

TECHNICAL BULLETIN

FORMULA VEE TECHNICAL MANUAL VER 3.6

REFERENCE:

2007 CAMS Online Manual of Motor Sport, Section 7, 1st Category: Racing Cars, Formula Vee Technical Regulations.

RATIONALE:

To promulgate the Formula Vee Technical Manual, revision 3.6, incorporating Restrictor Plate amendments to Article 9.2.6.

AUTHORITY:

This amendment was approved by the Australian Motor Racing Commission.

ACTION:

The attached is the current Technical Manual (Ver. 3.6) for Formula Vee. It replaces and cancels all previous versions and remains in force until any subsequent revisions are released.



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Distribution:

Board of CAMS	CEO (e)	National Managers (e)	NCR Review Committee
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Formula Vee Association
Of
Australia

FORMULA VEE TECHNICAL MANUAL

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National Administrator _____

CAMS



NOTE: This document is a controlled document issued in accordance with a specified distribution and updated as defined herein. The Specifications contained within this document are to be read in accordance with the CAMS Manual of Motor Sport. Where any discrepancy exists between the present Technical Manual and the CAMS Manual of Motor Sport, the CAMS Manual of Motor Sport shall take priority.

CONTENTS

Revision History

- Section 1: Introduction, interpretation, policy and authority**
- Section 2: Standard equipment required for scrutineering**
- Section 3: Standard scrutineering procedures**
- Section 4: Sealing and certification procedures**
- Appendix A: Change Notice Pro Forma**
- Appendix B: Certificate of Compliance Pro Forma**
- Appendix C: Details of Cylinder Bar**
- Appendix D: Details of Cylinder Gauge**

DOCUMENT REVISION HISTORY

Issue Number	Issue Date	Amendment summary
1.0		Original
2.0	Draft	Major revision; update of responsibilities; more detailed definition of procedures, introduction of Certificate of Compliance
2.1	Draft	Amendments to draft Issue 2.0 arising from FVAA meeting 16 October 1995
2.2	4/9/96	Includes amendments recommended by CAMS
2.3	10/9/96	Amendments including CAMS Bulletin B96/23 and CAMS Eligibility Committee determination of 22 May 1996
2.4	1/1/01	Amendments resulting from 2000 FVAA Ballot, recommendations from the FVAA National Committee and CAMS Bulletin B01-12
3.0	22/05/2003	Major Revision New Specifications for cars Re Ballot and 1600cc engines
3.1	13/10/2003	Revision to side rail heights, Article 9.4, Bulletin B03/082
3.2	01/01/2005	Introduction of Dunlop Tyres
3.3	04/11/2005	Addition of Safety Roll Bar requirements
3.4	10/11/2005	Revision to Restrictor Plate, 1600cc engines
3.5	24/11/2006	Amend Article 9.1.3(f) 2. Rocker Arms
3.6	03/05/2007	Amend Article 9.2.6 Restrictor Plate

Section 1

Introduction, Interpretation, Policy & Authority

1. SCOPE

In accordance with the CAMS rules pertaining to Formula Vee, this manual shall serve as the basis for all examinations and certification of eligibility of Formula Vee racing cars:

- prior to the issue of a CAMS log book
- prior to the sealing of engines and transmissions
- during pre and post race scrutineering

This manual defines the approved interpretation of the Formula Vee Regulations as specified in the CAMS Manual of Motor Sport, and wherever appropriate it specifies the procedure through which compliance with specific Regulations SHALL be measured and certified. (No alternative procedure for assessment of compliance with any Regulations may be used.)

It also defines standard formats for Scrutineering Sheets which shall serve as Certificates of Compliance for Formula Vee chassis & body structures, engines and gearboxes.

2. DEFINITIONS

The following definitions are used throughout this Manual:

Authorised recipient	A person or office who holds a controlled copy of this Manual and who shall receive controlled copies of all updates
CAMS	Confederation of Australian Motor Sport
FVAA	Formula Vee Association of Australia
Regulations:	The Formula Vee regulations as defined within the CAMS Manual of Motor Sport

3. DISTRIBUTION

3.1 This Manual shall have a controlled distribution to the following authorised recipients:

Authority	Copy Number:
FVAA National Administrator	Master
FVAA National Administrator	1
Manager CAMS Technical Services	2
Scrutineering Director FVA NSW	3
Scrutineering Director FVA Q	4
Scrutineering Director FVA SA	5
Scrutineering Director FVA Tas	6
Scrutineering Director FVA V	7
Scrutineering Director FVA WA	8
Secretary FVA NSW	9
Secretary FVA Q	10
Secretary FVA SA	11
Secretary FVA Tas	12
Secretary FVA V	13
Secretary FVA WA	14

Authorised recipients shall receive controlled copies of all Change Notices.

The Manual may be copied but holders of copies will not receive controlled copies of Change Notices. However, copies of all Change Notices shall be included in the Formula Vee National Newsletter which also shall include all issues a statement of the current Issue No of the Technical Manual.

4. STANDARD INTERPRETATION

The standard interpretation of the Regulations shall be that the formula is based on the use of components from Volkswagen Australian Type 1 sedan components, and that no component of the engine, transmission, front suspension, steering or brakes may be altered unless specifically defined as being permitted under the Regulations

All components must remain as manufactured or within the tolerances specified in Section 3 of this Manual.

The term "functional dimensions" within the FV Regulations shall be interpreted to mean made of the same materials and operates in the same FV manner and provides no additional advantages in operation to genuine VW parts.

5. SPECIFIC INTERPRETATION

Notwithstanding the standard interpretation, instances occur where clarification or more detailed interpretation is required on specific items.

The following procedures shall apply when seeking and obtaining specific interpretations of the Regulations.

- All requests from Association members for the interpretations shall be directed in the first instance to the Scrutineering Director in the member's State.
- The State Scrutineering Director may either:-
 - a. make a determination on more straightforward issues, which shall be provided in writing to the requesting member with a copy to the National Administrator, or
 - b. direct a query in writing to the FVAA National Administrator on more contentious issues.
- Following receipt of a request to resolve any ambiguous interpretations of the regulations the FVAA National Administrator shall seek a determination.
- If deemed relevant, the matter will be referred to the CAMS Eligibility Committee, it being noted that any findings or determinations of the CAMS Eligibility Committee are not appealable.
- If the matter is not referred to the CAMS Eligibility Committee, a determination shall be made by the National Administrator on the basis of the interpretation agreed on by a majority of State Scrutineering Directors. This determination is appealable to the CAMS Eligibility Committee.
- The interpretation shall be advised to all State Scrutineering Directors by the National Administrator and promulgated as a Change Notice to the Technical Manual, such Change Notice to include an update to the Issue No of the Technical Manual. (Refer to Appendix a for Change Notice pro forma.)
- Change Notices shall be issued by the National Administrator to all Authorised Recipients and copied to the Editor of the National Newsletter for inclusion in the next issue of the Newsletter.
- If appropriate, the Regulation which required interpretation shall be subject to revision via consultation between the FVAA and CAMS.

