NASCAR CUP SERIES OEM BODY APPROVAL PROCESS

Version ~~D~~E

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Table of Contents

Table of Contents 2
Introduction & Process Initiation 6
- Goals 6
- Purpose 6
- Scope of Process Use 6
- Process Initiation 6
- Decision Making Process 6
- Production Vehicle Model Eligibility 7
- Event Deadlines 7
- Leading Strategy and Following Strategy Definition 7

NASCAR Cup Series OEM Body Approval Process Initiation Request Form 8
Body Geometric Design and Submission File Requirements 13
- Body Geometric Design Requirements 13
- Submission Requirements 13

Wind Tunnel Test 14
- Official Wind Tunnel Test Rules 14
- OEM Prototype Body Panel Requirements 15
- Wind Tunnel Submission Scanning Process 16
- Target Body 18
- Target Body Removable Package 18
- Target Body Non-Removable Package 18
- Wind Tunnel Test Conditions 19
- Official Wind Tunnel Test Sequence 20
- Aerodynamic Coefficients 21
- Significant Digits 23

Preserved Bodies....23
Wind Tunnel Eligibility / Hours....24
Freezing Key Components....24
OEM Private Testing....24
OEM Production Panels Parity Test....25
Wind Tunnel Eligibility / Hours....26
OEM Resubmission Evaluation - Inaugural Submission....26
Major Rules Changes....26
Example Race Vehicle Requirements....28
~~Table of Contents....1~~
~~Introduction & Process Initiation....5~~
~~Goals....5~~
~~Purpose....5~~
~~Scope of Process Use....5~~
~~Process Initiation....5~~
~~Decision Making Process....5~~
~~Production Vehicle Model Eligibility....6~~
~~Event Deadlines....6~~
~~Leading Strategy and Following Strategy Definition....6~~
~~NASCAR Cup Series OEM Body Approval Process Initiation Request Form....7~~
~~Body Geometric Design and Submission File Requirements....11~~
~~Body Geometric Design Requirements....11~~
~~Submission Requirements....11~~
~~Wind Tunnel Test....12~~
~~Official Wind Tunnel Test Rules....12~~
~~OEM Prototype Body Panel Requirements....13~~
~~Wind Tunnel Submission Scanning Process....14~~
~~Target Body....16~~

Target Body Removable Package 16
Target Body Non-Removable Package 16
Wind Tunnel Test Conditions 17
Official Wind Tunnel Test Sequence 18
Aerodynamic Coefficients 19
Significant Digits 21
Preserved Bodies 21
Wind Tunnel Eligibility / Hours 22
Freezing Key Components 22
OEM Private Testing 22
OEM Production Panels Parity Test 23
Wind Tunnel Eligibility / Hours 23
OEM Resubmission Evaluation – Inaugural Submission 24
Major Rules Changes 24
Example Race Vehicle Requirements 24
NASCAR CUP SERIES OEM BODY APPROVAL PROCESS 1
Version 2.1 1
Released: April 16, 2022 1
Table of Contents 2
Introduction & Process Initiation 4
Goals 4
Purpose 4
Scope of Process Use 4
Process Initiation 4
Decision Making Process 4
Production Vehicle Model Eligibility 5
Event Deadlines 5
Leading Strategy and Following Strategy Definition 5

~~NASCAR Cup Series OEM Body Approval Process Initiation Request Form ..... 6~~
~~Body Geometric Design and Submission File Requirements ..... 10~~
~~Body Geometric Design Requirements ..... 10~~
~~Submission Requirements ..... 10~~
~~Wind Tunnel Test ..... 11~~
~~Official Wind Tunnel Test Rules ..... 11~~
~~OEM Prototype Body Panel Requirements ..... 12~~
~~Wind Tunnel Submission Scanning Process ..... 13~~
~~Target Body ..... 15~~
~~Target Body Removable Package ..... 15~~
~~Target Body Non-Removable Package ..... 15~~
~~Wind Tunnel Test Conditions ..... 16~~
~~Official Wind Tunnel Test Sequence ..... 17~~
~~Aerodynamic Coefficients ..... 18~~
~~Significant Digits ..... 20~~
~~Preserved Bodies ..... 20~~
~~Wind Tunnel Eligibility / Hours ..... 21~~
~~Freezing Key Components ..... 21~~
~~OEM Private Testing ..... 21~~
~~OEM Production Panels Parity Test ..... 22~~
~~Wind Tunnel Eligibility / Hours ..... 22~~
~~OEM Resubmission Evaluation – 2023 Season or Inaugural Submission ..... 23~~
~~Major Rules Changes ..... 23~~
~~Example Race Vehicle Requirements ..... 23~~

Introduction & Process Initiation

Goals

The goals of the NASCAR Cup Series OEM Body Approval Process are as follows:

- To ensure aerodynamic parity among all competing OEMs.
- To allow and encourage OEMs to produce race vehicle body designs that bear a strong resemblance to the OEM production vehicles.

Purpose

The purpose of this document is to define the process an OEM will use to obtain approval for a race vehicle body design for the NASCAR Cup Series.

