

# ***Circuit Excel Racing Assoc Inc 3E Technical Guide***

**Revised Feb 2023**

## **PREAMBLE**

This document is to be read in conjunction with Motorsport Australia Group 3E Circuit Excel Rules and provides guidance to assist in the interpretation of the official regulations.

The information in this document describes the checking and testing procedures to be implemented by Circuit Excel Racing Association Inc (CERA Inc) Category appointed component sealing officers and eligibility officers, and is useful information for engine and component builders, as well as competitors. This document is not a complete list of all areas of eligibility, but is produced as a guide; for full eligibility rules refer to the Motorsport Australia Group 3E Circuit Excel regulations. This guide also documents Category approved replacement mechanical components.

## **SEALING PROCESS**

Engines are to be checked by an approved sealer (refer to Motorsport Australia regulations for approved sealers) , and have seals affixed to :-

- The front timing cover/oil pump as per Photo 1....
- Between the cylinder head and the block at the drivers side rear of the cylinder head, Refer Photo 2
- Between the rear inlet and exhaust camshaft cap bolts, Refer Photo 3, and

The engine components must be pre-drilled to accommodate sealing wire in two oil pump/timing cover bolts as per Photo 1, cylinder head block casting to cylinder head casting at the front end of the engine on the inlet manifold side as per Photo 2, and bolts for two camshaft bearing caps as per Photo 3.

The approved sealer is to document the items checked by completing the category sealing sheet as supplied by the National Association , CERA Inc. The completed sealing sheet is to be provided to the competitor or component builder as their agent, one copy sent to CERA national management, and a copy retained by the sealing officer. The competitor is to produce the seal sheet upon demand to any Eligibility Officer or Motorsport Australia Scrutineer.

Gearboxes are to be checked by the method described below , in the section **TRANSMISSION/DIFFERENTIAL CHECKING AND SEALING** , and sealed by CERA authorised sealers with a seal affixed through two bolts as per Photo 4

The application of a component seal does NOT exclude the component from future eligibility checks.

## **ENGINE ASSEMBLY MEASUREMENT PROCESS :-**

At the time of sealing, all machining is to be completed, components are to be clean and organised ready for efficient assembly, but with the cylinder head, camshafts, and sump removed.

The crankshaft, conrods, and pistons must be fitted, but the engine sealer will ask for one piston of his choice to be removed for checking, then be refitted. The cylinder head should be fitted with all valves, springs, and retainers, but without camshafts, and the engine sealer will ask for some valves of his choice to be removed for checking , then refitted by the assembler.

Efficient and timely assembly of the engine in the presence of the engine sealer is requested.

The engine sealer shall confirm the **engine block** is an eligible G4FK factory stamped block with original identifications (**RULE 4.1(a)**) ; inspect the stampings at the back of the block to verify they have not been modified/ground/altered; inspect the cylinder block for any modifications including drilling or grinding; measure the bore size and record it in

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the sealing document. The cylinder block deck height is an optional check at sealing time, and may be measured at any future eligibility checking procedure.

Inspect the **crankshaft** for eligibility, visually two types of eligible crankshafts, inspect for evidence of balancing procedures used including grinding and drilling in excess of the allowance in the rules (RULE 4.2(e)), Inspect the **crankshaft timing wheel** for eligibility/comparison to an original sample; check the timing notch position in relation to the screw fixing hole; check for modifications; check the timing sensor hole in the cylinder block for modifications.

**Conrods** are to be visually inspected for evidence of balancing procedures used including grinding in excess of the allowance in the rules (RULE 4.2(e)); check that the conrods have original markings and have not been converted to fully floating gudgeon pins.

Check the **pistons** for eligibility, evidence from underneath the pistons that they are cast not forged, check they are not coated, check that they are fitted with three **rings** of an approved design by inspecting one piston that is to be refitted to the block, check for any crown machining, the piston crown has a distinctive cast section covering the valve reliefs and a small cast section adjoining, this cast area should remain untouched and the full circular machined area outside the cast region should remain as manufactured; refer to the specified crown dimension in Appendix 1 if needed; (RULE 4.2(b), 4.2(e), 4.2(f))

Note one conrod and one piston must remain original without any removal of metal.