6. SCRUTINEERING POLICY AND AUTHORITY

The following scrutineering policy and authority applies to the scrutineering of Formula Vee engines, gearboxes and chassis for eligibility. The actual scrutineering procedures relate to specific clauses in the Regulations.

The Formula Vee State Scrutineering Director is, at any race meeting he/she may attend, principal advisor to the Chief Scrutineer of the Meeting on matters of Formula Vee eligibility.

Each State FV Association shall train and appoint a number of authorised "FV Scrutineers".

FV Scrutineers shall be responsible to the State Scrutineering Director for execution of their duties in accordance with the requirements of this Manual and the general rules of CAMS.

FV Scrutineers shall be responsible for verification of conformance of FV engines and gearboxes submitted to them, for fixing approved seals to such items, and for issue of certificates of Compliance to certify that items are in conformity with the FV Regulations at the time of sealing.

It shall be the responsibility of each State FV Association to:-

- ensure that each FV Scrutineer is trained against the requirements of the FV Regulations and this Technical Manual, as well as the general rules of CAMS:
- ensure that each such appointee undertakes to comply with the requirements of the current issue of the technical Manual as a condition of appointment, and
- that appropriate training updates are undertaken, at least annually, to ensure that consistent procedures are being followed by all FV Scrutineers.

FV Scrutineers may assist the State Scrutineering Director in the discharge of his/her responsibilities, but if competing shall have no standing as officials of the meeting.

Every Formula Vee car shall be inspected by an FV Scrutineer and issued with a Certificate of Compliance prior to issue of a Formula Vee Log Book. (See Appendix B for Certificate of Compliance pro forma. Books of printed "triplicate" forms shall be provided by the FVAA to State Associations for issue to all FV Scrutineers.)

A Certificate of Compliance also shall be issued following the sealing or re-sealing of FV engines and transmissions.

No scrutineer may seal the engine or transmission of any car of which he/she is the owner or likely to be the driver, or of which he/she is the most recent builder/rebuilder of the assembly being sealed.

Sealing shall be done on a rotation or alternation basis, with the proviso that the Scrutineering Director may direct that the assembly in question is to be sealed by a specific scrutineer.

No scrutineer shall engage in collusion to seal an engine to provide a material advantage to a particular competitor.

The method by which cars are to be selected for post race or post practice examinations is at the discretion of the State Scrutineering Director, the Chief Scrutineer or Stewards of the Meeting.

Each FV Scrutineer shall be issued with a sealing device whose seals identify the State Association and the scrutineer, and shall be issued with measuring equipment required for discharge of scrutineering responsibilities.

All scrutineering is to be conducted with equipment detailed in Section 2 of this manual and in accordance with the procedures detailed in Section 3.

A new Certificate of Compliance shall be completed by scrutineers each time an engine and/or gearbox is sealed. The standard "triplicate" copies of completed sheets shall be distributed as follows:

- Original: To car owner
- Duplicate: To car owner who shall be responsible for delivery to the State Scrutineering Director
- Triplicate: To be retained by the scrutineer

A Register of Certificates of Compliance shall be maintained by the State Scrutineering Director, and shall be available at all FV race meetings held in that State.

Car owners shall be responsible for carrying Certificates of Compliance with vehicle Log Books, and for submitting them for inspection at race meetings or whenever so required by scrutineers and/or race officials.

7. PLACEMENT OF SEALS

Seals shall be attached by the scrutineer on approved sealing wire in accordance with Section 4 of this Manual so that key engine and transmission components cannot be replaced or modified.

Section 2

Equipment for Scrutineering

8 EQUIPMENT FOR SCRUTINEERING

8.1 *Equipment*

The following equipment is required for scrutineering Formula Vee engines and shall be issued to, or readily accessible to, all registered scrutineers:

- 50 ml burette for checking combustion chamber capacity
- Perspex disc with one centre hole no larger than 6 mm in diameter for checking combustion chamber capacity
- A small spirit level for setting the cylinder heads level
- Vernier calipers for checking basic dimensions, bore, valve and port diameters, valve guide length, etc.
- EITHER:
 - a. A cylinder hold down bar manufactured in accordance with Appendix C, for checking the minimum distance from the top of the piston to the top of the cylinder at TDC, and a spacing block 64.1 mm +0.00 mm in length for measuring engine stroke, OR
 - b. A gauge block manufactured in accordance with Appendix D (or similar) for checking the minimum distance from the top of the piston to the top of the cylinder at TDC and also the engine stroke.
- Weighing devices for measuring the weight of specified FV components to an accuracy of 1%. The following are recommended:
 - (a) TBA

8.2 *Calibration*

It shall be the responsibility of State FV Associations to ensure that all weighing devices issued to registered scrutineers shall be subject to calibration at least annually, and that calibration curves for each instrument are held by both State Scrutineering Director and the FV Scrutineer who is the custodian/user of that item of equipment.

In the spirit of maintaining FV as a minimum cost Formula, such calibration may be carried out directly by the State FV Associations. The minimum requirements for calibration of each instrument shall be:-

- Record zero error (if any) of instrument
- Record instrument reading at a minimum of three points over the measuring range, using known weights (retained as standards) for the calibration points. (Calibration weights close to those of the FV items to be measured are preferred.)
- After completion of one set of calibrations, repeat twice to check repeatability of measurements.
- Draw a graph of the true readings as the three sets of observed readings on a single. Provided that the repeatability is within 1% at points close to those representing FV components, and provided that the measured values are within 3% of the true reading, this calibration curve may be used to provide corrected results on this item of equipment.
- One copy of equipment calibration curve shall be provided to the State Scrutineering Director, and one copy shall be issued to the Scrutineer who is the custodian/user of that item of equipment.

8.3 *Certification of Compliance*

Scrutineers sealing FV items shall be required to sign Certificates of Compliance which certify that the measurements and inspections undertaken by that scrutineer are within the specified limits as measured by the approved measuring equipment issued to that Scrutineer.

Section 3

Standard Scrutiny Procedures

9. DRIVETRAIN, BRAKES and SUSPENSION

The following scrutiny procedures apply to all Formula Vee engines and transmissions and shall be carried out by registered scrutineers. On completion of scrutiny, approved seals are to be secured by the scrutineer on approved sealing wire using an approved scaling device to ensure that the key engine and transmission components cannot be modified or replaced without removing the seals.

9.1 ENGINES

9.1.1 General

All engine measurements shall be carried out with the components at ambient temperature to avoid errors arising from differential expansion.

