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Mobile Hydrogen Fuelling and Applicable Safety Standards.

BSI Flex 2073 – Code of Practice

Design and Implementation of Hydrogen Refuelling Sites

Presented by, Robin Futcher: Technical Author of BSI Flex 2073 and Managing Director of Commercial Fuel Solutions Limited

Robin is an accomplished engineer with a wealth of experience spanning over 28 years, and has worked on a diverse range of refuelling projects, from developing equipment for the British Antarctic Survey intended for use in sub-zero temperatures, to providing systems for leading Formula 1 teams.

Robin also has extensive expertise in developing regulatory guidance and currently serves on numerous technical committees for gaseous hydrogen fuelling, including BSI, British Standards Institute and ISO, the International Organisation for Standardisation.

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What is BSI Flex 2073?

BSI Flex 2073 is a free to access Code of Practice, funded by the Department for Transport and sponsored by CPC - Connected Places Catapult. This new document enables the user to navigate the otherwise complex regulatory and standardisation framework that encompasses hydrogen filling station development and operation.

It acts as a foundational document that is expected to accelerate the rapid deployment of hydrogen refuelling infrastructure throughout the UK.

Funded → **Sponsored** → **Facilitated** → **Authored**

Department for Transport

UK government body responsible for the English transport network

CATAPULT Connected Places

The UK's innovation accelerator for cities, transport & place leadership

bsi

The UK's national standards body, for products and services to ensure quality and safety in commerce.

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A UK company that specialises in manufacturing refuelling systems.

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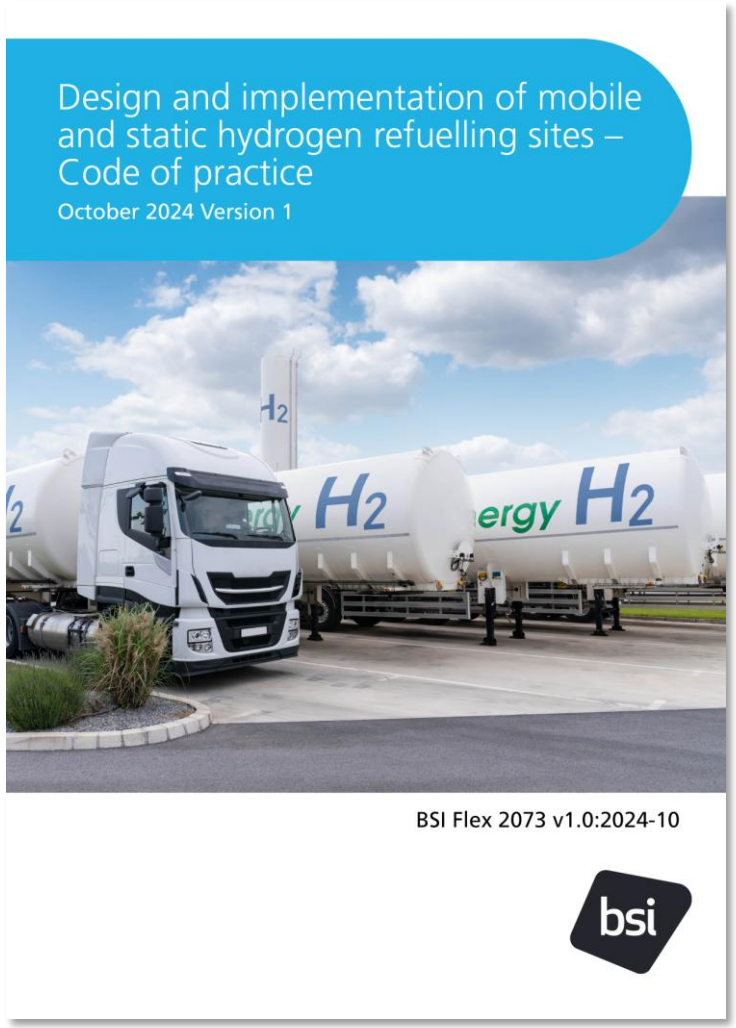
BSI Flex 2073 Code of Practice - Overview



BSI Flex 2073 is a Code of Practice that provides comprehensive guidance covering the entire lifecycle development and implementation of gaseous hydrogen refuelling systems up to 70 MPa.

