

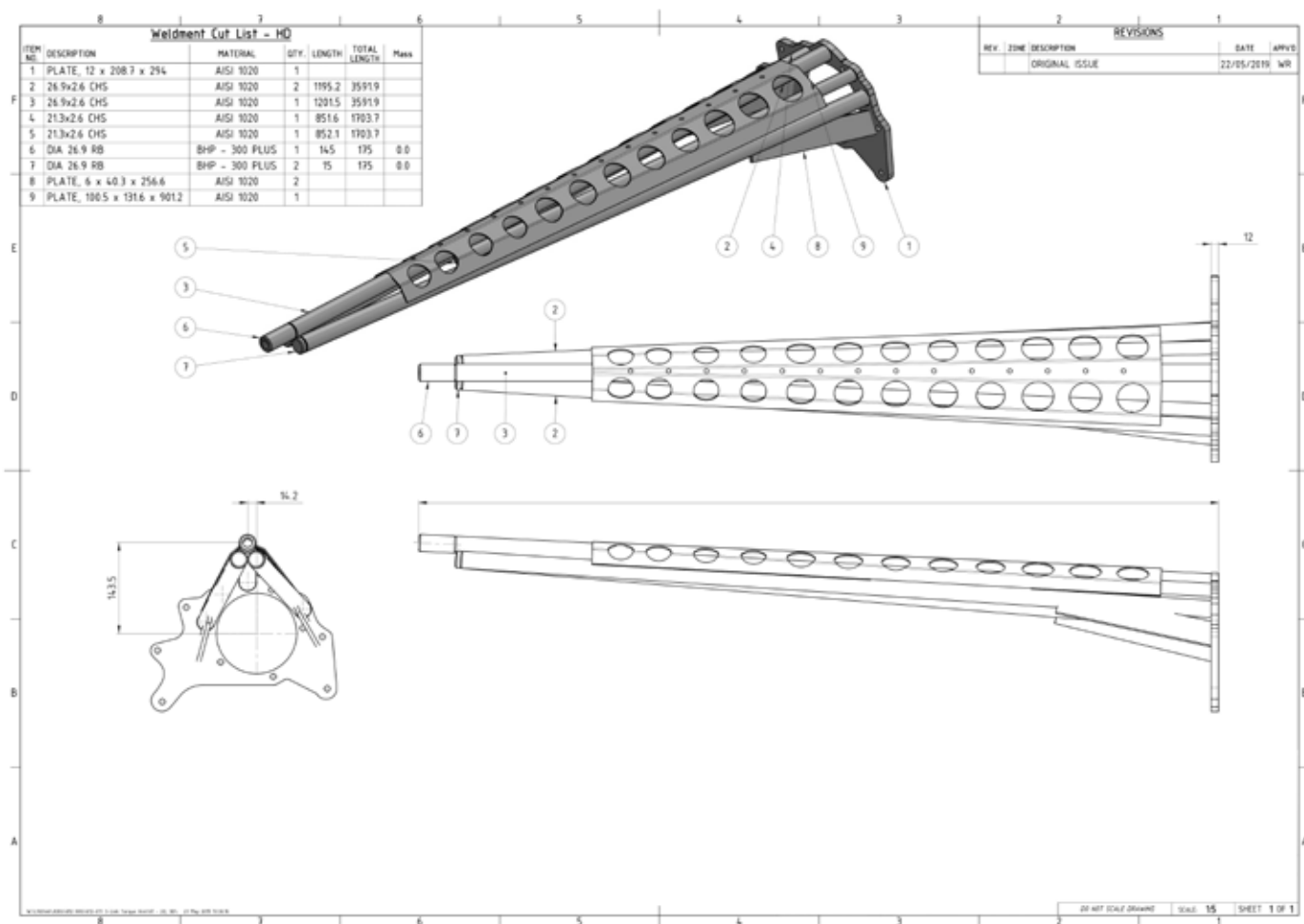
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TRANS-AM 3 LINK

INTRODUCTION

This document is to prove the RRS Trans-Am 3-link is compliant with LS5 Rear Suspension Modification (design) requirements. RRS will provide a design overview, parts specifics, load data.



TRANS-AM 3 LINK

Load Bearing Data

Load rated at 20Kn per side (2050kg) SF 3.5

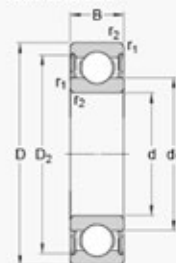


Ford 9" axle housing (with RRS 3 link Brackets)

SKF

STA1021 Load rated 19Kn (1937Kg)

Dimensions



d	40	mm
D	80	mm
B	21	mm
d ₁	≈ 52.6	mm
D ₂	≈ 69.8	mm
r _{1,2}	min. 1.1	mm

Calculation data

Basic dynamic load rating	C	30.7	kN
Basic static load rating	C ₀	19	kN
Fatigue load limit	P _u	0.8	kN



Ford F100 axles and bearings load rated 18Kn (1840Kg)
(Sourced from Ford F100 1977 Load rating data)



Mark Williams Master Line Series Axles
Load rated 28Kn (2855Kg)

Mark Williams Master Line axles are made to the exact length required, and feature hobbled involute splines to match stock differentials, posi-tractions, and after-market spools (28, 30, 31, and 35 spline). To accommodate the street market, these axles have a 45mm ID. Bearing journal and thicker flange that can withstand the higher weight and harsher surface conditions. Mark Williams Master Line axles are induction heat treated to provide 80% higher tensional strength.

