

Comments on the HKMPA energy label standard, draft 1

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March 10, 2014

Injection moulding machine energy consumption classification

Fully-electric machine

It is interesting to see that a fully-electric machine is not more energy saving than servopump machines. It is guessed that in order to avoid temperature override in barrel temperature, the barrel insulation was sacrificed. Had barrel heating energy consumption been measured separately, the motion energy consumption should have shown a lower value for fully-electric machine (and the barrel heater energy consumption shown a higher value) than servopump machines.

Three classes

The use of three classes is the minimum. It can tell apart servopump/fully-electric based machines from variable displacement pump machines and from fixed displacement pump machines.

Note that the Industrial standard has 6 classes, and Euromap 60.1 has 10 classes.

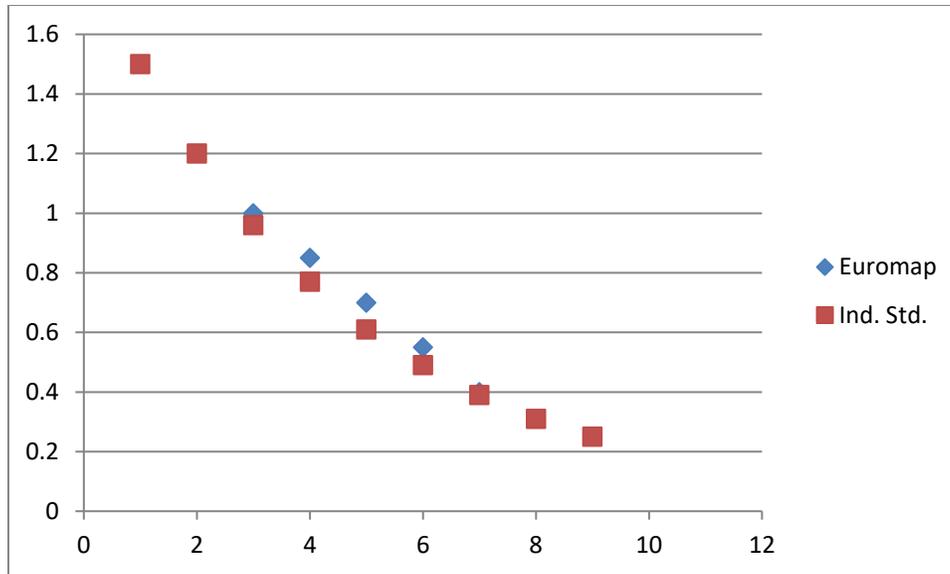
It was noticed that there are no data points in Class 2.

Class dividing lines

Euromap 60.1 has the following dividing lines for its 10 classes.

Euromap 60.1	
Class	Dividing line
1	>1.5
2	=<1.5
3	=<1.2
4	=<0.96
5	=<0.77
6	=<0.61
7	=<0.49
8	=<0.39
9	=<0.31
10	=<0.25

The values of the dividing lines are marked by the brown squares below.



The Industrial standard has the following dividing lines for its 6 classes.

- | | |
|---|--------|
| 1 | >1 |
| 2 | =<1 |
| 3 | =<0.85 |
| 4 | =<0.7 |
| 5 | =<0.55 |
| 6 | =<0.4 |