Measure the **stroke** of one piston, use an effective method such as:- use the back of vernier calipers from the deck of the block to the crown of the piston to find BDC (bottom dead centre), measure this dimension at the front and the rear of the piston at BDC and average the two measurements, wind the piston to TDC and find the position of maximum piston protrusion using a dial indicator; measure the piston to deck dimension at two points in line with the gudgeon pin axis, average the two measurements, (positive dimension for piston protrusion, negative dimension for pistons below the block deck) and add this to the stroke dimension obtained above; record this as the stroke of the cylinder. Record the average dimension of the **piston protrusion** measured above. Alternatively a magnetic bridge and dial indicator of sufficient stroke may be used to complete the stroke measurement process.

Fix a timing cover/oil pump seal supplied by CERA Inc to the two pre-drilled bolts, and record in the seal sheet.

Inspect the **cylinder head** for casting eligibility; be familiar with Excel heads as opposed to ineligible Accent heads and the casting shapes and cast marks for each (refer Eligibility Officers if any queries).

- Have the engine builder/assembler remove two valves of your choice; Check the valves head sizes, valve stem sizes, valve throat sizes, valve throat machining depth, check the overall height and position of the valve seat inserts;
- using the sharp pointed tips of vernier calipers measure the valve pockets for all inlet and exhaust valve recesses in the head; check the valves for stem and head profiling which changes their shape from original, original valves have a "h" marking, using vernier calipers check the back-cut profiling on the valves removed; using the sharp tips of vernier calipers measure the unshrouding dimension obtained between a valve head and the vertical wall of the combustion chamber;
- using an inspection mirror (if necessary) inspect the short-turn radius area in the head throats, a sharp edge should be seen where the throat machining meets the untouched port in the short-turn radius area; From Feb 23 measure the depth of the throat machining from the original cast combustion chamber roof between each mating valve seat (refer Photo tba) to the furthest point of throat machining, compare to dimensions listed in Appendix 1- Valve throat machining depth; check for concentricity of the throat machining, use a Category supplied and machined valve as a gauge for visual concentricity checks; check/measure the valve guide lengths and positions in the head and check for modifications to the portion of the guides that protrude into the throats; inspect the throats and ports for original casting finish and associated casting lines; inspect for evidence that any form of hand, machine, abrasive, or chemical modifications have been performed throughout the throats and ports;

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- check a valve spring against an original sample carried by the sealer, if any doubts about spring tensions, a notation can be made that further spring checks should be performed at a later date and refer your query to your State Eligibility Officer;
- check the combustion chambers for machining in excess of that allowed in Appendix 1; perform a volume check of one combustion chamber using a certified burette and flat 5mm clear Perspex plate or similar; Refer RULES 4.3

After the cylinder head has been fitted, fit a CERA Inc supplied seal between the pre-drilled holes to seal the head to the block at the front end of the engine on the inlet manifold side; ensure seals are visible for eligibility checks. Ref photo 2

Measure the camshaft lobe base circles on at least one lobe with micrometers or vernier calipers; similarly measure the maximum lobe height dimensions and record both; check the camshafts for surface finish on the lobes (original factory camshafts have a unique finish pattern), and check that they are Excel camshafts not Accent camshafts by comparison against factory samples- Excel camshafts have different inside sprocket dimensions and corresponding camshaft hub dimensions; check the camshaft sprockets for timing modifications; once the camshafts are fitted, check the timing chain is locating the camshafts in the original factory positions , ie keyways exactly opposite each other in a horizontal plane. Record the camshaft dimensions measured in the sealing sheet; seal the camshaft pedestal bolts with a metal seal supplied by the national CERA Inc that resists heat and oil. Refer Photo 3.

## **REPLACEMENT COMPONENTS**

-Due to the high cost of certain genuine components and the ongoing difficulties that occur from time to time in sourcing genuine replacement parts, the following replacement components are approved aftermarket replacement components.

Fuel Injectors may be reconditioned or be replaced with the AZNEW exchange Injectors, Part Number AZN-604-04

Preapproved replacement pistons are;

NASON Standard Replacement - Nason Part # 4P1464-STD  
NASON 0.5mm Oversize - Nason Part # 4P1464-050

Preapproved Replacement Valve Springs are;

Crow Cam - Part No. 0513-1  
Performance Springs - Part No. PS10084-16

Preapproved Replacement Valves are;

NASON Inlet Valves - Nason Part # IN3455  
NASON Exhaust Valves - Nason Part # EX3456  
Precision Inlet Valves - Part No. IN3455, (Supplier part # EVHY-01-I)  
Precision Exhaust Valves - Part No. EX3456, (Supplier part # EVHY-01-E)

Preapproved Replacement Lifter/Lash Adjuster/Cam Followers are;

NASON - Nason Part # HT2289  
Precision - Part No. VL5521D, (Supplier part # SF03-233)

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## **TRANSMISSION/DIFFERENTIAL CHECKING AND SEALING**

Authorised Circuit Excel Racing Australia component sealers are to use the following procedures to check and seal Circuit Excel Racing transmission assemblies, allowing the components to conform to the Motorsport Australia 3E Circuit Excel Rules.

