行政院所屬各機關因公出國人員出國報告書
（出國類別：考察）

「派員赴歐洲與官方單位進行噪音管制法規政策與技術交流」報告

服務機關：環境部
姓名職稱：林冠銘技正
羅博銘薦任技士
派赴國家：德國、英國
出國期間：113 年 11 月 23 日至 113 年 12 月 1 日
報告日期：114 年 2 月 11 日

摘要

本次考察行程及討論重點包括：

（一）掌握車廠因應歐盟規範，納入車輛設計與管理措施：

與德國巴伐利亞發動機製造廠股份有限公司(BMW)討論車廠對於歐盟及聯合國規範之需求，如何落實車輛管理及設計，並參訪其實驗室了解車輛噪音管理測試流程，並了解其因應 ESG 推動，導入產品設計之未來規劃與現況。

（二）了解歐盟國家對於環境噪音指引之管理措施：

拜訪德國聯邦環境局針對歐盟發布環境噪音指令，了解德國因應規範建立國內法規、政策之內容，並了解其執行行動計畫及噪音地圖之具體規劃與執行方式；從營建工程噪音管理，了解德國採行管制措施外之處置方式，及民眾陳情案件之處理，對於推動 ESG 導入噪音管理之作法，掌握德國官方管理手段。

（三）針對聲音照相科技執法與德國交流：

分享我國噪音管制作法，汲取該國寧靜區之推動經驗，以做為我國未來導入之參考，此外，德國官方針對我國推動聲音照相科技執法提出興趣，爰就我國管理經驗與德國環境局進行分享。

（四）針對車輛審驗管理及認證與英國官方單位交流：

拜訪英國車輛認證局針對英國脫歐後執行車輛認證之管理做法及認證規範，了解其執行方式，並掌握該國未來之推動方向，以確保英國車輛輸入我國符合國際規範內容。

本次考察掌握德國、英國，對於車輛、營建工程噪音之管理，業者藉由自主採行法規遵行措施，並了解德國對於民眾陳情之溝通與處理，從聯邦法規由上而下推動噪音管理行動計畫，並保留地方自治管制之作法。而對英國之管理，其因脫歐後，部分執行作法脫離歐盟規範，其車輛認證項目並無大幅度變化，有助於我國了解該國進口車輛之認證項目，避免車進口國車輛認證品質之差異，而德國、英國採行 ESG 係由企業先行方式，並非由政府機關建立規範。

目　　錄

壹、前言

我國都市化程度提升使交通噪音、空污為都會區主要環境公害來源之一。木前我國對於噪音管理，藉由噪音管制法及相關法規進行管制，從機動車輛、道路運輸、航空噪音、場所噪音管理、設施及工程管制等規範相關場所符合規範，解決民眾陳情之問題，對於整體噪音之改善，需藉由上位計畫思考及參考國際間推動噪音管制之經驗，檢討評估管制策略。

鑑於歐盟發布環境噪音指令（EU END），各成員國依循該指令內容推動噪音管制包括:噪音監管、行動計畫等管理措施，由於歐盟國家對於噪音之管理係依循歐盟規範，由於德國之交通噪音源管理措施已有相關推動經驗，值得了解其詳細規劃，此外，因淨零排放趨勢變化，各國企業開始推動 ESG 落實環境治理，本次亦將該議題納入本次考察內容，藉由考察了解國外噪音管制經驗及 ESG 推動情形，回饋於我國噪音管制政策研訂及作為參考方向。

德國自 1970 年代即推動噪音管制，於各類噪音源管理有較完整之制度規劃，本次針對我國較常見之陳情來源，如車輛噪音、營建工程等噪音類別就教德國管制經驗，德國為歐盟成員國，從該國管理制度可了解歐盟噪音指令執行方式，藉由本次訪問了解噪音指令執行方式及歐洲國家配合噪音指令政策採行之措施。

此外，本次考察英國，係因英國脫歐後，所採行車輛噪音、空氣污染認證單位及其管理制度與歐盟制度有所不同，因此，除了解歐盟管理制度外，針對英國推動車輛噪音、空污認證制度及運作管理機制進行掌握，將有助於了解歐洲國家對於車輛噪音、空氣污染管理之策略，亦可為未來輸入我國車輛認證內容進行把關。

本次出國以德國、英國為考察國家，針對噪音指令、營建工程噪音、車輛噪音及污染排放認證制度、ESG 等議題，訪問德國聯邦環境局、英國交通部與車輛認證局及巴伐利亞引擎製造廠股份有限公司，參考國外管制經驗回饋於我國噪音管制策略，進一步改善環境品質，提升國人的生活品質。

貳、考察行程

本次考察由環境部大氣環境司技正林冠銘、薦任技士羅博銘，共計 2 人赴派德國及英國進行考察，考察期間自 113 年 11 月 23 日至 12 月 1 日，考察行程規劃如表二。

表一、本次考察成員

單位	職稱	姓名
環境部大氣環境司	技正	林冠銘
	薦任技士	羅博銘

表二、考察行程

日期	行程與活動
11 月 23 日(六)	●臺北出發至德國慕尼黑機場(含轉機)
11 月 24 日(日)	●抵達德國慕尼黑機場，考察資料準備
11 月 25 日(一)	●拜訪德國巴伐利亞發動機製造廠股份有限公司（BMW）對應歐盟車輛噪音管理制度採行措施與技術，及因應 Euro END/ESG 推動對應方案
11 月 26 日(二)	移動至柏林 ●拜訪德國聯邦環境局 (UBA)及交通部，瞭解噪音管制法規與城市噪音治理政策措施 ●赴我國外交部駐德辦事處拜訪
11 月 27 日(三)	移動日（柏林－布里斯托）
11 月 28 日(四)	●英國交通部(DFT)及英國車輛認證局(VCA)，瞭解交通噪音與空污管制議題
11 月 29 日(五)	●與布里斯托政府交流噪音管制經驗 移動至倫敦
11 月 30 日(六)	●考察英國噪音寧靜區，自倫敦返程（含轉機）
12 月 1 日(日)	抵達臺北

參、考察重點

一、考察目的：

本次出訪考察之目的係為深入了解德國和英國在車輛噪音管制領域的相關經驗與技術，並探討歐盟環境噪音指令的執行方式及內容。隨著車輛數量與交通運輸的增長，車輛噪音已成為影響城市環境質量和居民健康的重要因素。因此，透過考察國際間噪音管理政策與措施，學習其在噪音管理、自主遵循法規、法規制定、技術創新及監管執行等方面的成功經驗，旨在提升我國在車輛噪音控制及環境保護方面的治理能力，並進一步優化相關政策與法規，達到減少噪音污染、改善民眾生活品質的目標。

二、考察內容：

（一）BMW 摩托車因應歐盟及聯合國噪音管制規定，及淨零趨勢發展方向採行之措施

1.BMW 對於車輛噪音管理制度及推動措施

BMW 產生車輛產業占有領導地位，該公司在車輛噪音管制水準及設計亦有較豐富的經驗，如因應聯合國車輛法規(UN Regulations)、歐盟法規(EU Regulations)以及單一國家法規(如韓國、馬來西亞)等需求方面，主要以低於法規限值且不觸碰灰色地帶為主要產品水準制定目標，其中不僅實踐於噪音管理，同時包括污染排放、燃油消耗以及車輛耐久性等項目。

以本次考察與該公司代表討論，該公司對於法規之遵循持嚴謹之態度，當法規噪音限值為 75 dB(A)時，BMW 研發目標即設定於 74 dB(A)，以 1 dB(A)容許範圍確保對應不同國家環境變化或測試場差異所造成之影響；此外，針對額外噪音排放程序(ASEP)方面，該公司針對車輛車速、引擎轉速等測試條件皆有固定範圍，即便不在法規範範圍的高轉速區域，也要求須依法規計算公式代入對應轉速計算噪音上限，且要求車輛產品噪音水準不得超過該上限值。

所有新車型產品一律先在 BMW 慕尼黑總部執行測試，測試與驗證流程方面均確保符合聯合國及歐盟法規，即便針對聯合國法規以外的市場，

依然以相同政策原則制定噪音管理目標，確保車輛噪音規格符合當地法規。

在歐盟規範方面，車廠自主執行品管外，另透過 EU 2018/858 規範各成員國須執行市場監管與符合性檢查，確保車輛在實際使用中仍符合噪音管制標準，其中可由主管機關或其指定機構執行。

德國對於車輛流通於市場之監管，由聯邦機動車輛管理局（Kraftfahrt-Bundesamt, KBA）負責，針對市售車輛以不定期租賃方式進行隨機抽檢，其檢驗係在了解車輛噪音之品質，每年檢驗數量則視各車廠認證車型數加乘適度比例或積分(例如包括來自消費者或非政府組織之檢舉)而定，BMW 表示 KBA 並未告知具體計算方式，僅透過所收到通知得知市場抽驗數量；檢驗項目包括噪音、污染排放及安全測試，若發現異常，KBA 會要求車廠解釋，並視實際情形進行改善。惟使用車輛車況較複雜，主管機關就此制度實施主要作為監督、監控性質，相關結果通常不另行通知車廠，該結果將不會對車廠進行實質裁罰。