Scope of Process Use

This process is intended for the following circumstances:

- When an OEM changes the production vehicle body design on which their race vehicle body is based.
- When an OEM wishes to introduce a new production vehicle model design into competition.
- When an OEM changes the race vehicle body design without changing their production vehicle design if allowed by NASCAR due to a demonstrable problem.

Process Initiation

To begin the NASCAR Cup Series OEM Body Approval Process, an OEM must complete and submit the NASCAR Cup Series OEM Body Approval Process Initiation Request Form on page 4 of this document.

Decision Making Process

Much effort has been made to produce a very objective and well-defined process, but due to the influence of competition, aesthetics, and product relevance among other factors, at times NASCAR must make decisions for which defined procedure and past relevant precedents do not exist. When decisions of this nature are made, this document will be updated, when possible, to reflect those decisions.

Production Vehicle Model Eligibility

The production vehicle model on which the race vehicle will be based must be approved by NASCAR. NASCAR will base production vehicle approval on the following criteria among other things:

1. Production vehicles models must be mass produced passenger vehicle production cars sold at US dealerships.
2. The production vehicle model must be sold sometime during the race season in which the race vehicle is introduced. The race season is defined as the start of the first event until the end of the final event.

Event Deadlines

Event deadlines for the NASCAR Cup Series OEM Body Approval Process are listed in Table 1. The first event deadline year listed is two years prior to the race season for which the race vehicle will be introduced (Year of Debut – YOD, which is defined as YOD-2 in the table. This convention is followed for all dates in Table 1.

Leading Strategy and Following Strategy Definition

- A **Leading Strategy** occurs when the race vehicle race Event debut leads the production vehicle start of regular production.

- A **Following Strategy** occurs when the race vehicle race Event debut follows the production vehicle start of regular production.

NASCAR Cup Series OEM Body Approval Process Initiation Request Form

OEM Company Name	
OEM Representative Name	
Vehicle Model Name	
Vehicle Model Year	
Vehicle Trim Designation	
Production Vehicle Start of Production Date (Following or Leading Strategy?)	
Race Season Year to Debut (Must debut race vehicle at 1st race event)	

The designated OEM Representative listed on this form has OEM decision making authority at official wind tunnel tests. If the designated OEM Representative is not present at the test, the OEM must designate an alternate representative with decision making authority.

Email completed form to: Chris Popiela. cpopiela@nascar.com

Event	Event Deadline	Responsibility	Event	Additional Details and Requirements
Process Initiation	~~97~~/1/YOD-2 (YOD: Year of Debut)	OEM	Submit NASCAR Cup Series OEM Body Approval Process Initiation Request Form.	
Notification 1	Process Initiation + 14 Days	NASCAR	Provide written communication granting approval to begin the NASCAR Cup Series OEM Body Approval Process or provide written communication requesting additional information and conditions with a specified deadline.	Communication from NASCAR will specify whether the Leading or Following Strategy event deadlines will be used.
Review 1	**Following Strategy:** ~~108~~/1/YOD-2 **Leading Strategy**: ~~11~~19/~~15~~1/YOD-2~~1~~	OEM	Display production vehicle and race vehicle renderings, photos, or models to NASCAR designated personnel.	For the renderings or photos, (5) side-by-side images of the race vehicle and production vehicle consisting of front, side, rear, left front 3/4 view, and left rear 3/4 view. Images must be suitably sized for evaluation by NASCAR.
Notification 2	Review 1 + 14 days	NASCAR	NASCAR provides written communication granting approval to proceed or requesting changes with a specified deadline.	
Notification 3	1/1/YOD-1	NASCAR/OEM	NASCAR to notify all body vendors by January 1st.	Must be notified by January 1.

Review 2	41/15/YOD-1	OEM	Display a prototype full scale race vehicle side-by-side with a representative full-scale production vehicle to NASCAR designated personnel. NASCAR to photograph both vehicles for and retain images.	For a Leading Strategy, an 1/8th scale model may be used in lieu of a full-scale production vehicle. For both Leading and Following, a full-scale race vehicle must be used.
Notification 43	Review 2 + 14 days	NASCAR	NASCAR provides written communication granting OEM approval to proceed requesting changes with a specified deadline.	
Deliverable 1	Test 1 – 30 days	OEM	Deliver preliminary baseline (at least one design) race body design CAD file and GOM inspection report for Test 1 via the NASCAR scanning provider. NASCAR to use photos from event #5 for comparison.	It is the OEM's responsibility to have the NASCAR scanning provider send the CAD file and inspection report to NASCAR by the deadline. If additional body designs differ greatly from the baseline design, it is advisable to submit all designs.
Review 3	Test 1 – 30 days	NASCAR/OEM	Preliminary production CAD of all components reviewed by NASCAR/Dallara/OEM for one option.	NASCAR/Dallara/OEM must have formal review of one submitted design. Review will consist of going through part design checklist.
Notification 54	Deliverable 1 + 7 days	NASCAR	Provide written communication granting approval to proceed or requesting changes with a specified deadline.	
Notification 65	Test 1 – 7 days	OEM	Inform NASCAR and competing OEMs of Test 1 in writing.	Test must occur before 79/1/YOD-1.