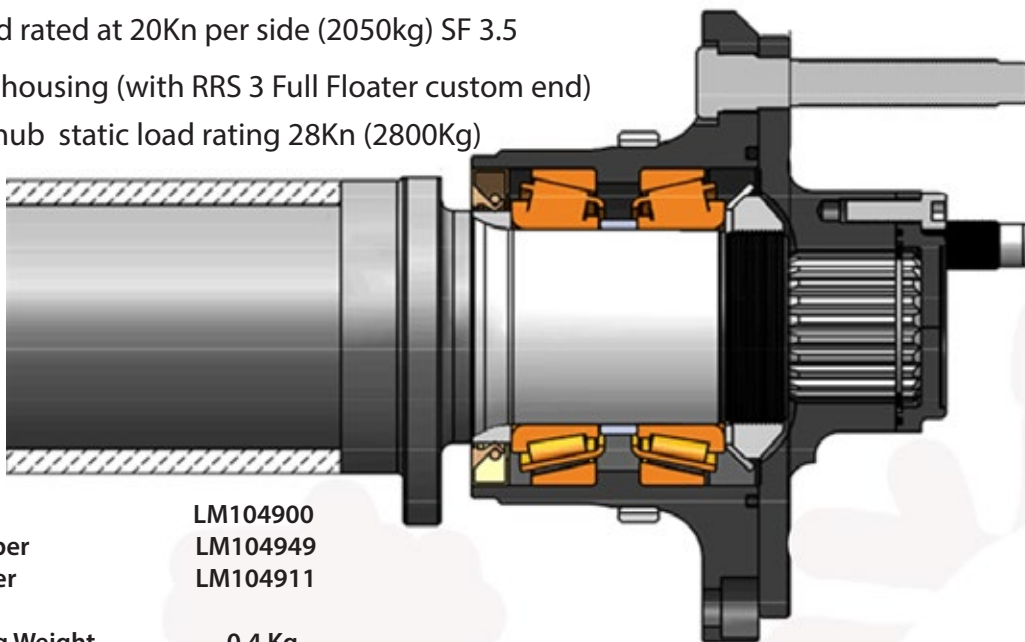
TRANS-AM 3 LINK

Full Floater Load Rating Data

Load rated at 20Kn per side (2050kg) SF 3.5

Ford 9" axle housing (with RRS 3 Full Floater custom end)

RRS floater hub static load rating 28Kn (2800Kg)



Series	LM104900
Cone Part Number	LM104949
Cup Part Number	LM104911
Design Units	
Imperial Bearing Weight	0.4 Kg
	0.9 Lb
Cage Type	Stamped Steel

Basic Load bearing Data

C90 - Dynamic Radial Rating (90 million revolutions) ⁴	5610 lb f 25000 N
C1 - Dynamic Radial Rating (1 million revolutions) ⁵	21700 lb f 96300 N
C0 - Static Radial Rating	23400 l bf 104000 N
Ca90 - Dynamic Thrust Rating (90 million revolutions) ⁶	2930 lb f 13000 N

Full floater design means the GVM is carried on the axle housing, (RRS use a Ford 9" housing with static rating of 4100Kg with a safety factor of 3.5 figures courtesy Ford), not the axle. The figures above show the load carry capacity of the axle housing, the load carry capacity of the bearings, and the other load carrier is the floater hub, RRS use a design used by Mark Williams LL C (USA) and Detroit Speed LL C (USA) made from CNC machined billet by PMP Engineering (Aus). The axles are Mark Williams LL C (USA) 300M 1500Hp rated.



Description

RRS-ONLINE

Part: 3-LINK TORQUE ARM

Configuration: Heavy Duty
Material: Steel 1045 Grade
Plate: 12mm THK

Simulation of 012-017

Date: 23 May 2019
Designer: W. Rogulski
Study name: SimulationXpress Study
Analysis type: Static

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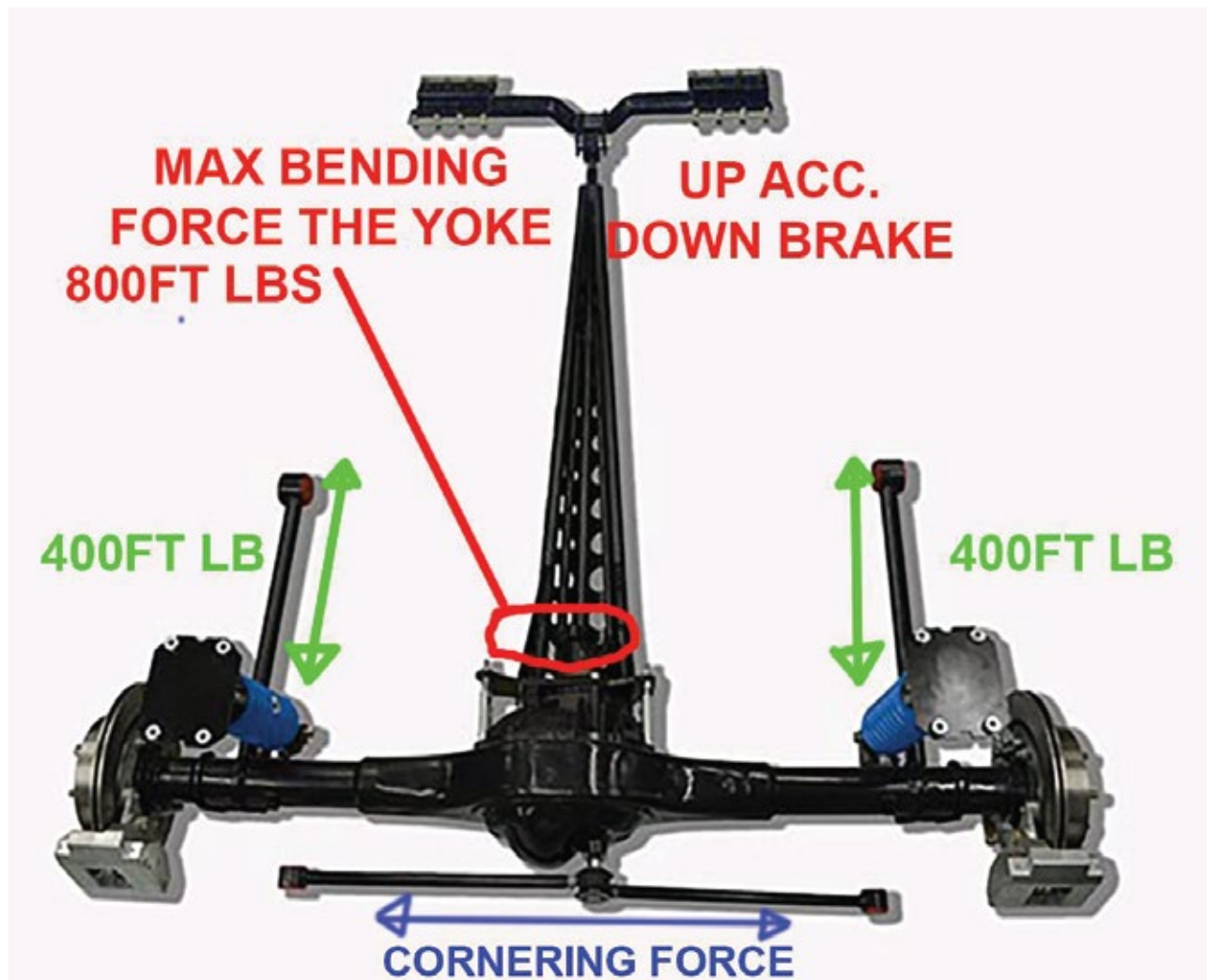


