>
<th>Ratio VP:VA</th>
<th>30:70</th>
<th>50:50</th>
<th>60:40</th>
<th>70:30</th>
<th>100:0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tg (°C)</td>
<td>~70</td>
<td>~90</td>
<td>~105</td>
<td>~110</td>
<td>~170</td>
</tr>
</tbody>
</table>

Table 4: Impact of varying VP:VA ratio on Tg of VipyDone PVPVA Copolymers

The Tg of the VipyDone VA64P polymer, coupled to binding and dispersing properties gives rise to a particularly interesting behaviour when used as an extrusion granulation aid. Hitherto poorly soluble active ingredients when dispersed in VA64P and granulated can show increased dissolution rates, as well as the physical benefits of controlled granule size, reduced dusting, etc. In conjunction therefore with the adhesive properties of PVPVA solutions, the resulting solutions can also show enhanced stick to eg: leaf surfaces in Agricultural applications.

**Storage and Handling**

Under normal storage conditions, VipyDone PVPVA polymers display high stability with little degradation. Extreme or prolonged high temperatures should be avoided where possible; the material is stable but can exhibit darkening upon prolonged exposure.

Material should be kept in sealed containers; the alcoholic solutions of PVPVA are flammable due to the solvent and therefore should be stored appropriately away from ignition sources.

Aqueous solutions of PVPVA can potentially become contaminated with airborne moulds and yeasts and hence it is recommended that the product is stored in closed containers, that full containers are used where possible, and material is typically offered for sale including a suitable preservative system.

While material is of low toxicity; nevertheless it is recommended that usual hygiene and safety standards are followed. For VA64P powder, creation or inhalation of dusts should be avoided and sources of ignition excluded from areas where dusts may be created.
VipyDone Crosslinked PVPP

Vinylpyrrolidone monomer can be cross-linked during the polymerisation reaction to create a physically cross-linked, insoluble variant of the PVP homopolymers. These polymers are insoluble in water, acid and alcohols. Two grades are offered, differentiated only by particle size.

<table>
<thead>
<tr>
<th>Property</th>
<th>VipyDone XL</th>
<th>VipyDone XLF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>White to off-white powder</td>
<td>White to off-white powder</td>
</tr>
<tr>
<td>Particle Size (approx.)</td>
<td>75µm</td>
<td>25µm</td>
</tr>
<tr>
<td>% Moisture</td>
<td>&lt;6</td>
<td>&lt;6</td>
</tr>
<tr>
<td>Residual VP monomer (ppm)</td>
<td>&lt;1000</td>
<td>&lt;1000</td>
</tr>
<tr>
<td>pH (1g/100ml DI Water)</td>
<td>5-8</td>
<td>5-8</td>
</tr>
</tbody>
</table>

Table 5: Commercially available standard grades of VipyDone PVPP

Superdisintegration

The cross-linked polymer retains the highly hydrophilic character of the homopolymers, and on contact with water will rapidly absorb water and swell. When used in tableting or granulation applications, this leads to a twofold effect; firstly the capillary network of PVPP particles in the tablet or granule enables water to be carried quickly to the centre, increasing the effective contact area and speeding dissolution. Second; the rapid, swelling action of the particles exerts a pressure on adjacent particles and thus leads to rapid disintegration of the tablet. As a result, PVPP polymers are extensively used as superdisintegrants in both Pharmaceutical and Technical applications.

Complexation

The cross-linked polymers show very similar complexing ability to the polymer solutions, and hence will form complexes with a wide variety of other molecules such as dyestuffs, polyphenols, tannins, etc. In comparison to the homopolymers however, the resulting complexes remain insoluble, and hence can be filtered out from the liquor by a variety of means. The most usual application for this property is in the clarification and stabilisation of beers, wines and fruit juices, by removing the polyphenolic compounds that lead to chill-haze formation on storage. Other applications include complexation of materials from wastewater streams, or as paper coatings for water based inks, where the ability to capture dyes close to paper surfaces leads to sharper, vibrant images.