Deliverable 2	Test 1 – 10 days	OEM	All CAD files and design inspection reports for bodies to be tested Test 1 must be in NASCAR's possession. OEM must designate a maximum of five CAD files for the bodies to be tested.	It is the OEM's responsibility to have the NASCAR scanning provider send CAD files and inspection reports to NASCAR by the deadline.
Review ~~3~~4	Test 1 – 7 days minimum	OEM/NASCAR	OEM & NASCAR to review all Test 1 options with applicable body vendors for manufacturability.	OEM & NASCAR to discuss implications of certain body features. In the event features exceed the capabilities of the vendor, alternative designs or manufacturing strategies may be requested.
Test 1	Before ~~9~~7/1/YOD-1	OEM	Official wind tunnel test 1	Test must occur before ~~9~~7/1YOD-1.
Notification ~~7~~6	Test 2 – 7 days	OEM	Inform NASCAR and competing OEMs of Test 2 in writing.	Test must occur before ~~9~~7/1/YOD-1.
Deliverable 3	Test 2 – 10 days	OEM	All CAD files and design inspection reports for bodies to be tested at wind tunnel test 2 must be in NASCAR's possession. OEM must designate a maximum of five CAD files for the bodies to be tested.	It is the OEM's responsibility to have the NASCAR scanning provider send CAD files and inspection reports to NASCAR by the deadline.
Review ~~4~~5	Test 2 – 7 days minimum	OEM/NASCAR	OEM & NASCAR to review all Test 1 options with applicable body vendors for manufacturability.	OEM & NASCAR to discuss implications of certain body features. In the event features exceed the capabilities of the vendor, alternative designs or manufacturing strategies may be requested.
Test 2	After Test 1 and before ~~9~~7/1/YOD-1	OEM	Official wind tunnel test 2 (if applicable).	Test must occur before ~~9~~7/1/YOD-1.
Notification ~~8~~7	Test 1 or Test 2 + 10 days	NASCAR	Provide written communication granting conditional approval or rejection of exterior body shape.	

Test 3	As soon as initial production parts are complete	NASCAR	Production body wind tunnel test	Final parity check between all OEM production body panels. NASCAR will schedule test at earliest date possible before first Event of the season.
Deliverable 4	3/1/YOD	OEM	Deliver OEM production parts to NASCAR R&D Center.	

Body Geometric Design and Submission File Requirements

Body Geometric Design Requirements

For design purposes, all dimensions are considered to have infinite precision. Dimensional constraints and submitted CAD dimensions will not be rounded or truncated.

Comparisons between the race vehicle and production vehicle will be made using the following tools and events: renderings and photos, scheduled model display events, submitted CAD, and private/official wind tunnel tests.

This process is intended to encourage resemblance between race vehicles and production vehicles. NASCAR will use its discretion in making decisions related to resemblance and OEM identity. If the production vehicle changes after the April 1st event the OEM must inform NASCAR of the changes and display the changes to NASCAR, either via physical example, CAD or photos.

OEM common geometric design requirements are contained in common elements CAD file:

- Gen 7 Common Elements V8.1.stp

Bodywork master split surfaces are contained in CAD file:

- Bodywork Master Split Surfaces – NG725175.stp

Please contact Chris Popiela (cpopiela@nascar.com) for most recent version.

Submission Requirements

- OEM CAD files must be submitted in STEP format.
- Each OEM body to be tested requires a unique CAD file. Unique OEM submission CAD must include:
  - OEM Body Gold Surface
  - OEM Radiator Exit Duct
  - Hood Louvers
  - Throttle Plate
- OEM CAD files will be subject to a detailed manufacturability review with each of the relevant body vendors. If a specific feature or features are likely to cause substantial cost increases, manufacturing/quality concerns or otherwise, NASCAR will request that alternative paths be pursued prior to accepting the submitted design.

- The OEM must submit their CAD files to NASCAR via the NASCAR scanning supplier. The scan supplier will transfer the CAD files and inspection reports proving compliance to the design requirements to NASCAR.
- An OEM may test a maximum of five bodies per official wind tunnel test. Bodies submitted for official wind tunnel test 1 may be resubmitted for wind tunnel test 2.
- NASCAR must issue final approval for all submission options, regardless of when CAD is submitted. It is the OEMs responsibility to ensure NASCAR is aware of any design or performance direction the OEM intends to take during the actual submission test. Review of designs can occur at any time in the process, regardless of the stated review guidance.

Wind Tunnel Test

An OEM may not begin more than two official wind tunnel tests when attempting to obtain approval for a race season. If the submitting OEM elects to use official Wind Tunnel Test 2 (WTT2), the OEM forfeits the aerodynamic results of any designs that fell within the Approval Band from official Wind Tunnel Test 1 (WTT1) but may resubmit the same body designs used in WTT1. Underperforming body designs from WTT1 and WTT2 may be Preserved. In extenuating circumstances, NASCAR has the right to grant additional official wind tunnel tests.

