

## CHAPTER 3: JS FACTORY MOULD SURVEY

In an attempt to better understand the conditions under which moulds are used, it was decided to investigate the moulds used at the Jonker Sailplanes factory. The daily wear and tear on moulds, as well as the resultant surface quality and general condition of moulds in a serial production environment, were investigated.

A survey was conducted where general information on the mould construction material, mould usage and surface roughness was gathered. This information was used to determine the durability of a mould manufactured from different materials as well as the degradation of the surface finish with use.

In view of the information obtained on the degradation of moulds after a few production cycles, insights could be reached regarding which type of a certain mould feature is more practical and durable than another. From a design point of view, the features might provide the same result, but if used in production for a while one feature might stand out as more practical in comparison to another.

Appendix A provides the data captured during the survey. This section will discuss the results as processed from the information captured.

### 3.1 TYPE OF INFORMATION GATHERED

At JS, a wide variety of different moulds manufactured from different materials is in use. The moulds can be divided into three broad groups. These are (1) moulds manufactured from so-called pink board, (2) composite moulds and (3) wooden moulds.

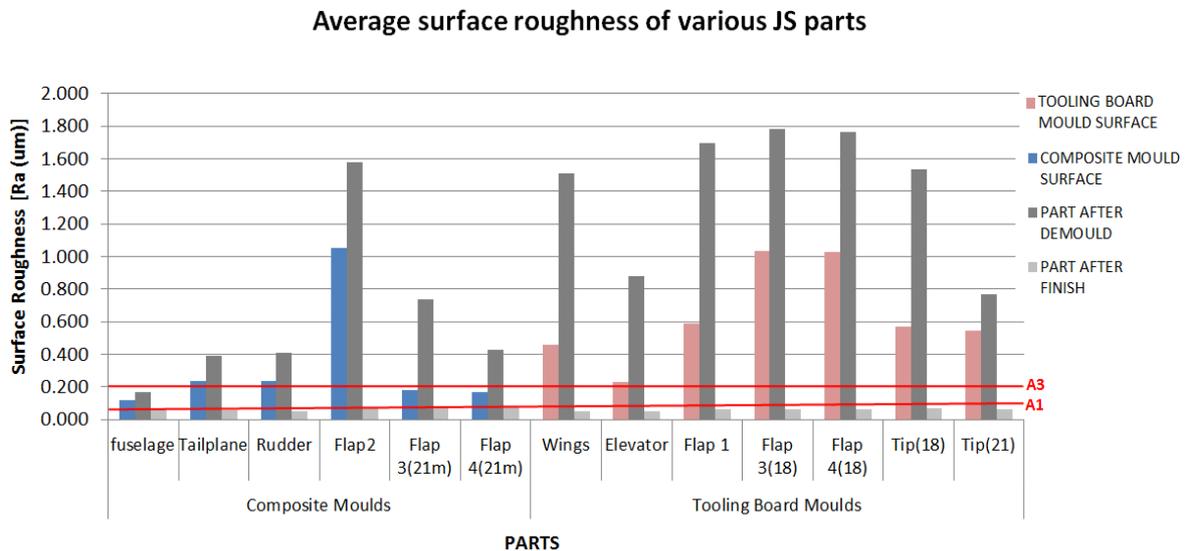
The following information was gathered during two of the normal 10 day production cycle, during February 2013:

- ◆ Surface roughness of the mould surface, part after demoulding and part after finishing
- ◆ Construction and dimensions of mould
- ◆ Demoulding, trimming and alignment features
- ◆ Mould material and dimensions

- ◆ Release agent used with mould, and
- ◆ Finishing times of the part.

### 3.2 RESULTS OBTAINED FROM SURFACE ROUGHNESS MEASUREMENTS

The surface roughness of the mould surface, the part surface after demoulding, as well as the part surface after finishing were measured. Twelve values on each part or mould were measured and the average of each was calculated. These average values are indicated in the Figure 3-1. (Refer to Chapter 4, Test 1 for Class A1,2,3 Ra values indicated on the graphs):



**Figure 3-1: Average surface roughness of various JS parts and their mould surfaces**

From Figure 3-1 above it can be observed that the average surface roughness (Ra) after finishing, of all the parts, is around 0.065 um, Class A1. This means that all the JS parts are finished to the same standard. This standard, however, requires different amounts of effort of finishing, as one can gather from the difference between the part after demoulding and part after finishing. This difference varies slightly between parts manufactured from composites moulds and parts manufactured from tooling board moulds. This is illustrated in the Figure 3-2.

