Gilmore Engineers New Product

# ADVANTAGE

## Olympic Success

When staff at Gilmore Engineers watched the achievements of Australia's kayakers at the Sydney Olympics, they felt a special sense of pride because of their own contribution to the teams' training efforts.

The team of Andrew Trim and Daniel Collins gained a silver medal in the Men's K2-500 metre event, and Katrin Borchert in the Women's K1-500 metre event gained a bronze medal.

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## Creativity + Planning = $$$

Creative ideas for new products are not unusual. What are unusual are creative ideas backed by focussed and well-planned programs of research, development, production and marketing that turn the ideas into dollars.

In other words, few people who have good ideas have the knowledge, skill or resources to follow-through and to exploit the economic potential of their idea on their own.

The importance of the "follow-through" is referred to in an editorial in the September 2000 edition of Automotive Engineering International which observes, "Obtaining good ideas and great ideas is easy. The key to success …is in their implementation".

This is also the experience of Gilmore Engineers' New Product Development Team which has found that entrepreneurs and companies which are successful in developing new products, are active in the 'making it happen' side of the business.

Conversely, those not fully focussed on the task, who have not researched the pitfalls and are not prepared to work with or accept ideas from others, are less likely to be successful.

Therefore, the key for a company or individual wanting to turn an idea into dollars is to work in conjunction with a group of experienced and reliable advisors - organisations able to provide guidance and support in everything from market research to legal protection to product development to financing, marketing and commercialisation.

According to Gilmore Engineers' President Dr Duncan Gilmore, those that are most successful at exploring new ideas work to a well-planned and visionary schedule.

"Most are also aware that their product will be subject to competition and it is therefore vital to take advantage of the best support and product advice available in order to stay ahead of the competition."

Dr Gilmore said any developer of a new product needed confidence that they could compete effectively, that they had the ability to achieve continual product improvement and to explore broader opportunities in the marketplace.

Gilmore Engineers Pty Ltd has extensive experience in supporting new product development, including expertise in project management.

The company also works closely with organisations skilled in marketing, protection of intellectual property, and obtaining development capital.

# Magnesium - *a Lightweight Solution to Many Problems*

From 'sports wheels' on motor vehicles to use in engine components or hospital racks, magnesium is becoming an increasingly popular material in a wide range of engineering and manufacturing applications.

While magnesium possesses structural properties that provide distinct advantages over many other materials, it also has some disadvantages. It is therefore important that when magnesium is being used the design takes advantage of the favourable properties and minimises the unfavourable physical aspects of the metal.

Magnesium's main advantage is its low density (1740kg/$m^3$) which is less than a quarter of that of steel (7800kg/$m^3$) and about two thirds that of aluminium (2800kg/$m^3$). The lower density can mean reduced weight, a more rugged component through the use of thicker sections, lower cost, or in some cases, a combination of the three.

If the weight of a component can be reduced then it may be possible to reduce the weight and strength of surrounding components, resulting in lower costs overall. Conversely, thicker and stronger sections can be used without a weight disadvantage, thus allowing simplified designs. An example is the use of monocoque construction that eliminates the need for stiffeners and ribs.

The low density of magnesium also allows more rugged construction and an extra safety margin to be built into a component while keeping it to the weight of a steel product. An example is a magnesium lawn mower housing which can resist the impact of stones better than a steel housing.

While the energy required to crack a magnesium component is usually less than in other metals, more energy is required to dent a magnesium component. Magnesium is therefore ideal for the manufacture of luggage or shipping containers.

A further cost-saving advantage is that it does not require special finishing processes and does not discolour when handled like other unfinished metals, which makes it an attractive alternative for use in hand rails.

Magnesium is also the most machineable of all metals and requires less power for metal removal, and produces less wear on tools. A high quality finish can also be obtained without the need for a final, low-feed cut.

However, magnesium does have some disadvantages, including corrosion. Because of its position in the galvanic series, magnesium is subject to corrosion if electrically connected to most others metal in the presence of an electrolyte. To overcome this problem it is necessary to give careful thought to design factors, or to provide a special finish or coating to protect the magnesium.

A number of factors should be considered when deciding if magnesium is the appropriate metal for an application.

- Is light weight important and will the mechanical properties, manufacturing requirements and general design mean that magnesium will serve the purpose better than any other material?

- Will the lower density result in benefits such as lower cost, simpler design or more rugged construction?

- Will the component be subjected to vibration and will the improved damping capacity of magnesium be an advantage?

- Is the non-discolouring surface important and will the surface need to be coated for protective or decorative reasons?

- Is the component likely to encounter a corrosive environment?

- Will the component require complex machining and will low machining costs be important?

## Olympic Success Cont.....

These were among contestants whose training program had benefited from a device developed by Gilmore Engineers to provide information about the forces applied by athletes to the foot bars in their kayaks.

This Foot Pad Sensor (featured in New Product Advantage - May 2000) enabled sports scientists to measure the timing between the upper body paddle action and the subsequent application of leg force through each stroke.

According to David Aitken, Senior Sports Scientist at the Queensland Academy of Sport, the sensor was valuable in providing more information that could be used in training programs.

"The information gained from the sensor adds to the coaches' knowledge and enables them to develop advanced biomechanical training programs for the kayakers," he said.

The eight Foot Pressure Pad Sensors developed by Gilmore Engineers were initially used only by the Queensland Academy of Sport. However, in view of their contribution to advanced training they are now being introduced at the Australian Institute of Sport in Canberra as well.

# Understanding Fires

Fires can be devastating and terrifying occurrences that can ravage a building within minutes, destroying lives and property in the process. Nevertheless, a greater understanding of fires and the factors that influence the way they spread can contribute to improved prevention and control techniques.