Official Wind Tunnel Test Rules

1. The submitting OEM is responsible for scheduling and paying for both the wind tunnel occupancy and the NASCAR selected and approved scanning services.
2. The submitting OEM is responsible for informing the other OEMs of the test day and time. The submitting OEM must inform NASCAR and the other OEMs a minimum of 7 days prior to an official wind tunnel test.
3. If an OEM cancels an official wind tunnel test within 3 days of the scheduled official wind tunnel test, the cancelled test counts as an attempt and the OEM forfeits the cancelled test.
4. The submitting OEM must inform the wind tunnel and scanning personnel in writing that NASCAR is the official customer and has the final decision-making authority in all matters related to the test, scan, and distribution of data.
5. Up to three representatives from each OEM competing in the NASCAR Cup Series are allowed at the tests.
6. In addition, up to four hands-on OEM team members representing the submitting OEM may be used for body installation and removal. Hands-on team members must remain outside of the wind tunnel control room for the entire test.
7. The submitting OEM is responsible for the delivery of their own body panels.

8. The submitting OEM is responsible for the installation and removal of their body panels. Submitting OEM may help with removal of NASCAR Target body panels.
9. All testing will be conducted under the guidance and observation of NASCAR officials.
10. Coefficient data will be released to all OEMs at the end of the test. Only NASCAR and submitting OEM may plug into the network at Aerodyn Wind Tunnel.
11. Pictures of the target body acquired by the wind tunnel data acquisition system will be released to all OEMs. Pictures of the submitted OEM body will only be released to NASCAR and the submitting OEM.
12. Scan data of the submitted OEM body will only be released to NASCAR and the submitting OEM.
13. If an OEM's body's performance falls within the Approval Band and the OEM accepts this design as their submission, the prototype body components must remain in NASCAR's possession. NASCAR will transport the prototype body back to the NASCAR R&D Center.
14. A Preserved body must remain in NASCAR's possession.

OEM Prototype Body Panel Requirements

The OEM must produce prototype body panels matching the submitted CAD files from composite components and designed to fit on the NASCAR submission chassis and meet the following requirements for official wind tunnel tests:

1. All external fasteners must be flush.
2. All rivets must be permanent. That is, a drill bit should not be required for installation and removal of OEM test components.
3. OEM body side panels are required to be trimmed and fitted to a flange to be provided by NASCAR.
4. The hood must be removable. Prototype hood must closely resemble the same cut lines as the production hood.
5. A minimum of four hood pins and hood pin bezels are required. Contact NASCAR for the current hood pin and bezel part numbers and requirements. The longest dimension of the hood pin clips must be parallel to the vehicle longitudinal centerline when installed. Hood pins and hood pin bezels will be scanned during the submission tests. These positions will be used in the production CAD for the front fascia and hood.
6. The NASCAR submission chassis may not be modified, except as approved by NASCAR and as necessary to accommodate mounting of OEM body panels. Every reasonable effort must be made to work with existing body mounts.
7. OEM body panels should be stiff enough to maintain shape without requiring permanent stiffeners affixed to the NASCAR submission chassis. A minimum number of temporary stiffeners to the submission chassis may be used and the panels must be sufficiently stiff as determined by NASCAR by making comparisons to the NASCAR target body and

previously approved OEM bodies. OEMs are encouraged to view the NASCAR target body for generally acceptable practices.

8. Small ancillary body parts (example: headlight rapid prototype surface addition to change shape of headlight) may be attached to a base body part, but must be mudded in. Mud/Bondo, etc. may only be used to blend existing parts but not to create new features. All body panels must be rigid and keep their shape for the purpose of future tests/repeatability after successful submission tests.
9. Except for at seams between major body panels, visible tape is not allowed. Tape may be covered with Mud/Bondo if used to secure feature. Tape may be placed at the discretion of NASCAR officials if problems occur at submission.
10. Hood flaps are not required for submission testing.
11. No inward facing return flanges permitted in wheel openings. The maximum thickness within 1.5 inches of the wheel opening must be 0.200 inches.
12. The OEM must fabricate outer crush panels to bridge from inner crush panels on submission chassis to OEM body panels. All crush panels must be taped and fully sealed.
13. OEM body panels may only be test fit on the NASCAR submission chassis at the NASCAR R&D Center. NASCAR will review acceptable body test fits with the submitting OEM.
14. OEM body features must have a minimum radius thickness of 0.050". Louvers will not be subject to radius thickness requirement. See NASCAR for approved radius gauge template.
15. Hood louvers/wickers must be no higher than 0.75 inches off hood surface and fit within the approved space from common elements file. Louvers must have a minimum thickness of 0.050 inches and must have a constant cross section (airfoils are prohibited for manufacturability).
16. VR tuning will be permitted on the exit side of radiator ducting in the form of a throttle plate. Throttle plate patterns must consist of identical circular holes and be isotropic at any point on the plate. Throttle plates must be approved by NASCAR.
17. Brake ducts must not be installed.
18. Submitting OEM must use same grill inlet provided in the CAD file Body Design Reference Models – NG725~~1~~75.stp. Grille screen must be 79% open hexagonal mesh. https://www.mcmaster.com/92725T5/ .
~~18.~~19. LR Quarter Panel must have recessed fuel bucket installed with appropriate hardware referenced in the NASCAR rulebook.

