THE DESIGN & DEVELOPMENT

by Mike Cawte

Trained as Industrial Designer at Central School of Art & Design in London 1961/64.

Worked in various Industrial Design Consultancies on Projects involving the aesthetic and ergonomic design of products ranging from computers and electronic equipment to coffee grinders and kitchen scales.

Joined Rank Strand in March 1977 as Staff Industrial Designer, working initially on the aesthetic and ergonomic aspects of products such as Duet, Micro 8 Mark II, Galaxy etc., with the Brentford R&D Team.

Took responsibility for Luminaire Development in September 1979 and moved to Kirkcaldy to set up new Luminaire R&D Team, whose major effort has been on the A to Z development programme.

The A to Z Development Project

AT the outset of this project — originally code named A to Z — the following major objectives were identified:

1 — To replace the existing product range and confirm Rank Strand as the leading manufacturer of theatre lighting equipment.

2 — To replace the wide range of manufacturing processes and materials employed in the current range of products with a new co-ordinated range capable of economic manufacture, whilst at the same time providing high quality in performance, durability and safety.

In view of the importance placed on designing for efficient production, it was decided to set up a new luminaire design team alongside the factory in Kirkcaldy where the products were to be manufactured. The close liaison between designers and the manufacturing functions being an essential factor in the design of the new luminaires.

The first major investigations for the new design team were a thorough study into the problems of the optics in order to achieve the high performance specified by the Marketing Department in their original design brief, and a thorough study into the problems of heat, so familiar to luminaire users.

A full time optics design engineer was recruited to control all optics design aspects of the new product range. He previously worked with British Rail, designing railway signalling, where clear visibility over a long distance is of prime importance, requiring highly efficient optical systems albeit over a narrow beam angle. Designing efficient optical systems for theatre luminaires was therefore familiar work to him, simply involving different beam angle and distribution parameters. Having said this, however, the greatest problem was in developing the optics within size constraints dictated by the need to use as many common components and sub-assemblies as possible.

The most interesting development from this work was the design of the Prelude Fresnel Lens. The original performance specification for this product from Marketing required the following performance:

	Spot Position	Flood Position
½ Pk. Angle	8°	45°
1/10 Pk. Angle	15°	50°
Pk. Candelas Using 500W T.18	40,000	4,000

No lens was available to provide this performance within the size constraints of the housing so a new lens was designed giving the following performance:

	Spot Position	Flood Position
½ Pk. Angle	9°	52°
1/10 Pk. Angle	16°	60°
Pk. Candelas Using 500W T.18	52,000	7,700

As will be seen, this exceeded the already high Marketing specification and has been incorporated in the excellent sub kilowatt range, under the name 'Prelude'.

To help in the arduous task of developing the optics from theoretical lens and reflector arrangements to the final pre-production prototypes, an Automated Illuminance Recording System was installed in the Optics Laboratory in Kirkcaldy. This is a microprocessor based system comprising:

1. Photometer — reads beam intensity in candelas and feeds information into the computer.
2. Gonometer — supports luminaire and scans it vertically and horizontally across the photometer head.
3. Computer — takes information from Photometer and Gonometer and produces VDU image of beam distribution curves from which hard copy can be printed along with a listing of beam intensities at all plotted angles.

This system cuts down Lab. Testing time drastically. A full iso candela diagram which, by hand, would have taken five or six hours, now takes about 20 minutes. In addition to this work, a remote terminal is incorporated allowing thorough optical evaluation of production luminaires. This will be an invaluable device in helping to control the quality of products leaving the production lines.

In parallel with the initial optical development work, preliminary mechanical design work was being concentrated on investigations into the heat problems experienced in luminaires. The three main areas being: lamp pinch temperatures, shutter assembly and skin temperatures. These investigations revealed information which could have drastically affected the mechanical construction of the range.

Of the total energy consumed by a luminaire, less than 10% is converted to light and of that, in a twin lens system, up to 20% can be absorbed by lenses and given up as heat again.

Therefore well over 90% of the total energy consumed is given up as heat and is lost to the surroundings by conduction, radiation and convection, the balance depending on the design of the lantern.

Thorough heat tests were carried out using a T.84 insulated with 2-in thick glass wool insulation material, proving that a lantern with a housing cool to the touch, relying on convection only to dissipate heat, was feasible. Moreover, if this convection could be arranged to pass over the lamp pinch this should improve the lamp life.

Work continued on designing and building a prototype to this theory incorporating an efficient baffle system with an insulated housing. The prototype was built around a 1-kilowatt lamp and proved to be remarkably cool to the touch. Most luminaire users would have been more than a little impressed at being able to pick up — by the housing — a 1-kilowatt luminaire which had been running for five or six hours!

However, three factors were against developing this design for production — excessive tooling costs for a complete range and excessive development time required to fully evaluate a design.

So a more traditional approach was taken whilst trying to use as much of this original design work as possible. Current products ranged from the all aluminium die cast Pattern 23 to the all pressed steel T-Spot, neither of which had been designed from the outset as a range of products. Of the two products the Pattern 23 was infinitely more reliable to build and more durable in use. However, the tooling investment required for an all die cast range of products was prohibitive but an essential requirement was to reduce the ever increasing labour cost of manufacturing and assembling complex pressed steel assemblies. The approach was therefore taken of investing in die casting tooling in areas where labour could be reduced, where strength and finish could be provided or where dimensional accuracy was required. Common side extrusion profiles were to be used and cut to required lengths, these extrusions providing features such as fixing points, adjustable fork mounting points and panel mounting grooves, all for no extra labour costs and with very low tooling costs. The remaining sheet metal parts where possible, were designed as progression tool pressings to cut down labour costs on handling between operations or where possible as parts to be produced on the new CNC Turret Punch now installed in the Kirkcaldy Factory. This machine is able to produce complex punched shapes from sheet steel without transferring between machines.

This approach has been the basis for the design of both Prelude and Harmony ranges as well as further products in the pipeline, and I believe the result is a range of luminaires with the same durable qualities so loved in the old Pattern 123 and Pattern 23 products.

The other area of mechanical design which has been given considerable attention has been the one of safety. Every effort has been made to conform to British and European Standards for electrical and mechanical safety.

The most interesting electrical safety feature is probably the use of a detachable input cable which has to be removed before access can be gained through the lamp tray to what would have been live parts. This cable is clipped to the fork so that it never becomes detached from the lantern.

Other examples of the attention to safety requirements are the inclusion as standard of a wire lens guard in all 1-kilowatt products and the inclusion of an attachment point on luminaires for a safety chain rather than relying on looping the chain around the fork which itself could become detached from the lantern.

These products have, then, been designed to provide a high standard of performance and durability and be convenient and safe for the operator to use and maintain whilst being capable of manufacture with consistency and quality. ●