**732**

**Joining Methods in Aeronautical Applications**

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**Acknowledgement**

Mr John Gibson is a highly regarded educator and engineer. John taught Industrial Arts at a number of high schools before taking a position at Sydney Teachers’ College, then University of Sydney. He had an engineering education consultancy and has extensive experiencing working with NESA on Engineering Studies syllabus development and the HSC examination committee. The STEM Industry School Partnerships (SISP) Program asked John for his responses to the iTeachSTEM topic discussion questions. SISP is grateful to John for submitting these example discussion responses.

# Discuss why the welding of materials is used in many engineering applications.

* there is a large array of suitable welding materials and processes
* the equipment is relatively small in size
* it is convenient
* it is efficient
* minimal plate preparation is required
* minimal plate clean-up afterwards
* there is minimal waste
* it has good strength and ductility value

1. **Describe potential issues with the welding of materials.**
* **Manual Arc Welding** – entrapped slag, hydrogen embrittlement, incorrect joint reinforcement
* **Oxy-acetylene Welding** – carbon-rich flame, excess temperature, blow holes, expansion/contraction – distortion
1. **Describe the process of welding mild steel sheets and the macro structure of the grains after welding.**
* **Manual Arc Welding** – Place the edge of two sheets to be welded, side by side. Connect the welder to the work and the rod to the handpiece. Set the required current rating and choose the correct welding rod size, and flux. Using an approved welding helmet, strike an arc between the welding rod and the work, causing the rod and the join in the sheet to melt. Move the rod along the joint, using correct technique. The joint will fill with molten metal. Cool and solidify, creating a neat, strong joint.
* **Oxy-acetylene Welding** – Place the edge of two sheets to be welded, side by side. Clamp the two sheets. Set the equipment in preparation for welding – cylinder of acetylene gas and, cylinder of oxygen gas. Attach the regulator, gauges and blowpipe to the bottles. Note maximum pressure of cylinders and set required flow rate for the blow torch. Light the blow torch. Adjust to neutral flame. Prepare the welding rod material ready to be fed into the joint. Start heating an area around the joint. When hot enough (bright red), feed the filler rod into the joint so as to melt both the joint and the rod. Use correct safety glasses to protect the eyes. AND remember to close down the two cylinders **properly** for safety when finished.

*(add macrostructure diagram)*

1. **Describe the advantages and disadvantages of adhesives used for aircraft applications.**

**Advantages:**

* allows combination of different materials
* avoids local loads
* no metallurgical damage
* no distortion
* allows accurate assembly
* has little or no residual stress
* repair is simpler than welding
* corrosion is reduce
* fatigue-resistance is enhanced

**Disadvantages:**

* failure can be catastrophic
* surface cleanliness is essential
* joints can be easily damaged

1. **Name and explain the application of two aircraft adhesives.**
* Toughened acrylics ~ strong and durable
* Heat-cured epoxides ~ strong and durable