

# DIN EN 13445-5:2024-11 (E)

## Unfired pressure vessels - Part 5: Inspection and testing (includes Amendment A1:2024)

---

<b>Contents</b>		<b>Page</b>
European foreword .....		6
1	Scope .....	7
2	Normative references .....	7
3	Terms and definitions .....	8
4	Performance of inspection and testing .....	10
4.1	General .....	10
4.2	Inspection .....	10
4.3	Non-destructive testing (NDT) .....	10
5	Technical documents .....	10
5.1	General .....	10
5.2	Information to be contained in the technical documents .....	10
5.2.1	General .....	10
5.2.2	General description of the pressure vessel .....	10
5.2.3	Design and construction drawings .....	11
5.2.4	Descriptions and explanations necessary for an understanding of the drawings and diagrams and the operation of the pressure vessel .....	11
5.2.5	Results of design calculations and examinations carried out .....	11
5.2.6	Test reports .....	13
5.2.7	Technical/manufacturing schedule .....	13
5.3	Design review .....	14
5.3.1	General .....	14
5.3.2	Design review .....	14
6	Inspection and testing during fabrication .....	14
6.1	General .....	14
6.2	Manufacturing procedures and construction drawings .....	15
6.3	Material traceability .....	15
6.3.1	General .....	15
6.3.2	Special Conditions - Material marking .....	15
6.4	Preparation for manufacturing processes .....	15
6.4.1	General .....	15
6.4.2	Joint preparation testing .....	15
6.4.3	Inspection of vessel supports .....	15
6.4.4	Inspection associated with forming .....	16
6.4.5	Testing of areas subject to significant through thickness tensile stress .....	16
6.5	Welding .....	16
6.5.1	General .....	16
6.5.2	Verification of welder and welding operator qualification and procedures qualification ...	16
6.5.3	Inspection of repairs .....	16
6.6	Non-destructive testing of welded joints .....	17
6.6.1	Extent of non-destructive testing .....	17
6.6.2	Determination of extent of non-destructive testing .....	20
6.6.3	Performing non-destructive testing .....	28
6.6.4	Description and acceptance level of imperfections .....	29
6.6.5	Stage of performance .....	29
6.6.6	Procedure for non-destructive retesting .....	29

6.6.7	Non-destructive testing documentation .....	30
6.7	Destructive testing .....	30
6.7.1	Extent of destructive testing .....	30
6.7.2	Schedule for destructive testing .....	30
6.7.3	Verification of destructive tests .....	30
6.7.4	Records .....	30
6.8	Heat-treatment .....	30
7	Subcontracted items .....	31
7.1	General .....	31
7.2	Subcontracted non-destructive testing activities .....	31
7.2.1	Use of contract NDT personnel at the premises of the vessel manufacturer .....	31
7.2.2	Subcontracting of NDT at a subcontractors premises .....	31
8	Miscellaneous tests .....	32
9	Calibration .....	32
9.1	General .....	32
9.2	Calibration procedure .....	32
9.2.1	General .....	32
9.2.2	Calibration .....	33
9.2.3	Frequency .....	33
9.3	Identification .....	33
9.4	Registration .....	33
10	Final assessment .....	34
10.1	General .....	34
10.2	Extent of final assessment .....	34
10.2.1	Visual and dimensional inspection .....	34
10.2.2	Review of documentation .....	35
10.2.3	Proof test .....	35
10.2.4	Post pressure test inspection .....	46
10.2.5	Inspection of safety accessories .....	46
11	Marking and declaration of compliance with the standard .....	46
11.1	General .....	46
11.2	Marking method .....	46
11.2.1	General .....	46
11.2.2	Direct stamping .....	47
11.2.3	Nameplate .....	47
11.3	Marking units .....	47
11.4	Marking contents .....	47
11.5	Declaration of compliance with the standard .....	49
12	Documents .....	49
12.1	Type of documents .....	49
12.2	Control and access of documents .....	50
12.3	Retention of documents .....	50
	(normative) Inspection and testing of serially produced pressure vessels .....	51
A.1	Introduction .....	51
A.2	Limitations for vessels permitted to be classified as serially produced .....	51
A.3	Limitations for model .....	51
A.4	Prototype test .....	52
A.5	Model acceptance .....	52
A.6	Quality or manufacturing plan .....	52
A.7	Inspection, non-destructive testing and pressure testing .....	53
A.7.1	Introduction .....	53
A.7.2	General NDT procedure for serially produced pressure vessels .....	53
A.7.3	Pressure test for serially produced pressure vessels .....	53
A.8	Marking .....	53