Wind Tunnel Submission Scanning Process

Gold Surface Body Scanning

1. All body scanning will be performed in chassis coordinate system. The unprocessed 3D data will be used to verify that the body meets both common elements and OEM specific deviation requirements as defined by NASCAR. The prototype body surface must match the CAD file within ± 0.060 inches for common elements areas and ± 0.100 inches for all other areas in a coordinate system alignment. For production panel parity testing, the body surface must match the CAD file within ± 0.100 inches for common

elements areas and ± 0.150 inches for all other areas in a coordinate system alignment. Once scanning is complete and results have been verified by NASCAR and the submitting OEM, the remaining OEM's will be invited to enter the tunnel and review the scanning results.

2. Submitting OEM will have the opportunity to tune the submitted body within the allowable tolerance. Once an official scan takes place, submitting OEM may correct only areas that are not within the allowable tolerance range. Submitting OEM will not be allowed to go back and tune on areas within the allowable tolerance range.
3. Body rescans will use unprocessed data to verify that the body meets both common elements and OEM specific deviation requirements as defined by NASCAR. Once scanning is complete and results have been verified by NASCAR and the submitting OEM, the remaining OEM's will be invited to enter the tunnel and review the scanning results.
4. If any area of the body is thought to be out of tolerance based on the body position in chassis coordinate system or due to the shape being altered, that area will be post-processed and best fit to CAD. Using the best fit data, a tighter tolerance band will be used to interrogate the area in question, (+/-.020"). Section cuts may also be used to help define radii in any locations that may seem to exceed the given tolerance.
5. Reports using post-processed data will be generated and delivered to NASCAR in PDF format along with supporting STL files.
6. Deviation Reports will utilize the following parameters for deviation analysis:
    - Max deviation of normal set to 30.00 degrees
    - Max opening angle set to 30.00 degrees
7. NASCAR reserves the right to implement templates or any other inspection method necessary to ensure the wind tunnel model accurately represents the submitted CAD.

Radiator Exit Duct

1. Interior of the radiator exit duct will be scanned prior to installation. The radiator exit duct surface must match the CAD file within ± 0.100 inches.
2. 3D Data will be post processed and best fit to CAD using the entire inner surface.
3. Go-No-Go reports using NASCAR common surface tolerance, will be generated, and delivered to NASCAR in PDF format along with supporting STL files.

Radiator Inlet Duct

1. Interior of the radiator inlet duct will be scanned prior to installation. The radiator inlet duct surface must match the CAD file within ± 0.100 inches.
    a. 3D Data will be post processed and best fit to CAD using the entire inner surface and mating flange.

2. Go-No Go reports using NASCAR common surface tolerance, will be generated, and delivered to NASCAR in PDF format along with supporting STL files.

Templates

A standard set of templates will be used for all body submissions and resubmissions. All areas of the common elements, including wheel openings, will be checked with handheld templates at NASCAR's discretion. NASCAR reserves the right to implement templates or any other inspection method necessary to ensure the wind tunnel model accurately represents the submitted CAD.

Target Body

The target body will be adjusted to fit the target body CAD file to a tolerance of ± 0.060 inches for common elements areas and ± 0.100 inches for all other areas in a coordinate system alignment. The underwing will be adjusted to fit the target underwing CAD file to a tolerance of +/-0.030 for a coordinate system alignment. The target body used will be the production parts of the 2022 Chevrolet Camaro.

Target Body Removable Package

- NASCAR Target Body Panels
  - Front Fascia – BSI Front Bumper Camera
  - Hood / Louvers
  - Fenders
  - Doors
  - Quarter Panels with Refueling Bucket and Hardware
  - Rear Fascia – No BSI Rear Bumper Camera
- NASCAR Target Body Crush Panels
- NASCAR Target Body Radiator Duct - Exit
- NASCAR Target Body Grill Screen/Bezel
- Short Spoiler Base – 4" Spoiler Face
- Long Spoiler Base – 7" Spoiler Face

Target Body Non-Removable Package

- Greenhouse
  - Windshield with Driver Cooling Duct
  - Rear Glass with Driver Cooling Slots
  - A-Post Deflector

- RHS Window
- Quarter Windows (No NACAs)
- Roof Rails
- Deck Fin / Shark Fin
- BSI Roof Antenna
- BSI Roof Camera

- Decklid
- Underwing – Long Stuffers
- Skid Blocks – NG721C42
- NASCAR Radiator/Oil Cooler and Radiator Duct - Inlet

Wind Tunnel Test Conditions

Location: AeroDyn Wind Tunnel – Mooresville, NC.

Test Parameters

Table 1 below contains dimensions, constants, and settings applicable to the wind tunnel tests. Table 2 below lists the height and yaw matrix to be used. Inspection height is defined as a 4.00-inch splitter height measured at the left and right skid plate corners and a 3.25-inch rear diffuser skirt height, measured 26.0-inches from the right-side forward edge of the outer fence of the diffuser.