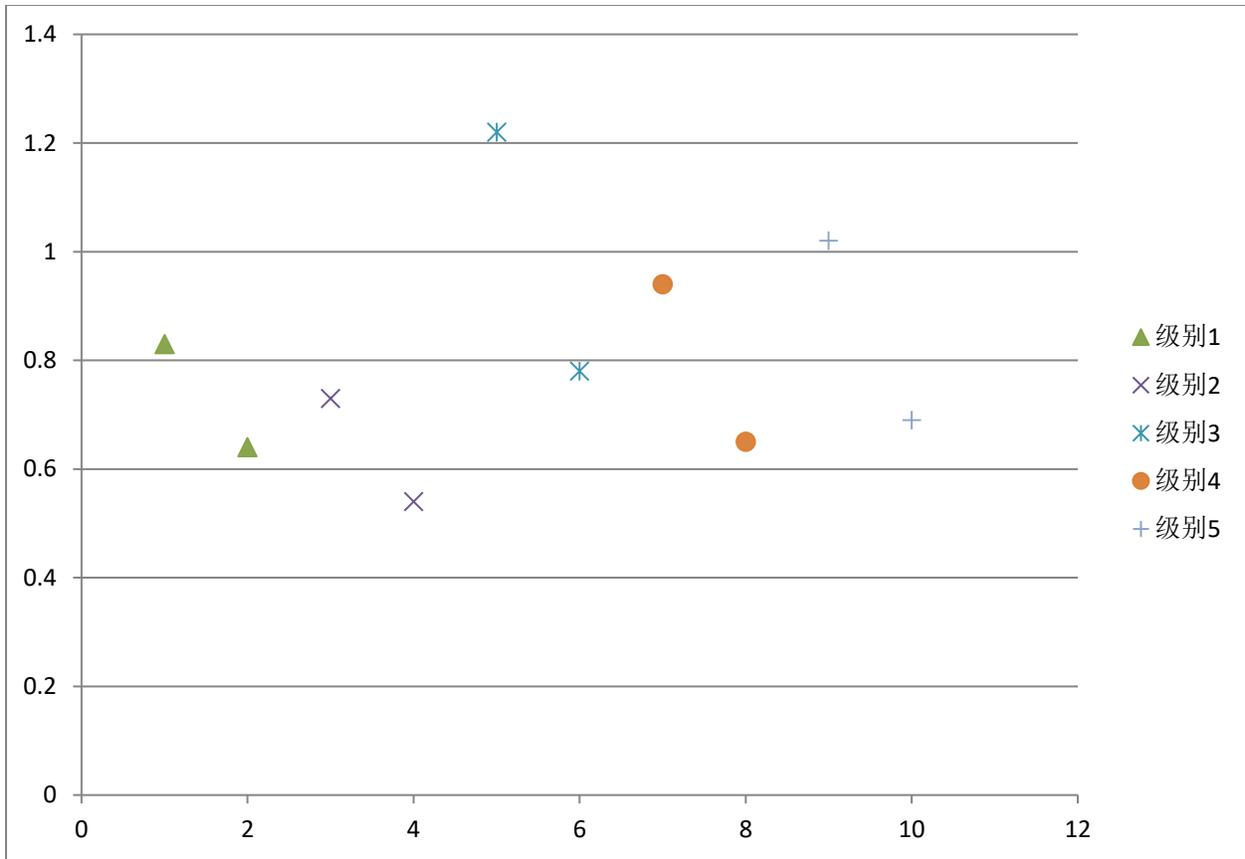
The blue diamonds above mark the values of the dividing lines of the Ind. std.

The five blue diamonds more or less match the middle 5 brown squares of Euromap 60.1. Alternatively, Euromap 60.1 could be thought of as extending the 6 classes of the Ind. std. to 10 classes by adding two classes at each end.

