

# HIGH STRENGTH, IMPACT RESISTANT, ELASTIC COMPOSITE LAMINATES

高强度，抗冲击，有弹性的复合层压板

## ELACO<sup>®</sup> - The Composite Edge

ELACO<sup>®</sup> - 复合材料技术之先锋

[www.elaco.com.au](http://www.elaco.com.au)

### **What is ELACO<sup>®</sup>**

什么是 ELACO?

ELACO<sup>®</sup> is a new concept for creating fibre metal laminate structures exhibiting high impact resistance and damage tolerance.

ELACO<sup>®</sup> 是一种创造纤维金属层压结构的新概念，这种结构体现了高抗冲击和耐损坏性能。

ELACO<sup>®</sup> provides uniquely designed structures for producing innovative fibre/metal composite laminates.

ELACO<sup>®</sup> 提供了用于生产革新性的纤维/金属复合层压板的结构，其设计独特非凡。

ELACO<sup>®</sup> structures are based on cost-effective, standard materials to achieve enhanced performance against cost benefits. For maximum performance, specialised materials such as Carbon, Aramid, etc. can be incorporated into the structure.

ELACO<sup>®</sup> 的结构是基于使用性价比高的标准材料，从而在节约成本的同时提高性能的。为达到最高性能，可在结构中加入诸如碳和聚芳基酰胺等的特殊材料。

ELACO<sup>®</sup> structured laminates display high impact resistance coupled with exceptional levels of elastic deformation.

ELACO<sup>®</sup> 结构的层压板显示出高抗冲击性，同时具有超常水平的弹性形变。

ELACO<sup>®</sup> structured laminates show exceptional properties when compared against other, currently in use, composite structures, which can suffer from brittleness.

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与其他目前使用中的复合结构相比，ELACO® 结构的层压板显示非同一般的性能，而其他结构则较为脆弱易碎。

A Comparison of composite laminates using various materials and composites utilizing ELACO® structures are shown in Figure 1. Notably, the ELACO® based laminates show significantly high levels of impact energy absorption whilst having significantly reduced specific weight.

图一显示了使用各种其它材料的复合层压板与使用 ELACO® 结构的复合产品的对比。显然，基于 ELACO 的层压板显示了非常高水平的冲击能量吸收能力。与此同时材料比重显著地减少。

Figure 1. 图一

### **Advantages of ELACO®**

#### **ELACO® 的优势**

By applying ELACO® principles to design structures for laminated composites, impact resistance is enhanced by utilising significant contributions from the mechanical properties of the reinforcement fibres together with the properties of the composite matrix.

通过把 ELACO® 原理应用到层压复合结构的设计中，利用增强纤维的力学性质与复合材料阵列的性质使其抗冲击性能得到了增强。

ELACO structured composites are able to dissipate outer transversal/perpendicular loading and impact forces and redirect these along the longitudinal axis within the inner plies of the fibre reinforcement, so providing specific beneficial properties, including –

ELACO®结构的复合产品能够耗散外部横向/垂直方向载荷和冲击力量，并且使它们的方向改变成沿内层增强纤维的轴纵向分布，从而提供特殊的材料有益特性。如：

	Thickness [mm]	Density [kg/m <sup>3</sup> ]	Area Weight [kg/m <sup>2</sup> ]	Impact Strength [kJ]	Tensile Strength [MPa]	Tensile Modulus [GPa]
ELACO 1v1	0.5	1,800-2,350	0.900-1.175	not tested	150-210	15-40
ELACO 1v2	2	1,280-1,750	2.560-3.500	3.5	170-450	10-30
ELACO 1v3	4	1,280-1,550	5.120-6.200	3.9	220-640	10-30
Glare	2.6	2,350-2,550	6.110-6.630	0.15	250-650	60-120
Glass/Epoxy	2.5	2,100	5.250	-	140-600	12-45
Carbon/Epoxy	2.5	1,700	4.250	-	220-700	7-200
Steel Mild	1.5	7,850	11.775	4.1	380-650	190-210
Aluminium	2	2,850	5.700	-	90-480	69-72