對於車輛輸出國外而言，以台灣、韓國與馬來西亞為例，雖然前述國家也都接受歐盟認證，但 BMW 仍透過契約要求當地代理商，產品須由德國總公司認可完全符合當地法規，方可辦理進口。

2.BMW 因應 ESG 推動，採行車輛噪音管理或相關措施

BMW 摩托車設計中心接洽人員主要為技術人員，對於 ESG 推動策略並沒有詳細資訊，其工作內容亦無涵蓋 ESG 相關工作項目，但是其分享因應 ESG 推動在產品設計方面，該公司透過使用環保塗料及塗裝技術，降低化學塗料用量及散逸，進一步促進車輛製造過程，減少對環境負擔；辦 公大樓底層階配置大量消防水池，目前已加設循環管道，將消防用水抽取並於建築頂樓與外部環境進行熱交換循環，達到自然降溫及降低空調使用等節能目的，節約電力資源使用，由相關措施了解，歐洲企業已經從自主落實 ESG 達到自主管理目的，非政府機關督促企業推動。

此外，在產品設計方面，以二輪摩托車產品為例，跟隨公司發展趨勢，整體仍與公司四輪汽車部門技術開發趨勢一致，當四輪汽車部門有新技術量產使用且市場反應良好時，BMW 二輪摩托車設計開發團隊均會設定實施

導入目標。

本次考察車廠行程主要與該廠技術人員與法規人員進行交流討論（如圖 1），從車輛設計與管理可以了解德國車廠對於車輛標準之遵循，藉由系統化管理與測試，確保其技術保持領先，並符合各國規範。

圖 1 BMW AG 二輪摩托車法規人員合影
(由左至右依序 Selman Kurban、Fedric、Max Porsin 等法規人員)

（二）德國聯邦環境局(Umweltbundesamt, UBA)考察其綠建築作法與噪音管理制度

1.環境局辦公大樓綠建築導覽

德國聯邦環境局(UBA)為環境、自然保護、核能安全與消費者保護部(Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection)轄下二級執行機關（如圖 2），主要據點在距離首都柏林約 130 公里處的德紹(Dessau)，當初總部選址主要基於德國統一後，地區平衡發展政策，展現 UBA 於環境永續、文化及自然保護理念。德紹所在的薩克森-安哈特邦(Sachsen-Anhalt)屬於前東德領地，聯邦政府於德國統一後致力於促進東部經濟復甦與發展，因此將 UBA 遷至德紹，以平衡東西部經濟及就業。此外，德紹位於中歐綠心生態保護區(Mittelelbe Biosphere Reserve)，該區域具備豐富自然生態系統，同時也是研究氣候變遷與生物多樣性的理想

地點；地理位置靠近柏林與萊比錫等主要城市，同時遠離高密度工業區，環境相對安靜及無污染，適合進行環境監測與研究。在環境保護研究領域中，UBA 認為選擇德紹可不受傳統工業區(如北萊茵-威斯特法倫邦)影響，有利於推動環境永續發展等前瞻研究。

基於前述背景，UBA 總部在德紹的建築本身就具備成為全國、甚至全球環保標杆之理念，該建築設計大幅減少能源消耗，並於周邊規劃大量綠化區域（如圖 3），同時採用雨水回收與廢棄物循環系統，力求將科研、政策制定與公眾教育結合，使該單位總部成為功能全面、環境友好之指標建築。硬體方面，整體建築頂部由大面積玻璃及太陽能板覆蓋，透過風力發電及被動式熱交換系統調節內部室溫，在與距離建物本體數百公尺遠的塔樓，設置地下空氣管路並連接兩棟建築，整合溫度感測器及風扇系統藉此調節辦公區域溫度，據導覽員說明，辦公大樓全區均未裝設空調，僅透過前述機制調節室溫；儘管拜訪當日，德紹室外約 5℃，UBA 內部仍是溫暖的 20℃。此外，建物配置有雨水回收及循環系統，所有非飲用水需求(如灌溉及清潔)均由該系統供應，有效節約水資源使用；同時設置智能垃圾分類回收系統，利用廚餘堆肥設施回饋於土壤及植栽，促進資源再利用。

圖 2 德國聯邦環境局位置及外觀

<table>
<tr><td>  </td><td> 
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<tr><td>綠建築設計</td><td>綠建築熱能循環設計降低室內溫度</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>空橋設計降低電梯使用</td><td>廢棄玻璃作為植栽土壤</td></tr>
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圖 3、德國環境管理局 UBA 綠建築設計

2.歐盟環境噪音指令架構及德國噪音管理制度推動策略

德國人口密度約 243 人/平方公里，台灣人口密度 643 人/平方公里，德國人口密度約為台灣的四成。然而德國汽車普及率相當高，平均每 1,000 人擁有約 580 輛汽車，而台灣則約 400 輛。近幾年德國與台灣面臨的相同的挑戰，由於人口過度集中於都市區域，例如柏林、法蘭克福和慕尼黑等城市，加劇基礎設施負荷，並帶來顯著的交通噪音問題，在追求經濟發展、城市建設與民眾生活安寧之間的平衡時，德國針對城市噪音管理策略，考察討論內容大致分類噪音地圖、交通噪音、營建噪音等分類，說明如下：

(1)噪音地圖

德國聯邦環境局在噪音管理政策推動，配合盟環境噪音指令

2002/49/EC 為基礎，制定國內法「聯邦污染防治法」（Bundes-Immissionsschutzgesetz, BImSchG）。要求城市必須繪製噪音地圖，定期評估交通、工業、營建等主要噪音來源，並制定噪音行動計畫，針對高噪音區域實施具體的降噪措施。該評估結果用以作為未來噪音負荷量之估算，其並非以持續降低環境噪音為目的，而係評估在符合環境噪音標準之水準上，可增加之各類噪音源負荷量，以環境背景噪音作為管理基準，對噪音源之新增、改善進行規劃。

主要使用模擬軟體繪製噪音地圖初稿，並結合地理資訊系統資料進行分析，同時配合道路交通現地噪音量測結果進行驗證，最終獲得道路交通、鐵路、航空及工業噪音等可視化圖層，反映不同地區聲音分布情形。實際執行步驟大致如下：

- 由地方政府負責數據收集及地圖製作，德國聯邦環境局擔任全國技術指導角色，並根據歐盟技術要求，必須製作並更新涵蓋全國道路交通、鐵路、航空和工業噪音地圖，並定期報告噪音曝露情形。
- 噪音地圖基於交通流量、機場起降次數以及工業運營數據進行建模，並結合地理資訊系統(GIS)技術，形成具有清晰噪音分布之功能，每 5 年更新一次，確保數據反映最新環境狀況。
- 噪音地圖繪製結果，德國聯邦環境局與各邦共同討論相關政策作法，討論過程中，須依噪音地圖所標示噪音源類型，分別計算不同地點的日間和夜間噪音暴露水準，並以分貝(dB)為單位標示。這些數據將提供各邦進行城市規劃過程，方便識別受噪音影響嚴重的地區，例如主要道路、繁忙的鐵路樞紐或機場周邊。
- 噪音熱區管理方面，德國聯邦環境局會與各邦政府討論及建議噪音管制標準草案及推動噪音改良措施，具體細節及實際政策制定則由各邦政府負責推動。例如，在交通高噪音區域，採行降低噪音之措施，安裝隔音牆、使用低噪音路面材料，甚至規劃城市中的寧靜區域(如公園或自然保護區)，為當地居民提供寧靜空間。

(2)交通噪音

聯邦污染防治法公佈噪音管制標準及規範防制措施，管理策略強調基礎設施升級及技術改良，積極推廣低噪音路面材料(如多孔瀝青)，期望降低輪胎與地面摩擦噪音；同時在高速公路及城市主要道路沿線安裝隔音牆。此外，在政策推動上，在基於符合環境背景值目標下，調整道路速限、尖峰時段車流量、大眾交通運輸路線、班次，或提供腳踏車或電動滑板車等移動工具租賃服務，鼓勵民眾降低使用自家機動車輛；此外，部分都市人口過度集中邦區政府甚至要求新建物須採用具備足夠隔音性能之門窗建材，確保維持民眾生活環境不受外部噪音影響。

針對航空噪音管理，德國的策略由聯邦政府負責制定法規與標準，例如根據「航空噪音保護法」(Gesetz zum Schutz gegen Fluglärm, FluglärmG)規範機場周邊噪音保護區域、噪音管制標準，同時要求機場定期執行噪音監測，並視實際噪音情形限制機場夜間航班起降數量；從參與國際民航組織(ICAO)相關討論會議，鼓勵航空公司採用更安靜飛機及營運規範，各邦政府會依據上述規範及實際情況各自推動對應做法，例如監督機場運營商落實噪音改善措施，包括優化航線設計、調整飛行時段限制，必要時甚至公告夜間飛行禁令；此外，邦政府也推動噪音補助計畫，協助受影響的居民提供隔音窗戶安裝或其他建築改裝補助，其中以慕尼黑、柏林等邦政府因財力較為充足，所訂定之補助措施亦較為優渥。