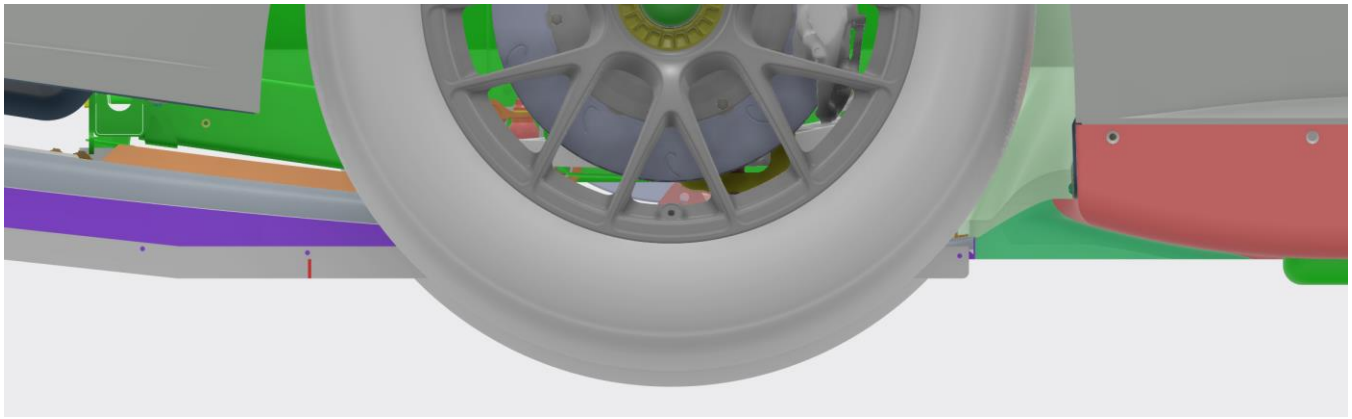

Figure 1. Rear ride height measurement point.

Table 1: Test Constants

Name	Value
frontal area	24.111 ft^2
wheelbase	110 inches

nominal wind speed	130 mph
nominal tire speed	130 mph
tares	tare at point 1 (see Table 3).

Table 2. Height and Yaw Matrix

Point #	*Yaw Angle (Deg.)*	*Splitter Gap measured at left and right skid plate corners (in.))*	*Diffuser Skirt Gap measured at right side diffuser axle centerline (in.)*	*Purpose*
1	0.0	1.00	0.75	Drag
2	0.0	0.75	0.25	Lift, Drag
3	-3.0	0.75	0.25	Lift, Side
4	-3.0	1.50	0.25	Lift, Side
5	-3.0	0.75	0.75	Lift, Side

NASCAR will set heights for official wind tunnel tests.

NASCAR approved tire sets shall be used for official wind tunnel tests.

Official Wind Tunnel Test Sequence

Table 3 below lists the test steps and typical approximate times assuming the test begins at 6:00 AM for an official wind tunnel test. All steps for the target body listed below are required. The OEM body steps below are typical and may vary depending on the submitting OEM's decisions. In all cases, for an official run, the loose tape check is required following the warmup. The warmup runs shall be completed using the same yaw and height matrix as used for Test runs. Data shall be acquired during the warmups but will not be considered official.

Table 3. Official Wind Tunnel Test Sequence

Start Time	Typical Duration (minutes)	Body	Event
6:00	30	Target	Install submission chassis with target body components installed. Set inspection.
6:30	5	Target	Shake down
6:35	15	Target	Reset inspection height and set heights
6:50	20	Target	Scan
7:10	20	Target	Warmup - Open Tape, Establish VR.
7:30	5	Target	Tape check
7:35	20	Target	Test (2 runs) - 7" Spoiler - Closed~~Open~~ Tape. ~~Calculate targets.~~
7:55	20	Target	Test (2 runs) - 7" Spoiler - Open~~Closed~~ Tape.
8:05	10	Target	Install 4" Spoiler
8:15	20	Target	Test (2 runs) - 4" Spoiler - Open Tape. Calculate targets.
8:35	30	OEM	Remove Target Body. OEM hands-on personnel may assist.
9:05	90	OEM	Install OEM Body.
10:35	20	OEM	Warmup - Maximum VR measurement, no throttle plate/grille plate.
10:55	30	OEM	Scan
11:25	30	OEM	Warmup - Open Tape, Establish VR VR may only be tuned if outside of tolerance range. Once VR lands within the tolerance range, it may not be tuned again. Establishing VR will not count towards any runs.
11:55	20	OEM	Test (2 Runs) - 4" Spoiler - Closed~~Open~~ Tape. ~~Calculate Targets~~
12:15	20	OEM	Test (2 Runs) - 4" Spoiler - Open~~Closed~~ Tape. Calculate Targets
12:35	10	OEM	Install 7" Spoiler
12:45	20	OEM	Test (2 runs) - 7" Spoiler - Open Tape. Calculate targets.
13:05	If OEM passes requirements, test has ended. If not, OEM repeats steps beginning with "Install OEM Body".		

*The submitting OEM may request an alternate configuration order for the Official Test Sequence with approval by NASCAR and the other OEMs in attendance. All procedures remain unchanged.