The practice of standard reconditioning of serviceable parts is permitted under regulation 2.6 (xv). The intent of the rule is to allow second hand parts to be made serviceable, it is not the intent of the regulation to allow the narrowing of gears or the re-profiling of piston skirts to gain advantage.

Engine

The aim of the rules on engine are to allow the minimum blue printing of engine componentry to ensure reasonable equality of engine performance between professional and home engine built engines at a realistic cost. Standard engine reconditioning practices as carried out by commercial engine re conditioners to make parts serviceable is permitted provided that it does not conflict with the rules. Any machining of previously machined surfaces must be done on the same plane as previous. The intent of the rule 2.6(xv) is to allow second hand parts to be made serviceable; it is not the intent of the regulation to allow the narrowing of gears or the re-profiling of piston skirts etc. to gain advantage.

9.1.2 Bottom End Build

The following sections detail the checks required as part of bottom end building and in order to complete Build Section B of the Certificate of Compliance; see Appendix B.

9.1.2 (a) Crankcase: Regulation 2.6 (iv)

Check crankcase for compliance with Regulation 2.6 (iv). Examine the crankcase for machining consistent with normal reconditioning procedures and as allowed by Regulation 2.6 (iv).

Use of any VW crankcase is permitted, as is the machining of the front of the crankcase to accept oil seal and the machining of the labyrinth scroll from the rear of the crankshaft pulley.

Centring rings, if used on 1200cc engines, shall be checked to ensure that they have a uniform wall thickness so that the 1200 cc cylinder axis is the same as that of the cylinder originally intended for the crankcase.

Check cam follower bore face dimension for compliance with Regulation 3.3 (I).

9.1.2 (b) Crankshaft: Regulation 2.6 (v)

Check crankshaft for compliance with Regulations 2.6 (v). Stroke shall not exceed 64.1mm for 1200cc engines, or 69.1mm for 1600cc engines. Stroke shall be checked through the procedure defined in clause 10.1.3 (h) below.

Check that metal has not been added in the process of balancing, and that no polishing has been carried out except on moving contact surfaces. (Regulations 2.6 (ii) and (iii)) (NOTE: The surface finish which is intended to be described by "polishing" will be clarified in a future update of this Manual.)

Check crankshaft weight for compliance with Regulation 3.3 (ii) . Crankshaft weight (8.1 kg

minimum for 1200cc and 8.8kg minimum for 1600cc) as specified includes four flywheel dowels, one each camshaft drive gear and woodruff key, camshaft drive gear, distributor drive gear spacer, drive gear circlip, No. 3 main bearing and distributor drive gear.

Material must not have been removed from the crankshaft for 1600cc engines, other than that consistent with that required for balancing where material may be removed from the *circumference of the crankshaft webs*.

9.1.2 (c) *Flywheel:* Regulation 3.3 (iii)

The use of any flywheel, as used on a Type 1 or Type 3 VW originally fitted with a 6 volt or 12 volt electrical system, is permitted. **Note 1600 cc engines must use flywheel to suit 200mm clutch p.c.d.**

Check flywheel weight for compliance with Regulation 3.3 (iii).

9.1.2 (d) *Connecting Rods:* Regulation 2.6 (vi)

Examine all four (4) connecting rods, and check that connecting rod weights comply with the specification in Regulation 3.3 (iv).

Metal may be removed for balancing purposes using any normal machining process but rods shall not be polished. For 1600cc engines, at least one complete big end on one rod, one complete little end on one rod (not necessarily the same rod) and all beams must remain unmodified.

9.1.2 (e) *Camshaft Followers:* Regulation 2.6 (ix)

Check cam followers for compliance with Regulation 2.6 (ix). The only machining allowed is at the camshaft contact face.

9.1.2 (f) *Camshaft:* Regulation 2.6 (viii)

The valve timing of the assembled engine is no longer specified. It is permissible to vary the engine valve timing of the assembled engine by the method defined in Regulation 2.6 (xiv)(b).

The camshaft profile is required to meet the specification in Regulation 3.3 (iv) Wade 1038. Camshafts sealed into engines after 1 January 1992 shall be from the nominated supplier -

Wade Camshafts
27 Wells Road
Oakleigh 3166.

Measurement of camshaft profiles is a specialised process which can only be accurately undertaken by specialists known in the trade as "Cam Doctors". Camshafts shall be controlled and/or verified through the following process:

- i) All States shall nominate a specialists camshaft organisation who shall be their designated State authority for measurement of cam profiles. That authority shall be required to,
 - provide a fast service for measurement of cam profiles and verification that the profile meets the FV specification,
 - etch or otherwise mark a unique identification number on each camshaft referred to them for measurement.
- ii) Whenever camshafts are received by State Scrutineering Directors, or by approved engine sealers (except when supplied directly to them by the State Scrutineering Directors), they shall be referred to the designated State camshaft authority for verification and marking.
- iii) When an engine sealer receives a camshaft to be sealed into an engine he/she shall have the profile verified by the designated State camshaft authority prior to sealing the camshaft into the engine, and the unique identification number of the camshaft shall be recorded in Build Section B of the Compliance Certificate (see Appendix B1)

The only exceptions to this process shall be:

- When the sealer is fitting a camshaft which has previously been checked and

uniquely numbered by the designated State camshaft authority and which has been totally under the control of the sealer or the State Scrutineering Director since the time of verification.

- Where a camshaft which has previously been checked and uniquely numbered by the designated State camshaft authority is removed from a sealed engine in the presence of the engine sealer and held by that sealer for the subsequent refitting to the engine by him/her or in his/her presence.
 - In both such cases there will be no need for additional verification. The identification number shall be recorded in Build Section B of the Compliance Certificate in the normal way.
- iv) The identification number of the camshaft shall be recorded by the sealer and included in Build Section B of the Certificate of Compliance; see Appendix B. Remember to do this before the crankcase is sealed.

9.1.2 (g) *Bottom End Sealing*

Sealing of the bottom end shall be carried out as defined in Section 4.

9.1.3 *Top End Build*

The following sections detail the checks required as part of top end building and in order to complete Build Section A of the Certificate of Compliance; see Appendix B.

9.1.3 (a) *Pistons & Gudgeon Pins* Regulation 2.6 (x)

Examine all four (4) pistons/gudgeon pin assemblies and ensure that any machining undertaken for balancing is in accordance with Regulation 2.6 (x), and for 1200cc engines that weights comply with the specification in Regulation 3.3 (v). For 1600cc engines, at least one piston must remain unmodified.

9.1.3 (b) *Cylinder Bore*

Measure the bore of all four cylinders and check that the bore size does not exceed 77.21mm for 1200cc engines or 85.70mm for 1600cc engines.

9.1.3 (c) *Cylinder Head - General* Regulation 2.6 (xi)

Examine each cylinder head and check compliance with Regulation 2.6 (xi).

