

# DC FAN LIFE EXPERIMENT REPORT

|                                                                                                                                                                                                          |  |  |  |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|
| Available for these models with lower speed and same physical structure. All model may be followed by Rxx or Fxx series suffixes. This test report applies to PFB 120x120x38mm series as the right table |  |  |  |  |  |
|                                                                                                                                                                                                          |  |  |  |  |  |
|                                                                                                                                                                                                          |  |  |  |  |  |
|                                                                                                                                                                                                          |  |  |  |  |  |

**Representative Test P/N:** PFB1224UHEC8X\_\_

**Equipment:** 1.Oven: F00-5, E24-T060 2. DC Source: GW GPC-3060D

**Life Expectancy:** **L10** **50,000** hours minimum @ fan rated voltage and the temperature of 50°C

According to the equation for **Weibull distribution**, **MTTF**  $7 \times L10 =$  **350,000** hours

And we rely on a zero failure Weibull test strategy and accelerated testing technique, to determine the total test time (**t**) for verifying the above life estimation by the equations,

$$t = 1.036 \times MTTF \times [(B_r; c) / n]^{0.91} / AF, \text{ and } AF = 2^{(Ts-Tu)/10}$$

where, ( $B_{r;c}$ ) is Poisson distribution factor with the failure number of r equal to 0 and the decimal confidence level of c equal to 0.90(90%).

| Stress/Elevated Temperature<br>$T_s$ (°C)<br>(Actual Test Temperature) | Unstress Temperature<br>$T_u$ (°C) | Acceleration Factor<br>$A_F$ | Quantity of Test Devices<br>$n$ (pcs) | Poisson Distribution Factor<br>$B_{r;c}$ | Required test time with zero failure<br>$t$ (hours) | Actual test time with zero failure<br>$t$ (hours) | Verified MTTF<br>50°C<br>(hours) | Verified L10<br>50°C<br>(hours) |
|------------------------------------------------------------------------|------------------------------------|------------------------------|---------------------------------------|------------------------------------------|-----------------------------------------------------|---------------------------------------------------|----------------------------------|---------------------------------|
| 70                                                                     | 50                                 | 4.00                         | 30                                    | 2.303                                    | 8,767                                               | 9,205                                             | 367,466                          | 52,495                          |

## Test Progress:

| Date for Test Beginning | Date for Test Termination<br>(at least) | Current Test Status                 |                                                                      |                                      | Current Total Test Time (hours) |
|-------------------------|-----------------------------------------|-------------------------------------|----------------------------------------------------------------------|--------------------------------------|---------------------------------|
| 25-Jun-18               | 11-Oct-19                               | <input type="checkbox"/> In process | <input checked="" type="checkbox"/> In process<br>(exceed requested) | <input type="checkbox"/> Termination | 9,205                           |

Herewith , we could assume as right on the basis of above test result. Besides, if the actual test time exceed the required, it comes out that those fans' L10 expectancy and MTTF are greater than the warrant. ( MTTF : means Mean Time To Failures, it should be used in a non-repairable system setting. Now we show the MTTF in our life report, that's because we will not repair the failed fans during life experiment. MTBF: means Mean Time Between failures, it should be used in a repairable system setting).

| Temperature for MTTF Estimation<br>( ) | Acceleration Factor<br>$A_F$ | Estimated MTTF (hours)                            | Estimated L10 (hours) |
|----------------------------------------|------------------------------|---------------------------------------------------|-----------------------|
| 25                                     | 22.63                        | 2,078,700                                         | 296,957               |
| 30                                     | 16.00                        | 1,469,863                                         | 209,980               |
| 40                                     | 8.00                         | 734,932                                           | 104,990               |
| 50                                     | 4.00                         | 367,466                                           | 52,495                |
| 60                                     | 2.00                         | 183,733                                           | 26,248                |
| 70                                     | 1.00                         | 91,866                                            | 13,124                |
|                                        |                              |                                                   |                       |
| <b>Test Result</b>                     |                              | <input checked="" type="checkbox"/> <b>Accept</b> |                       |
|                                        |                              | <input type="checkbox"/> <b>Reject</b>            |                       |

