INFORMATION SHEET
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LOW VOLUME VEHICLE TECHNICAL ASSOCIATION Inc

Welded Forged Aftermarket Suspension Struts

Introduction:

This LVVTA Information Sheet provides guidance to LVV Certifiers on how to treat aftermarket forged suspension struts that incorporate welding, particularly in relation to the attachment, by welding, of the steering arm to the strut housing.

Background:

LVVTA has become aware that several aftermarket manufacturers of adjustable suspension struts have incorporated, as part of their manufacturing process, the attachment of cast or forged ancillary components by welding to the strut housing; - usually steering arms or flanged ball-joint housings. Because of the high level of inherent risk with welding of castings or forgings, LVVTA has never permitted this work, and so these aftermarket struts are correctly being rejected by LVV Certifiers.

These strut assemblies are commonly found on Integra DC5, Civic EP3, and Toyota AE85 models, however there are many other models which also share the same welding attachment process.

In each of the examples identified so far, the process of welding the cast or forged component (eg steering arm) to the strut tube is, in principle, a copy of the OE attachment method, however unlike an OE item where a high volume vehicle manufacturer takes responsibility for the welding process, an aftermarket adjustable suspension strut requires LVV Certification, and so the LVV certification system must bear the responsibility for the safety of the component, and therefore the applicable LVV requirements must be met.

Although there are potentially thousands of similar aftermarket components in use throughout the world, due to the large number of dubious aftermarket components finding their way into New Zealand, from regions where the standards and manufacturing processes of their aftermarket industry are unproven, LVVTA cannot assume that all such aftermarket components are manufactured correctly.

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Engineering principles at risk:

A basic but very important engineering principle that has been threaded throughout the whole LVV certification process in New Zealand for 20 years is that a forging or a casting in a critical situation like a suspension, steering, or brake component, must not be heated and bent, or welded, except in highly-controlled circumstances. It is critical that a forging or a casting that is heated during a welding process, is returned to its pre-heated condition via the appropriate pre and/or post heat-treatment process. The appropriate heat-treatment process cannot be applied correctly unless the exact molecular structure of the material used in the forging or casting has been properly established beforehand by a metallurgist – which in turn enables the appropriate heat-treatment method to be established. This process is costly, and not practicable in one-off or low volume situations.

If the correct steps are not taken, or the processes are not applied correctly, there is a very real risk of changes occurring within the molecular structure of the forging or casting when a welding process is applied - particularly if too much heat is applied - and in some case the problems that this can create are often irreversible. A component that is not manufactured properly is likely to become weak or brittle, and therefore likely to fail. The failure mode in such cases is more likely to be a catastrophic failure rather than a bending failure, which clearly is unacceptable in components used for a vehicle's directional or braking control.

Given this basic engineering principle, and the high risk involved, it would be careless and unprofessional of the LVV system to make an assumption that these aftermarket components have been manufactured correctly and are safe, especially when the manufacturers either have no agents in NZ, or the NZ agents are unable or unwilling to provide documented evidence that supports a thorough and correct manufacturing process.

LVVTA testing carried out:

LVVTA concurred that, as a preferred alternative to the blanket-banning of such components, steps need to be taken to establish the safety of such components, which if established, would allow their use.

During the early stages of developing a process with which to deal with these components, LVVTA and the LVVTA Technical Advisory Committee (TAC) had some preliminary testing carried out on a readily-available example. The results from this test raised very real concerns about the manufacturing methods used (or not used) by that manufacturer. As a result, after discussions with various metallurgists and testing laboratories in New Zealand, and discussion within the industry, an LVVTA process has been developed to deal with a component which incorporates a welded casting or forging, so that it can be approved for LVV Certification.

Basis of new LVV approval system:

<u>LVVTA Technical Requirements:</u>

The NZ Hobby Car Technical Manual, Chapter 7, section 7.41.2 says:

A component within a steering system in a low volume vehicle specified in 7.41.1 may only be welded if:

b) a steering component has been modified or custom manufactured, due to no other practical option being available, in which case:

(i) the component must meet all requirements specified in 18.9 'critical function welding requirements' in 'Chapter 18 - Attachment Systems'; and

(ii) the modification or custom-manufacturing process must be carried out by a person who is professionally engaged in motor vehicle construction, has substantial experience in steering component manufacture, and who is specifically nominated in writing by the Technical Advisory Committee of the Low Volume Vehicle Technical Association (Inc).

This requirement enables an approval process to be developed, providing that the TAC can be satisfied, on sound engineering grounds, that a given manufacturer's components are safe.

Basic principles of new approval system:

LVVTA has agreed on an approval system that checks one component from a manufacturer, and if passed, approves all similar components from that manufacturer. The checking process can be either by destructive testing of the component here in NZ, or by provision of documented evidence of the component's manufacturing process by the manufacturer or its NZ agent.