(3)營建噪音

德國在營建噪音管理制度對應上，由聯邦政府制定聯邦污染防治法，針對不同類型的建築工地，例如:住宅區或工業區設置，具有不同噪音限制；同時發布相關附屬技術指引，如「建築工地噪音技術指導」（Technische Anleitung zum Schutz gegen Baulärm, TA Lärm），確保各邦使用相同標準及原則進行噪音監測與評估。

並且藉由推動寧靜區域（Ruhezonen、Quiet Zone）概念，將城市公園、自然保護區和低密度居住區設置為噪音保護區，並要求新建或翻修

的住宅建築需遵守隔音標準，並優先考慮選用低噪音建材。此外，市區內的建築工地需採取降噪措施，如限制施工時間、使用低噪音機具等。

各邦政府依執行上述規範，並根據當地特定需求制訂對應做法，邦政府環保部門會監督建築工地是否遵守噪音限制值，並對違規行為採取罰款或要求停工，同時也可依地方民眾需求規定建築施工的允許時間段(例如限制夜間或周末施工)，或協調施工廠商提供受影響民眾臨時住所(通常是遠離工地的飯店)；對重大建設項目，邦政府還會與廠商合作制定噪音管理計畫，包括使用低噪音設備或設置臨時隔音屏障等措施，降低對居民影響。

由於營建工程噪音為民眾陳情來源之一，德國政府亦提升資訊揭露以及民眾參與，強調資訊公開與公眾參與措施，居民可以通過線上行動計畫平臺查詢噪音地圖，瞭解其所在區域的噪音暴露情形，並在政策制定過程中提出意見，確保管理方案符合民眾需求，提高政策接受度。

3.噪音車聲音照相、科技執法經驗交流

本次拜訪就我國推動噪音管制經驗進行分享，針對聲音照相科技執法為德國政府較為感興趣之議題，爰就本項議題與該國分享，我國自2021年起開始推動聲音照相、科技執法政策，藉此行程像德國聯邦環境局介紹各項細節，包括政策推動背景、管制標準制定緣由、儀器設備架設原則及裁罰作業(包括認定原則及罰鍰)。討論過程德國聯邦環境局也提及柏林過去曾經規劃過類似管理制度，惟在線上行動計畫討論階段，受多數民眾質疑個資保密嚴謹性而未行程具體政策，因此目前推動方式僅作為監測用途，不做裁罰用途。

4.因應國際淨零碳排及ESG企業永續經營之政策推動方向

德國官方單位針對國際淨零排放主要係由企業推動 ESG 管理制度，由減碳制度係由聯邦政府一級機關規劃及制定。在歐盟「氣候法」架構下，德國預計 2045 年實現碳中和的目標，各面向政策推動一級機關包括聯邦經濟與氣候保護部、聯邦環境/自然保護/核安全與消費者保護部、聯邦交通與數位基建部、聯邦教育與研究部及聯邦財政部，整體

推動方向包括推動可再生能源轉型、強化碳定價機制、支援企業 ESG 轉型、發展綠色技術與產業(包括氫能、碳捕集與封存、智能電網和能源效率技術)、加強國際合作與標準制定、社會參與與教育推廣。

由於德國聯邦環境局之機關任務屬性並非推動前述內容之機關，該局並未投入相關政策推動與執行，惟該局仍持續觀望其他歐盟成員國或相關企業執行淨零排放及 ESG 等工作，為下一階段預計展開討論之領域。

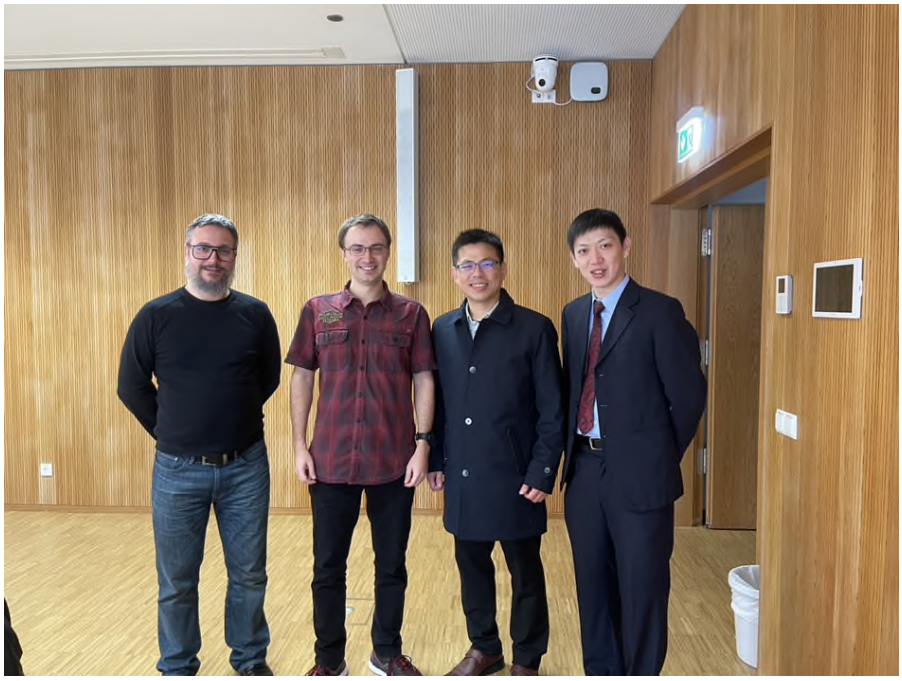

圖 4 德國聯邦環境局交流及合影
(由左至右依序 Christian Fabris、科長、UBA 導覽人員)

（三）與我國外交部駐德國柏林辦事處討論考察內容

本次出訪受我國外交部駐德國柏林辦事處協助與聯繫，了解德國官方單位對於歐盟及聯邦法規之規範內容及噪音管制執行之措施，爰安排行程赴辦事處拜訪(如圖 5)，並就本次考察行程之收穫與相關同仁進行交流，以利未來進一步持續連繫與開創雙邊合作之可能性，討論議題包含兩國之間產業合作或引進投資等內容，從本次考察行程了解德國產業及官方在實務管理或現況之作法，可進一步與我國相關機關連結，進行後續合作。

圖 5 與我國外交部駐德國柏林辦事處人員交流

（四）英國車輛認證局(Vehicle Certification Agency, VCA)車輛噪音考察

車輛認證局為於英國市郊區布里斯托(Bristol)，該機關為英國交通部下屬之機關，主要針對英國車輛進行認證及管理，本次討論議題包含英國脫歐後對噪音、污染防制法規推動方向、管理制度，及其因應 ESG 推動有無明確之措施，本次考察該國車輛噪音及污染排放認證機制（如圖 6），概述如下:

1.英國脫歐後噪音及污染法規推動方向

VCA 負責各類車輛型式認證工作，同時也提供國際認證服務，全體職工人員約 250 名，分布於英國及全球多個地點(如中國、巴西、印度等)、每年核發 2 萬件認證，隨著英國脫歐，2018 年起基於歐盟法規架構下發展英國本地 GB(Great Britain Type Approval、大不列顛型式認證，經過英國立法後預計 2026 年全面啟用，屆時所有車輛都需獲此認證才能進入英國市場（原依循歐盟認證規範輸入英國之車輛可於其他歐盟國進行認證），VCA 型式認證證書核發數量至該年預估將成長達 3.5 萬件，預期未來認證規模將提升 1.5 倍。

GB 認證之計畫主要是用乘用車、貨車、卡車、摩托車及拖車，進

入英國應辦理認證，另也適用車用特定零部件，確保其設計與製造符合規範。其認證由英國政府指定 VCA 擔任技術服務機構(Technical Service)，負責執行 GB 型式認證測試及評估。

製造商需提交完整技術規格文件及測試報告，通過審查後，VCA 將核發 GB 型式認證證書，作為產品合法進入英國市場依據。目前 GB 型式認證的基礎規範多與歐盟標準類似，部分內容依英國管理需求有所調整，建立本地化設計條款，例如未來在環保類測試參數及標準可能略有差異，以反映英國本地的獨特需求(具體內容目前尚在研議中，後續將視國內實際需求，持續關注該國政策推動)。

相關措施 2026 年實施，為降低過渡期間製造商之衝擊，英國政府將針對既有歐盟型式認證(EU Type Approval)的車輛及產品規劃過渡期。相關產品在此期間可暫時使用歐盟認證文件進入英國市場，但需要在過渡期結束前取得 GB 型式認證，此外 VCA 與其他國家及國際機構合作，確保 GB 型式認證同時具備全球性。對於全球化車輛製造商，GB 型式認證的推動有助於簡化進入英國市場程序，提升產品競爭力。

