Welding Process for Cast or Forged Steel Components

Introduction

Example of SO-CAL cast/forged steel brackets welded to a differential

This document provides a process for the attachment by welding of both aftermarket and OEM components manufactured using a ***steel*** casting or forging process and which are specifically intended by the OEM or known and reputable aftermarket component manufacturer to be attached by welding. This process, beginning on page 3 in the easy-to-follow flow-chart, will confirm the material composition (the step which is needed to enable a welding process to be developed), it will verify that the welder is competent, and it will ensure that the welding process is appropriate. The process can be used by any competent welder, and uses industry best-practice methods and processes.

Background

LVVTA has always taken a cautious approach with the welding of cast or forged components. It has been widely accepted that the welding of such components requires more scrutiny, and therefore cost, to develop and verify an appropriate welding process. This is based on the principle that before a welding process can be developed, you must first know exactly what it is that you're welding. Particularly in our hobby-based environment, this added burden has generally resulted in such welding being deemed too costly. Over time however, the growth in aftermarket components which are designed to be welded, easier access to quality modern welding equipment, and relative ease with which metallurgists can be accessed has meant that undertaking this kind of welding is more achievable than it has been in the past.

Items that are not covered by this document

It is important to recognise that not all components are designed to be welded, and the design of the component and the intent of the modification would first need to be assessed. The following examples are ***not*** covered within this document unless individual approval in writing has been granted by the Technical Advisory Committee of the LVVTA:

1. Any OEM component that was not originally welded.

    ⌦ *Note: It's not the intention of this document to allow the welding of an OEM component that was originally designed for a different method of attachment.*

2. Any OEM component that was originally welded but that is being used in an application other than that for which it was originally designed.

    ⌦ *Note: It's not the intention of this document to allow components to be used in situations they weren't designed for.*

3. Any aftermarket component that was not intended by its manufacturer to be welded.

    ⌦ *Note: It's not the intention of this document to allow the welding of a component that was designed to be bolted or clamped.*

4. Any cast ***iron*** component.

    ⌦ *Note: It's not the intention of this document to facilitate welding of cast iron (or derivatives thereof). This is largely due to the increased potential for inconsistency through the casting process.*

5. Any component that has already been welded

    ⌦ *Note: It's not the intention of this document to approve existing welds on cast or forged components. Such welds cannot be approved retrospectively.*

6. Drive-shafts, where a drive-shaft specialist is already required to undertake this work.

    ⌦ *Note: The LVVTA Engine & Drive-train Standard contains full details.*

7. Any OEM weld on a cast or forged component.

    ⌦ *Note: OEM welds are already able to be LVV Certified. Evidence may be required to prove OEM welds.*

Assessment of the design of modifications incorporating a cast or forged steel component

The design of a modification refers to how a particular modification has been carried out. For example, in a tube axle (which is a typical hot-rod style front axle), to install the forged end into the tube, the tube would be angle-cut to maximise the available weld area, the forged end 'spigot' would be slid inside the tube to maximise strength and allow for plug-welds, and would be fully welded around the circumference. Each modification will have its own specific design requirements, and various factors, such as maximum loads, and failure-points, maximum weld areas, and minimising loads on welds will all need to be carefully considered.

Due to almost every modification being different, design aspects are purposely not covered in this document. In every instance, the design must be assessed and accepted as being suitable on a case-by-case basis by a 1D-category LVV Certifier, or where necessary, by the LVVTA Technical Advisory Committee, before the modification has taken place.

LVVTA expects that the design of all modifications will follow generally-accepted time-proven 'best-practice' engineering methods, and where applicable should consider the manufacturer's instructions. In every case, all applicable LVV requirements must be met. If any doubts exist as to the suitability of the design or of the modification itself, advice should be sought from LVVTA prior to commencing any modification.