Aerodynamic Coefficients

For the target and OEM bodies, aerodynamic coefficients for each individual run number are calculated as follows. CD_1 denotes CD for height and yaw point 1 from Table 2, etc.

$$CD_{RUN} = (CD_1 + CD_2)/2$$

$$CL_{RUN} = (CL_2 + CL_3 + CL_4 + CL_5)/4$$

$$CLF_{RUN} = (CLF_2 + CLF_3 + CLF_4 + CLF_5)/4$$

$$CLR_{RUN} = (CLR_2 + CLR_3 + CLR_4 + CLR_5)/4$$

$$\%\, Front_{RUN} = \frac{CLF_{RUN}}{CL_{RUN}}$$

$$CS_{RUN} = (CS_3 + CS_4 + CS_5)/3$$

$$VR_{MAX} = VR_{1\ -\ NO\ THROTTLE\ PLATE}$$

$$VR_{RUN} = (VR_1 + VR_2 + VR_3 + VR_4 + VR_5)/5$$

For the target and OEM bodies, average coefficients are calculated by taking the average for each parameter over two runs, except for VR which is calculated from one to two points. Target body coefficients utilize the subscript 'TARGET' and the submitted body coefficients use the subscript 'OEM'. These calculations will be performed for both the 4" and 7" spoiler options.

For **Closed Tape**, performance data is only recorded data keeping. Closed tape performance data is not used in the criteria for final submission decisions but rather as a potential opportunity to identify model issues when compared with the open tape runs.

For **Open Tape**, the performance targets achievable by a submitted body during a test are defined by the target body for each spoiler size (except for %Front). The aerodynamic limitations are defined below:

$$CD_{MIN} = CD_{TARGET}$$

$$CL_{MIN} = CL_{TARGET}$$

$$CD_{MIN\ R-1} = CD_{TARGET} + 0.004$$

$$CL_{MIN\ R-1} = CL_{TARGET} + 0.008$$

$$CS_{MAX} = CS_{TARGET}$$

$$VR = 0.075 \pm 0.003$$

$$\%\,\boldsymbol{Front}\; = \%\boldsymbol{Front}_{\boldsymbol{TARGET\ 4"}} \pm\; \boldsymbol{2.0}\%$$

When OEM average coefficients meet the following criteria, they are defined as falling within the Approval Band. Provided that the following conditions are met, an OEM may elect to declare a body as Preserved.

$$\boldsymbol{CD_{MIN}} \;<\; \boldsymbol{CD_{OEM}}$$

$$\boldsymbol{CL_{MAX}} \;<\; \boldsymbol{CL_{OEM}}$$

$$\boldsymbol{CS_{MAX}} \;<\; \boldsymbol{CS_{OEM}}$$

$$\boldsymbol{VR_{MAX}} \;>=\; \boldsymbol{0.100}$$

$$\boldsymbol{0.072} < \boldsymbol{VR_{OEM}} < \;\boldsymbol{0.078}$$

$$\%\boldsymbol{Front_{TARGET\ 4"}} - \boldsymbol{2.0}\% < \;\%\boldsymbol{Front_{AVG}} < \%\boldsymbol{Front_{TARGET\ 4"}} + \boldsymbol{2.0}\%$$

If an OEM body has met the following conditions (and all previous conditions):

$$\boldsymbol{CD_{OEM}} < \;\boldsymbol{CD_{MIN\ R-1}}$$

$$\boldsymbol{CL_{OEM}} \;<\; \boldsymbol{CL_{MIN\ R-1}}$$

the OEM has one additional attempt to improve their submission. If the subsequent attempt does not meet all of the requirements or is worse in performance, the attempt that exceeded the above criteria will be deemed the OEMs' Preserved Body.

Significant Digits

The aerodynamic coefficients output from the wind tunnel data acquisition system will not be rounded or truncated. The coefficients will be taken directly from the data acquisition system and used to calculate all coefficients referred to in this document. The calculated coefficients will not be rounded or truncated for comparison.

Preserved Bodies

An underperforming body may be Preserved. All parts of a Preserved body must remain in NASCAR's possession and must not be altered. Preserved parts may not be used in OEM

private testing. If parts remain on the submission chassis during an official wind tunnel test, the parts are considered to be in NASCAR's possession.

Wind Tunnel Eligibility / Hours

Only NASCAR approved wind tunnels as defined by the NASCAR rule book (13.3) are permitted for development.

- Aerodyn Wind Tunnel – Full-Scale (Mooresville, NC)
- Auto Research Center (ARC) – Scale Model (Indianapolis, IN)
- Penske Technology Group Wind Tunnel – Scale Model (Mooresville, NC)
- Windshear Wind Tunnel – Full-Scale (Concord, NC)
- Ford RRWT – Full-Scale (Allen Park, MI)

A Submitting OEM may only use a maximum of ~~400~~ 300 total wind tunnel hours during the body approval process, of which ~~350~~ 250 maximum hours may be used up to the time of successful body submission. Upon successful submission, 50 additional hours are allocated to be used prior to the first points paying Event. A maximum of ~~100~~ 75 hours of testing is permitted at either Windshear or the Ford RRWT or some combination thereof. If the submitting OEM cancels the body approval process at any time, the wind tunnel hours used at either tunnel will be subtracted from the OEMs annual wind tunnel testing allocation for either that year or the following year as required. Official wind tunnel test hours are not included toward this total.