From Figure 3-2 it can be gleaned that the average composite mould surface has a better surface roughness than the average tooling board mould surface. The tooling board mould surface has an average surface roughness of around 0.68 um, while the average composite mould surface roughness was around 0.33 um (neither is Class A). This can possibly be

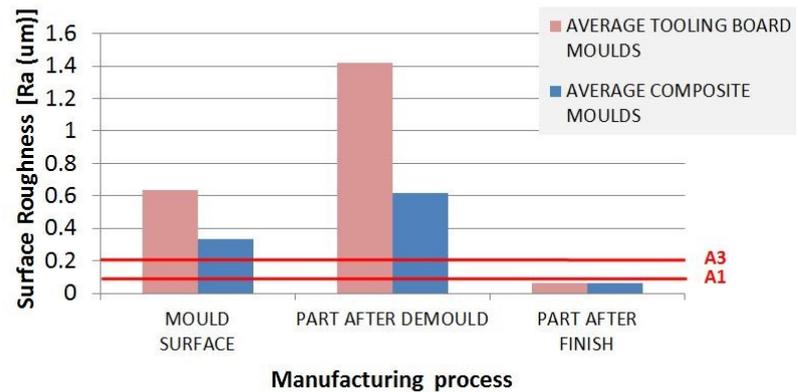
attributed to the original surface finish of the plug from which the composite moulds was manufactured.

This showed that, on average, the composite surfaces did not only have about a 50% better surface finish than the tooling board surfaces, but it also produced a 60% better surface than the tooling board surfaces.

It was historically found that there is a tendency at JS to finish a plug from which a composite mould was to be manufactured to a higher standard as the surface for a tooling board mould. The rationale here is that tooling board moulds are only temporary moulds and there is a mind-set that permanent composite moulds will still be manufactured, although those moulds often do not actually get manufactured.

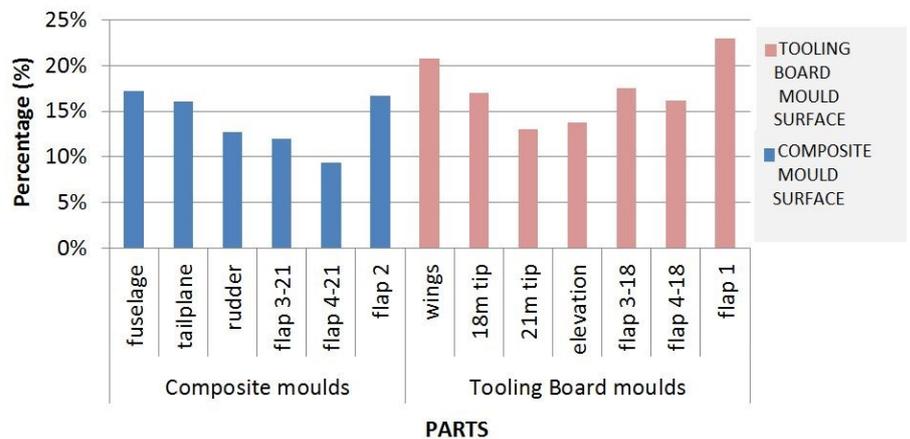
This results in lower quality part surfaces than could be obtained if the moulds were of a higher quality. This tendency is further shown by evaluating the percentage of finishing time spend on finishing the parts to a P600 grit, Class B surface, for the different types of mould surfaces, as illustrated in Figure 3-3. On average, the parts demoulded from the composite moulds had a 3% higher P600 and required more finishing than the tooling board moulds.

**Average surface roughness of composite moulds versus tooling board moulds**



**Figure 3-2: Average surface roughness of composite moulds versus tooling board moulds**

**Percentage of P600 and lower finishing required of various JS parts**



**Figure 3-3: Percentage of P600 and lower sanding of various JS parts.**

### 3.3 GENERAL RESULTS OBTAINED

The general data captured here comprised information that was not directly related to the surface finish of the part, but nonetheless proved valuable information for the manufacturing of moulds. This information can be summarised as follows:

- ◆ **MOULD BACK STRUCTURE:** All moulds make use of metal frame structures. Some of these structures are bonded directly to the mould and others have composite bracket attachments.
- ◆ **RELEASE AGENTS:** All the moulds surveyed made use of the Loctite Frekote 770-NC release system.
- ◆ **CLAMPING METHODS:** All moulds make use of G-clamps. They do not have dedicated clamping positions or indicated clamping forces.
- ◆ **DEMOULDING:** Parts are demoulded using screw drivers, wedges etc. No proper demoulding assistance was noted.
- ◆ **TRIMMING:** Trimming occurs before closure on mould, as well as after demoulding. Trimming tools are used directly on mould surfaces. A few moulds, like the fuselage and wing moulds have trim plates, but not all the moulds do.
- ◆ **ALIGNMENT:** Metal alignment on pins and bushes are used for all moulds. Dimensions of pins vary and no two moulds have the same pins.
- ◆ **VACUUM ASSISTANCE:** All moulds have vacuum ports dedicated for vacuum bagging, but no further assistance is given. Vacuum bagging occurs with no disposable plastic bags and does not proceed with permanent vacuum bags.

### 3.4 CONCLUSION

The mould survey proved that composite tooling does deliver, on average, a 60% better part surface than tooling board moulds, due to the tooling board moulds being more prone to damage than the composite tooling. However, with a finish of only 0.33  $\mu\text{m}$  the average composite moulds in the JS factory are still not Class A finished moulds.

It was clear that a well-developed mould manufacturing process was not in place and that each mould was manufactured according to the best practice of the specific engineer and technician developing that particular mould. This implies that different manufacturing

standards exist, and thus varying production results have been found for the produced components. As a result, most components required a great deal of effort to finish to the required Class A finish. JS will benefit from a concise and uniform mould-manufacturing standard.