Examine closely the combustion chamber, the inlet and exhaust ports of the cylinder heads and check for signs of material having been added, and, in the case of 1600 engines, removed. Note: Isolated "spot" removal of casting dags and occlusions using a punch or chisel only is permitted. Check that any machining of the combustion chambers is only on the same surface as the cylinder spigot contact face and within the limits specified in Regulations 3.3 (vi).

Check that inserts do not exceed the specification in Regulation 3.3 (vi) and that the surrounding combustion chamber is not modified. For 1600cc engines check that any throat cut is isolated to the insert only.

Check that valve guides are replaced in standard position and that the guides are centrally drilled. To be deemed eligible under the existing rules, the position of valve guides in the cylinder head must be that demonstrated on standard Volkswagen component. That is, valve guides with shoulders must be pressed into the cylinder head "all the way home". (Specification for the location of non-shouldered valve guides on 1200 engines is currently under consideration.)

Check that no artificial turbulence devices have been fitted in the inlet tract.

9.1.3 (d) Cylinder Head - Ports Regulation 3,3 (vi)

Check port diameters, valve seats and valve seat. angles and valve guide dimensions and depth for consistency with dimensions specified under Regulation 3.3 (vi); diameters at flange face shall not exceed 29mm inlet and 33 mm exhaust for 1200cc engines and 31.0mm and 32.0mm respectively for 1600cc engines.

9.1.3 (e) Combustion Chamber Volume Regulation 3.3 (vi)

Check combustion chamber volume. The minimum volume of each combustion chamber as specified in Regulation 3 is 43cc for 1200cc engines, or as specified in the table below for 1600cc engines. This shall be measured as follows:

- Insert a spark plug with the correct reach (Bosch W8AC or equivalent) and with only one gasket fitted, tighten to correct torque
- Using a spirit level, position and firmly fix the cylinder head such that the cylinder spigot contact surface is horizontal
- Clean the combustion chamber cylinder spigot contact surface and ensure the combustion chamber surface is dry
- Coat an area of the Perspex disk equivalent to the top of the cylinder spigot with just sufficient light grease or Vaseline to create a seal between the disk and the cylinder spigot contact surface
- Place the disk into the combustion chamber so that the grease or Vaseline provides a seal between the disk and the cylinder/Head sealing face
- Using the burette, meter out the required amount of kerosene to fill the combustion chamber to the bottom of the hole in the Perspex disk correcting for the shape of the meniscus
- Check that there has been no leakage of fluid out past the valves, spark plug or the edges of the Perspex plate

The above test shall be repeated if any leakage or spillage occurs. The volume of fluid metered into the combustion chamber as described above without any leakage or spillage must be at least the volume specified. The volume can be increased to this amount only by fitting thinner valves, recessing the valve seats or by secondary fly cutting of the cylinder head as permitted under Regulation 2.6 (xi)(g).

For 1600cc engines, the combustion chamber volume shall be determined as follows:

The procedure is to measure the cc capacity of both combustion chambers and take their average, then from the table determine the required deck height (the distance from the top of the piston to the top of the barrel). The barrel is then shimmed to meet the required deck height. No more than 0.5 mm thickness of paper shims may be used, the remainder must be made of metal.

From	To	Deck Height
48cc	And above	1.00mm
47cc	48cc	1.30mm
46cc	47cc	1.50mm
45cc	46cc	1.65mm
44cc	45cc	1.80mm
43cc	44cc	2.00mm
42cc	43cc	2.20mm
41cc	42cc	2.35mm
40cc	41cc	2.50mm

9.1.3 (f) *Valve Train:* Regulation 2.6 (xii)

Remove at least one Inlet and one exhaust valve.

Check that the valve sizes and valve seat angles conform with the specification in Regulation 3.3 (vii), and examine for any unauthorised machining of the valve especially in the valve seat area.

Check that valves are to the same functional dimensions as standard VW valves, noting that the definition of "functional dimension", when considered in relation to engine valves, requires that valves shall use the same materials as those used by VW for both the heads and stems of valves, and shall have the same valve profile between the stem and the valve seat as standard VW valves since variation in this profile can confer an advantage in operation.

Check rocker arms for compliance to regulation 2.6 (xii) (b).

The rocker arm ratio shall be defined as the tappet side lever arm length divided by the pushrod side lever arm length. This shall not exceed 1.18:1.

The tappet side lever arm length shall be defined as the mutually perpendicular distance between the axis of the rocker shaft and the axis of the tappet adjusting screw.

The pushrod side lever arm length shall be defined as the perpendicular distance from the centre of the hemi-spherical pushrod seat to the axis of the rocker shaft.

The use of non-standard swivel foot valve adjusters is permitted provided no non-authorised modifications to any other components are made.

9.1.3 (g) (Not applicable to 1600cc engines) Minimum Clearance from Top of Piston to Top of Cylinder

Regulation 3.3(v) specifies a minimum distance of 1.0mm between the top of each piston and the cylinder face seal.

After installing each piston and corresponding cylinder, check the distance from the cylinder spigot to the top of the piston with the piston at top dead centre. Two methods of measurement are acceptable, namely:

Method A - Clearance Bar

- Use a clearance bar manufactured in accordance with the drawing shown in Appendix C, or similar.
- Position the clearance bar over one cylinder and tension down, with the 1mm step facing the piston, to a torque setting of 3.0-3.2m.kg or 22-23 ft. lbs.
- Rotate the crankshaft so that the piston travels past the top dead centre position without any resistance imposed by the bar.

Method B - Clearance Gauge

- Use a clearance gauge manufactured in accordance with the drawing shown in Appendix D, or similar.
- Note the gauge calibration dimension [Dimension (A)] stamped on the side of the gauge.
- Position the gauge block across a pair of cylinders and tension down to a torque setting of 3.0-3.2m.kg or 22-23 ft. lbs.
- Fix a Vernier or digital caliper across one of the gauge holes over one of the pair of cylinders.
- Rotate the engine until the piston on the cylinder to be measured is at TDC.
- Adjust the Vernier or digital caliper until the probe just touches the top of the piston, then read the dimension recorded by the caliper; Dimension (B).
- Subtract Dimension A from Dimension B to give the piston clearance dimension; compare this with the dimension recorded conformity or otherwise.
- Rotate the engine until the piston is at BDC, and adjust the caliper until the probe just touches the piston, the read the dimension recorded by the caliper, Dimension C.
- Subtract Dimension A from Dimension C to give the stroke of that cylinder; compare

this with the specified stroke and record conformity or otherwise.

- Without moving the gauge, shift the Vernier to the gauge hole over the other piston, and repeat the above to measure piston clearance and stroke for the other cylinder of that pair.

9.1.3 (h) *Crankshaft Stroke*

Regulation 3.3 (ii) specifies a maximum engine stroke for each engine.