- high impact strength,

- 高冲击强度
- ❑ high energy-absorbing ability,  
高吸收能量能力
- ❑ high elastic/plastic deformability under impact,  
冲击下高弹性/塑性形变适应能力
- ❑ high percentage of elastic recovery during plastic deformation,  
塑性形变中高比例的弹性恢复能力
- ❑ low density,  
低密度
- ❑ high tensile strength in all directions,  
在所有方向上具有高抗拉强度
- ❑ high fatigue resistance and durability,  
高抗疲劳性及耐用性
- ❑ simple and cost-effective machining and fabricating.  
易于加工和制造，性价比更高

ELACO® structured composites can be produced using most existing manufacturing processes commonly available to the composite/ laminates industry.

ELACO 结构的复合产品的生产可使用复合材料/层压板业界的多数现有常规的工艺。

### **Benefits of ELACO®**

#### ELACO® 的优点

Laminated composites utilising ELACO® structures provide the following benefits for manufacturers and end-users

利用 ELACO 结构的层压复合材料能为制造商和最终用户带来以下好处：

1. Lower component production cost,  
降低组分的生产成本
2. Lower product production cost,  
降低产品的生产成本
3. Increased transportation load capacities,  
增加运输载荷能力
4. Lower fuel consumption,  
降低燃料消耗
5. Lower recycling cost,  
降低再生成本
6. Lower environmental impact,  
减少对环境的影响
7. Lower maintenance costs,  
降低维护成本
8. Increased customer satisfaction,  
用户满意度获得提高
9. Increased corporate profit,  
效益增加
10. Build positive brand awareness,  
建立正面的品牌认知
11. Increased market share,  
增加产品市场占有率
12. Higher share price,  
提高股价

13. Higher market capitalisation,  
提高市场资本总额
14. Increased corporate value.  
增加公司的价值

Primary and secondary structures designed, created and manufactured using ELACO<sup>®</sup>, provide significant advantages for the following industries:  
运用 ELACO<sup>®</sup> 技术设计、创建并制造出的初级和次级结构为以下各行业创造了极大的有利条件:

- aviation (civil and military),  
航空 (民用及军用)
- space (civil and military),  
太空 (民用及军用)
- train and rail industry (civil and military),  
火车及轨道 (民用及军用)
- maritime industry (civil and military),  
海洋工业 (民用及军用)
- automotive industry (civil and military),  
汽车工业 (民用及军用)
- building industry (civil and military),  
建筑业 (民用及军用)
- protective/security industry, related to ballistics (civil and military),  
与发射 (民用及军用) 相关的保护/安全业)
- construction industry, decoration, machinery, furniture and municipal engineering, road-side safety barriers, and similar, multiple general applications.  
建筑业, 装饰, 机械, 家具和市政工程, 路边安全隔离及类似的多种一般应用

***It is extremely important to understand that properties and cost of each composite laminate structure based on ELACO<sup>®</sup> may vary depending on components such as type of fibre used, % of fibre in structure, % and type of resin in structure, type of material and structures used as specific element according to specific product requirements.***

特别重要的是要懂得基于 ELACO 技术所生产的每一种复合层压结构的性质和成本也许不会不同。它们取决于多种要件, 例如所使用的纤维的类型, 结构中纤维的百分比, 结构中树脂类型和百分比, 以及根据特别的产品要求所选用的材料和结构等特别要素。

***When compared to steel, for example steel 1.5 mm thick, ELACO 6 can achieve lower deflection under the same load conditions. Steel of between 2,5 – 3 mm thickness is needed to match the performance of ELACO<sup>®</sup> 6 and, ELACO 6 has the advantage of a 10% weight reduction, a significant benefit, in particular, for the maritime industry including submarines, large ships, etc.***