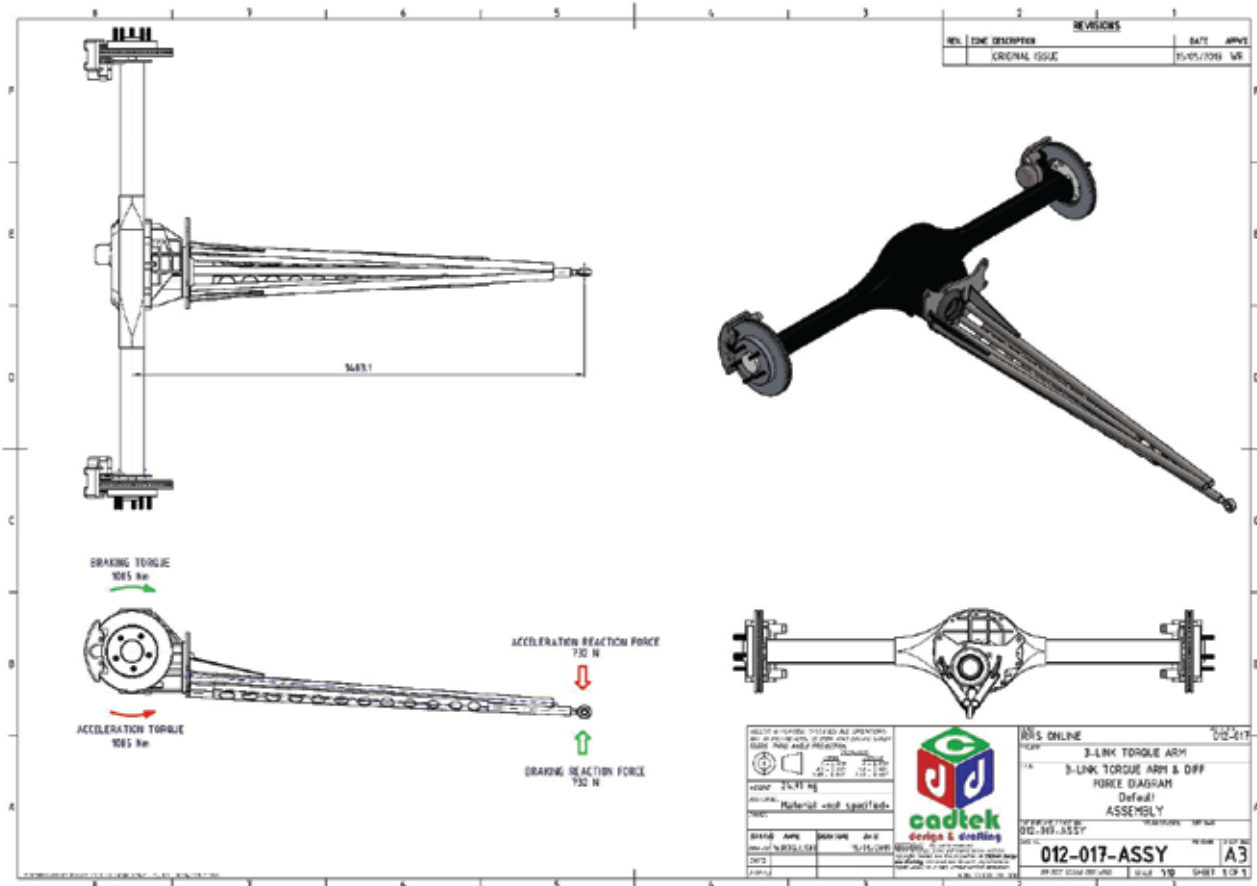
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Analyzed with SOLIDWORKS Simulation