Two methods of measurement are acceptable, namely:

Method A - Clearance Bar

- Use a clearance bar manufactured in accordance with the drawing shown in Appendix C, or similar.
- After setting the clearance from the top of the piston to the top of the cylinder, and retaining the clearance bar torque down settings, measure the actual clearance between the piston at TDC and the bottom of the cylinder hold down bar.
- Remove the clearance bar, set the piston to bottom dead centre and insert a stroke gauge manufactured to the drawing shown in Appendix E, or similar.
- Reinstall the clearance bar and tension down to 3.0-3.2m.kg or 22-23 ft. lbs.
- Measure the clearance between the underside of the hold down bar and top of the stroke gauge. The clearance must be equal to, or less than the clearance when the piston was at TDC.

Method B - Clearance Gauge

- Using the clearance gauge defined above, stroke is measured as part of the same process as piston clearance; see above.

The cylinder heads may be installed and tensioned down after the cylinder height of each cylinder has been adjusted and the stroke length has been checked as detailed above.

9.1.3 (l) *Top End Sealing*

Sealing of the top end shall be carried out as defined in Section 4.

9.1.4 *Inlet Manifold:* Regulation 2.7 (ii)

Inspect the inlet manifold for unauthorised machining or metal removal. For 1200cc engines, measure the outside diameter and the weight and ensure measurements comply with those nominated in Regulation 3.4 (ii). The maximum thickness of the inlet manifold gasket between the contact face of the head and the contact face of the manifold is 3mm.

For 1600cc engines, check the amount removed from the runners is no greater than 23mm, and that any cleaning up of the welded section does not extend beyond 30mm from the port face, or exceed 31.0mm in diameter.

9.1.5 *Fan Housing and Ductwork:* Regulation 2.7 (vi)

Inspect the fan housing and ductwork to ensure compliance with this Regulation. Make sure that the internal deflector is unmodified.

9.1.6 *Generator:* Regulation 2.7 (v)

The generator is not required to function. The generator body must be retained and the fan must remain driven by the generator shaft.

9.2 *CARBURETTOR* Regulation 2.7 (l)

9.2.1 *Carburettor Top (1200cc only)*

Inspect the throttle top. The only modification permitted to the carburettor top is the removal of casting flash at the base of the carburettor top where it meets the carburettor body, such that the width of a scrape removing any flash shall not exceed 1mm.

9.2.2 Throttle Shaft (1200cc only)

Inspect the throttle shaft for unauthorised modification. The minimum thickness on standard throttle shafts is 4.8mm possibly +/- 0.1mm. Throttle shafts less than 4.7mm thick shall be rejected.

9.2.3 Throttle Body (1200cc only)

Inspect the throttle body for unauthorised modification.

Removal of excess casting flash within the throttle body is permitted provided that the basic dimensions of the carburettor body are not altered.

Note the diameter at the base of the carburettor taken in any given direction shall not be greater than 28.1mm.

9.2.4 Air Cleaner

Check compliance with Regulation 2.7 (iii).

9.2.5 Carburetion (1600cc engines)

Only carburation allowed will be the Solex 34 PICT-3 or equivalent BoCar, The carburetor must remain standard. No metal shall be removed from the carburetor casting.

The use of any jets or floats which may be fitted without alteration to the carburetor is permitted.

The removal of the choke mechanism and plugging of the holes is permitted. Plugs must be flush with the inner surface of the carburetor top.

The fuel cut off solenoid may be removed and a screw in plug fitted.

9.2.6 Restrictor Plate (1600cc engines)

The restrictor plate shall be provided by the Formula Fee State Scrutineering Director. The orifice shall be inspected to ensure that the throat edges are sharp and have not been radiused nor chamfered in any way. **The restrictor plate shall be anodised red and be validated by the attachment of an FVAA seal after anodising.**

A fibre gasket must be placed either side of the restrictor plate, the gasket shall have a minimum inside diameter of 34mm and a maximum thickness of 1.6mm.

Carburettor mounting studs/bolts shall be such as to securely locate the restrictor plate with the orifice centred in the carburettor throat.

9.3 TRANSMISSION Regulation 2.8

Check compliance with Regulation 2.8.

With transmission dismantled, examine the ratios and ensure that they are consistent with those specified in Regulation 2.8 (iii)(a).

Ensure that no gears are straight cut except reverse gear and that gear dimensions are standard.

Ensure that synchromesh is present on at least top, third and second gears.

9.4 SUSPENSION Regulation 2.3

9.4.1 Tyres

Tyres shall be Dunlop CR82 (434): Front 120/590-15

Rear 135/620-15

9.4.2 Suspension

Removal of front shock towers – permitted only if vehicle complies with upgraded forward roll over protection requirements as specified for vehicles first issued with log books on or after January 1st 2003;

- the location of the front shock absorbers is free provided that only modifications that are not in conflict with these Regulations are made;
- the standard shocker absorber mount on the lower control arm is to remain the actuating point;
- the actuation mechanism for the shock absorber is free;
- the welding of mounting brackets to the front suspension tubes.
- Check for compliance with regulations 2.3

9.4.3 Steering

Check that steering rack is securely mounted, and that is purely mechanical in operation i.e. no power assistance.

The reinforcement of the LH stub axle by the fitment of a 8mm HT (Grade 10.9 min) bolt and nut is compulsory. Such bolt shall be inserted into the hole originally provided for the fitment of the speedometer cable, and is to be held in place by resin and be a minimum of 75mm in length.

9.4.4 Brakes

The use of 4 wheel Disc Brakes is permitted, and is compulsory on cars with log books first issued on or after 1 January 2003 and all 1600cc engines.

The following are permitted:

- the use of any disc rotor/hub assembly. Disc brake rotor/hub assemblies must be made from predominantly ferrous material. The disc rotor/hub assembly may only be of one or two-piece construction, and must comply with specifications as detailed in 3. Weights and Dimensions;
- the use of any calipers of proprietary manufacture, ie the calipers must have been bought as an assembly from a retail supplier (Harrop, Brembo, PBR, Ford etc) for front and rear , that the number of pistons per caliper is not more than 2, and the number of calipers per wheel is not more than 1. Calipers must comply with specifications as detailed in 3. Weights and Dimensions, and show no signs of modification from specifications as supplied. Ask vehicle owner for source of supply if in doubt.;
- the fitment of caliper mounting brackets and removal of drum backing plates;
- the use of any brake pad friction material.

No cross drilling or grooving of rotors or is permitted. No modifications of calipers and disc rotor assemblies is permitted other than standard reconditioning procedures. The minimum disc rotor thickness shall be 8mm or the dimension set by the manufacturer, whichever is the greater Disc rotors must also be from a proprietary supplier, see comments as for calipers.