It covers both mobile and static systems and includes guidance on scaling those installations in future.

70+ Pages of guidance

30+ Relationships with external standards defined

250+ Code of Practice clauses

It encompasses all aspects from the initial design, site selection and materials specification, through to the deployment, installation, and operational phases, concluding with decommissioning.

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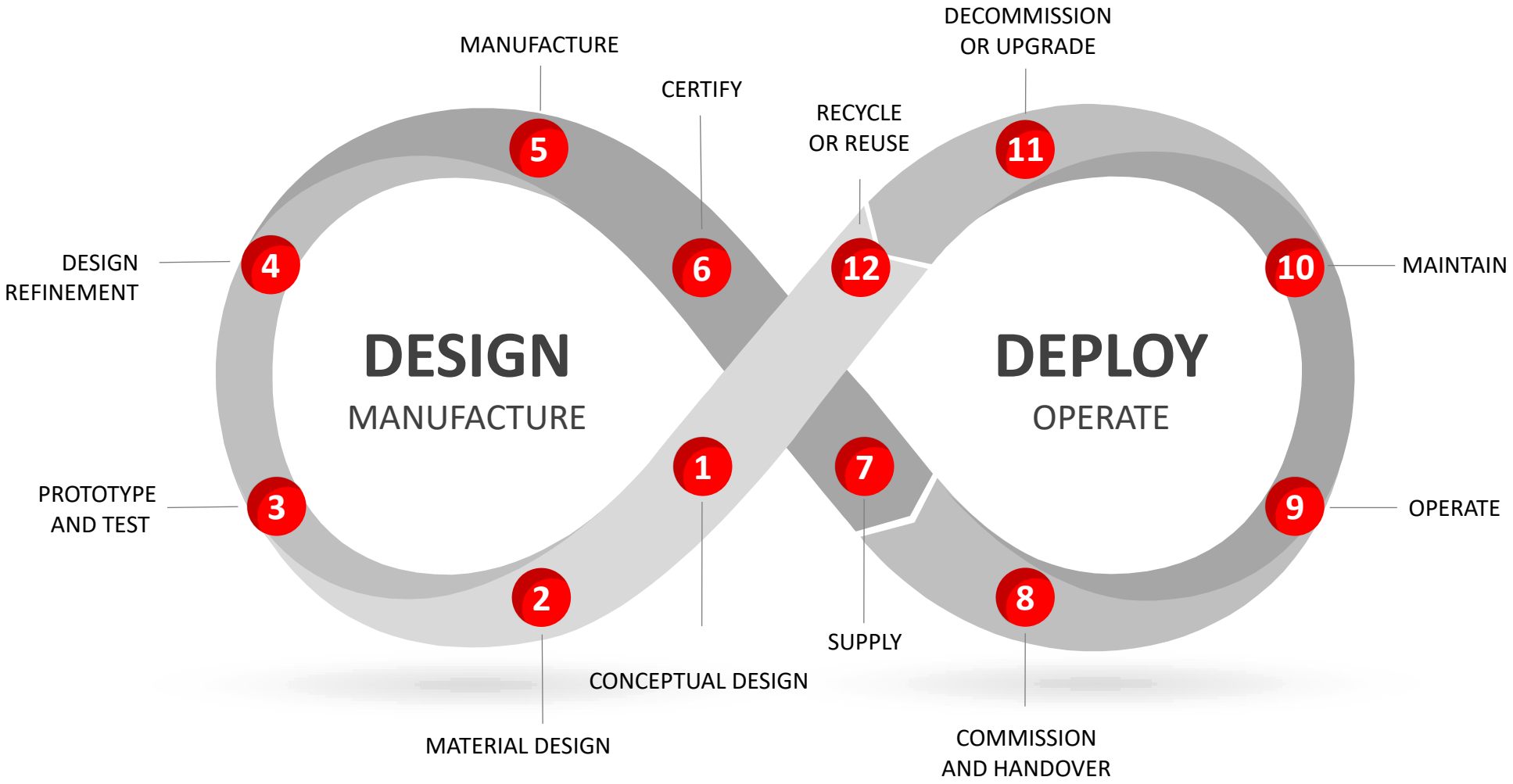
System Lifecycle Management