Simulation of 012-017 1

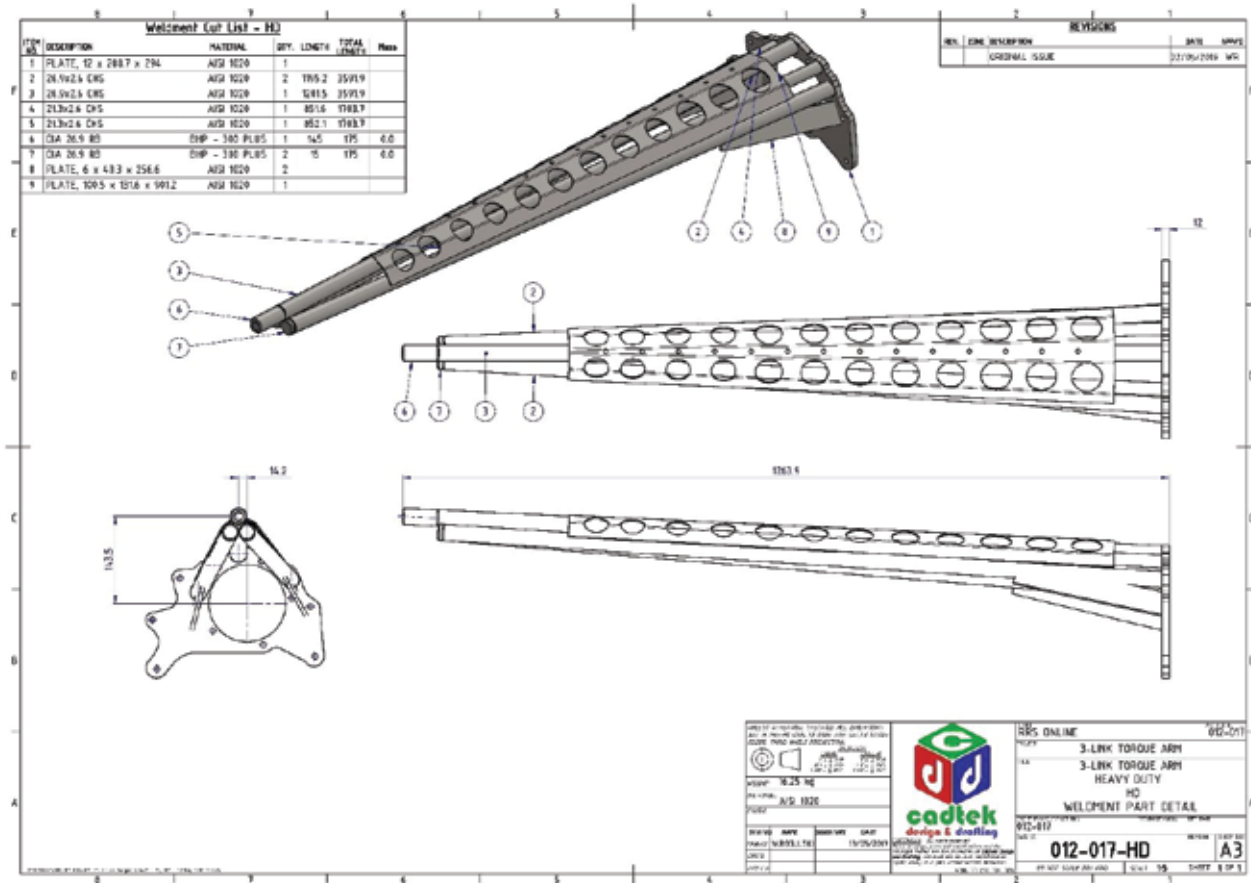
Assumptions







W. Rogulski
 23/05/2019



Model Information



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Simulation of 012-017

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W. Rogulski
 23/05/2019



Model name: 012-017
 Current Configuration: HD FEA

Solid Bodies

Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
DeleteFace1 	Solid Body	Mass:16.3111 kg Volume:0.00207761 m ³ Density:7,850.92 kg/m ³ Weight:159.849 N	W:\CADtek\JOBS\012 RRS\012-017 3-Link Torque Arm\01 - 2D, 3D\012-017.SLDPRT May 22 22:30:40 2019




SOLIDWORKS

Analyzed with SOLIDWORKS Simulation


Simulation of 012-017

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Material Properties

Model Reference	Properties	Components
	Name: AISI 1045 Steel, cold Drawn Model type: Linear Elastic Isotropic Default failure Criterion: Max Von Mises Stress Yield strength: 530 N/mm ² Tensile strength: 625 N/mm ²	Solid Body 1(DeleteFace1)(012-017)

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-1		Entities: 29 face(s) Type: Fixed Geometry

Load name	Load Image	Load Details
Force-1		Entities: 1 face(s), 1 plane(s) Reference: Top Plane Type: Apply force Values: ---, ---, -,732 N



RRS PTY LTD.
57/42-46 Wattle Road
Brookvale NSW 2100
Sydney Australia

Ph: 61 2 9907 3755
Mob 61 417 226 693
Email: alex@rrs-online.com



W. Rogulski
23/05/2019

Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	2 mm
Tolerance	0.1 mm
Mesh Quality Plot	High

Mesh information - Details

Total Nodes	2831986
Total Elements	1750298
Maximum Aspect Ratio	48.827
% of elements with Aspect Ratio < 3	99.6
% of elements with Aspect Ratio > 10	0.0887
% of distorted elements(Jacobian)	0
Time to complete mesh(hh:mm:ss):	00:54:42
Computer name:	DUPA-JASIU-02



SOLIDWORKS

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Simulation of 012-017

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RRS PTY LTD.
57/42-46 Wattle Road
Brookvale NSW 2100
Sydney Australia

