

Revised ISO 10844 Test Surface: Technical Principles

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General Motors LLC

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ABSTRACT

ISO has revised the 10844 International Standard for test surfaces used in measurement of exterior vehicle and tire noise emission. The revision has a goal to reduce the track to track sound level variation presently observed by 50%, without changing the mean value. ISO has incorporated improved texture measurement procedures, improved acoustic absorption measurement procedures, and has added measurement procedures for track roughness. In addition, specifications for texture, absorption, roughness, planarity, and asphalt mix were revised or added to recognize improved technical methods and to achieve the goal of variation reduction. The specification development was supported by a construction program where four candidate ISO 10844 tracks were constructed in Japan, France, and the US to verify the technical principles and to validate construction process capability. This paper will address the technical changes and reasons for these changes in the revised ISO 10844.

INTRODUCTION

ISO has revised the 10844 International Standard [1, 2] for test surfaces used in measurement of exterior vehicle noise emissions and for quantifying tire noise according to regulatory specifications. The intention of the revised standard is to reduce the observed track to track variation in sound level values measured on the same test object by 50%, without changing the mean expected value of the result. To this effect, ISO has investigated the primary objective criteria of the 10844 surface that contribute to and correlate with the observed measured noise results for vehicles and tires. The primary mechanism for track to track variation is due to the changes in the tire-road noise. Based on this investigation, ISO has revised existing specifications, incorporated additional specifications, and added significant information in

the appendices on the construction processes necessary to successfully build a research grade measurement surface meeting the requirements of the revised ISO 10844 International Standard.

This work has been carried out by ISO Working Group (WG) 42, a joint workgroup of ISO TC43/SC1 "Noise" and ISO TC22 "Road Vehicles". Members of the working group included experts in vehicle exterior sound measurement, tire-road noise generation mechanisms and measurement, road design and construction processes, measurement of road surface texture, and measurement of acoustic absorption of road surfaces. WG42 experts came from a wide range of professional backgrounds; experts included national road research authorities, noise and vibration engineering consulting firms, tire manufacturers, vehicle manufacturers, road construction firms, certification and regulatory authorities, and academic bodies.

The work of WG42 identified two major road surface criteria which correlated to observed variations in measured noise levels. These were: 1) Road surface texture in the texture ranges important for tire/road noise generation phenomenon and, 2) Road surface absorption. Other secondary texture factors were the road smoothness and evenness, which allow the vehicle to maintain a constant tire contact patch over the duration of a measurement run. Changes in specifications were made in ISO 10844:2011 relative to ISO 10844:1994 to provide reduced variation of observed noise emissions by setting target and tolerance limits for the two main road surface criteria relevant for ISO 10844. From the scope of the revised 10844, the following is noted:

"In general, the road surface parameters affecting the noise emission of vehicles are the texture and sound absorption characteristics. In addition, the mechanical impedance and

the skid resistance properties of the surface layer may also influence measured noise levels. In order to minimize the variation in rolling sound emission and vehicle sound emission measurements made at different testing locations it is, therefore, necessary to specify the relevant surface properties and recommend carefully the properties of the materials, design, construction of the test surface. The principal objective of this International Standard is to provide a revised specification of the surface which improves the reproducibility of measurement. This International Standard is designed in a way that test tracks conforming to this International Standard are compatible with ISO 10844:1994, but in addition the variability of properties is reduced. It is important that the test provides a high degree of reproducibility between different test sites and that the surface design should not only minimize the inter-site variation of tyre/road noise, but should also ensure that the propagation of noise is unaffected by the surface used. This latter consideration precludes the use of road surfaces which have open textures and which have the property of absorbing noise from the power unit and other related sources.”

The revised ISO 10844 International Standard was published in February 2011. As such, it has the designation ISO 10844:2011.

DEVELOPMENT OF REVISED ISO 10844 TECHNICAL PRINCIPLES

REVIEW OF PREVIOUS VERSION OF ISO 10844

The previous version of ISO 10844 (ISO 10844:1994) was developed with the specific goal to reduce the tire/road contribution to an overall vehicle noise measurement result when using existant technical procedures, i.e. ISO 362 and similar that we dominated by powertrain noise sources, for the measurement of vehicle exterior noise (pass-by). At the time of the development of the ISO 10844:1994 standard, the track so specified represented a realistic lower limit of tire-road noise using standard road building procedures and knowledge, and also using commonly available materials and processes used in construction of public roads by road authorities. To this purpose, ISO 10844:1994 stands in good credit to its authors for meeting the objectives and scope of the standard for 17 years.

However, there were a number of assumptions made and technical limitations faced by the authors that necessitated a review of ISO 10844 due to developments in road building practice, the use of the 10844 surface in conjunction with vehicle test procedures specifically designed to include tire-road noise (ISO 362-1:2007, ECE 117), and the use of suboptimal validation procedures which themselves were subject to variation and used destructive processes (coring) to

obtain road samples for evaluation. In addition, the knowledge of proper construction processes for the successful construction of ISO 1044 surfaces was limited, resulting in the common occurrence of track owners having to repeatedly construct a 10844 surface until it met specifications. After significant investigation, including the measurements of numerous existing ISO tracks in the United States, Japan, and Europe, the following issues were noted with the ISO 10844:1994 International Standard:

1. Texture specification was one-sided: meaning texture was uncontrolled in one direction.
2. Absorption specification allowed for tracks to be “designed” to maximize absorption in such a manner inconsistent with the original intent of the specification.
3. The measurement method for texture was subject to variation due to the manual hand process used.
4. The requirement for absorption could be indirectly inferred through the void content, rather than direct measurement of absorption.
5. The terms “flatness” and “smoothness” were used, but without numerical specification.
6. Restriction on the use of modern polymer modified bitumen limited the ability of a track to be properly designed to withstand climatic and load conditions.
7. The sieving curve, a primary engineering guideline for asphalt mix design, was provided only as an informative recommendation.

Each of these items was determined to have some influence on the observed track to track variation. There were other properties investigated, but they could not be sufficiently linked to the observed variation for the workgroup to include them as issues for further analysis.

DEVELOPMENT OF REVISED TECHNICAL SPECIFICATIONS

Texture

The first order of business for the workgroup was a detailed assessment of existing ISO track database acquired in the variation review phase to determine a “Target” or “Nominal” track performance. This was done using a number of proposed texture specifications with the same principle: The median track performance represented the “true” value expected from an ISO 10844 track as was referred to as the reference track. This reference track was used in all subsequent development of the revised ISO 10844. [Figure 1](#) shows the results of texture measurement on global ISO 10844 tracks and the target texture determined to represent the “true” ISO 10844 texture.