Section Detail

4	5	6	7	8	9	10
Conceptual Design	**Material Design**	**Risk Analysis**	**Preparing for Operation**	**Installation & Commissioning**	**Inspection & Maintenance**	**Decommission and Recycling**
Evaluation	**Development**	**Mitigation**	**Procedures**	**Verification**	**Processes**	**Administer**
Inherent safety & fault tolerance	Site layout, access & construction	Design risk assessment	Drafting suitable procedures	Installation competence	Documented maintenance	Risk assessment & compliance
Defined parameters & control	Materials & components	Prevention, mitigation & control	Process management	Post installation checks	Safe system of work	Safe isolation & shut down
Hazardous area classification	Hydrogen supply & storage	Site specific risk assessment	Emergency response protocol	Testing and commissioning	WSE & permit to work	Purging and neutralisation
Accessibility	Dispensing, control and architecture	Risk management	Operator training & competency	Correct signage	Preventative maintenance	Dismantling
Location & scalability	SAT & FAT	Emergency response planning	Documentation	Handover & initial operation	Reporting	Disposal, recycling & repurposing

Annex Detail

In addition to the comprehensive sections listed above, there are 6 detailed annexes to further assist the user in understanding important factors that encompass a hydrogen refuelling station and their relationship to the Essential Health & Safety Requirements (EHSRs).

Annex A – Risk Assessments

Annex B – Transporting Hydrogen Units

Annex C – Technical File

Annex D – Safety Distances

Annex E – O-Ring Selection

Annex F – Permitting and Licensing

Annex G – Lightning Protection

Annex Detail

A	B	C	D	E	F	G
Risk Assessment	**Transporting Hydrogen**	**Technical File**	**Safety Distances**	**O-Ring Selection**	**Permitting & Licensing**	**Lightning Protection**
HSE	**DfT**	**OPSS**	**HSE**	**HSE**	**GOV**	**HSE**
Design risk assessment	Transporting hydrogen	Contents of the technical file	Types of separation distance	Advanced material selection	Planning, permitted development rights	Assessment & compliance
Installation risk assessment	TPE Transportable Pressure Equipment	Reference designations	Fire safety and blast wall barriers	Explosive decompression	Hazardous substance consent	Risk to mobile systems
Site specific risk assessment	Vehicle and trailer requirements	Regulatory compliance	Emergency escape routes	Monitoring & detection	Environmental permitting	Protective measures
Mobile fuelling risk assessment	Permissible drive train technology	Verification documents	Positioning and sizing	Diffusion and PFAS awareness	Relevant authorities & agency liaison	Relationship to infrastructure

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Essential Heath & Safety Requirements

BSI Flex 2073 is also written to help the user understand not only the important factors that encompass a hydrogen refuelling station but also their relationship to the Essential Health & Safety Requirements (EHSRs) and other safety regulations.

Relevant EHSRs

EPS - The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996 (EPS)
PER - The Pressure Equipment (Safety) Regulations (PESR)
SMR - The Supply of Machinery (Safety) Regulations 2008 (SMR)

Other Safety Regulations

DSEAR - The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR)
PSSR - The Pressure Systems Safety Regulations 2000 (PSSR)
CDG-TPE - The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (CDG-TPE)
CDM - The Construction (Design and Management) Regulations 2015 (CDM)
HSWA - The Health and Safety at Work etc. Act 1974 (HSWA)
EWR - The Electricity at Work Regulations 1989 (EWR)
RRO/FSO - The Regulatory Reform (Fire Safety) Order 2005 (as amended) (RRO or FSO)
- The Fire Safety (England) Regulations 2022

Additional Questions?