Fan acceptance criteria for the measurements after test :

- Speed can not decrease  $\geq 15\%$  below the original measured RPM.
- Current cannot increase  $> 15\%$  over original measure current.
- Noise cannot increase  $> 3\text{dB}$  over the original measured noise.

| QE File No. | Time-out for function test or others (hours) | Date of issue | Reported By   | Approved By |
|-------------|----------------------------------------------|---------------|---------------|-------------|
| TH18FNL004  | 2,147                                        | 11-Oct-19     | Natthichakorn | Niranam     |



# DC FAN FUNCTION TEST RECORD FOR CUSTOMIZED LIFE EXPERIMENT

Available for these models with lower speed and same physical structure. All model may be followed by Rxx or Fxx series suffixes. This test report applies to PFB 120x120x38mm series as the right table

| Required Test Time (hrs)                                      | Date for Test Beginning | Date for Test Termination | Sample Size (pcs):  | Failure (pcs):                      | Current Total Test Time (hrs)                                                                          |
|---------------------------------------------------------------|-------------------------|---------------------------|---------------------|-------------------------------------|--------------------------------------------------------------------------------------------------------|
| 8,767                                                         | 25-Jun-18               | 11-Oct-19                 | 30                  | 0                                   | 9,205                                                                                                  |
| Representative Test P/N: PFB1224UHEC8X__                      |                         |                           | Current Test Status | <input type="checkbox"/> In process | <input checked="" type="checkbox"/> In process (exceed requested) <input type="checkbox"/> Termination |
| Equipment: 1.Oven: F00-5, E24-T060 2. DC Source: GW GPC-3060D |                         |                           |                     |                                     |                                                                                                        |

