Design Check List - Section I, 2015 Edition and B31.1-2012			
MAWP vs DP	design pressure (DP) ≥ MAWP		PG-21, PG-21.4, 101.2
DT (design temperature)			PG-27.4.2, 101.3
Loadings	all loadings shall be considered		PG-22, 101.2 thru 101.7
Materials	plate, forging, casting, pipes, tubes, stays etc.		PG-6-9, PG-12-14; Chapter III
Standard pressure parts			PG-11; 102.2.1; Tab.126.1, A-360
Minimum thicknesses	plates	6 mm + corrosion	PG-16.3
	pipes > 5" used as shell	min(6 mm; min.std.)+cor	PG-16.3
	seamless threaded pipe	Sch.80	104.1.2(C)
	nonferrous pipe	<3/4" → ASME B88 Type K; ≥ 3/4" 1.25 mm min.	104.1.2(C)
	stayed plates (not cyl.shell)	8 mm + corrosion	PG-16.3
Min. dished head thickn.	≥req. thickness of seamless shell of the same diameter		PG-29.6
Threaded pipe thickness, threaded tube thickness			PG-27.4.3, PG-27.2.1.3, PWT-9.2
Stress values	Section II Part D Tables 1A and 1B (Section I) Tables A-1 thru Tables A-10 (B31.1)		PG-23 102.3.1
Steel Casting	material, quality factor, allowable stress		PG-8, PG-25;102.4.6
Pipe/Tube	required internal/external pressure calculation, nonferrous pipes/tubes maximum size 3"!		PG-27.2; PG-28; 104.1; 104.3.1; 122.1.1(E)
Openings in shells	single and multiple		PG-32; PG-33; PG-36; PG-38
	ligaments		PG-52; PG-53
Dished Heads	required thickness		PG-29.1; PG-29.13; PG-29.9
minimum thickness	≥ req.thickness of the seamless shell with same Dia.		PG-29.6
F&D unstayed	larger radius <= OD straight flange of the head		PG-29.2; 104.4.1
	knuckle radius ≥ max(3*t; 0.06*ODhead)		PG-29.13
unstayed	elliptical 2:1		PG-29.7, PG-29.8
unstayed	hemispherical		PG-29.11, PG-29.12
	openings in unstayed heads		PG-29.3-5; PG-32.1.5
head attach. to shells			PW-9.3.3
min. straight flange length	25 mm (OD<=600 mm); 38 mm (OD>600)		PW-13
Flat heads and covers	unstayed		PG-31; 104.4
	openings in flat heads		PG-35; 104.4.2
Stays	material		PG-13
Stayed surfaces	min. req. thickness, max. P	all except Firetube	PG-46.1
min. req. thickness, max. pressure, max. spacing		Firetube boiler	PFT-22 thru PFT-30; App. A-8
staytubes		Firetube boiler	PFT-31
diagonal stays		Firetube boiler	PFT-32
minimum thickness of stayed plate			PG-46.2
staybolts, welded stays, holes for welded stays, holes for threaded stays			PG-47.2; PW-19; PG-82; PFT-28-30
	location of staybolts		PG-48; App. A-8
	dimensional requirements		PG-49
staybolts box-type headers and waterlegs		Watertube boiler	PWT-12
staying of heads	Watertube & Firetube boiler		PWT-13; PFT-25
stayed dished heads			PG-30
Nozzles	methods of attachments, weld sizes		PG-39; PW-16; 127.4.8
	minimum required nozzle thickness		PG-43
	reinforcement calculation		PG-32
	necks and tubes, one side attachment		PW-16.6
	weld strength calculation		PW-15
Combustion Chambers			PFT-13 thru PFT-20
Cold forming	austenitic steels		PG-19; 129.3; Table 129.3.4.1
	CSEF steels		PG-20
Feedwater	DP ≥ 30 bar shield, sleeves		PG-59.2
	HS > 47 m^2 two means of feeding		PG-61.1
feedwater connection	HS > 9.3 m^2 min. 0.75" (DN20)		PG-61.3
	HS ≤ 9.3 m^2 min. 0.5" (DN15)		PG-61.3