If we run out of time or you think of a question later, please send us an email or connect on LinkedIn

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SCAN ME

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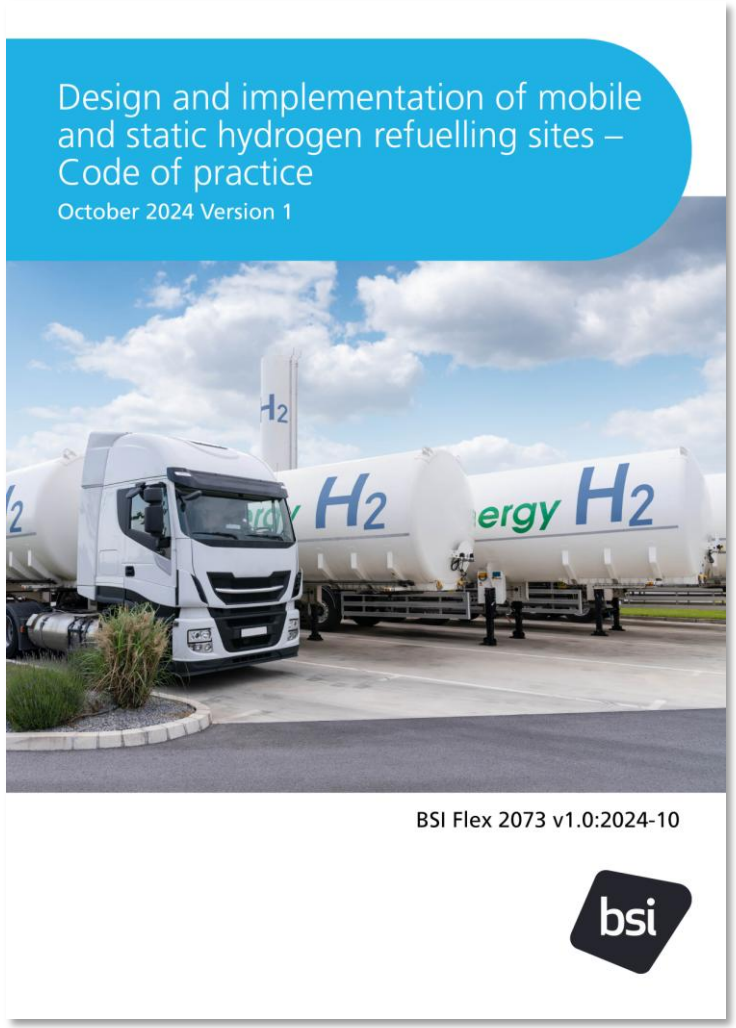
BSI Flex 2073 Code of Practice - Access



Access a free copy of the latest version of BSI Flex by scanning the QR code below.

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When is mobile hydrogen fuelling likely to be needed?

Firstly, we need to look at where electrification is not practical

It's not practical to fit a tractor or excavator with an additional 2 tonnes of batteries, especially not when it is intended to operate on a farm or construction site, as it will simply sink into the ground. And HGV's are not always best suited to electric drive trains either, specifically those with heavy payloads or projected range requirements that exceed the current capabilities of electrification.

The list of vehicles where electrification is not necessarily an option is extensive, most of these vehicles operate within the Transport and NRMM sectors:

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When is mobile hydrogen fuelling likely to be needed?

Mobile hydrogen refuelling stations are particularly valuable in several scenarios where traditional fixed refuelling infrastructure is limited, impractical, or in development. Here are some key areas where they are most likely to be needed:

Remote Locations: Areas at distance from existing hydrogen infrastructure, such as rural communities, remote industrial or construction sites, can benefit from mobile units that provide hydrogen for vehicles or machinery that require clean energy solutions.

Fleet Operations: Businesses operating fleets of hydrogen-powered vehicles, such as buses, trucks, or municipal vehicles, might use mobile refuelling units to refuel vehicles at a multiple depots. This can be more cost-effective and efficient than having each vehicle travel to a distant fixed station.