GB 型式認證計畫，係英國自主法展之認證法規發展架構，同時規劃數位轉型，並思考如何利用自動化工具提高型式認證作業效率，同時滿足不同領域(例如安全及環保)資訊共用及減少重複測試成本，並因應噪音及污染排放管制要求持續發展趨勢，確保英國市場車輛符合國際及國內要求。英國不僅確保本地車輛安全與環保品質，也為國際車輛製造商提供明確市場准入制度，VCA 因此預估未來幾年，市場需求將隨英國在地化政策推動下，認證市場將隨之增加，對 VCA 的運營及團隊均能持續成長，同時協助英國汽車產業進一步提升全球競爭力。

2.機動車輛噪音管理制度

英國機動車輛噪音相關管理規定列表，經初步瞭解，英國規範車輛製造、使用和維護過程中的噪音管制標準，主要依該國「1986 年道路車輛(建造與使用)條例」(Road Vehicles (Construction and Use) Regulations 1986)及相關補充修訂法規 ，其架構彙整如下：

- 機動車輛噪音管制標準(Regulations 54、57)：針對新車型消音系統及其他噪音來源制定噪音管制標準，降低道路交通噪音。
- 噪音測試規範(Regulation 99)：針對前述管制標準制定量測方法，在車輛領牌銷售前，需以標準測試程序確保噪音符合標準。
- 排氣系統噪音規範(Regulation 37)：規範消音系統設計及安裝規定，須滿足噪音標準及耐久性要求，並且不得進行任何增加噪音水準之改裝，如非法拆除消聲器或更換高噪音部件。
- 使用中車輛噪音管制(Regulations 97、98)：車輛在使用期間須保持消音系統正常運作，包括對相關部件更換及定期維修，避免因零部件老化或損壞，造成噪音水準超出管制標準。
- 特殊車輛豁免條款(Regulation 55)：針對特殊用途車輛(如農業機械或骨董車)規定可申請免符合噪音標準，並制定相關配套規定，其中包括限定使用用途、使用時間/地點、行駛速度、規定骨董車輛消音器不可過度損耗或改裝；車身應明顯標識農用或骨董車標示以利執法機構及公眾識別、須取得地方政府或主管機關許可、提供噪音改良措施獎勵，及車主應承擔被檢舉噪音或安全等事件/事故責任且可能喪失豁免資格。
- 低噪音區域的特殊限制(Regulation 57)：在特殊環境如市中心、學校和醫院附近等低噪音區域，須遵守更嚴格的噪音管制要求，其中包括禁止使用非法改裝消音系統或其他噪音部件(如擴音器)、禁止車輛長時間怠速、運輸車輛應避免在夜間或清晨進行裝載或卸載操作、救護車或警車在非緊急情況下應避免不必要鳴笛、建築施工車輛應採用低噪音機械或設置隔音措施、限制車輛在夜間或特定時段(如學校上課時間)運行、地方政府可設置噪音監測設備並對超標車輛即時檢測及罰款、執法機關可對低噪音區域車輛進行現場檢查並要求立即改正違規行為。

（五）英國因應國際淨零碳排及 ESG 企業永續經營之政策推動方向

對於淨零排放，英國政府由各面向政策推動機關包括英國商業與貿易部、能源安全與淨零部、環境、食品與鄉村事務部、財政部、英國運輸部，及金融行為監管局，整體推動方向包括能源轉型與清潔技術推廣、綠色金融與企業責任、綠色交通與基礎設施建設、社會責任與公平轉型等面向，其中針對認證局工作職掌，無觸及相關範疇，惟其表示未來如有相關資訊可提供本部參考。英國企業對於國際淨零碳排及企業 ESG 管理制度推動方面，承諾 2050 年實現淨零碳排放，未來亦可持續蒐集相關企業所提措施，如有關噪音管制納入管理者，亦將納入我國政策導入之評估，協助提升企業的社會責任與競爭力，推動綠色經濟增長。

圖 6 英國 VCA 交流合影

(英國 VCA 代表右四 Peter Housden-Rowe、右五 Eleanor Deansmith)

（六）英國布里斯托市(Bristol City)環境噪音現地考察

英國布里斯托市就環境噪音管理政策，主要針對交通、工業設備以及其他固定噪音源進行監測及防制，該國曾為歐盟成員國，依據歐盟環境噪音旨令規範，英國亦依「環境噪音指令」(Environmental Noise Directive, END)提出「噪音行動計畫」(Noise Action Plans)及「英格蘭噪音政策聲明」(Noise Policy Statement for England, NPSE)等政策架構下，制定「布里斯托地方計

畫」，並於法規章節核心策略(Core Strategy)- BCS23 規範各項污染管制要求及指引，開發管理政策(Development Management Policies)DM35 設置噪音防制說明 ，其中後者對噪音敏感地區(例如住宅、學校和醫院)規範具體噪音管制標準及要求。

本次考察依 VCA 代表提供之建議，實際前去布里斯托市政府瞭解當地噪音管理情形（如圖 7），該市政府設有噪音陳情機制，居民可針對持續性噪音問題(如音樂、派對或施工噪音)提出陳情，同時須檢附 14 日噪音紀錄日誌。市政府將針對週期性噪音問題透過噪音日記追蹤噪音干擾情形。

整體而言，英國布里斯托市車流量相當繁忙，雖然機車能見度相對較低，但市區道路上車輛的通行量仍非常大。與德國或台灣相比，布里斯托市區的車輛噪音給人的主觀感受噪音問題較為嚴重。依觀察結果發現，噪音源包括高車流密度、市區內老舊道路設計，使噪音傳遞效果放大，特別在高峰時段或交通繁忙路段，居民和遊客普遍感覺到嚴重噪音情形。惟市中心大量規劃公園、及徒步區，由於車輛無法進入，這些區域環境則顯得相對寧靜，英國對於噪音寧靜區之推動主要係針對特定需要安寧之區域，例如公園或是其他公共場所，惟並無針對道路等噪音源進行限縮，其限制內容多為宣示性而無實質裁罰措施，為英國當地民眾為法規遵循度較高之國家，對於宣告內容亦多為遵守，使特定區域可維持寧靜之環境品質。

圖 7 造訪英國布里斯托市政府

肆、心得及建議

一、心得

（一）蒐集德國噪音地圖、行動計畫及交通噪音管制經驗

德國在噪音地圖的建立方面上，依循歐盟(2002/49/EC)規定已行之有年，並有豐富經驗，該國利用活動強度估算並分析不同地區的噪音數據，這些數據涵蓋了交通、工業、建設等多個領域的噪音源。通過這些地圖，政府能夠精確了解噪音的來源、強度和分佈情況，並根據這些資訊進行有效的規劃與干預，並了解德國如何使用這些數據來制定有針對性的減噪措施，特別是在交通區和營建工程等噪音敏感區域。這些地圖不僅對噪音管理提供助益，亦幫助城市規劃部門作出了更加科學的決策。

德國的噪音管理工作依循德國環境噪音指令與政策架構規定城市與交通噪音的限值，並對各種噪音源的管理進行了統一規範。此外，德國每 5 年都會對噪音監測數據進行評估，並根據需要更新相關法規及管理措施，由各邦政府定期與民眾溝通揭露資訊，聽取居民的意見與建議，提升政策接受度。

（二）德國、英國噪音寧靜區推動措施及因應 ESG 淨零排放趨勢採取作為。

德國及英國推動噪音寧靜區皆係由地方政府推動執行，依據管制需求劃定，在住宅區、學校、醫院等特別敏感區域，設立噪音寧靜區，在管制層級方面，屬聯邦政府管制上位政策事項，上位政策多為宣示性質，使民眾採行減少噪音之措施，此外，德國積極推動公共交通的電動化，減少燃油車，對噪音減輕亦有所貢獻。

英國對於噪音寧靜區規範區域噪音限值，其同樣為地方政府的責任範疇，依據區域特性和需求來設立，使噪音源採適當的噪音控制措施。

隨著 ESG（環境、社會與治理）理念的興起，企業與政府機構越來越關注在環境保護方面的責任，並將其融入到社會責任和治理結構中。淨零排放目標也要求各國和企業在減少碳排放的同時，對環境的其他污染物質進行有效管控，噪音管理作為其中一個重要的環境保護領域，逐漸受到重視，目前在歐洲國家推動多由企業發起，依本次考察了解，政府機關尚無由上

而下全面推動及輔助企業界定範疇，後續可持續蒐集歐洲國家執行管理規則。

（三）英國車輛認證及車輛噪音管理作為

VCA 由歐盟 CE 認證部分做法已經改變，因不再被歐盟認可，目前係依循 GB（英國大不列顛）型式認證（英國及北愛爾蘭），初步估計，藉由認證方式改變，認證數將由 2 萬輛/年增加至 3.5 萬輛/年，在噪音認證方面，VCA 執行認證制度，相較脫歐前，認證項目並無明顯的差異，該國積極與投入國際合作，使其他國家接受 GB 認證，提升該國車輛競爭力。

二、建議事項:

評估國內噪音管制策略

國內現行噪音管制係依噪音管制區及都市計畫等劃分方式，由地方政府定期檢討噪音管制區，以管制標準進行規範，未來城市開發過程可評估將交通、工業等噪音背景條件納入規劃，確認寧靜區推動之可能性，維持低噪音區域之環境品質，提升民眾生活品質。

伍、附錄

附錄一、德國聯邦環境局發布噪音地圖相關文獻

附錄二、德國聯邦環境局分享簡報內容

附錄三、英國道路車輛規則 1986

附錄四、本次考察接洽人員彙整表

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Construction Noise Regulation

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2. Abstract

The common increase of construction activities directly corresponds to the growth of population. The construction of modern buildings requires excellent machinery and methods. Though small working stages still demand handiwork, the majority of the construction process is done with the help of hi-tech equipment. This machinery-based work is necessary for a fast, exact and efficient result.