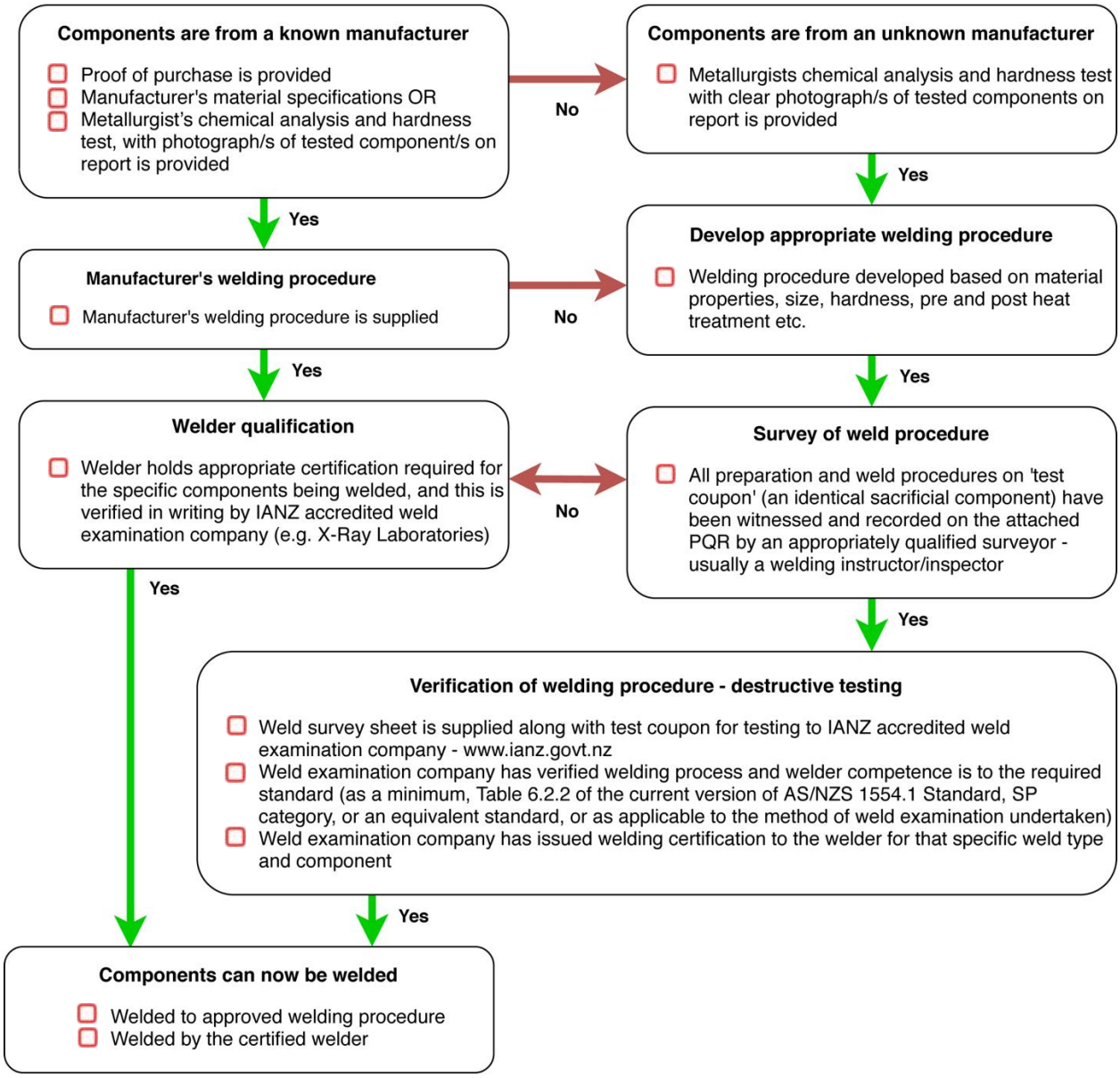
Finally

It is recommended that you make contact with an LVVTA technical team member (using the contact details on the bottom of this page) *before* you begin, to discuss your specific details, and so that you receive the best possible advice and guidance.

The remaining pages contain the flow-chart, and the PQR (Process Qualification Record) sheet, both of which will be required to complete the process. Once finalised, copies of all of the information gathered during this process must be provided to your LVV Certifier for verification purposes. Your LVV Certifier is then required to forward these on to LVVTA who will retain copies on file.

Flow chart – MODIFIERS' SECTION

☐ ✓ Use check-boxes.



Check-list – LVV CERTIFIERS' SECTION

☐ ✓ Use check-boxes.

Critical function welds

- ☐ Identity of components and documentation as per top flow-chart box confirmed and copies supplied
- ☐ Confirmation provided by way of written statement and invoice (if applicable) confirming component/s welded by approved person, to the approved procedure
- ☐ All parts of section *18.9; Critical Function Welding Requirements* in Chapter 18 of the *NZ Car Construction Manual,* including the requirement for non-destructive testing have been met
- ☐ Confirmed that welds are acceptable by visual inspection

Non-critical function welds

- ☐ Identity of components and documentation as per top flow-chart box confirmed and copies supplied
- ☐ Confirmation provided by way of written statement and invoice (if applicable) confirming component/s welded by approved person, to the approved procedure
- ☐ All parts of section *18.7; General Welding Requirements* in Chapter 18 of the *NZ Car Construction Manual,* including the requirement for no grinding of welds have been met
- ☐ Confirmed that welds are acceptable by visual inspection. Where agreement can't be reached, the pass criteria will become the non-destructive testing requirements provided in section *18.9; Critical Function Welding Requirements* in Chapter 18 of the *NZ Car Construction Manual*

WELD PROCEDURE QUALIFICATION RECORD (PQR)
Record of Actual Variables Used to Weld Test Coupon

Location and Date	
Company	
PQR ID	Test Witness
Weld Process	Welder's Name

Base Metal Specs	
Thicknesses	
Joint Type	Prep Angle
Root Gap	Root Face
Weld Position	Other

Filler Metal 1 Spec	Filler Metal 2 Spec
Filler 1 size	Filler 2 size
Shielding Gas & composition	Shielding Gas 2/ backing

Preheat	Post weld heat treatment (attach details)

Other Details: (Tungsten Electrode Size, Nozzle size, Gas Cup Size, Stick-out, cooling rate etc)

Root Pass

Temp	Filler	Current/Polarity	Gas & Flow
Amps	Volts	Wire Feed	Travel Speed
String/weave	Progression (up/down/NA)	Deposit Thickness:	

Pass 2

Interpass Temp	Filler	Current/Polarity	Gas & Flow
Amps	Volts	Wire Feed	Travel Speed
String/weave	Progression	Deposit Thickness:	

Pass

Interpass Temp	Filler	Current/Polarity	Gas & Flow
Amps	Volts	Wire Feed	Travel Speed
String/weave	Progression	Deposit Thickness:	

Pass

Interpass Temp	Filler	Current/Polarity	Gas & Flow
Amps	Volts	Wire Feed	Travel Speed
String/weave	Progression	Deposit Thickness:	

Pass

Interpass Temp	Filler	Current/Polarity	Gas & Flow
Amps	Volts	Wire Feed	Travel Speed
String/weave	Progression	Deposit Thickness:	

Pass

Interpass Temp	Filler	Current/Polarity	Gas & Flow
Amps	Volts	Wire Feed	Travel Speed
String/weave	Progression	Deposit Thickness:	

Notes

The above form was supplied by X-Ray Laboratories (Auckland), however other recognised Weld Qualification Record (WQR) document should also be acceptable. Check with your weld surveyor and/or your IANZ accredited weld examination company first.