Ph: 61 2 9907 3755
Mob 61 417 226 693
Email: alex@rrs-online.com



W. Rogulski
23/05/2019

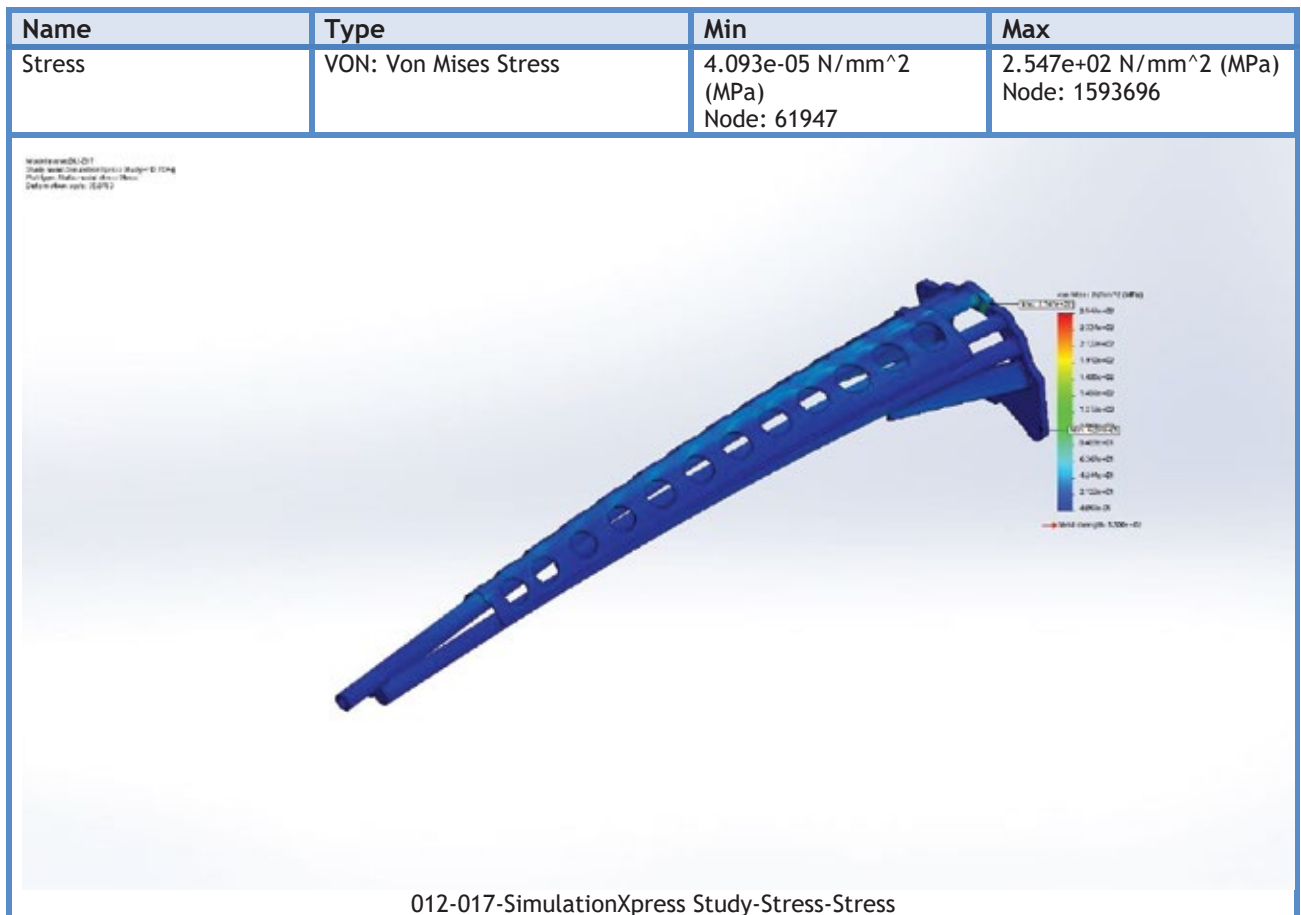


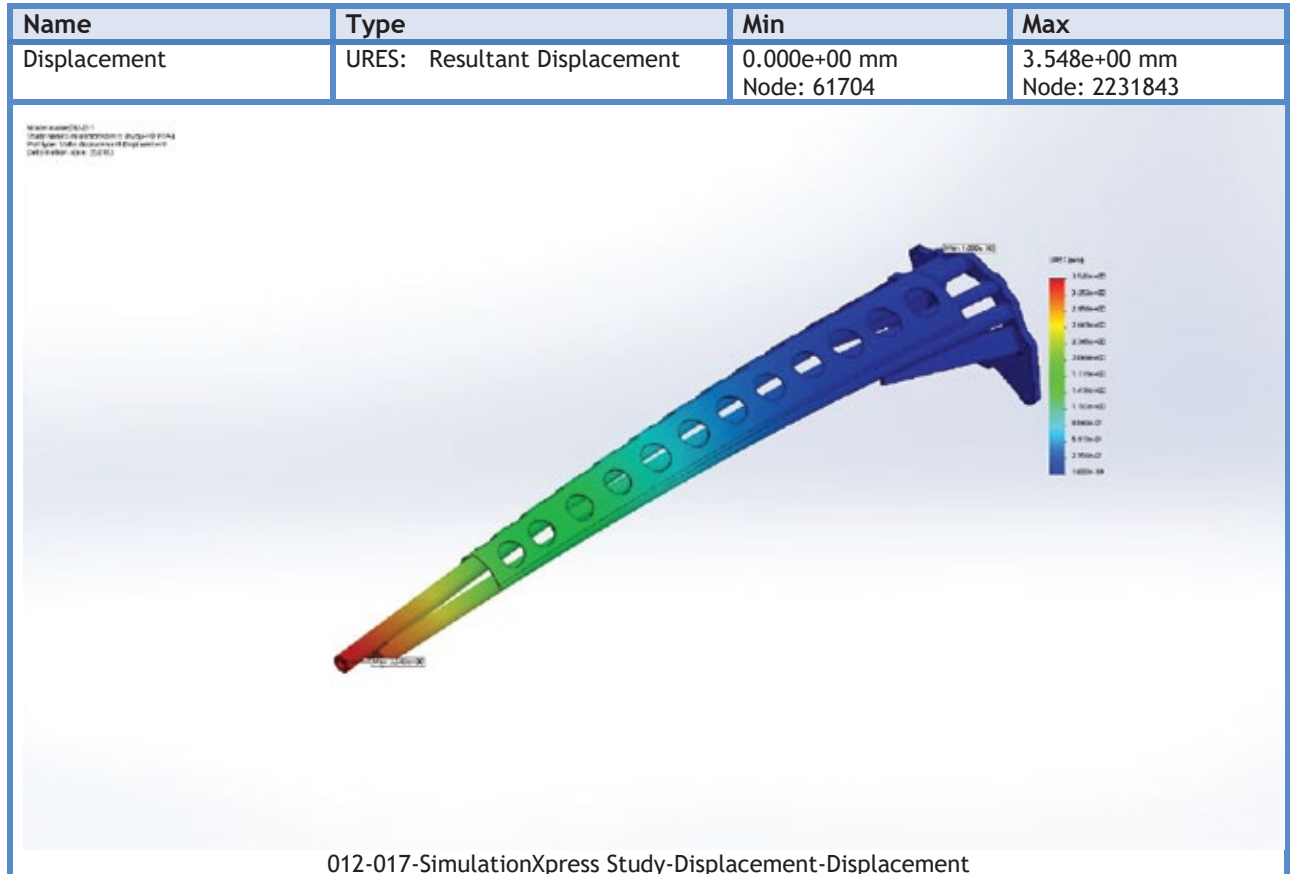
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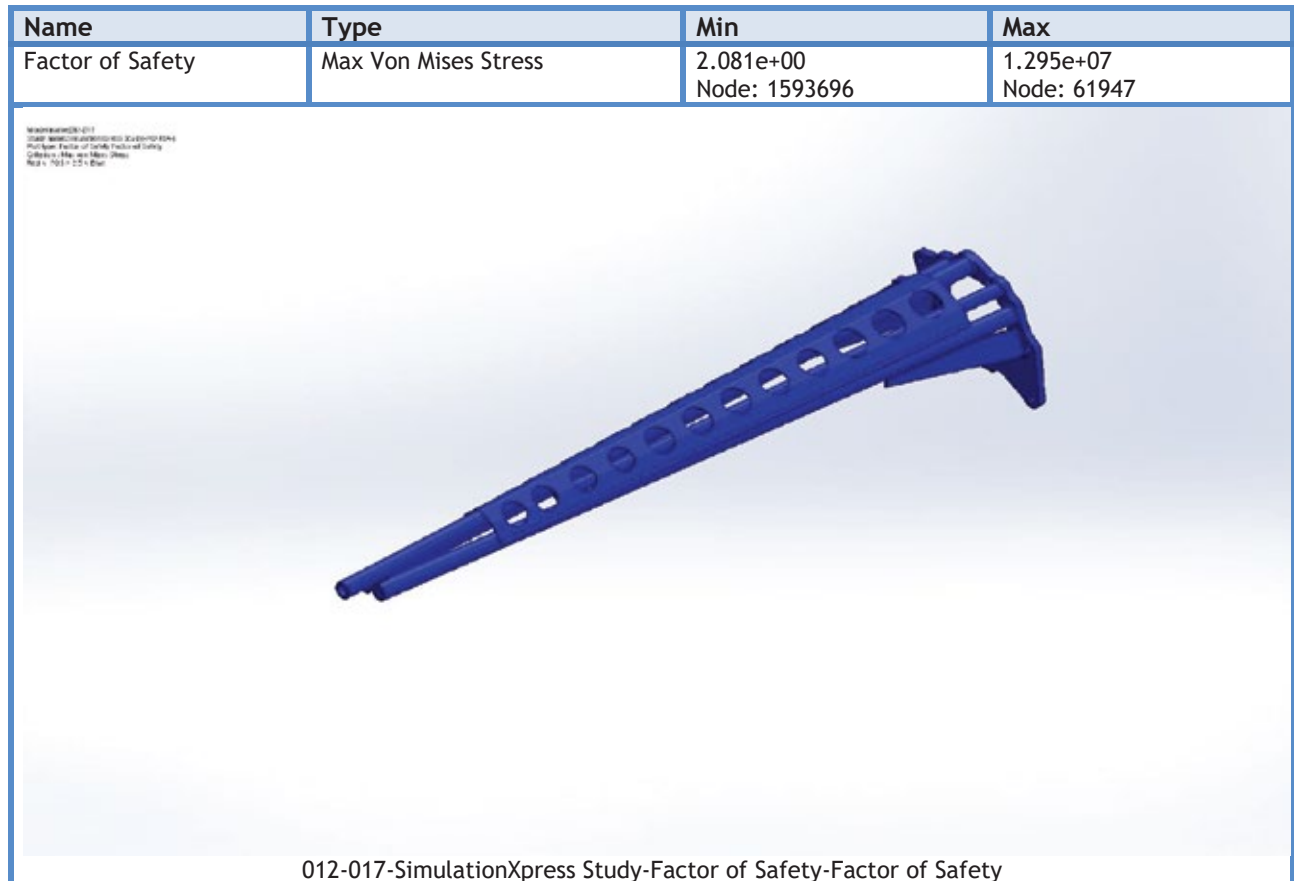
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Study Results





Name	Type
Deformation	Deformed shape
 <p>012-017-SimulationXpress Study-Displacement-Deformation</p>	



Conclusion

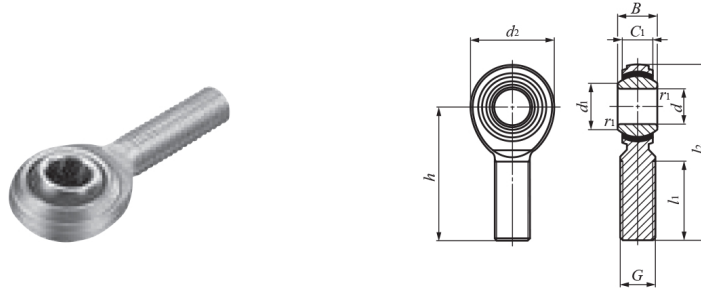
FEA study carried out for purpose of design validation.

Using selected material Steel 1045 (refer material properties on page 6), FEA study Results show minimum FOS of 2.1, Which is above normal practice absolute minimum of 1.0, and deemed satisfactory.

Rod End Load Rating

IKO

Maintenance-free Type PILLOBALL Rod Ends **With Male Thread**



POS...EC

Identification number	Mass (Ref.)	Boundary dimensions mm										Dynamic load capacity	Static load capacity	
	g	d	Thread G	d_2	C_1	B	d_1	l_2	h	l_1	$r_{1smin}^{(1)}$	Ball dia. mm (inch)	C_d	C_s
													N	N
POS 14EC	126	14	M14×2	34	13.5	19	16.9	77	60	36	0.2	25.400 (1)	33 600	17 200
POS 16EC	185	16	M16×2	38	15	21	19.4	85	66	40	0.2	28.575 (1 1⁄8)	42 000	21 100
POS 18EC	260	18	M18×1.5	42	16.5	23	21.9	93	72	44	0.2	31.750 (1 1⁄4)	51 400	25 100

Note(1) Minimum allowable value of chamfer dimension r_1

Remarks1. Neither oil hole nor grease nipple is provided.