9.5 NON-GENUINE PARTS

The use of non-genuine VW replacement parts is permitted. The parts must be standard replacement parts in terms of configuration and functional dimensions and shall not result in unauthorised modification of any other component.

a	Gaskets and seals	n	Torsion arm link pins
b	Cylinders and pistons (1200cc only)	o	Axle boots
c	Bearings	p	Camshaft
d	Valve guides (1200cc only)	q	Steering box
e	Engine valves (1200cc only)	r	Oil pump
f	Valve springs	s	Distributor
g	Fuel pump	t	Air correction jet carrier
h	Voltage regulator	u	Valve seat inserts
i	Fan belt	v	Brake Drums
j	Brake shoes	w	Cam Followers
k	Wheel cylinders	x	Valve Push Rods
l1	Pressure plate (1200cc only)	y	Crank Cases
l2	Clutch plate	z	Ball joints
m	King pins		

9.6 AUTHORIZED PARTS

The following parts can be from any source, provided their use does not result in the unauthorised modification of any other component:

- a Threaded fasteners (but not wheel mounting bolts)
- b Brake lines
- c Fuel lines
- d Spark plugs
- e Master cylinders
- f Carburettor jets and venturi
- g Push rod tubes
- h Ignition coil
- i 6v or 12v batteries
- j Shock absorbers
- k Fuel filters
- l Ignition points
- m Washers
- n Piston rings
- o Starter motor
- p Swivel foot valve adjusters

9.7 WEIGHTS AND DIMENSIONS

Vehicle:

Racing weight	1200cc	475kg minimum
	1600cc	490kg minimum
	(see "Definitions")	
Wheelbase	2095 ± 25mm	
Front Track	1295 to 1405mm	
Rear Track	1276 to 1389mm	
Overall Length*	3125mm min. and 3425mm max.	

(*Measured between vertical planes at the vehicle foremost point and the rearmost point of the gear selector housing).

9.7.1 Body:

- (a) Refer to Class Regulations 2.2, 3.1 and 3.2 in CAMS Manual of Motor Sport.

Width at firewall: 600mm min.

Main body profile only, (not including crushable structures where required). Width at fire wall must be maintained over a vertical cross section, 300mm in height, for at least 300mm forward from the fire wall. Vehicles subject to a log book issued prior to 1 January 2001 shall be exempt from the requirements of the present article subject to continued compliance with the body width requirements in force at the time of issue.)

- (b) Additionally:

- (i) body panels may incorporate side impact protection (See 10.2 (h));
- (ii) if vehicles log booked before 1 January 2001 retain use of winglets to meet the former regulation of 860 mm minimum body width at the firewall, then the winglets must form part of the bodywork and must have a minimum radius of 15 mm on every projected edge.

Note: On safety grounds, winglets must not be configured as a flat piece of sheet metal in single plane.

Ground Clearance: 40mm min.

9.7.2 Engine:**(i) Crankcase:**

Cam follower bore face to crankcase joint face: 31mm max.

(ii) Crankshaft:

Stroke: 64.1mm max 1200cc.

69.1mm max 1600cc

Weight: 8.1kg min 1200cc.

8.8kg min 1600cc

(iii) Flywheel Weight:

5.4kg min.1200cc

7.0kg min 1600cc

(iv) Camshaft:

Inlet and Exhaust Phase Angle: 107° ± 15'

Lobe Lift Table maximum (mm):

Degrees	Inlet	Exhaust
90 Opening	0.061	0.165
75	0.266	0.353
60	0.651	0.700
45	2.552	2.448
30	5.297	5.017
15	7.152	6.793
0 Peak	7.778	7.391
15 Closing	7.154	6.787
30	5.310	4.993
45	2.596	2.364
60	0.679	0.632
75	0.310	0.288
90	0.118	0.081

(v) Cylinder, Piston and Connecting Rod:Cylinder bore 1200cc 77.21mm max.
1600cc 85.70mm max.

Piston top to cylinder seal face (1200cc only) 1.0mm min.

Weight: piston/gudgeon pin (less gudgeon clips & piston rings)

1200cc 330g min.

1600cc One piston to be standard, other three may be reduced to match.

Weight: connecting rods (incl. little end bush, cap, bolts but not big end shells)

1200cc 440g min.

1600cc 570g min.

(Note for 1600cc. One big end and one little end to be untouched per set, but need not be on the same rod)

(vi) Cylinder Head:Intake port diameter at flange face: 29.0mm max 1200cc.
31.0mm max 1600cc.Exhaust port diameter at flange face: 33.0mm max 1200cc.
32.0mm max 1600cc.Combustion chamber volume: 1200cc 43cc min.
1600cc See Table

Valve guide length 1200cc 62.5mm ±2.5mm

Cylinder head secondary cut OD		77.0 ± 0.5mm 1200cc 85.0 ± 0.5mm 1600cc
Outside diameter of inlet and exhaust port inserts 1200cc:	inlet	36.5mm
	exhaust	33.5mm
(vii) Valve Train:		
Valve Head Sizes		
1200cc engine	intake	31.49mm max.
	exhaust	29.97mm max.
1600cc engine	intake	35.50mm max.
	exhaust	32.00mm max.
Valve seat angle		45° ± 1.5°
Top Cut		15°
Throat of seat		75°
(Cuts to be only in insert, not alloy of head)		
(viii) Lubrication System:		
Sump extension volume:		500cc max.
9.7.3 <i>Engine Ancillaries:</i>		
(i) Carburettor (1200cc only):		
Venturi dimensions		
OD		27.8 ± 0.5mm
Length		26.0 ± 0.5mm
(ii) Inlet Manifold Dimensions (1200cc only):		
OD horizontal tube:		25.25mm max.
OD vertical tube:		28.75mm max.
Weight:		680g min.
(iii) Air Cleaner:		
Maximum envelope diameter:		150.0mm max.
Height above carburettor top:		80.0mm max.
(iv) Fan Housing:		
Oil hose orifice dimensions:		75.0 x 30.0 mm max.
9.7.4 <i>Brakes:</i>		
Front disc rotor/hub assembly (less bearings)		5.9kg minimum
Rear disc rotor/hub assembly		5.2kg minimum
Calliper assembly (less pads& brake hoses)		1.9kg minimum
Disc rotor diameter front & rear		280mm maximum

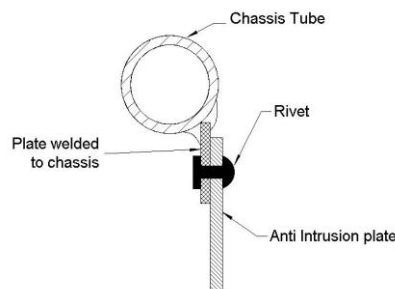
10 CHASSIS AND ROLL OVER PROTECTION**10.1 CHASSIS Regulation 2.1**

In all vehicles, the chassis must be of steel tube welded construction.

