Cyclone Screw Testing

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Universal Multi-Seal Cyclone Assembly

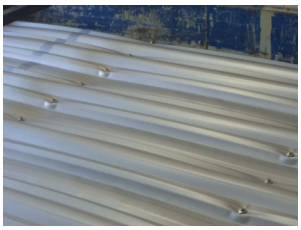
The Hobson Engineering (HEC) DRiLLX screw range incorporates the HEC Universal Multi-Seal Cyclone Assembly. These products are endorsed, like all Hobson products, with the assurance that they have been tried and tested to perform to the high standard that our customers rely on. To ensure full confidence in the Universal Multi-Seal Cyclone Assembly we have completed testing at the James Cook University (JCU) Cyclone Testing Station in Townsville. In discussion with JCU and DEKS Industries, we instructed JCU to carry out Static and Cyclic simulated wind load strength testing of the Assembly.

The Universal Multi-Seal Cyclone Assembly is comprised of a 14-10x53mm self-drilling screw and a bonded 25mm aluminium washer. The washer with a bonded EPDM seal has an improved design giving the assembly greater performance. All tests, static and cyclic Low-High-Low (LHL), were conducted in an airbox as pictured, which is located in the wind tunnel facility at JCU. All trials for this testing were performed in accordance with NATA requirements and in conjunction with JCU, DEKS Industries and our knowledge of the Shed and Roofing Industry. Purlins, cladding and roof sheets were selected to give results best suited to the application of the HEC Multi-Cyclone Assembly.

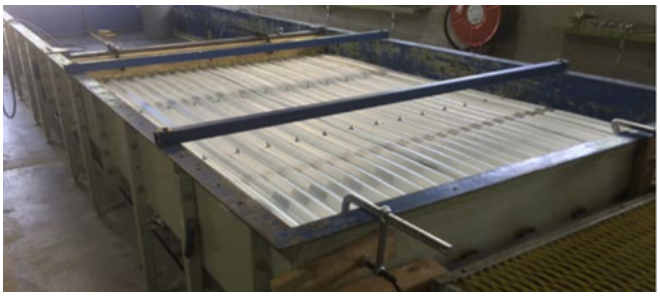
The Airbox

The airbox is an open topped pressure chamber just over 10m long and 2m wide. It is used to simulate wind pressure on structural roof sheeting, wall cladding, fasteners and other various building components. The airbox is used to predict the likely response of products when subjected to high wind pressures. We used the JCU facility to verify the performance of our Universal Multi-Seal Cyclone Assembly and develop span tables to show the design parameters for using this product.

The chamber uses two large centrifugal fans, powered by 45 kW motors. They can generate air pressures far in excess of what the strongest tropical cyclone would inflict on a shed or house. This pressure can be made to simulate the combined effect of both outward/negative pressure (suction) and the internal positive pressure acting on the cladding. Computer controlled valves apply uniform pressure for both static and cyclic pressures to simulate the gustiness within a tropical cyclone or steady state pressure to simulate gale winds. The chamber can be divided into compartments so that strategic opening or closing of the inlet ducts can produce differential pressures, testing the fastener and cladding performance. A manometer was used to measure the applied pressure.



Assembly and cladding under load.



The airbox.

Static Testing

Static testing applies increasing pressure onto the inside face of the roofing sheet in increments, and each pressure is held for a set period of time. This procedure is repeated until failure of either the sheet or assembly or the maximum capacity of the airbox is reached. The last reading at which the assembly was able to support the load is used to calculate the ultimate limit state design pressure. The pressure always finds the weakest link, therefore, completing static testing gave us the data to set the criteria for the LHL cyclic testing..

LHL Cyclic Testing

LHL cyclic testing of the Universal Multi-Seal Cyclone Assembly, cladding and immediate members is carried out over many hours of LHL testing, achieved by opening and closing pressure dump valves to simulate cyclone gusts. The assembly and cladding is subjected to the relevant fatigue loading sequence as shown in Table 1. The fatigue loading sequence increases cyclic simulated wind load strength tests then decreases them back to the starting load. During the test the assembly and cladding are examined for any permanent distortion, fracture or damage.

Sequence	No. of Cycles	Cummulative Cycles	Load
A	4500	4500	0 to 0.45 P_t
B	600	5100	0 to 0.60 P_t
C	80	5180	0 to 0.80 P_t
D	1	5181	0 to 1.00 P_t
E	80	5261	0 to 0.80 P_t
F	600	5861	0 to 0.60 P_t
G	4500	10361	0 to 0.45 P_t

Table 1: Low-High-Low Fatigue Loading Sequence

Conclusion

As previously mentioned, in order to replicate the typical materials used in domestic dwellings, steel sheds, garages and roofing, HEC conducted extensive testing using three base metal thicknesses (BMT) of cladding supports, purlins and roof battens, and two types of commonly used cladding. The cladding selected was 0.42 mm Monoclad and Corrugated sheeting, and 0.75 mm top hat roofing battens, 1.0 mm and 1.5 mm BMT purlins. The top hat material was fixed into timber supports using HEC 12-11 x 40 mm vmaX® batten screws, and various spans were tested. Testing was carried out in accordance with AS 1562.1 and AS 4040.2. The following span tables were then produced after conducting three static simulated wind load strength tests, and nine LHL cyclic tests.

With design pressures for the proposed building determined, Engineers can use the span tables to specify the HEC Universal Multi-Seal Cyclone Assembly in accordance with design loads on sheds, garages or domestic dwellings in cyclonic regions throughout Australia. The span tables provide valuable knowledge and information for the correct spans and number of assemblies required, and will assure our distributors that this product will perform and can be sold with confidence. The HEC Multi-Cyclone Assembly is available in plain and Colorbond® colours.

Steel Sheds and Garages in Cyclonic Regions

- 0.42 BMT Monoclad fixed to 1.5mm BMT purlin
- 3 equal spans and greater than 3 spans
- 5 fasteners per sheet at 190mm ctrs
- HEC Multi-Cyclonic Assembly, 14-10 x 53mm self-drilling carbon screw
- HEC 25mm diameter aluminium washer with bonded EPDM seal

Span (mm)	Strength Limit State Capacity (kPa) - Cyclonic
1200	3.82
1100	4.08
1000	4.34
900	5.07
800	5.81
700	6.54
600	7.27

Table 2: Monoclad Span table (3 Spans or greater)

Domestic Dwellings in Cyclonic Regions

- 0.42 BMT Corrugated fixed to 0.75mm BMT purlin
- 3 equal spans and greater than 3 spans
- 6 fasteners per sheet at 152mm ctrs
- HEC Multi-Cyclonic Assembly, 14-10 x 53mm self-drilling carbon screw and 12-11 x 40mm
- HEC vmaX® batten screws
- HEC 25mm diameter aluminum washer with bonded EPDM seal

Span (mm)	Strength Limit State Capacity (kPa) - Cyclonic
900	4.96
800	5.40
750	5.62
700	6.11
600	7.08

Table 3: 0.42 BMT Span table (3 Spans or greater)