2. When a metric fine thread specification for inner ring bore deameter d of 8 mm to 14 mm is required, please contact IKO.

1N=0.102kgf=0.2248lbs.

1mm=0.03937inch

K44

K

**PB
PHS
PHSB
POS
POSB
PHSA**

Conclusion:

RRS use POS 16EC fine thread rod ends.

(IKO advise when using fine thread to use load rating of POS 14EC)

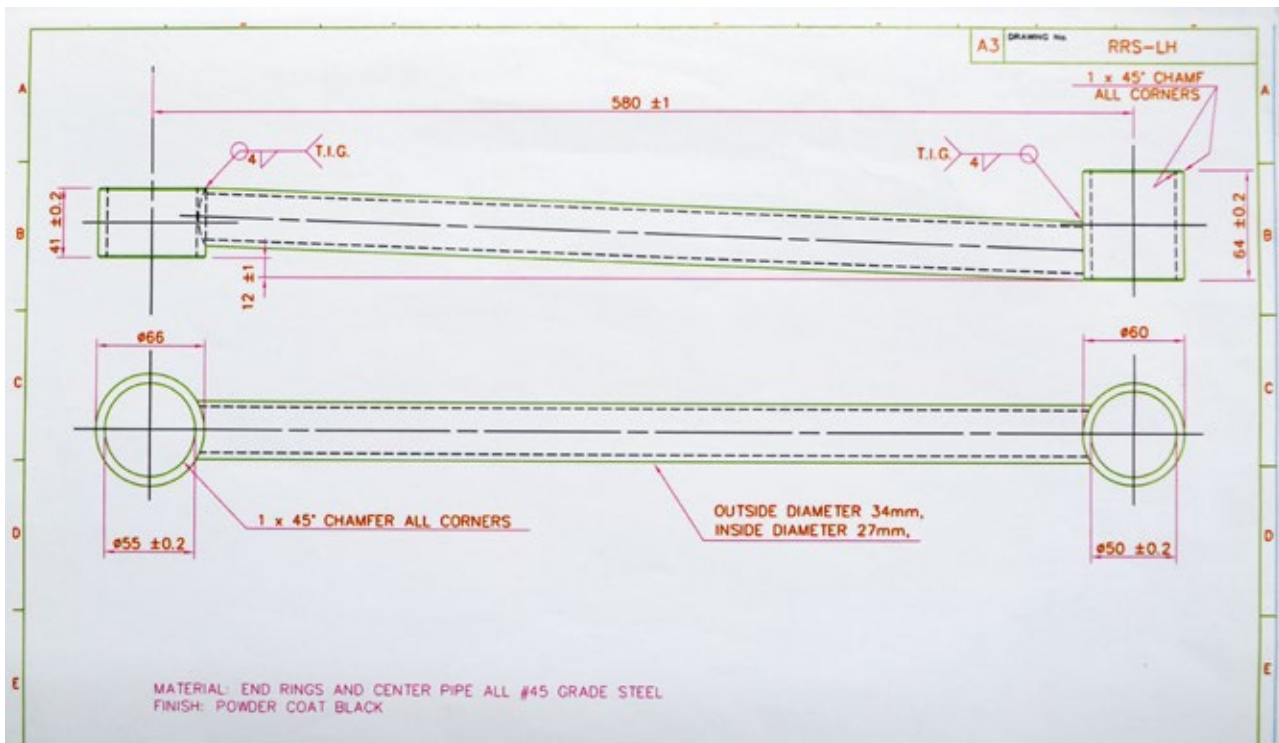
Max Dynamic Load applied to rod end is 732 N

Dynamic Load Rating of Rod End is 17 200 N

Therefore a safety of $\geq 20X$ is achieved

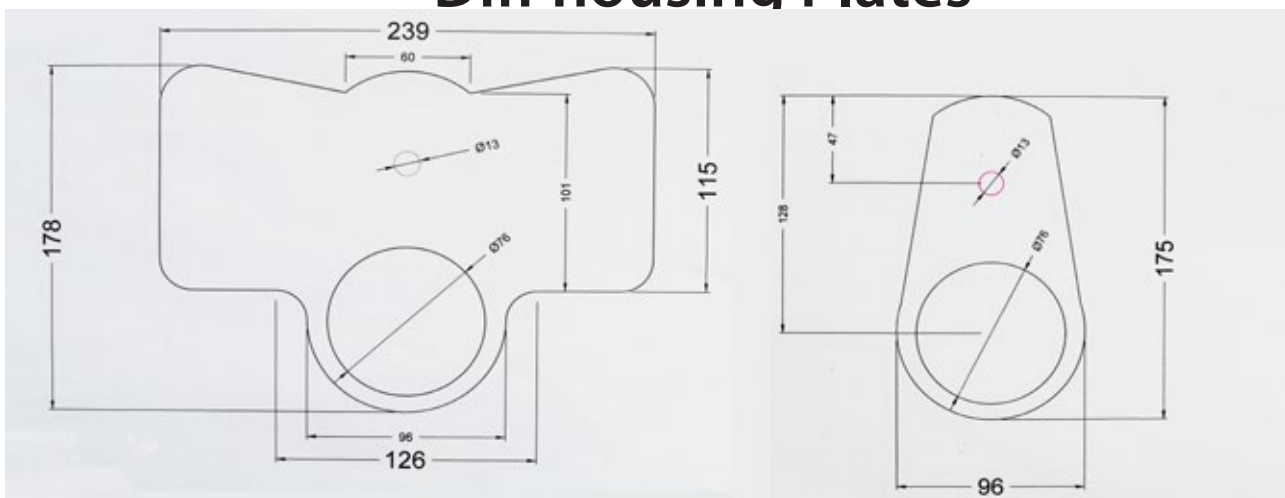
TRANS-AM 3 LINK

Trailing Arms



The RRS Trans-Am 3 link has 2 offset trailing arms, these robotically welded and load rated to 12Kn pull and 14Kn push with a safety factor of 2.8.