Storage and Handling

Under normal storage conditions, VipyDone PVPP polymers display high stability with little degradation. Material should be kept in sealed containers; the material is highly hygroscopic and will readily absorb atmospheric moisture. Where possible it is recommended that full containers are used.

While material is of extremely low toxicity it is recommended that usual hygiene and safety standards are followed. Creation or inhalation of dusts should be avoided and sources of ignition excluded from areas where dusts may be created.
Examples of Industrial Applications of VipyDone Polymers

Cleaning and Detergents
- Dye Transfer Inhibitor – PVP is used in powder and liquid formulations, and in dye scavenging sheets, to prevent transfer of fugitive dyes onto clean fabrics.
- Inhibit Soil Redeposition – low K value PVP is used to stabilise particulate soil suspensions and prevent redeposition on clean fabrics.
- PVP is used as binder / coating additive for powdered enzymes to prevent dusting and reduce irritancy.
- PVPP – used as a tablet disintegrant in laundry and dishwasher tablets to ensure fast dissolution of the powder.

Agricultural
- PVP and PVPVA – used to improve viscosity and reduce run-off of sprayed formulations.
- To improve wettability of powder formulations.
- To improve dispersion and reduce the tendency for crystallisation of low solubility actives.
- As binder for granulated formulations.
- To stabilise emulsions, reduce settling / coagulation and improve dosing control.
- As protective coating for seeds – PVP and PVP VA polymers reduce dusting / improve durability / improve Rhizobia uptake and survival rates.
- PVPP – as binder and disintegrant for granule dispersions.

Adhesives
- To provide high initial tack in eg; glue stick formulations
- Excellent film formers and hence adhesives for metal / glass / plastic substrates
- Can be cast from solvents or water to leave water remoistenable clear films.
- High green strength binder for ceramics and firing sands, with no residual polymer left after firing.
- VA64P is thermoplastic with Tg of ca. 105°C; enables formulation of water remoistenable hot melt adhesives.

Paint/Ink/Coatings
- Dispersant for pigments.
- Protective colloid stabiliser for emulsion polymers / coatings.
- High adhesion to plastic, metal, glass substrates.
- PVP and PVPVA can increase viscosity of inks and coatings.
- PVPP or cross-linked PVP’s can be used to form water insoluble hydrophilic coatings for water based inks; binding capability prevents dye bleed and increases vibrancy and sharpness.
- PVP increases the hydrophilicity of coatings for medical devices; improves lubricity and comfort.

Polymerisation
- PVP used as an emulsifier in production of expanded polystyrene beads.
- Used to provide colloidal stabilisation / suspension of lattices during emulsion polymerization.
Separation Membranes
- Tightly controlled K-value PVP’s used to control pore size during membrane manufacture.
- Increase hydrophilic properties of the membrane.

Metal Treatment
- High K-value PVP polymers is used as aqueous metal quenchants; tight control K-value enables highly reproducible quenching behaviour and reduced contamination and hazard compared to oil-based quenchants.

Textiles
- Used as a binder, lubricant and protective coating for glass fibres to reduce abrasion and improve processing.
- Increase viscosity of textile treatment formulations.
- Improved dye transfer performance in dye stripping / dye scavenging applications.
- Improve receptivity of hydrophobic surfaces for dyeing.

Oil and Gas
- Additive for drilling fluids; used to reduce cement cure rates / improve sealing properties of well casings.
- Shale swelling inhibitor.

Paper
- Dye receptive coatings for water based dyes.
- Dispersant for organic pigments.
- Improves gloss and lustre of papers.

Battery
- Binder for electrode cores.
- Paper coating for battery separator papers.

References:
1. Encyclopedia of Polymer Science and Engineering (2nd Ed.); Vol 17 P.207
2. Encyclopedia of Polymer Science and Engineering (2nd Ed.); Vol 17 P.209

The information provided in these notes is given in good faith and is based on the material available at the time of writing. The information contained in this guide is believed to be reliable, but we do not guarantee its accuracy and any user must make their own determination of a product’s suitability for use. Lambson Limited cannot be held responsible for any claims for loss or damage arising out of the application of this information or any part of it.