But engine-driven construction equipment has high amounts of both nominal and sound power at the same time and is usually operated non-stationary. And the construction site and residential areas are often only a few steps apart, too. Construction site noise is unpredictable and thus particularly annoying for the people in the neighborhood, especially in conurbations where you sense many and constantly new construction sites. On the other hand the operators of construction equipment are also directly affected by the machinery noise which occurs just next to their ears. Thus more and more people are annoyed and even their health is affected by the impact of construction noise.

The noise situation is influenced by many factors like the number and type of machines and workers on a site, the acceptance in the vicinity or the worker's individual way of operation. If you want to effectively decrease construction noise you have to consider many measures for any of these different influences. Only the interaction of reasonable measures can lead to a considerably noticeable silencing.

You have to think about construction noise abatement as a system of measures where only many players can reach the goal. Manufacturers of machinery should develop quieter machines and technologies. From the legislator you should expect both feasible limitation of the machinery noise emission and a regulation for the silent operation of equipment or sites. Standardization Organizations shall develop harmonized noise measurement methods and adapt to new technologies if necessary. Private and public builder-owners should stipulate noise abatement in both their announcements and contracts. Contractors should support their workers with hearing protection as well as with trainings for the silent operation of equipment. Building authorities shall sensitively consider noise impacts of construction activities and set abatement measures at an early stage of planning for development.

This paper analyzes the different measures and shows examples of some countries' authorities – especially Germany's – and their measures for construction noise abatement. The author works for the Federal Environment Agency of the German government and is member in relevant international and German regulation and standardization boards. In the paper you will furthermore find information about the relevant European Directives as well as the German environmental label 'The Blue Angel'.

***Index Terms*—Noise, Construction Site, Construction Noise, Noise Policy, Noise Limits, Blue Angel**

3. Regulation of Machinery Noise in Europe

3.1. Outdoor Noise and Machinery Directives

The Outdoor Noise Directive 2000/14/EC [1] (OND) regulates noise emissions of a large number of machines and equipment for outdoor use. The OND applies mainly to construction equipment but also to municipal vehicles or gardening and landscaping equipment. It contains provisions for measuring, labeling and limits on equipment noise emissions. Thus, the OND serves immission control.

Objectives of the OND:

- Ensure the smooth functioning of the internal market,
- Harmonization of regulations concerning the noise emission in the environment of equipment for use outdoors,
- Protection of human health and well-being.

The Machinery Directive 2006/42/EC [2] (MD) regulates safety requirements for machines. According to the MD, a machine shall be constructed according to the state of the art of noise abatement. So the MD serves occupational safety.

Objectives of the MD:

- Ensure the smooth functioning of the internal market,
- Setting out basic requirements for the design and construction of machinery,
- Protection of health and safety during mounting and operation of machines.

The European rulemaking for products requires manufacturers to ensure their products' conformity to all the relevant directives or regulations. Therefore, OND and MD contain similar requirements and measures to meet the objectives:

Table 1 – Noise limits on construction equipment according to OND [1]

Equipment type	Net installed power ***P* in kW** Mass ***m* in kg**	Permissible Sound Power Level L_{WA} **in dB**
vibrating rollers, vibratory plates	$P \leq 3$	105
vibrating rollers, vibratory plates, vibratory rammers	$P \leq 8$ $8 < P \leq 70$ $P > 70$	108 109 89 + 11 lg *P*
tracked loaders (≤55 kW), tracked backhoes	$P \leq 55$ $P > 55$	103 84 + 11 lg *P*
tracked loaders (>55 kW), tracked dozers	$P \leq 55$ $P > 55$	106 87 + 11 lg *P*
wheeled dozers, wheeled loaders, wheeled backhoe, dumpers, graders, mobile cranes, non-vibrating rollers, paver-finishers w/o compacting screed, hydraulic power packs	$P \leq 55$ $P > 55$	101 82 + 11 lg *P*
combustion-engine driven counterbalanced lift trucks, paver-finishers w/ compacting screed	$P \leq 55$ $P > 55$	104 85 + 11 lg *P*
excavators, builders' hoists for the transport of goods, construction winches	$P \leq 15$ $P > 15$	93 80 + 11 lg *P*
hand-held concrete-breakers and picks	$m \leq 15$ $m > 15$	105 94 + 11 lg *m*
tower cranes	-	96 + lg *P*
welding and power generators	-	95 + lg P_{el}
compressors	$P \leq 15$ $P > 15$	97 95 + 2 lg *P*

- Harmonized measurement and declaration of noise values on the equipment,
- Harmonized limits of the noise emissions,
- Harmonized conformity assessment,
- Well-functioning market surveillance in the Member States of the EU
- Collection and publication of data on noise emission of equipment placed on the internal market.

3.2. Consequences for manufacturers

In accordance with the OND [1] manufacturers of construction equipment shall:

- Determine the guaranteed sound power level (including uncertainty [3]) of the product by measurement or let it be determined by a notified body (if equipment is subject to a noise limit);
- Labeling of the CE marking and the guaranteed sound power level on each product (see Figure 1);
- Comply with the noise limit if subject to;
- Each product is accompanied by declaration of conformity (DOC) with the prescribed information;
- A copy of the DOC for the product group shall be sent to the competent national authority and to the European Commission;
- Expect production monitoring by competent authorities or notified bodies.

Figure 1. Pattern for indicating the A-weighted sound power level in connection with the CE mark in accordance with OND

Table 2 – Information required for the marketing of construction equipment according to OND [1] and MD [2]

scope of MD		scope of OND
emission sound pressure level at workstations	**declared value in the instruction manual**	**declared value on product**
< 70 dB(A)	'L_{pA} < 70 dB(A)' **or** 'L_{pA} = … dB(A)'	L_{WA}
71 – 80 dB(A)	'L_{pA} = … dB(A)'	
> 80 dB(A)	'L_{pA} = … dB(A)' **and** 'L_{WA} = … dB(A)'	

In accordance with the MD [2] manufacturers of construction equipment shall:

- Determine the emission sound pressure level at workstations by the internal production control
- Determine the uncertainty value corresponding to ISO 4871 [4]
- Indicate the emission sound pressure level at workstations together with the uncertainty value as a two-number indication or the guaranteed value as a single number in the instruction manual

Table 2 shows the necessary information which is required for the placing on the market of construction equipment.

3.3. Consequences for consumers

For consumers, both directives should imply an improvement of the information they could get on the noise emitted by construction equipment and thus more transparency in the market. Experience shows, however, that it is difficult for consumers in spite of both directives, to obtain and classify this information. First, it cannot be assumed in any case that the information is available and correct (see [5]). The consumer rarely receives all of the relevant information if he is forced to rely on the label on the product. If there is a sound power level value labeled on the product, it does not mean that it is also indicated in the sales documents. Hence, the selection of low-noise machinery is unnecessarily complicated.

4. The Blue Angel for Construction Equipment

The state of the art of construction machines is represented by machines which meet the requirements of the German environmental label 'Blue Angel' RAL-UZ 53 [6]. The following procedure is used to create a basic award criteria document:

Figure 2. The Blue Angel environmental endorsement label. This special type can be awarded for construction equipment. The circumscription says 'The Blue Angel – for low-noise – protects environment and health'

- A verification procedure, in which the criteria are developed for the award (in this process, the German Environment Agency, as well as experts from academia, industry, associations and public authorities are involved);
- A Jury consisting of independent public persons, who decide the criteria for the award;
- Manufacturers prove compliance with the criteria with every machine type which they wish to use the environmental label for. They sign a legally binding contract that they use the Blue Angel for promotion only for own products that meet the strict criteria of the Jury;
- Products that meet the criteria are labeled with the Blue Angel (see Figure 2).

Until 2000, the Blue Angel had a representative character, signaling that the manufacturer of construction equipment offers a low noise premium product. By the use of the Blue Angel builders showed the clear will to protect people against disturbing construction noise. In recent years, the entire process has fallen asleep a little bit, so temporarily there were only one or two awardees of the Blue Angel.