feedwater DP	HS ≤ 1.9 m^2 blow off used for feeding			PG-61.3
	up to the check valve: DP=min(MAWP+15.50 bar; MAWP* 1.25)+H between check and regulating valve: DP=feed pressure→ DP ≥ max(feed pressure, 7 bar)			122.1.3 (A.1)
feedwater DT	Saturated Steam Temperature @ MAWP			122.1.3 (B)
	Size up to the first valve ≥ boiler connection			122.1.3 (C)
Surface blowoff	max. 2.5"			PG-59.3.2
DP	lowest drum SV set pressure			122.1.4 (B.1); PG-59.3.1
DT	Saturated steam temperature@MAWP			122.1.4 (B.2)
Constraints	Galvanized pipes and fittings shall not be used! If DP≤6.90 bar, nonferrous pipe is allowed, fittings from bronze, cast iron… If DP>6.9 bar, all pipes and fittings shall be of steel, all of at least Sch. 80 size			122.1.4 (B.3)
Size	≥ size of the connection on the boiler			122.1.4(B.4)
Feedwater piping and Blowoff piping for HS>1.9 m^2 shall not be used through the same connection!				PG-59.2; PG-61.3
Blowoff piping	Galvanized pipes and fittings shall not be used! If DP≤6.90 bar, nonferrous pipe is allowed, fittings from bronze, cast iron… If DP>6.9 bar, all pipes and fittings shall be of steel, all of at least Sch. 80 size			122.1.4.(A.3)
	HS > 9.3 m^2 min. 1" max. 2.5"	1.9 m^2<HS≤ 9.3 m^2 min. ¾" max. 2.5"	HS ≤ 1.9 m^2 min. ½" max. 2.5"	PG-59.3.5
	Blowoff piping has only one valve when content ≤ 380 l			PG-58.3.6
Blowoff DP	DP=min(MAWP+15.50 bar; MAWP*1.25)+H (min. 6.9 bar)			122.1.4 (A.1)
Blowoff DT	DT= Saturated steam temperature @ MAWP			122.1.4 (A.2)
Constraints	Galvanized pipes and fittings shall not be used! If DP≤6.90 bar, nonferrous pipe is allowed, fittings from bronze, cast iron… If DP>6.9 bar, all pipes and fittings shall be of steel, all of at least Sch.80 size			122.1.4 (A.3)
Blowoff Size	≥ size of the connection on the boiler			122.1.4(A.4)
Steam piping DP / DT	up to the first stop valve (integral SH): DP=max (lowest set pressure of any SH SV; 0.85*set pressure of any drum SV) (min. 7 bar) DT= expected steam T up to the first stop valve (isolable SH): DP=lowest Drum SV set pressure (min. 7 bar) DT=saturated steam T @DP between two valves: DP=max (maximum operating pressure; 0.85*set pressure of any drum SV) (min. 7 bar) DT= expected steam T			122.1.2; 122.1.2(A.1) thru (A.3)
Exemption	For boiler + prime mover: max (DP at the throttle valve inlet*1.05; 0.85*lowest drum SV set pressure; sustained op. pressure)→ T=expected steam T at the SH outlet			122.1.2(A.4)
Drains	all piping shall be provided with drains			PG-59.4.1
	superheater drains			PG-59.4.1.1
DP / DT	minimum DP= 6.9 bar and DT= 105°C			122.1.5 (E)
	can be used as blowoff only when all blowoff requirements are met			122.1.5 (B) PG-58.3.7
	all parts in the line shall not be smaller than the drain conn.			122.1.5 (A)
	if draining not under pressure→ only one valve is acceptable with additional conditions			122.1.5 (D)