当与钢相比, 例如 1.5 毫米厚的钢材, 在同样负荷条件下 ELACO 6 可达到更低的挠度。要达到 ELACO 6 产品的性能, 钢材厚度需要 2.5 - 3 毫米。并且 ELACO 6 相对别的产品具有重量低 10% 的优势, 这点对于特别是海洋工业包括潜水艇、轮船等具有极大的好处。

***Use of laminates based on ELACO<sup>®</sup> delivers highly controlled and predictable behaviour under load for many hundreds of possible configurations.***

应用 ELACO 技术的层压板产品可在成百上千种可能的应用配置中表现出高度可控及可预测的承载行为。

### **Opportunities**

#### 机会

The many and varied laminated composite structures uniquely available using ELACO® concept allows the user significant opportunities to apply laminated composite structures to increasing numbers of practical applications.

应用 ELACO® 概念可独特地获得多种多样的层压复合结构，它们给予用户极大的可能性来将层压复合结构应用到数目不断增长的实践应用中去。

ELACO® exhibits easily replicated, tightly controlled behaviour under a wide range of loads, especially under extreme impact loading.

在较大范围的载荷条件下特别是在极端冲击载荷条件下，ELACO® 的行为易于重现并紧密受控。

The physical properties of laminates can be widely varied and precisely tailored to the needs of the particular end-use application. Variety of ELACO® based structures can be created by combining various types of materials in large number of permutations.

层压板的物理特性可以广泛变化且可针对特定最终应用的需求度身定做。通过合并多种材料的大量组合，可形成多样化的基于 ELACO® 的结构。

Consequently, the use of ELACO® in high-tech, high-impact strength, elastic/plastic, cost-effective, lightweight products and components for everyday use in manufacturing, transport, packaging and variety of civil and military industry in general, present an opportunity with global implications for the astute OEM.

因此，若将 ELACO® 应用于制造、交通、包装和多种一般民用和军事工业中的高科技、高冲击强度、弹性/塑性、成本效益高的轻型产品和组件，会为敏锐的 OEM 提供一个蕴含全球化发展意义的机会。

Notably, the examples of ELACO® detailed for illustrative purposes, are a small sample of possible structures based on ELACO®. Further modifications and arrangement of structures are available based on application are uniquely available using ELACO®.

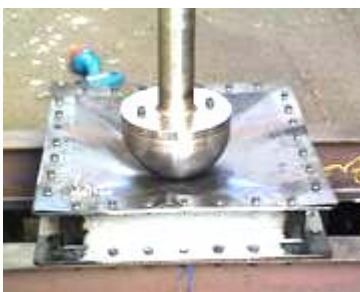
值得注意的是，详示的 ELACO® 样例是用于说明目的的，它们仅仅是基于 ELACO® 的所有可能结构中的一小部分而已。可以根据应用进一步修改和安排结构，利用 ELACO® 即可独特地做到这一点。

Photos of some samples after impact:

下面是一些样品受冲击后的照片：

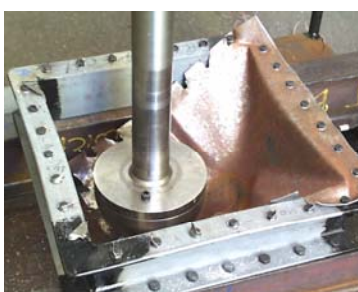
Steel 1.5 mm

钢 1.5 mm



Steel 0.8 mm

钢 0.8 mm



Aluminium 1.5 mm

铝 1.5mm



ELACO® 1  
厚 2.9mm  
Thickness: 2.90 mm



ELACO® 2  
厚 5.0mm  
Thickness: 5.00 mm



ELACO® 6  
厚 15.20 mm  
Thickness: 15.20 mm



See full Video Clip of the testing under [www.elaco.com.au](http://www.elaco.com.au) – Technical Characteristics.

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