Meanwhile, many builders, especially in metropolitan areas, are aware that they have an obligation to protect residents close to a construction site against the noise and emissions. Since this cannot alone be accomplished by compliance with regulations, a call for a complete revision of the RAL-UZ 53 had become louder.

A new basic criteria document was drafted in 2014 and was enacted in 2015. Table 3 shows the low-noise requirements for construction machine types which the Blue Angel can be awarded.

Table 3 – Low-Noise Requirements according to RAL-UZ 53 [6]

Equipment type (in brackets: No. according to Annex I of OND [1])	Net installed power **P in kW** Electrical power P_{el} **in kW**	Maximum test value for the guaranteed sound power level L_{WAd} **in dB** $L_{WAd} \leq$ **104 dB**
(8) vibratory plates, vibrating rollers, vibratory rammers	$P \leq 8$	103
	$P > 8$	104
(1) aerial access platforms with combustion engines, (16) dozers, (21) tracked excavator-loaders, (37) tracked loaders, (43) tracked pipelayers	$P \leq 55$	101
	$P > 55$	82 + 11 lg P
(8) non-vibrating rollers, (13) conveying and spraying machines for concrete and mortar, (16) wheeled dozers, (17) drill rigs, (18) dumpers, (21) wheeled excavator-loaders, (23) graders, (29) hydraulic power packs, (36) lift trucks, combustion-engine driven, counterbalanced, (37) wheeled loaders, (38) mobile cranes, (41) paver-finishers, (43) wheeled pipelayers	$P \leq 55$	99
	$P > 55$	80 + 11 lg P
(3) builders' hoists for transport of goods, (12) construction winches, (20) excavators	$P \leq 15$	91
	$P > 15$	78 +11 lg P
(14) conveyor belts, (55) truck mixers	all	98
(4) building site band saw machines, (5) Building site circular saw benches, (10) concrete-breakers and picks, hand held, (28) hydraulic hammers, (30) joint cutters, (48) road-milling machines	all	104
(53) tower cranes	all	94 + lg P
(45) power generators, (57) welding generators	$P_{el} \leq 5$	91
	$5 < P_{el} \leq 10$	94
	$P_{el} > 10$	95
(9) compressors, (11) concrete or mortar mixers	$P \leq 15$	95
	$P > 15$	93 + 2 lg P

5. Regulation of Construction Noise Exposure

Noise pollution from construction sites usually occurs temporarily (weeks, months, years) and is conceivably unlasting. Due to short distances between the site and people working or living nearby the noise impact can be very high though.

It is not generally possible to prohibit the operation of construction sites due to excessive noise emissions. Thus the operation of construction sites is often regulated with the aim to keep the resulting noise impact as low as possible.

There is a wide variety of solutions for the regulation of construction noise. While some countries have set national standards and guidelines others are better off with local regulations. Sometimes there are no laws at national level but accepted recommendations and guidelines, which are followed and implemented by the local planning authorities.

If there are any existing regulations or recommendations in a country, they often apply similar measures. Usually, the following limits are set:

<u>Noise limits:</u>
- Noise emission limits (machine-specific)
- Noise exposure/immission limits (equivalent continuous noise and / or peak)

<u>Local limits:</u>
- Impact area (e.g. residential, industrial, mixed use)
- Distance regulations

<u>Temporal boundaries:</u>
- Daytime, nighttime and rest period
- On weekdays, Sundays and holidays

Those basic limitations can be completed by a number of regulatory adjustments. The most common are:

- Annoyance supplements (e.g. for tonality, impulsiveness, modulation depth)
- Dependence on the prevailing ambient noise
- Gradation of limits and operating times depending on the intended duration of the construction activities
- Obligation to prepare the construction site with noise prediction and management
- Accompanying noise measurements
- Obligation to use low-noise construction machinery and procedures
- Monetary incentives
- Public information and participation

The range of approaches is demonstrated by the following selection of different regulations.

Table 4 – Assessment periods and binding immission values for building sites in Germany [8]

	Assessment period	
	7AM - 8PM	8PM - 7AM
Impact Area	**Binding Immission Values**	
Spas, hospitals and nursing	45 dB(A)	35 dB(A)
purely residential areas	50 dB(A)	35 dB(A)
general residential areas	55 dB(A)	40 dB(A)
mixed-use zones	60 dB(A)	45 dB(A)
commercial zones	65 dB(A)	50 dB(A)
industrial areas	70 dB(A)	70 dB(A)
Binding Immission Values can be raised by…	**if construction activities only last …**	
10 dB(A)	2.5 h	2 h
5 dB(A)	2.5 h – 8 h	2 h – 6 h

5.1. Germany

Construction sites in Germany are considered non-subject to approval within the meaning of the Federal Pollution Control Act [7]. They shall be installed and operated so that

- Harmful environmental impacts can be prevented according to the state of the art;
- Harmful environmental impacts which cannot be prevented according to the state of the art are kept to a minimum.

These very general requirements are concretized in the General Administrative Regulation on the Protection against Construction Noise [8]. This regulation is to be considered by the competent local authorities when identifying and assessing the noise exposure by a construction site. On one hand it defines binding immission values for the protection against noise of construction sites (see Table 4). It shows on the other hand measures to be taken by the authority when these targets are exceeded. Some special features should be noted:

- The average sound pressure level (below: impact level) is calculated by the cycle time maximum equivalent continuous sound pressure level with a cycle time of 5 seconds.
- In determining the rating level out of the impact level the assessment periods are 13 hours during the day (7 AM until 8 PM) and 11 hours during the night (8 PM until 7 AM).
- An annoyance supplement up to 5 dB can added to the rating level when tones are audibly present.
- By using the cycle time maximum equivalent continuous sound pressure level the rating level automatically increases when the noise is impulsive. So an impulse supplement cannot be added.
- Shortened working hours are compensated by an increase of the binding immission values.

The binding immission values should be abided by where possible. However, the authorities will only intervene if the calculated rating level exceeds the binding immission values by more than 5 dB (‘intervention value’). This is to respond to the temporary noise exposure by construction sites. If the intervention value is exceeded, the authority shall mandate measures to reduce noise.

5.2. Australia

In Australia, each state has its own approach to reduce construction noise. These are so fundamentally different that any scheme is particularly discussed below.

In Western Australia [9] noise is generally limited by setting aside 1%- and 10%-percentile- and maximum level criteria. A distinction is additionally made in residential areas between daytime, evening and night, as well as between weekdays and Sunday. It is of particular interest here that the level limits can be increased variably by a so-called impact factor. This factor is calculated from the area ratio between residential, industrial and commercial use, and the amount of traffic in a 450-meter-radius around the point of impact on the zoning map. The impact factor can increase the immission by tens of Decibels, in theory.

Construction sites in the Northern Territory [10] can be operated on weekdays from 7 AM till 7 PM and on Sundays and holidays from 9 AM till 6 PM. In addition, the equivalent continuous sound level is limited depending on the impact area.

Construction activities in South Australia [11] may in principle only take place on weekdays from 7 AM till 7 PM. If the equivalent continuous sound level / maximum sound pressure level falls below 45/60 dB (or the higher ambient noise level), the work could also be carried out at night. Exceptions to this restriction may be made if a disproportionate interference with vehicle or pedestrian traffic would result from the limited construction times.

In Queensland [12] construction noise may be generated in principle only on weekdays from 6.30 AM till 6.30 PM.

In Tasmania [13], an emission-side approach is applied. Thus certain machines may only be operated if their sound power level is lower than a specified limit. Furthermore, the machines may be operated on weekdays from 7 AM till 6 PM, on Saturdays between 8/9 AM (depending on the machine type) and 6 PM and even on Sundays and public holidays from 10 AM till 6 PM.

In New South Wales and Victoria, there are only authorizations to local administrations to regulate construction noise adequately.

5.3. Austria

Protection against noise in general and particularly against construction noise is regulated individually in the federal states of Austria.

In Carinthia [14], there is the general requirement that construction noise should be avoided. However, there are no limits or guidelines.

In Upper Austria [15] construction work may take place in all areas on weekdays from 6 AM till 8 PM. In residential and spa areas on Saturdays construction work is to be done between 7 AM and 2 PM. Moreover, rating levels of 55 dB must not be exceeded in residential and spa areas (70 dB in all other areas). Recurrent noise peaks must not exceed 85 dB.

In Vienna [16] construction work must not be carried out in the night hours from 8 PM until 6 AM.

In Tyrol [17] exposure limit values for individual categories of areas have been established, similar to that applicable in Germany. In Tyrol, the difference between day and night limit is 10 dB. These limits must be respected not only at the relevant point of impact, but at each measurement point in the area affected by the construction noise. If the continuous traffic noise exceeds the construction noise limit at a measuring point, the measured value will be considered as the new limit for the construction noise at that point.

In the other Austrian provinces there are no corresponding regulations.