- Gearboxes are not to have a seal fitted to them by any authorised sealer unless the sealer performs a bench rotation check and diff action check, with the transmission removed from the vehicle. DO NOT fit a seal to any transmission whilst it is still fitted to a vehicle.
- Gearboxes are to be removed from the vehicle, may be complete or partially assembled, and must have drive shafts removed.
- Visually inspect the output drive splines and look for a crossshaft which should be visible between the two output splines. Using your fingers against the output splines, rotate one output splined gear whilst noting that the opposing output splined gear rotates in the opposite direction. As any modifications to original shims/thicknesses/shapes are not permitted in the 3E Circuit Excel Rules, the output splined gears will rotate freely with finger pressure. If it is necessary to insert any form of shaft into the output drive splines to rotate the output gears, it has not performed as an original unmodified transmission.  
This test is described as a Diff Action Check, and is a basic test, whilst assembled, to ensure the diff is original and has not been replaced with any other form of diff centre.
- Slide a piece of square 5mm (or 6mm) steel, approx. 300mm long, through the two output spline gears, thereby locking the output gears together. Square keystone is useful, and will require a small amount of grinding/shaping to ensure it slides inside both output splines, yet fits firmly enough to minimise individual movement of either output gear.
- Mark the output square steel position against the adjacent cast housing, whilst marking the input shaft spline position against the adjacent throw-out bearing support. A white paint marker is best for marking.
- Select any gear using the external gear selector lever, turn the input shaft clockwise by hand, count the number of input shaft rotations required to complete one rotation of the output keystone. Refer to the attached table to determine the correct number of rotations of the input shaft to complete one turn of the output shaft. The table of rotations accounts for the gearbox ratios plus the diff ratio combined.
- After completing each gear rotation check, return the shift lever to neutral, return both the input shaft and the output shaft to the original markings, some drag is occasionally felt so it may be necessary to hold the output keystone in position whilst returning the input shaft to the marked position; then select the next gear to be checked and repeat the rotation count procedure.
- After the rotation checks are complete, its important to cover at least 4 of the forward gears used regularly during racing, a seal may be fitted to two bolts in the gearbox casing as per the Photo 4 in the Technical Guide. It is the responsibility of the competitor/mechanic to have two bolts crossdrilled with 2mm holes to allow you to fit the CERA supplied seal.
- Record the seal number in an authorised seal sheet, mark on the sheet that a “bench rotation check and diff action check” has been completed, draw an oblique line across other parts of the seal sheet if not applicable to the current checks performed. Please advise the competitor that the seal sheet is to be carried to each race meet as it is verification that the approved checks have been performed on the transmission
- Please note that the 3E Circuit Excel Rules do not allow any changes or modifications to the transmissions , no gear polishing, coatings, modifications to synchro components, all components need to be as per original without any changes. If there is any doubt about any transmission eligibility, it may be dismantled and inspected more thoroughly under scrutiny by officials. DO NOT FIT SEALS TO GEARBOXES UNLESS THE BENCH ROTATION CHECKS LISTED ABOVE ARE PERFORMED.

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Table of transmission shaft rotation counts for twin-cam transmissions, for one rotation of the locked output shaft, the input shaft should rotate the following turns:-

1st Gear 14.00      2<sup>nd</sup> Gear 7.89      3<sup>rd</sup> Gear 5.26      4<sup>th</sup> Gear 3.96      5<sup>th</sup> Gear 3.22

**TRANSMISSION/DIFFERENTIAL TRACK/FIELD CHECK, NOT FOR SEALING** :- The following methods are to be used to check transmission/diff component eligibility by a scrutineer or eligibility officer at a racetrack before or after races when the transmission is fitted to the vehicle. These test procedures are un-intrusive, but are not to be used by component sealers as an alternative to the method described in **TRANSMISSION/DIFFERENTIAL CHECKING AND SEALING** above.