<b>A.9</b>	<b>Documentation / Certification</b> .....	<b>53</b>
	<b>(normative) Detailed dimensional requirements for pressure vessels</b> .....	<b>54</b>
	<b>(normative) !Openings for examination, closing mechanisms and special locking elements</b> .....	<b>56</b>
<b>C.1</b>	<b>Openings for examination</b> .....	<b>56</b>
<b>C.1.1</b>	<b>General requirements</b> .....	<b>56</b>
<b>C.1.2</b>	<b>Exemptions for openings for examination</b> .....	<b>56</b>
<b>C.2</b>	<b>Types and dimensions of openings for examination</b> .....	<b>56</b>
<b>C.2.1</b>	<b>Sightholes</b> .....	<b>56</b>
<b>C.2.2</b>	<b>Handholes</b> .....	<b>56</b>
<b>C.2.3</b>	<b>Headholes</b> .....	<b>57</b>
<b>C.2.4</b>	<b>Inspection openings</b> .....	<b>57</b>
<b>C.2.5</b>	<b>Access openings</b> .....	<b>57</b>
<b>C.3</b>	<b>Types, location and minimum number of openings for examination</b> .....	<b>57</b>
<b>C.4</b>	<b>Alternative requirements for sightholes openings on small vessels</b> .....	<b>59</b>
<b>C.5</b>	<b>Closing mechanisms and special locking elements</b> .....	<b>59</b>
<b>C.5.1</b>	<b>Purpose</b> .....	<b>59</b>
<b>C.5.2</b>	<b>Definitions</b> .....	<b>59</b>
<b>C.5.3</b>	<b>Materials of construction, design</b> .....	<b>59</b>
<b>C.5.4</b>	<b>Screw clamps</b> .....	<b>60</b>
<b>C.5.5</b>	<b>Hinged bolts</b> .....	<b>61</b>
<b>C.5.6</b>	<b>Yoke-type closures</b> .....	<b>62</b>
<b>C.5.7</b>	<b>Quick opening and closing devices</b> .....	<b>62</b>
	<b>(informative) Leak Testing</b> .....	<b>69</b>
<b>D.1</b>	<b>General</b> .....	<b>69</b>
<b>D.2</b>	<b>Leak testing personnel</b> .....	<b>69</b>
	<b>(informative) Acoustic emission</b> .....	<b>70</b>
<b>E.1</b>	<b>General</b> .....	<b>70</b>
<b>E.2</b>	<b>Useful standards</b> .....	<b>70</b>
<b>E.3</b>	<b>Acoustic emission personnel</b> .....	<b>70</b>
<b>E.4</b>	<b>Additional requirements</b> .....	<b>70</b>
	<b>(normative) Inspection and testing of pressure vessels or parts subject to creep</b> .....	<b>71</b>
<b>F.1</b>	<b>General</b> .....	<b>71</b>
<b>F.2</b>	<b>Extent of inspection and testing</b> .....	<b>71</b>
<b>F.3</b>	<b>Performance of NDT and acceptance criteria</b> .....	<b>73</b>
<b>F.4</b>	<b>Documents</b> .....	<b>73</b>
	<b>(normative) Inspection and testing of pressure vessels subject to cyclic loads</b> .....	<b>74</b>
<b>G.1</b>	<b>General</b> .....	<b>74</b>
<b>G.2</b>	<b>Extent of inspection and testing</b> .....	<b>74</b>
<b>G.3</b>	<b>Performance and acceptance criteria</b> .....	<b>74</b>
<b>G.4</b>	<b>Technical documentation, additional requirements</b> .....	<b>75</b>
	<b>(informative) Declaration of compliance with this standard</b> .....	<b>76</b>
	<b>(informative) Specific tests during construction to assist in-service inspection</b> .....	<b>78</b>
<b>I.1</b>	<b>General</b> .....	<b>78</b>
<b>I.2</b>	<b>Metallographic investigation</b> .....	<b>78</b>
<b>I.3</b>	<b>Hardness measurements</b> .....	<b>78</b>
<b>I.4</b>	<b>Dimensional measurements</b> .....	<b>79</b>

<b>Annex ZA (informative) Relationship between this European Standard and the essential requirements of Directive 2014/68/EU aimed to be covered .....</b>	<b>81</b>
<b>Bibliography .....</b>	<b>83</b>