5.4. Hong Kong

In Hong Kong [18] construction work is no subject to noise restrictions in the daytime of weekdays. Construction activities with powered equipment during the night time (7 PM until 7 AM) and on public holidays have to be authorized. Pile driving (which is a frequent construction activity in Hong Kong) is only permitted on weekdays from 7 AM till 7 PM. The permit is issued by the Environmental Protection Department, which determines appropriate exposure values and checks their observance.

5.5. The Netherlands

In the Netherlands, no legal provisions for protection against construction noise in residential neighborhoods existed until 2012. Appropriate regulations could only be enacted at the municipal level. In 2011, the government published the "Bouwbesluit 2012" [19] which finally regulated noise from construction and demolition work at a national level. The noise reduction approach regulates the duration of all activities at a construction site in dependence of the equivalent continuous noise level of the construction site.

Sometimes these requirements cannot be met. For example, if the site operation is required at night or on Saturdays or the maximum permitted level is exceeded. Then, the construction site is generally allowed to be operated only with construction equipment and procedures that meet the state of noise reduction technology. These exceptions must be approved by the local authorities, often in combination with other conditions such as specific noise limits, rest periods and the involvement of local residents in the planning stage of the construction site.

5.6. Singapore

It is noteworthy that in Singapore apart from the protection against construction noise only noise from industrial facilities is regulated by law [20]. Regulations to protect against traffic noise cannot be found here at the moment so far. This can be explained with the permanently rapid development of infrastructure in this geographically restricted state. The current applicable limit values for new construction sites for regulation of construction noise are therefore comparatively high. For residential buildings, only the loudest night hour is judged. Otherwise, short-term noise peaks of no more than 5 minutes may occur here, which would exceed the limits during the day around 15 dB and in the evening / night by 5 dB. In residential buildings also the loudest 5 minutes between 10 PM and 7 PM may not be louder than the loudest hour.

The development in Singapore in recent years also shows a rapid change in the (construction noise) legislation. Thus construction sites that have been started by 1 September 2010 are allowed to be operated also on Sundays and public holidays (even

at night). It has no longer been allowed to work at nights to Sundays or public holidays on construction sites which begun until 1 September 2011. Now there is a new OSH Act in Singapore, which prohibits Sunday and holiday work. Therefore, construction work is currently stopped from 10 PM on a Saturday / evening before a holiday until 7 AM on a Monday / day after a public holiday.

5.7. Sweden

In Sweden [21] is worth mentioning that exposure limit values do not apply to areas, but for the interior and exterior of buildings with a defined use. Moreover, there are night maximum level criteria, but only for buildings with residential use.

When the scheduled construction period takes no longer than two months, the limits may be exceeded by 5 dB. Short-term noise peaks of not more than 5 minutes per hour may exceed the limit values of 10 dB, but not in the evening or at night.

References

[1] Directive 2000/14/EC of the European Parliament and of the Council of 8 May 2000 on the approximation of the laws of the Member States relating to the noise emission in the environment by equipment for use outdoors

[2] Directive 2006/42/EG of the European Parliament and of the Council of 17 May 2006 on machinery

[3] Working Group of Notified Body's 2000/14/EC Recommendation for Use No. 07-003 R2, 2014

[4] ISO 4871: Acoustics -- Declaration and verification of noise emission values of machinery and equipment

[5] Report on the "NOMAD" project – A survey of instructions supplied with machinery with respect to noise and the requirements of the Machinery Directive, May 2012

[6] Basic Criteria for Award of the Environmental Label Construction Machinery RAL-UZ 53, RAL, Deutsches Institut für Gütesicherung und Kennzeichnung e.V., February 2015

[7] Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnliche Vorgänge (Bundes-Immissionsschutzgesetz - BImSchG)

[8] Allgemeine Verwaltungsvorschrift zum Schutz gegen Baulärm – Geräuschimmissionen

[9] Western Australia Environmental Protection Act 1986; Regulations 1997 Environmental Protection (Noise) Regulations 1997, As at 19 May 2014

[10] Noise guidelines for development sites in the Northern Territory, NT Environment Protection Authority, Januar 2013

[11] South Australia Environment Protection (Noise) Policy 2007 under the Environment Protection Act 1993

[12] Queensland Environmental Protection Act 1994, Current as at 7 November 2014

[13] Tasmania Environmental Management and Pollution Control (Miscellaneous Noise) Regulations 2014 (S.R. 2014, No. 60)

[14] Österreich - Kärnten - Kärntner Bauordnung 1996 K-BO, geändert am 11.10.2006

[15] Verordnung der Oö. Landesregierung, mit der Durchführungsvorschriften zum Oö. Bautechnikgesetz 2013 sowie betreffend den Bauplan erlassen werden (Oö. Bautechnikverordnung 2013 - Oö. BauTV 2013)

[16] (Land Wien) Gesetz vom 26. Jänner 1973 zum Schutz gegen Baulärm, zuletzt geändert durch LGBl 2001/78 am 12.10.2001

[17] (Land Tirol) Verordnung der Landesregierung vom 15. September 1998, mit der Grenzwerte für den Baulärm und die Art ihrer Messung festgelegt werden (Baulärmverordnung 1998), LGBl. Nr. 91/1998

[18] Hong Kong Noise Control Ordinance - To provide for the prevention, minimizing and abatement of noise; the appointment of a Noise Control Authority; the powers and duties of the Noise Control Authority relating to the control of noise; the creation of offences; and for connected purposes. (Enacted 1988), Version 30/06/1997

[19] Bouwbesluit 2012: Staatsblad 416 - Besluit van 29 augustus 2011 houdende vaststelling van voorschriften met betrekking tot het bouwen, gebruiken en slopen van bouwwerken, Staatsblad van het Koninkrijk der Nederlanden, Jaargang 2011

[20] Environmental Pollution Control (Control of Noise at Construction Sites) Regulations 1999, Singapur, 2011

[21] NFS 2004:15 - Naturvårdsverkets allmänna råd om buller från byggplatser (Baustellenlärmrichtlinie Schweden), ISSN 1403-8234, 9 december 2004

For our Environment

Umwelt Bundesamt

12th WESPAC: Noise II

Construction Noise Regulation

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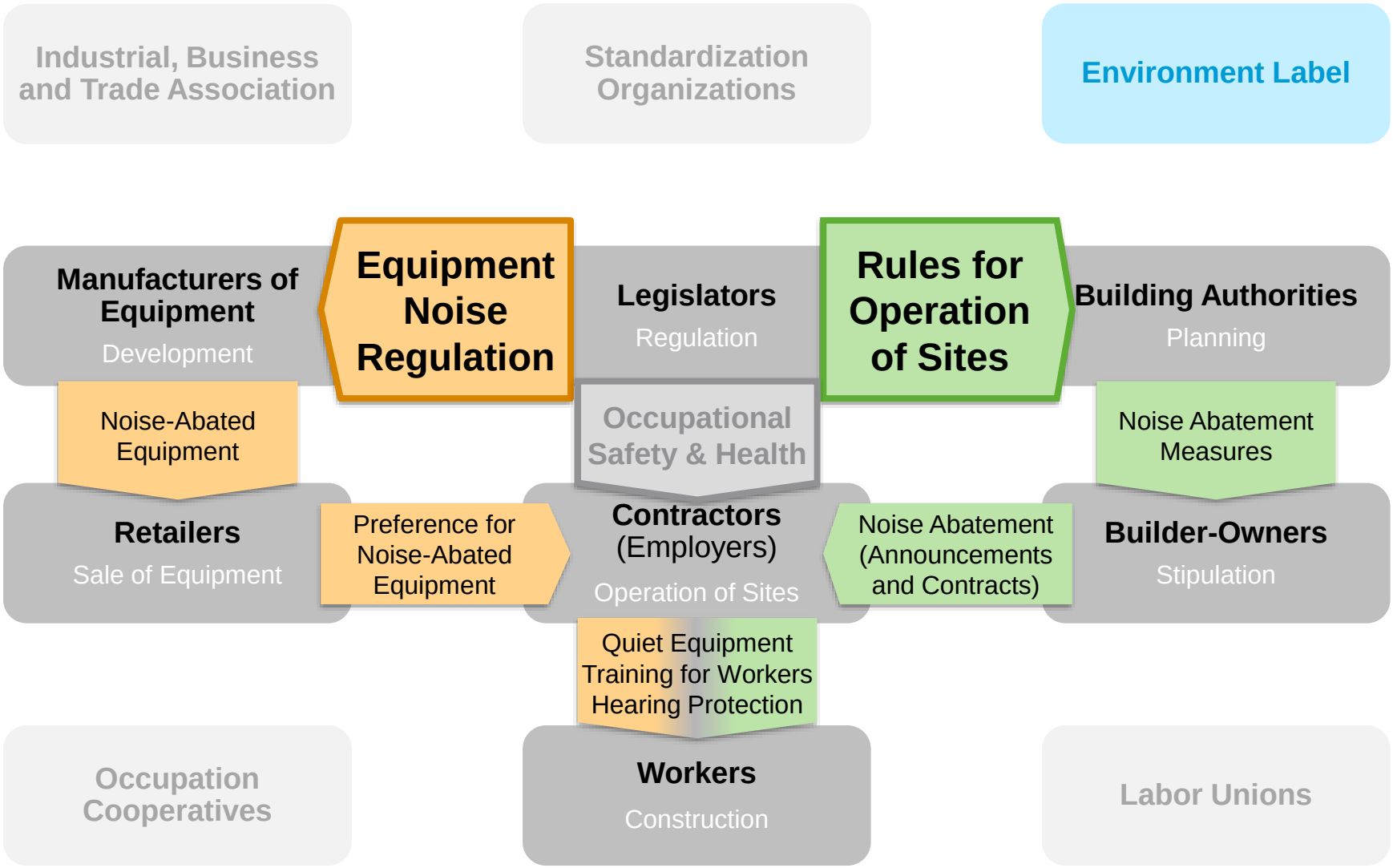
Construction Noise