Temporary Needs and Events: During special events, demonstrations, or pilot projects involving hydrogen vehicles, mobile refuelling stations can provide a temporary solution for fuelling vehicles without permanent infrastructure. In areas with emerging hydrogen vehicle adoption, mobile refuelling can supplement fixed stations to meet growing demand until more permanent solutions are established.

Emergency Services: In disaster response situations where infrastructure might be damaged or non-existent, mobile hydrogen refuelling stations can quickly provide fuel to emergency vehicles and backup power units.

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What differentiates static and mobile hydrogen fuelling?

Characteristic	Static Station	Mobile Unit
Storage and Infrastructure	Typically serve higher volumes which require substantial infrastructure, including compressors, pre-cooling, and space for tube trailer replacement or onsite production.	The need to frequently transport mobile units to different locations introduces risks related to the handling and moving of high-pressure hydrogen tanks. Accidents during transport could lead to leaks or explosions.
Safety and Security	Being fixed locations, static stations can be continually monitored and protected from unauthorised access to prevent vandalism or terrorist attacks.	Unlike static stations, which can be equipped with permanent and robust security measures, mobile stations are often temporarily set up in diverse locations where controlling site security can be challenging.
Emergency Response	Planning emergency response for a static hydrogen refueling installation tends to be less complex than for a mobile site due to the permanent nature of the infrastructure and the predictable operational environment.	Mobile stations must be equipped to handle emergencies in a variety of settings, often without the immediate support available in more permanent locations.

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Available ISO Standards and Technical Reports

Currently, there are a range of applicable safety and design standards that are applicable to hydrogen refuelling. However, many of them are focused on static installations and may not necessarily apply to mobile solutions.

Standard	Status	Applicability to Mobile Fuelling Stations
ISO 14687:2019 Hydrogen Fuel Quality – Product Specification	Current (under review)	Full applicability
ISO 17268:2020 Gaseous hydrogen land vehicle refuelling connection devices	Current (under review)	Full applicability
ISO 19885-1 Fuelling protocols	Under development	Note, work ongoing for -2 & -3 to accommodate heavy duty vehicle fuelling
ISO TR 15916:2015	Current (Under review)	This is a technical report and not an ISO standard, so can be adapted.

ISO 19880 Suite of standards for Gaseous hydrogen - Fuelling stations

Taking a quick look at this range of standards, and their applicability to mobile fuelling.

Standard	Status	Applicability to Mobile Fuelling Stations
ISO 19880-1:2020 General Requirements	Current	Partial applicability How are mobile systems protected against lightning strikes? How is the mobile system protected from damage by a collision?
ISO/DIS 19880-2 Dispensers and dispensing systems	Under development	Partial applicability How are hazardous areas marked and enforced for a mobile system? How are venting locations approved when the system is mobile?
ISO 19880-3:2018 Valves	Current (due for review)	Partial applicability Vibration fatigue, should valves for a mobile dispenser be subjected to different tests?

ISO 19880 Suite of standards for Gaseous hydrogen - Fuelling stations

Standard	Status	Applicability to Mobile Fuelling Stations
ISO 19880-4 Compressors	Under development	
ISO 19880-5:2019 Dispenser hoses and hose assemblies	Current (under review)	Full applicability Mobile dispenser hoses may be subjected to more aggressive environmental conditions
ISO 19880-6 Fittings	Under development	Partial applicability Vibration fatigue
ISO 19880-7 O-Rings	Under development	Full applicability

ISO 19880 Suite of standards for Gaseous hydrogen - Fuelling stations

Standard	Status	Applicability to Mobile Fuelling Stations
ISO 19880-8:2018+A1:2021 Fuel Quality Control	Current (under review)	Partial applicability
ISO 19880-9 Sampling for fuel quality	Under development	Full applicability
ISO/AWI TS 19880-10 Mobile fuelling stations	Under development	New standard under development for mobile applications