Over the past five years Gilmore Engineers Pty Ltd has been involved in investigating and preparing expert witness reports on numerous building, vehicle and machinery fires. However, undertaking a high-level analysis of aspects affecting a fire such as the timescales involved and the movement of heat and smoke and toxic gases, is an extremely complex process and involves a range of computerised modelling tools.

The Failure Analysis Division of Gilmore Engineers (which involves five professional engineers) employs a range of modelling procedures to undertake the analysis of fires.

## 'Hand' Calculations

These calculations are based on empirical data and the basic principles of thermodynamics and chemistry. Generally, these elements are used to analyse very specific and localised features within a fire including heat transfer through walls and doors, the probability of flashover (as gas temperatures increase) and the effect on building structure.

## Zonal Models

These are numerical computer models that essentially solve the conservation equations for energy, mass and momentum through multi-compartment geometry. Each room or compartment of a structure is treated as a two-layer system consisting of a cooler lower layer, and an upper hot gas layer. Empirical correlations which are based on data from experiments and testing are generally included to take account of fire development, the movement of smoke and gases, and the effects of ventilation. While the results obtained from such modelling can provide a much better overview of the fire scenario than either experience alone or hand calculations, only macro features are predicted.

## Field Models

This approach essentially breaks each compartment of a fire into many smaller units (cup size to suitcase size) which are analysed by numerical techniques which can be compared to Computational Fluid Dynamics (CFD). This model allows the prediction of localised 'flow' effects of hot gases, carbon monoxide, smoke etc at any point in a building such as up stairways, through windows or collecting in ceilings. Temperatures, pressures, types of gases and velocities can also be predicted accurately.

## Fire Growth Models

This is a state-of-the-art technology that is even more computationally demanding than the field model, since it also models fire growth and spread through a structure. However, it is generally limited to open plume or simple compartmentalised fire situations.

Research by Gilmore Engineers continues to provide valuable information on the cause of destruction and loss of life by fire. This information provides the basis for determining the most probable method and effects of the spread of fire in specific circumstances. It also contributes to the updating of fire-response training courses and the ongoing review of legislation.

## WEBSITES OF INTEREST

www.austrade.gov.au/ACCESSUSA
*(Business assistance in the world's richest market.*

www.minerals.org.au
*(Australian minerals industry and magnesium information).*

www.fire.nist.gov
*(Building and Fire Research Laboratory, MD, USA).*

*Features of fire behaviour were studied when a derelict Brisbane house was burned down as part of the CrimTrac 15th International Symposium on the Forensic Sciences in March 2000. The 'housewarming' was attended by Dr Nicholas Agnew and Dr Duncan Gilmore of Gilmore Engineers Pty Ltd.*

# Too Much Pressure - *Overstressed...?*

Most mechanisms and structures have components that are in contact with each other, and the safety and reliability of these objects depend to a large extent on how the components interact. It is therefore important to have a detailed understanding of the pressures and stresses that occur between the contact areas in order to ensure that they are taken into account in both the design and manufacture of the product.

For example, it may be necessary to be sure that a highly loaded bolt can be tightened and loosened many times without failing or deforming. It is therefore vital to know whether the load is distributed evenly over the thread or whether there are regions of high stress that may cause a component to deform or fracture.

The method used to obtain this complex and detailed information is computational contact analysis that enables a particular problem to be simulated. A computer model of the object is created which includes information on how various components move in relation to each other and what forces may be involved.

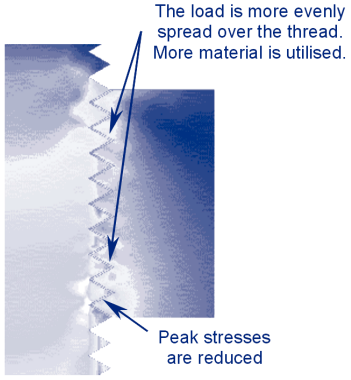
The computer then calculates where the components will make contact, how hard they will press together and what stresses and deflections will occur in each component. Variations in design can then be simulated to establish which design works best.

Nevertheless, computational contact analysis results can be difficult to interpret. Contact areas are often very small giving rise to highly stressed components even when loads are comparatively low. Knowledge of the relationship between theoretical stresses and actual damage is required to interpret computational results and establish if components are likely to fail.

The alternative to computational contact analysis may be an expensive experimental trial-and-error approach which will indicate when a product will fail, but may not give much insight into why it failed, or how a design can be improved.

While computer simulations allow a skilled operator to determine what is happening at any point within a component, physical experiments should be used to verify the simulation. However, the experiments can be kept to a minimum if the simulation is performed correctly. The overall benefit is that products can be designed in the knowledge that they will have higher levels of safety and reliability, and economic advantages as well.

Computational contact analysis is one of the techniques employed by Gilmore Engineers in both new product development and failure analysis procedures which have been utilised by clients throughout Australia and internationally.




Contact analysis showed that "stretching" the thread on the nut by just 0.003 mm reduced peak stress by 30%.

## STOP PRESS

**CRC Press LLC recently invited Gilmore Engineers Pty Ltd to submit a chapter for the 2002 edition of the Mechanical Engineering Handbook, edited by Frank Kreith and M Capobianchi.**

**Company President Dr Duncan Gilmore and Research and Development Engineer Mr Philip Teakle will provide a chapter on "New Product Development", an area in which the company has considerable expertise.**

**This chapter will also be included in an updated version of the current edition of the handbook which is available on the website www.ENGnetBASE.com**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