NOISE

Construction Noise Abatement – System Players



Options for Construction Noise Regulation

- Harmonized Measurement
- Noise Level Limits
- Location Limits
- Customer Information
- **Equipment Noise Regulation**
- **Rules for Operation of Sites**
- Time-based Limits
- Noise Emission Limits
- Market Surveillance
- Noise Prediction and Management
- Annoyance Adjustments
- Mandatory R&D
- Periodic Inspections
- Public Information
- Monetary Incentives

Operation of Construction Sites

Germany		Singapore
impact areas / zones	**noise impact location**	affected buildings
5 s cycle time maximum equivalent continuous SPL for **13h/11h**	**time-based rating for daytime/night**	Equivalent continuous SPL for **12h/12h**
annoyance of tones (impulses will be auto-rated)	**adjustments**	-
shortened working hours may increase noise limits	**allowances**	peak noise levels of less than 5 minutes may increase noise limits

Rules for Operation of Sites

Impact Area	7am-8pm	8pm-7am
spas, hospitals and nursing	45	35
purely residential areas	50	35
general residential areas	55	40
mixed-use zones	60	45
commercial zones	65	50
industrial areas	70	70

Types of affected buildings	7am-7pm	7pm-10pm	10pm-7am
hospital, schools, institutions of higher learning, homes for aged sick, etc.	60 / 75 12h / 5min	50 / 55 12h / 5min	
Residential buildings < 150m from the construction site	75 / 90 12h / 5min	65 / 70 1h / 5min	55 / 55 1h / 5min
Other Buildings		65 / 70 12h / 5min	

Equipment Noise Regulation in Europe

Outdoor Noise Directive 2000/14/EC

Machinery Directive 2006/42/EC

Equipment Noise Regulation

- Mandatory in any EU member state
- Harmonized measurement
- Customer information (L_{pA} in instruction manual, L_{WA} Label)
- Noise emission limits
- Market surveillance

emission sound pressure level at workstations	declared value in the instruction manual	declared value on product
< 70 dB(A)	'L_{pA} < 70 dB(A)' or 'L_{pA} = … dB(A)'	L_{WA}
71 – 80 dB(A)	'L_{pA} = … dB(A)'	
> 80 dB(A)	'L_{pA} = … dB(A)' and 'L_{WA} = … dB(A)'	

Labeling of the Sound Power Level

The Blue Angel for Construction Equipment

RAL-UZ 53 Award Criteria Document for Environment-Friendly Construction Equipment

Environment Label

Blue Angel in General

- oldest environment label in the world (since 1978)
- top product (20 … 30 % of all products on the market)
- technical requirements beyond legal requirements
- competition to create the best available technology
- Blue Angel products preferred in tendering procedures (in Germany)

Requirements for Construction Equipment

- minimized air pollution
- noise-related requirements:
  - harmonized noise measurement according to legal test code
  - declaration of sound power level in technical documents
  - test values lower than legal requirement

Noise Limits vs. Blue Angel Test Values

Equipment type	Permissible Sound Power Level L_{WA} in dB	Power / Mass P in kW / m in kg	Sound Power Level BA Test Value L_{WA} in dB	Additional Equipment Type in Blue Angel Criteria Document
(8) vibratory plates, vibrating rollers	105	$P \le 3$	103	
(8) vibratory plates, vibratory rammers, vibrating rollers	108 109 89 + 11 lg P	$P \le 8$ $8 < P \le 70$ $P > 70$	103 104 104	
(21) tracked excavator-loaders, **(37)** tracked loaders (≤55 kW),	103 84 + 11 lg P	$P \le 55$ $P > 55$	101 82 + 11 lg P	**(1)** aerial access platforms with combustion engines, **(43)** tracked pipe layers
(16) tracked dozers, **(37)** tracked loaders (>55 kW)	106 87 + 11 lg P	$P \le 55$ $P > 55$	101 82 + 11 lg P	
(8) non-vibrating rollers, **(16)** wheeled dozers, **(18)** dumpers, **(21)** wheeled excavator-loaders, **(23)** graders, **(29)** hydraulic power packs, **(37)** wheeled loaders, **(38)** mobile cranes, **(41)** paver-finishers without compacting screed	101 82 + 11 lg P	$P \le 55$ $P > 55$	99 80 + 11 lg P	**(13)** conveying and spraying machines for concrete and mortar, **(17)** drill rigs, **(29)** hydraulic power packs, **(43)** wheeled pipe layers
(36) lift trucks, combustion-engine driven, counterbalanced, **(41)** paver-finishers with compacting screed	104 85 + 11 lg P	$P \le 55$ $P > 55$	99 80 + 11 lg P	
(3) builders' hoists for the transport of goods, **(12)** construction winches, **(20)** Excavators	93 80 + 11 lg P	$P \le 15$ $P > 15$	91 78 +11 lg P	
	-	all	98	**(14)** conveyor belts, **(55)** truck mixers
(10) hand-held concrete-breakers and picks	105 94 + 11 lg m	$m \le 15$ $m > 15$	104	**(4)** building site band saw machines, **(5)** building site circular saw benches, **(28)** hydraulic hammers, **(30)** joint cutters, **(48)** road-milling machines
(53) tower cranes	96 + lg P	all	94 + lg P	
(45) power generators, **(57)** welding generators	95 + lg P_{el} 96 + lg P_{el} 96 + lg P_{el} 95 + lg P_{el}	$P_{el} \le 2$ $2 < P_{el} \le 5$ $5 < P_{el} \le 10$ $P_{el} > 10$	91 91 94 95	
(9) compressors	97 95 + 2 lg P	$P \le 15$ $P > 15$	95 93 + 2 lg P	**(11)** concrete or mortar mixers

Summary

1. **Construction Noise Regulation**
   Emission – Environment – Occupation
2. **Equipment Noise**
   Regulation of Noise Emission in Europe
3. **Construction Site Noise**
   Operation of Construction Sites in DE / SG
4. **Blue Angel for Construction Equipment**
   State of the Art for low-noise construction

Thank you for your attention!
Questions?

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UK Regulation

Road Vehicles (construction and Use) Regulations 1986

- Regulation 99 - audible warning systems
- Regulation 54 – Requirements for silencers - general
- Regulation 97 – avoidance of excessive noise (driver behaviour)
- Regulation 55 - Noise limits
- Regulation 56 - Noise limits--agricultural motor vehicles and industrial tractions
- Regulation 57 – Noise limits – motorcycles
- Regulation 37 – Audible warning instruments
- Regulation 98 – stopping of engine when stationary (idling)

A link to the above regulations can be found here: http://www.legislation.gov.uk/uksi/1986/1078/contents/made

The motor cycle silencer and exhaust system regulations 1995

A link to the above regulation can be found here: https://www.legislation.gov.uk/uksi/1995/2370/regulation/6/made

The motor cycle noise act 1987

A link to the above regulations can be found here: https://www.legislation.gov.uk/ukpga/1987/34

公務出國期間國外人士個人資料彙整表

1、 出國計畫名稱：因應歐盟所發布之環境噪音指令，派員赴歐洲與官方單位進行噪音管制法規政策與技術交流

2、 出國人員：林冠銘技正、羅博銘薦任技士

3、 出國日期：113 年 11 月 23 日至 12 月 1 日

外賓姓名	單位及職稱	國別	專長領域	會晤日期	聯絡電話	電子郵件	我方接洽者姓名職稱	交流內容	備註
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René Weinandy	Head of Division, the Noise Abatement in Transportation	德國	噪音管制理智及政策	2024/11/26	+49--34021036554	**rene.weinandy@uba.de**	林冠銘技正、羅博銘薦任技士	噪音管制政策	
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Christo-pher Mc-Cabe	Chief Technical & Statutory Operations Officer	英國	車輛排放及噪音認證	2024/11/28	+44 20 3443 8791,,50941 0334	Peter.Rowe @vca.gov.uk	林冠銘技正、羅博銘薦任技士	車輛認證制度	