10.2 Side Impact Protection

In regard to all vehicles issued with a CAMS log book on or after 01 January 2003, and all vehicles configured with a 1600 cc engine:

- (a) In the area bounded by the firewall/main rollover hoop support, the upper and lower side rails and the dashboard /steering wheel support all chassis members must be of minimum 25.0 x 25.0 x 1.6 mm mild steel square tube or other section of equivalent or greater strength.
- (b) The maximum area enclosed by any set of adjacent members shall not exceed 0.10m²
- (c) The floor area of the cockpit shall be adequately braced to prevent the bottom rail moving inward in the event of side impact.
- (d) When measured at the firewall, the minimum height of the upper side rail shall be not less than 500 mm above the lower edge of the lower chassis rail.
- (e) The area bounded by the firewall, lower side rail, upper side rail and dashboard/steering wheel support shall be covered by a protective panel securely fixed around its perimeter by 4.8 mm diameter steel rivets at centres of not greater than 150mm and not less than 50 mm.
- (f) The protective panel shall be either
 - (i) aluminium sheet of 2.0 mm 5052-H32 alloy or other aluminium alloy of equivalent or greater strength; or
 - (ii) two layers of bi-directional Kevlar 250 gm minimum cloth bonded with epoxy or vinyl ester resin.
- (g) In the case of side rails being of round tube construction, mounting plates are to be welded to the side of the tubes. (See figure 8 below.)



- (h) Alternatively, a Kevlar composite panel consisting of two layers of 250 gm cloth may be bonded to form part of the bodywork, provided it covers the cockpit area described and is adequately fastened to the vehicle.

10.3 Roll Over Protection Structure (ROPS)**10.3.1 Application**

All vehicles in all competitions must be fitted with a roll over protection structure (ROPS). The specification below applies to all vehicles with the exception of:

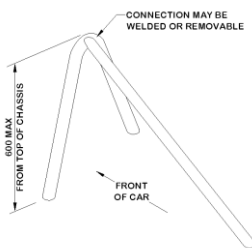
- Cars for which a valid CAMS Rollover Protection Certificate or Integral Rollover Protection Structure Certificate is held, or;
- Those cars configured with a 1200cc engine which were first issued with a log book prior

to 01 January 2000. Such vehicles may continue to compete with the existing ROPS in place provided it remains in conformity with the regulations that were in force at the date of the log book issue.

10.3.2 Configuration

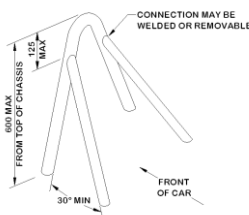
The complete ROPS comprises:

- (a) main roll bar - a near vertical hoop located laterally just behind the cockpit;
- (b) braces - forward or rear angled longitudinal members attached near the top bend of the main roll bar and to the chassis or engine/gearbox assembly at their lower ends;
- (c) front roll structure - a substantial support structure integrated into the chassis at or forward of the front of the cockpit.
- (d) The general design and form of the ROPS shall comply with any one of the Drawings A, B, or C below.



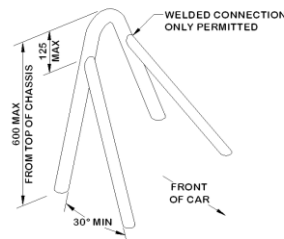
SINGLE REARWARD FACING BRACE

Drawing A



2 REARWARD FACING BRACES

Drawing B



FORWARD FACING BRACES

Drawing C

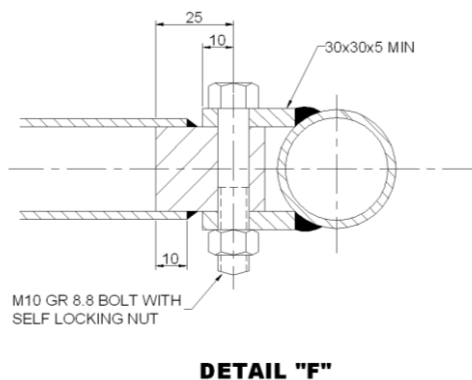
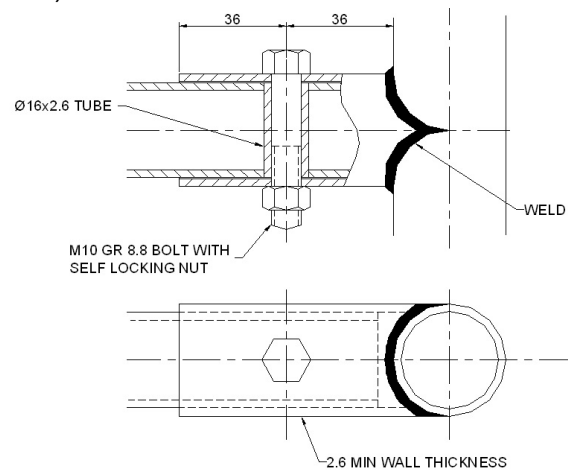
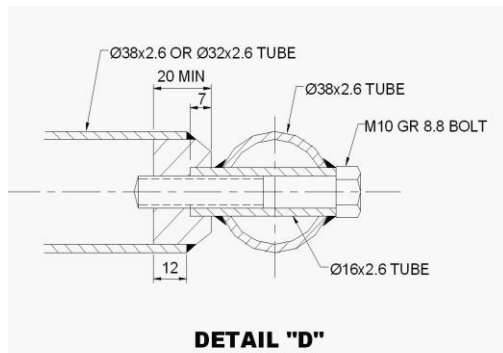
- (e) The main roll bar shall be located immediately behind the cockpit with the plane of the main hoop perpendicular to the longitudinal centreline of the vehicle. With the driver seated in the normal position the hoop shall:
 - (i) be of a height such that a line drawn between the tops of the hoop and the front roll structure be not less than 50 mm above the driver's helmet;
 - (ii) in conjunction with the vehicle's structure, not leave unprotected any part of the driver's shoulders, when viewed from the front or rear;
 - (iii) be within 150 mm of, but not overhang, the driver's helmet;
 - (iv) be constructed so that the driver's helmet is prevented from passing between the hoop bars to the extent that the helmet is visible at the rear of the hoop when viewed from the side.

10.3.3 Fabrication

- (a) The main hoop must be made in one piece, without joints.
- (b) All bends must be performed by a cold bending process and shall be smooth, without evidence of rippling, cracking or significant weakening.
- (c) The bend radius on the centreline shall be not less than twice nor more than four times the tube diameter.
- (d) Where the tubing is distorted during bending the ratio of the minor diameter to major diameter must be 0.9 or greater.
- (e) The legs of the hoop shall be straight between the uppermost bend and a point no more than 100 mm above the point at which they meet a predominantly horizontal portion of the chassis.
- (f) All welds should encompass the full circumference of the joint and be of the highest possible quality with full penetration; the TIG welding process is preferred.
- (g) Holes drilled in the main roll bar must be fitted with a bush, the wall thickness of which is not less than that of the drilled tube. Any attachments to the main roll hoop which penetrate the wall of the tube must be TIG welded.