Water column	austenitic and Ni materials not allowed	PG-12.3; PG-8.2-3; PG-42; PG-60.2.4
Column to boiler	min 1“ (DN25)	PG-60.3.4
Valved drain connection	min ¾” (DN20)	PG-60.2.3
Water level indicators fixed water level-gage glass	shall be connected to the shell/drum directly	PG-60.3.1
	at least one gage glass in service at all times	PG-60.1
	connection directly to boiler/ column min ½” (DN15)	PG-60.3.4
	the lowest visible water level in the gage glass shall be at least 50 mm above the lowest permissible water level	PG-60.1 PG-60.1.1.2
	gage glass body and connector materials shall comply with a Manufacturer’s standard	PG-12.1
	gage glass body and connectors may be made of austenitic steels and Ni-based alloys→ Note 1	PG-12.1
	for MAWP ≤ 7 bar gage glass shall have a drain cock/ valve with a drain opening minimum 6 mm for cleaning For MAWP>7 bar the valved drain shall be piped to the ash pit or other safe place	PG-60.1.2
	MAWP >30 bar: 1. two gage glasses or 2. one gage glass and 2 remote level indicators (continuously indicating water level) ATTENTION: this required gage glass may be shut off but shall be maintained in serviceable condition MAWP ≤30 bar: one gage glass (cannot be substituted by 2 remote level indicators!)	PG-60.1.1
	gage glasses with multiple sections (except ported and reflex) shall have minimum overlap of 25 mm of all adjoining sections	PG-60.1
fixed water level-remote level indicators with floating sensing devices (magnetic)	display shall have marked minimum water level reference 50 mm above the lowest permissible water level	PG-60.1.1.2
	design shall include provisions for cleaning	PG-60.1.1.3
	pressure chamber shall be calculated acc.to PG-27	PG-12.2
	for MAWP ≤ 60 bar allowed only	PG-12.2
	remote level indicators connections: from boiler to valve (incl.): min ¾” (DN 20) from valve to the remote level indicator: min ½”(OD 13 mm)	PG-60.3.4
	pressure chamber and connectors material according to PG-9.1.2 and PG-12.3 and welding acc.to Part PW	PG-12.2; PG-12.3
gage glass/water-level-sensing device/water column	must have a min. 6 mm drain for cleaning if MAWP>7 bar → valved drain for safe discharge	PG-60.1.2
	must have top and bottom shutoff valve with pressure rating min. MAWP+H@saturated steam T	PG-60.1.2
	DP=MAWP+H	122.1.6
	p>30 bar shield, sleeves or other suitable means are required	PG-60.3.5
no fixed water level **(FFSG)**	no gage glass needed	PG-60.1.1
Inspection openings	elliptical (300x400), circular (ID 380), handhole (70 x 89), threaded (min. 25 mm)	PG-44
Flanges and fittings	SA-181 allowed up to Class 300	PG-42.3
	general requirements	PG-42; 106.1; 108; Tab. 112
	hub-type flanges made from plate prohibited	PG-42.3; 122.1.1(G);
	slip-on max. size 4”(boiler proper all Classes permitted; BEP max. Class 300 permitted)	PG-42.4.7; 104.5.1; 122.1.1 (F)
	couplings are restricted to max. size 3”	104.3.1(B)

	socket-welded: up to Class 600 ≤ 3” permitted; Cl. 900-Cl.1500 ≤ 2.5” permitted	PG-42.4.8; 122.1.1
Studded connection	minimum thread engagement	PG-39.4
	depth of the studded holes	PG-39.4
Threaded connections	shall not be used T>495°C (496°C)/other constrains	PG-39.5.2; 114.2
	threads according B1.20.1	PG-39.5.1
	size and pressure limitation of thread application: seamless pipe, tensile strength, Sch.80 min	PG-39.5.2; 114.3; 104.1.1.(C)
	minimum number of threads	Table PG-39
	threaded right angle branch connection	104.3.1(B.4)
	threaded plug closures limitations	Table PG-39
Expanded connections		PG-39.6
Pressure gage	placed to be easily readable, shall continuously indicate pressure	PG-60.6.1
	when T > 208°C do not use brass or copper pipe for pressure gage connection	PG-60.6.1
	connection to the boiler min. ¼” (DN 8), for steel or wrought iron min. ID 13 mm (1/2”) Syphon (when used) min. ID 6 mm (1/4”)	PG-60.6.1
	dial of gage graduated approx. 2 x set pressure of safety valve, min. 1.5 x set pressure	PG-60.6.1
	valve conn. min. ¼ “(DN 8) for testing purpose only	PG-60.6.3
Socket type and sleeve type joints	pipe max. 3” (DN 80) tube max. 3,5” (89 mm) other requirements	PW-41.5.1 thru .6; 104.3.1 (B.4); 111.3; Fig.127.4.4(B),(C)
Tapered transitions	shell, drums	PW-9.3.1
	pipe, tubes	PW-9.3.2
Flat plate/corner joints examination		PG-93
Supports, attachments	in general, loadings	PG-55, PG-56; 120-121
Bolting		108.5; 108.6; Table 112
Volumetric Examination		136.4; PW-11; Table PW-11
PWHT	welds with ferritic filler metal Cr>3% shall be HT	132; Table 132; PW-39
Test pressure		137; PG-99; PW-54

Stamping, inspection, valves and pressure relief requirements are not covered in this design check list.

Boiler Proper (Section I) and Boiler External Piping (B31.1) considered only.

Nomenclature:
BEP –boiler external piping
CSEF – creep strength enhanced ferritic steel
DP - design pressure
DT - design temperature
FFSG – forced flow steam generator
H - hydrostatic head
HS – heating surface
MAWP - maximum allowable working pressure
SH - supeheater
SV – safety valve