Diff housing Plates



The RRS Trans-Am 3 link has 2 sets diff housing plates welded to housing tubes made from 12mm and 8mm HR250 steel these create the mounting platform for the trailing arms. The plates are continuously welded onto the housing tubes, creating 952mm of welded surface giving the plates a load rating of 12Kn pull and 14Kn push with a safety factor of 2.

TRANS-AM 3 LINK

SPECIFIC REQUIREMENTS

1 REAR SUSPENSION

The following requirements must be met for all rear suspension modifications. Where a modification involves a change to the suspension system design, the basic functional requirements for suspension modifications/conversions are provided as a guide to suitably qualified and experienced signatories when designing or certifying such modifications or conversions. The design should also comply with the general guidelines contained in both sub-section 2 General Requirements and Specific Requirements in Approval Code LS3 Front Suspension and Steering Conversion – Design. Each design should be fully documented, with drawings, calculations, procedural details, test results, wheel alignment specifications and any other data necessary to fully describe the vehicle modifications and should have a unique design number. The design should contain:

- Details of all drawings needed to fully describe the full extent of the modification;
- Details of any special modification techniques, procedures or adjustments; and
- Details of any testing of components and performance (e.g. bump steer plots) with related acceptance criteria.

All necessary diagrams, descriptions, materials, and load rates have been supplied in this document.

It is recommended that rear suspension conversions utilize production components that do not require cutting, heating, bending or welding.

The Trans-Am 3 link uses the upper shock mount position and adds a large spreader plate and an upper shock mount frame to triangulate and dissipate the load. The long torque arm is secure by a heim joint to a rail to rail boxed cross member. The trailing arms use stock leaf spring connection points, these design features strengthen chassis stiffness and reduce original load hot spots.

2 WATTS LINKAGE, PAN HARD ROD

A Watts linkage or a Pan hard rod can be used for sideways location of a rear axle and should be installed to comply with the following:

- It must locate sideways only and allow free movement of the axle in other directions;
- A Pan hard rod should be mounted so that it is horizontal at the vehicle's normal ride height. This minimizes lateral movement of the axle on full bump or rebound;
- Mounting brackets must not interfere with any other vehicle component through the full range of suspension movement.

The Trans-Am 3 link uses either Watts Link or Mumford frame, both carry no weight, both systems are only used for lateral stability, both systems do not impede vertical suspension movement.

3 TRACTION AIDS N/A

Traction aids attached to a live rear axle near the spring mountings must comply with the following:

- The geometry of the system must be compatible with the geometry of the spring and not cause any binding with suspension movement;
- Parallel ladder bars which do not provide for body roll without a tendency to twist the axle must not be used for street use when used in conjunction with a torsionally rigid axle. A more suitable arrangement is the 4-link suspension system; and
- Under body clearances and ground clearance must be maintained and continue to meet regulation requirements.

TRANS-AM 3 LINK

4 RELATIONSHIP BETWEEN THE FRONT AND REAR SUSPENSION HEIGHTS

Following the completion of modifications the vehicle attitude must remain as per original specifications – i.e. the original relationship between the front and rear suspension heights must not be changed and therefore the front and rear suspensions must be both raised by the same amount.

The Trans-Am 3 link is height adjustable, allowing the installer to match stock or compensate for changed front suspension setting.

1	REPLACEMENT REAR BEAM AXLE ASSEMBLY			
1.1	Rear axle Beam Selection			
	Is the axle assembly at least of equivalent capacity to original?		Y	N
1.2	Rear axle modifications			
	Are the proposed modifications in accordance with the specific requirements detailed in Code LS5?	N/A	Y	N
1.3	Rear Axle Mounting			
	Does location and angle of axle replicate original?	N/A	Y	N
	Is mounting of axle equivalent strength to original?	N/A	Y	N
	Does mounting allow vehicle to roll relative to axle?		Y	N
2	REPLACEMENT REAR SUSPENSION CROSS-MEMBER AND SUSPENSION			
2.1	Cross member Mounting			
	Is the mounting for the cross member equivalent strength to original?		Y	N
	Has the strength of the chassis rail been assessed and provisions made to strengthen it as necessary?	N/A	Y	N
2.2	Design Loadings			
	Do all components have adequate strength for the application?		Y	N
3	REPLACEMENT REAR SUSPENSION STRUTS OR UPRIGHTS			
3.1	Ball Joints and Tie-rod Ends			
	Are all ball joint tapers compatible and are the proposed modifications in accordance with the specific requirements detailed in Code LS5?	N/A	Y	N
3.2	Suspension geometry			
	If geometry is to be altered, is bump steer still within specified limits?	N/A	Y	N

TRANS-AM 3 LINK

4	DESIGN INCLUDING WELDING AND FASTENERS		
4.1	Does the design of the conversion comply with all of the requirements outlined in Code LS5?		Y N
4.2	Has all work that has been specified in the certification of the LS5 design, been determined in accordance with recognised engineering standards and the relevant Appendices of Section LZ Appendices?		
4.3	Will the vehicle been raised by no more than 50mm following the completion of all modifications including changes to tyre size?	N/A	Y N
4.4	If the vehicle was originally equipped with ESC and if the modification affects the ESC, has the ESC system been adjusted and tested and found to operate satisfactorily?	N/A	Y N

Note: If the answer to any question is **N (No)**, the design cannot be certified under Code LS5.

CONCLUSIONS

The RRS TransAm 3 link is built for the Ford 9" housing.

This document demonstrates that:

All RRS TransAm brackets are CAD designed, laser cut, and jig welded in precision fixtures.

The RRS TransAm trailing arms are TIG welded with urethane bushes and ISO grade 8.8 bolts.

The RRS TransAm differential housing are robot welded.

The RRS TransAm torque arm is a tapered design with FEA analysis.

The RRS TransAm axle housing, bearings and axles are load rated to run 325 tyres with a 200mm +/- offset with radii of 340mm.

The real world testing and the data supplied in this document should satisfy LS5 and all other relevant parts of VSB14.