- (a) Differential action- vehicle front is to be jacked up to allow both wheels to rotate, transmission in neutral, hand brake off, either wheel is to be rotated by hand, the opposite wheel to be observed, the opposite wheel is to remain stationary or rotate in the opposite direction to the rotated wheel. Failure to comply deems the differential non-compliant.
- (b) Differential ratio- The method for scrutineer testing of differential ratios, in the instance a transmission/diff is not dismantled, is to place the vehicle on a relatively level area, use two checkers plus a driver to apply the brake, ensure the engine ignition is off and the engine cannot be cranked; remove engine spark plugs, engage 4<sup>th</sup> gear, move the vehicle forward to remove any gear backlash, mark the front engine pulley and one front tyre, roll the car forward, count the engine pulley rotations for one drive wheel rotation. The results can be compared to the table of diff and gearbox ratios in 3E Rules Appendix 2, Table 1; for any mathematical calculations to verify the results obtained, refer to your State Eligibility Officer.
- (c) Transmission ratios- The method for testing of gearbox ratios by scrutineers, in the instance a gearbox is not dismantled, is to place the vehicle on a relatively level area, use two checkers plus a driver to apply the brake, ensure the engine ignition is off and the engine cannot be cranked; remove engine spark plugs, engage the gear to be checked, move the vehicle forward to remove any gear backlash, mark the front engine pulley and one front tyre, roll the car forward, count the engine pulley rotations for one drive wheel rotation. The results can be compared to the table of diff and gearbox ratios in Appendix 2, Table 1; for any mathematical calculations to verify the results obtained, refer to your State Eligibility Officer.

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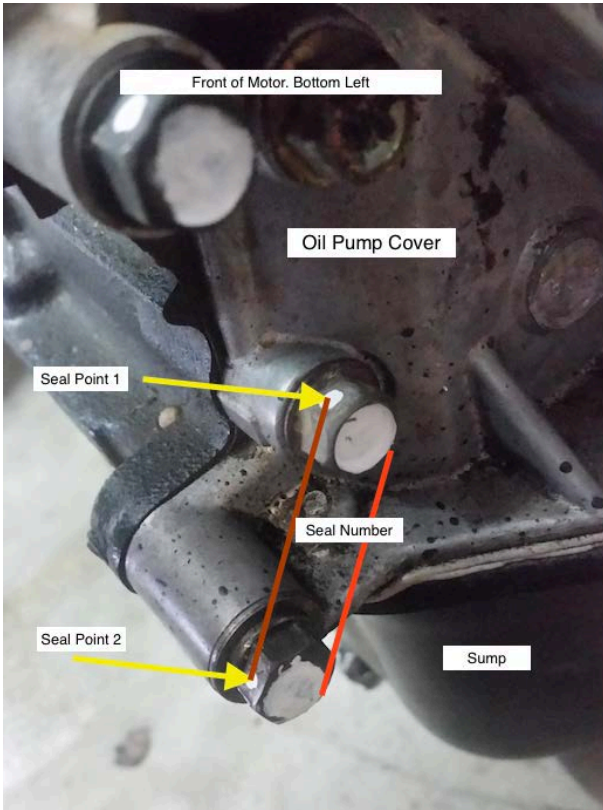


Photo 1

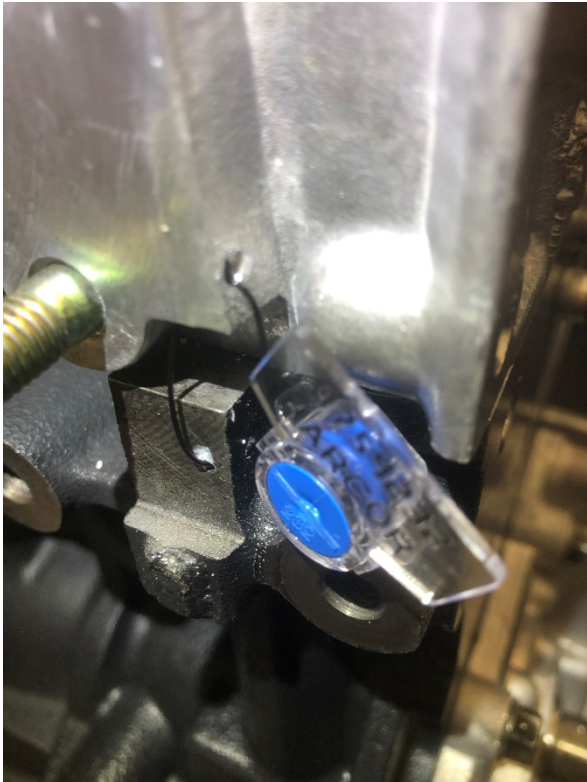


Photo 2

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Photo 3



Photo 4