10.3.4 Braces

- (a) Braces may comprise:
- (i) a single rearward angled brace located along the longitudinal centreline of the vehicle (Drawing A);
 - (ii) two rearward angled braces (Drawing B);
 - (iii) two forward angled braces (Drawing C).
- (b) All braces must comprise a single, straight, continuous piece of tube between their points of attachment to the main roll hoop and their first point of attachment to the chassis or engine/gearbox assembly.
- (c) All braces must form a minimum 30 degrees angle to the vertical plane at right angles to the centreline of the vehicle.
- (d) Rearward angled braces may be removable to facilitate engine/transmission access or removal.
- (e) Where removable braces are employed, the demountable joints used must be of an approved type (See Drawings D, E, F below).



- (f) The chassis mounting point for rearward angled braces may comprise a sub-frame/bracket securely attached to the engine/transmission assembly.
- (g) Where forward angled braces are employed they must not impede the driver's access or egress.
- (h) Holes drilled in a brace must be fitted with a bush, the wall thickness of which is not less than that of the drilled tube.

10.3.5 Protective Padding

Where the driver's helmet could come into contact with the main roll bar or braces, non-flammable padding to any one of the following standards must be provided for protection.

FIA 8857 – 2001 Type A, FIA 8857 – 2001 Type B or SFI Standard 45.1

10.3.6 Material Specifications

All material used in the construction of the main hoop and struts shall be circular section cold drawn steel tube (CDS, CDW or CEW)

Carbon content:	0.3% max.
Manganese content:	1.0% max.
Other alloy content:	0.5% max. for any element
Tensile strength:	350 MPa min.

All screws and bolts used in connection with the ROPS must be at least ISO Standard 8.8.

10.3.7 Dimensions

Main roll bar hoop	-	38.0 mm min. OD x 2.6 mm min. wall thickness
Single brace	-	38.0 mm min. OD x 2.6 mm min. wall thickness
Double brace		31.7 mm min. OD x 2.6 mm min. wall thickness

10.3.8 Certification by CAMS

(a) Designs of roll over structures which do not comply with the above specification may be submitted to CAMS for approval through the issue of an Integral Rollover Protection Structure Certificate. Constructors/owners contemplating this course should seek guidance from CAMS before proceeding.

(b) Where a basic ROPS as depicted in Drawings A, B, or C is constructed in compliance with the above material specifications and dimensions, and to which the only change is the addition of bars, CAMS may issue a ROPS Certificate directly, without requiring any testing of the structure.

(c) CAMS reserves the right to accept or to refuse to approve any ROPS in accordance with the design prescriptions established by CAMS.

Section 4

Sealing & Certification

11.1 Sealing Requirement

Seals shall only be affixed by authorised FV Scrutineers appointed in accordance with Clause 7 above.

Prior to affixing seals the FV Scrutineer shall ensure that compliance is checked in accordance with each applicable clause of this Manual. As each item is checked the sealer shall annotate Pass or Fail in the relevant boxes of the applicable Build Sections on the Certificate of Compliance; see Appendix B. Detailed measurements shall not be recorded.

11.2 Placement of Seals

The following is the recommended placement for seals.

Engines:

- one seal at the flywheel end of the engine, on sealing wire between the two halves of the crankcase through appropriately drilled holes.
- one seal on sealing wire between two appropriately drilled head nuts.

Transmissions:

- one seal on sealing wire between the tunnel case and gear carrier section on tunnel type transmissions
- one seal on sealing wire between halves on split transmissions
- For transmissions used in combination with 1600cc engines, a small metal tag stamped 26 must be placed on the sealing wire prior to the seal being fitted to the gear carrier. Also the left hand differential plate (starter motor side) must be sealed. This shall be done by fitting a sealing wire through a hole in a stud that holds the differential plate on and a hole in the case.

Both the 4.125 and the 4.375 differentials have a 8 tooth pinion, we need to make sure the 33 tooth crown wheel is fitted, not the 35 tooth of the 4.375.

11.3 Certificate of Compliance

When all items have been verified as conforming to the Regulations and a "Pass" has been recorded in the relevant Build Section boxes on the Certificate of Compliance the certificate shall be completed by:

- recording all seal numbers on the Certificate of Compliance form
- signing the Certificate of Compliance

When complete the triplicate copies of the Certificate shall be issued as defined under Clause 7 above, namely:

ORIGINAL:	To car owner
Duplicate:	To car owner who shall be responsible for delivery to the State Scrutineering Director
Triplicate:	To be retained by the scrutineer

Appendix A: Change Notice Pro Forma

**Notification of Change
To
Formula Vee Technical Manual**

1. Changes to the FV Technical Manual have been approved which will update the Issue number from
 Issue ****
 to Issue ****
2. These changes require the following action by Authorised Recipients of the document:
 - a. Replace the Cover Sheet and the Document Revision History Page of Issue *** with the attached Cover Sheet and Document Revision History Page of Issue ***
 - b. Replace Page(s) *** of Issue *** with the attached replacement Page(s) *** of Issue ***
 - c. Update any State records which advise State members of the current Issue No of the FV Technical Manual

Authorised by: _____ (FVAA National Administrator)

Date: _____

Appendix B: Certificate of Compliance Pro-Forma

To be released by future Bulletin

Appendix C: Details of Cylinder Bar

To be released by future Bulletin

Appendix D: Details of Cylinder Gauge

This fitting is constructed in 3 parts.

The "cylinder plate" is surface ground on both sides. The thickness of the "cylinder plate" is measured accurately (to within 0.01mm or better) and this measured thickness is stamped onto the side of the plate as a permanent reference.

The "top plate" is bolted permanently to the "cylinder plate" with 3 cap screws. The "clamp plate" is loosely attached to the top plate and retained by 1/4" cap screws.

The whole assembly is then fitted across a pair of VW cylinders and clamped down using the cylinder head studs. A Vernier caliper is zeroed, then fitted into the slot between the "top plate" and the "clamp plate" and lowered until the lower face of the caliper abuts the gauge "cylinder plate", then clamped into position.

Step1. The engine is rotated to bring the piston to TDC and the distance to the top of the piston measured with the Vernier caliper. The deck height is the measured distance less the reference thickness of the "cylinder plate".

Step 2. The engine is then rotated to BDC and the Vernier caliper is used to measure the distance to the top of the piston. The engine stroke is the measured distance less the distance measured in Step 1.

Steps 3 & 4. Without moving the gauge fitting, the Vernier caliper is moved to the second slot in the "top plate" and Steps 1 & 2 repeated to measure deck height and the stroke of the second cylinder on that bank.

Details: See attached diagrams. (To be provided)

Fig 7