For Chevrolet's next body submission or a new OEM's body submission, a maximum of 400 total wind tunnel hours are permitted during the body approval process, of which 350 maximum hours may be used up to the time of successful body submission. Upon successful submission, 50 additional hours are allocated to be used prior to the first points paying Event. A maximum of 100 hours of testing is permitted at either Windshear or the Ford RRWT or some combination thereof.

Freezing Key Components

Submitting OEM may freeze key components at any time during the body approval process. Components and CAD must be approved by NASCAR. Frozen key components are not permitted to be changed during the body approval process. If changed, submitting OEM must cover any costs applied to all single-supplier vendors affected.

OEM Private Testing

OEMs may utilize the NASCAR submission chassis for private wind tunnel tests to prepare for the official wind tunnel tests. The OEM must notify NASCAR a minimum of two weeks in

advance of a private wind tunnel test. It is desirable for an OEM to schedule all anticipated private and official wind tunnel tests at the beginning of the process. A NASCAR official will be present at all tests with the NASCAR submission chassis. The OEM must supply a detailed test plan to NASCAR one day prior to the private test. The OEM must supply NASCAR all data and photos from private tests. Private testing involving NASCAR personnel or vehicles are strictly limited to 10 hours in duration, this includes any post-test scanning and body fitment.

OEM Production Panels Parity Test

The final step in the body approval process will be a wind tunnel parity test on the production body panels. The parity test will include the new submitting OEM body and the remaining other OEM bodies. NASCAR will endeavor to test the production body as soon as the new submitting OEM production body panels become available. Submitting OEM must provide all production body panels to NASCAR for this test. NASCAR will conduct the test with their own personnel and OEM observers in attendance. The production panel test will utilize all components as defined in the Target Body Removable Package section. The Production Panels Parity Test does not count toward the OEM wind tunnel hour limitation.

All test conditions and test sequences from **III. Wind Tunnel Test** will be used. The target body for the production panels parity test will remain the production panels for the 2022 Chevrolet Camaro, regardless of new submitting OEM. The following will be used to set the performance tolerances for each submitting OEM:

- Target Body Results from Production Panels Parity Test
- Delta from Submitting OEM Results and Target Body Results from OEM Submission Test
- Production Parts Tolerance
    - CD: +/- 0.003
    - CL: +/- 0.005
    - CS: +/- 0.002

If the submitting OEM does not meet the performance tolerances, the submitting OEM may apply corrective measures to achieve parity through the resubmission process. These corrective measures will likely include a short term and long-term plan based on parts' availability.

Corrective measures must consist of a short-term measure for existing production parts and tooling alterations for long-term measures. Submitting OEM must receive approval for specific

corrective measures before any testing occurs. Long-term corrective measures will be subject to wind tunnel testing evaluation.

Wind Tunnel Eligibility / Hours

The following Wind Tunnels are eligible for developmental work during the resubmission process:

- Aerodyn Wind Tunnel
- Windshear Wind Tunnel

The resubmitting OEM may only use a maximum of ~~150~~ 100 wind tunnel hours during the resubmission process. The wind tunnel hours must be used between the approved start of the resubmission process and the start of the official resubmission test. Below is the hour allotment for each wind tunnel:

- Aerodyn – ~~130~~ 90 hours
- Windshear – ~~20~~ 10 hours

OEM Resubmission Evaluation - Inaugural Submission

Any new OEM that submits an initial vehicle in their first season are permitted a one-time concession to enter the resubmission process. During the inaugural season, the submitting OEM is allocated the ~~150~~ 100 wind tunnel hours as defined by the resubmission process whether they decide to resubmit or not. The resubmission performance requirements are the same as outlined in section **Wind Tunnel Test**. OEMs must notify NASCAR of their intent to utilize this provision by May of the inaugural season. It is the intention of this concession that there are no body/cooling related alterations to the vehicles at any Events beyond the inaugural season, with the exception of dirt Events or in the case of a new race venue.

The following components, from A-post forward, may be resubmitted:

- Front fascia
- Fenders
- Hood
- Louvers / Radiator Exit Ducts

Major Rules Changes

In the event of major rule changes involving alteration of aero packages that impact points paying races, NASCAR will endeavor to retest all submitted vehicles prior to the season the change will be implemented. NASCAR will conduct the test as a Production Panels Parity Test,

and the process will follow the sequence outlined previously. In the event of package changes necessitating this action, each OEM will be allocated ~~30~~ 20 additional wind tunnel hours to be used between the Championship race of the preceding season and the Championship of the effected season.

Example Race Vehicle Requirements

The submitting OEM must deliver all OEM production panel parts to the NASCAR R&D Center by March 1, YOD. NASCAR will apply new production parts to the current OEM vehicle at the NASCAR R&D Center. The submitting OEM must also deliver a front fascia and rear fascia to NASCAR by February 1, YOD for competition purposes.

The submitting OEM must supply all documentation and graphics files for new decal packages by February 1. The submitting OEM must supply CAD or graphical representations as required to broadcast and commercial partners with appropriate need and/or rights by February 1, YOD.