This process will inevitably cause inconvenience for some vehicle owners, where they are the first to be required to undergo this process for a particular aftermarket component manufacturer. This will be a frustrating situation for some, however once a manufacturer is approved, it will clear the path for each subsequent certification to proceed without the need for any such approvals.

It is expected that there will be some cases where a vehicle owner will not have the assistance of the component manufacturer, importer, or supplier, to complete this process. Additionally, there may be components which cannot have their manufacturer identified, in which case such components will not be able to be approved, and therefore will not be able to be LVV certified.

New three-step process to be applied:

Basics of new three-step process:

A three-step process is to be applied, which is set out below. Note that there are two available options available by which to satisfy the requirements of step 1.

1. 'Technical Validation': - the LVV Certifier is to determine whether or not the component has been correctly manufactured. This can be done either by 'Option 1 – testing' which is a metallurgical testing-based analysis which will require that the unit be sectioned for analysis rendering it useless, or by 'Option 2 Provision of Technical Information' which is based around the provision of technical data.
2. 'Quality Control': - the LVV Certifier is to establish via documented evidence that the manufacturer has certified quality control processes in place for the manufacturing of the components, thus assuring that each component they manufacture follows a set process which is identical to the previous.
3. 'Published Database': - LVVTA is to record approved manufacturers on a database. This will be maintained and hosted on the LVVTA website, available to both LVV Certifiers, and members of the public.

Step 1 - Technical Validation (Option 1 – Testing):

The first option to satisfy step 1 of the new process is by an analysis, which involves the sectioning or removal of a sample (meaning the component will be rendered useless), by a testing facility agreed to by the TAC, using an off-the-shelf component from the manufacturer. The full details of the test process will be provided to LVVTA in confidence. The test process will identify:

- full material specifications including chemical compositions for the cast/forged component and tube; and
- whether the component is a casting or a forging; and
- hardness values/readings for both the forged/cast component, and the tube; and
- photo micrographs of the microstructure of weld zone (including parent materials) showing micro-hardness readings traversed across both parent materials' heat-affected zones from 5 mm from toe of the weld to 1mm into the weld, parent material heat-treatment conditions, weld penetration depth, and the presence of cracks, defects, etc.

This testing process is to be paid for, and the component supplied by the importer, wholesaler, or customer. Cost estimate for the testing analysis is approximately $1300, excluding the cost of the component.

Step 1 – Technical Validation (Option 2 - Provision of technical information):

The following technical information is to be sourced from the component manufacturer and provided to LVVTA in confidence. The technical information will establish:

- whether the component is a casting or a forging; and
- full material specifications for the cast/forged component and tube; and
- hardness values/readings for the forged/cast component, the tube, the weld area, and the heat affected zones at 1 mm from toe of the weld on the forging/casting; and
- welding processes (including pre and post heat treating details).

Step 2 – Quality Control:

In order to ensure ongoing conformity of production of components, the LVV Certifier must obtain, and provide to LVVTA in confidence:

- a statement from the component manufacturer, in English, relating directly to its manufacturing and quality control processes for the components in question, giving details and ongoing confirmation of conformance to an ISO or similar internationally-recognised quality assurance accreditation programme; and
- verification or confirmation of the manufacturer's conformance to the ISO or similar organisation from that accreditation organisation, as a double-checking process to prevent fraudulent activity.

Step 3 - Published Database

Upon the approval of the manufacturer by LVVTA, and verification that the manufacturer conforms to an ISO or similar accreditation organisation, that manufacturer will be listed as an 'approved manufacturer' on a database published on the LVVTA website.

LVV Certifier quick-check list:

The following is a basic check list for LVV Certifiers when they are presented with a vehicle fitted with aftermarket adjustable suspension incorporating welded castings or forgings.

Note: As the steering arm is on the strut, this is potentially a geometry-changing modification, and so can only be approved by a category 1D LVV Certifier, or where a category extension has first been approved. Much the same as a dropped spindle or other geometry-altering modification, the dimensions and location of the steering arm must be checked against an OE equivalent, and if any variation exists, or if an OE equivalent is not available, a full bump-steer swing-check must be completed.

- Has component manufacturer been identified?
  - Yes – go to step 2
  - No – this component cannot be LVV certified if the manufacturer cannot be identified.
- Is the component manufacturer listed on the 'LVVTA approved component manufacturer' database?
  - Yes – complete LVV certification process as normal
  - No – forward a copy of this LVVTA Information Sheet to the component supplier, manufacturer, or vehicle owner, or contact LVVTA for assistance.

Finally:

For any further information or clarification on this information sheet please contact one of the Technical Team at the LVVTA office.

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