## Test Data Between Initial Test and Final Test

| Sample No. | Initial Test              | Final Test                | Deviation (%) | Initial Test               | Final Test                 | Deviation (%) | Initial Test                 | Final Test                   | Deviation dB |
|------------|---------------------------|---------------------------|---------------|----------------------------|----------------------------|---------------|------------------------------|------------------------------|--------------|
|            | Current Spec. Max (A) 2.4 | Current Spec. Max (A) 2.4 |               | Speed Spec. REF (RPM) 5500 | Speed Spec. REF (RPM) 5500 |               | Noise at 1 m Max (dB A) 70.5 | Noise at 1 m Max (dB A) 70.5 |              |
| 1          | 1.76                      | 1.83                      | 4.2           | 5738                       | 5368                       | -6.4          | 68.5                         | 68.3                         | -0.2         |
| 2          | 1.84                      | 1.79                      | -2.7          | 5381                       | 5386                       | 0.1           | 68.4                         | 68.4                         | 0.0          |
| 3          | 1.85                      | 1.78                      | -3.5          | 5403                       | 5372                       | -0.6          | 68.8                         | 68.2                         | -0.6         |
| 4          | 1.78                      | 1.72                      | -3.3          | 5528                       | 5366                       | -2.9          | 68.9                         | 68.1                         | -0.8         |
| 5          | 1.68                      | 1.70                      | 1.4           | 5613                       | 5272                       | -6.1          | 69.1                         | 68.0                         | -1.1         |
| 6          | 1.76                      | 1.73                      | -1.4          | 5399                       | 5371                       | -0.5          | 68.7                         | 68.2                         | -0.5         |
| 7          | 1.79                      | 1.75                      | -2.2          | 5296                       | 5397                       | 1.9           | 68.8                         | 67.9                         | -0.9         |
| 8          | 1.74                      | 1.71                      | -1.7          | 5449                       | 5386                       | -1.2          | 68.9                         | 68.3                         | -0.6         |
| 9          | 1.63                      | 1.65                      | 1.4           | 5661                       | 5310                       | -6.2          | 68.7                         | 68.4                         | -0.3         |
| 10         | 1.80                      | 1.76                      | -2.1          | 5424                       | 5404                       | -0.4          | 68.8                         | 68.2                         | -0.6         |
| 11         | 1.77                      | 1.75                      | -1.3          | 5308                       | 5375                       | 1.3           | 68.7                         | 67.3                         | -1.4         |
| 12         | 1.71                      | 1.69                      | -1.1          | 5446                       | 5284                       | -3.0          | 68.9                         | 68.2                         | -0.7         |
| 13         | 1.75                      | 1.78                      | 1.9           | 5793                       | 5400                       | -6.8          | 68.6                         | 67.9                         | -0.7         |
| 14         | 1.76                      | 1.73                      | -1.5          | 5312                       | 5385                       | 1.4           | 68.7                         | 68.3                         | -0.4         |
| 15         | 1.79                      | 1.76                      | -1.5          | 5411                       | 5376                       | -0.6          | 68.6                         | 68.2                         | -0.4         |
| 16         | 1.78                      | 1.75                      | -1.7          | 5525                       | 5352                       | -3.1          | 68.7                         | 68.5                         | -0.2         |
| 17         | 1.72                      | 1.69                      | -1.6          | 5553                       | 5375                       | -3.2          | 69.1                         | 68.3                         | -0.8         |
| 18         | 1.80                      | 1.78                      | -0.9          | 5411                       | 5428                       | 0.3           | 68.7                         | 68.4                         | -0.3         |
| 19         | 1.74                      | 1.73                      | -0.7          | 5444                       | 5384                       | -1.1          | 69.2                         | 68.5                         | -0.7         |
| 20         | 1.76                      | 1.75                      | -0.6          | 5577                       | 5362                       | -3.9          | 68.4                         | 68.6                         | 0.2          |
| 21         | 1.69                      | 1.67                      | -1.0          | 5772                       | 5292                       | -8.3          | 68.5                         | 68.1                         | -0.4         |
| 22         | 1.84                      | 1.80                      | -2.1          | 5470                       | 5405                       | -1.2          | 68.6                         | 68.3                         | -0.3         |
| 23         | 1.83                      | 1.77                      | -3.2          | 5521                       | 5399                       | -2.2          | 68.5                         | 67.9                         | -0.6         |
| 24         | 1.70                      | 1.77                      | 4.3           | 5475                       | 5302                       | -3.2          | 68.4                         | 68.1                         | -0.3         |
| 25         | 1.76                      | 1.80                      | 2.6           | 5771                       | 5416                       | -6.2          | 68.6                         | 67.9                         | -0.7         |
| 26         | 1.84                      | 1.76                      | -4.1          | 5431                       | 5392                       | -0.7          | 68.7                         | 67.8                         | -0.9         |
| 27         | 1.78                      | 1.73                      | -2.9          | 5293                       | 5368                       | 1.4           | 68.8                         | 68.3                         | -0.5         |
| 28         | 1.81                      | 1.74                      | -3.8          | 5554                       | 5389                       | -3.0          | 68.9                         | 68.5                         | -0.4         |
| 29         | 1.82                      | 1.78                      | -2.0          | 5562                       | 5415                       | -2.6          | 68.8                         | 68.4                         | -0.4         |
| 30         | 1.75                      | 1.79                      | 2.2           | 5380                       | 5407                       | 0.5           | 68.6                         | 68.2                         | -0.4         |
| X-bar      | 1.77                      | 1.75                      | -             | 5497                       | 5371                       | -             | 68.7                         | 68.2                         | -            |
| $\sigma$   | 0.05                      | 0.04                      | -             | 142                        | 40                         | -             | 0.2                          | 0.3                          | -            |

| QE File No. | Time-out for function test or others (hours) | Date of issue | Reported By   | Approved By |
|-------------|----------------------------------------------|---------------|---------------|-------------|
| TH18FNL004  | 2,147                                        | 11-Oct-19     | Natthichakorn | Niranam     |