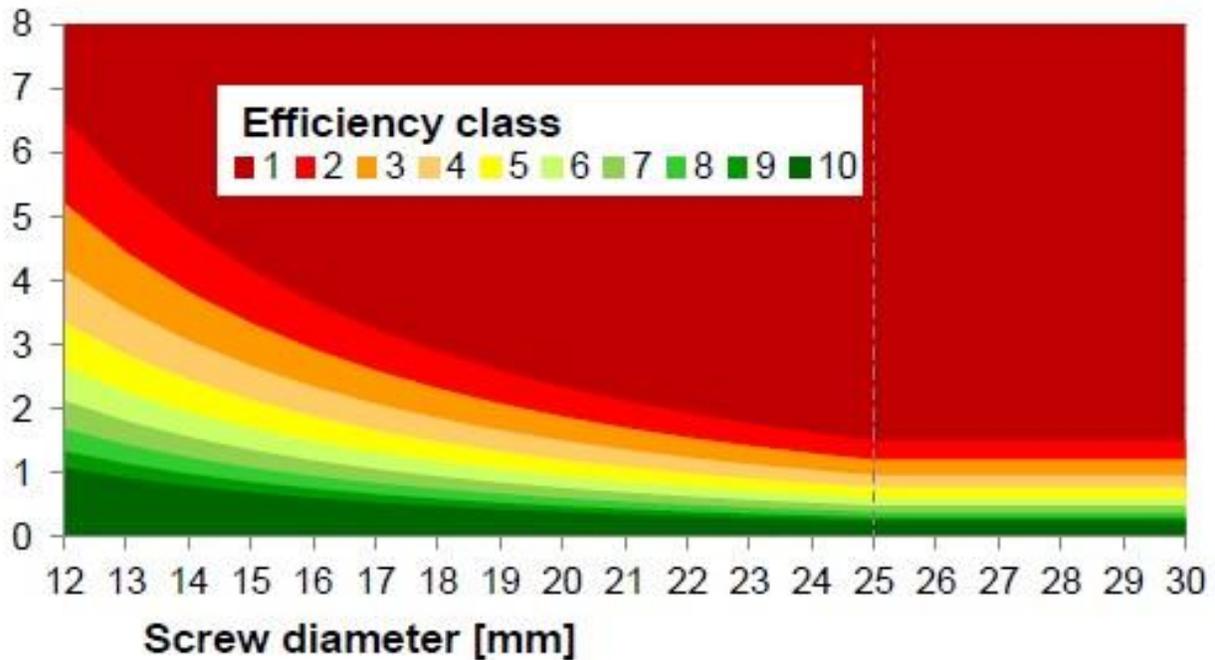
The Euromap squares form a geometric series so the squares trace a curved locus on the linear scale.

The Ind. std. diamonds form an arithmetic series so the diamonds trace a straight locus on the linear scale.

The HKPMA dividing lines are dependent on 级别。They are plotted below for the 5 级别。



The dividing lines of 级别 2 being lower than those of 级别 1 are expected. The same is shown in the Euromap 60.1 specification for screw diameter below 25 mm.



It is believed the ‘mass production’ nature of the bigger diameter screw reduces the kWh/kg value, and plasticizing is the dominating consumer of energy in an injection moulding cycle. As a result, the fact the dividing lines for 级别 3、级别 4、级别 5 are higher than those of 级别 1 and 级别 2 is not in line with this theory.

Lower dividing line

The lower dividing line of the 5 级别 are studied below.

级别 1

The two data points are 0.4548 and 0.5908. The dividing line at 0.64 is 8% above the 0.5908 point.

级别 2

The five data points are 0.3475, 0.3815, 0.3956, 0.4716, 0.5048. The dividing line at 0.54 is 7% above the 0.5048 point.

级别 3

The four servomotor/fully electric data points are 0.3265, 0.4, 0.4005, 0.4364. The variable displacement pump data point is 0.4801. The dividing line at 0.78 is 79% above the 0.4364 point and 62% above the 0.4801 data point.

At 8% above the 0.4364 data point, a dividing line at 0.47 is more reasonable. Furthermore, this dividing line would have put the variable displacement pump data point into class 2.

级别 4

The four servomotor/fully electric data points are 0.3656, 0.3810, 0.4160, 0.4461. Two variable displacement pump data points are 0.4804 and 0.5012. The dividing line at 0.65 would have included all the points.

A dividing line set at 0.45 would separate out the variable displacement pump machine.

A dividing line set at 0.43 would separate out the fully electric machine data point at 0.4461. In this case, the fully electric machine is paying a price for its less barrel insulation in order to reduce temperature override.

级别 5

The three data points are 0.3600, 0.4354, 0.5184. A dividing line at 0.69 would have included all the points.

A dividing line at 0.4 would have included only the 0.3600 data point.

Note that 0.4 kWh/kg is the dividing line below which is class 1 in Industrial standard. Similarly, 0.39 kWh/kg is the dividing line below which is class 8 in Euromap 60.1.

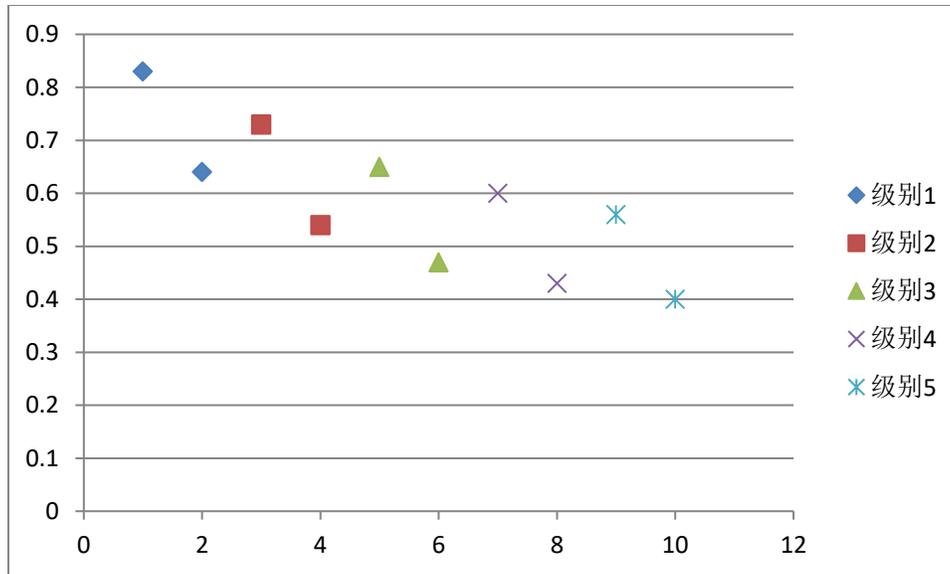
If the lower dividing lines for the five classes are 0.64, 0.54, 0.47, 0.43, 0.40, they will plot as shown in the graph below.

Upper dividing lines

Let us add 0.19, 0.19, 0.18, 0.17, 0.16 to the lower dividing lines to get the upper dividing lines at 0.83, 0.73, 0.65, 0.6, 0.56.

The graph on page 6 looks more like the Euromap graph on page 4 than the graph on page 3 does.

Please notice that the dividing lines for 级别 5 is 0.56 and 0.40, which are almost the same as that of Industrial standard's at 0.55 and 0.40. It is understood there are many differences between the two standards, e.g. material, barrel temperature, mould, part thickness, etc.



These dividing lines would put all the servopump/fully electric machines in 级别 1, 2 and 3 into Class 1 and the variable displacement pump machine in 级别 3 into Class 2.

They will also put all the servopump machines in 级别 4 into Class 1 and the fully electric and variable displacement pump machine into Class 2.

Only one machine in 级别 5 will be in Class 1. The remaining two servopump machines are in Class 2.

In all 级别, the fixed displacement machines are in Class 3.

Setting dividing lines so there are data points in Class 1, Class 2 and Class 3 could be better.

Auxiliary data

Other than proclaiming the energy class an injection moulding machine falls into, additional information like cycle time, 级别, shot weight could be provided by the manufacturer.

Hopper dryer energy consumption classification

There are two ways to save on hopper dryer energy consumption. One is using recycled air, the other is providing insulation.

Using recycled air has the following issue. Recycled air carries the moisture removed from the resin. The drying effect using recycled air is different from that using atmospheric air.

It would be interesting to see the difference insulation provides but there were no data points comparing insulated and uninsulated hopper dryers.

Mould temperature controller energy consumption classification

For 组别 2, point 5 at 2.5994 is about twice of point 4 at 1.2846.

For 组别 3, point 2 at 7.4038 is about seven times of point 1 at 1.1090.

It would be interesting to find out the reason for the big difference.

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