

Figure 1 (REVISED)
Boiler Cleanliness Criteria - Relationship of Deposit Loading Measurement to Cleanliness or Chemical Cleaning Recommendation Status

Boiler Pressure Operating (psi)		Deposit Loading Quantity Measurement (g/ft ² ; for all practical purposes 1 mg/cm ² = 1 g/ft ²)				
		1250-1800	1800-2600	1800-2600	2600-3200	>3208.2
Boiler Type			Drum Type	Subcritical Units Once-Through	Subcritical Units Once-Through	Supercritical Units Once-Through
Source	Status					
Combustion Engineering (Solvent Method Determination) ¹	Clean	-	<15	<15	<15	<15
	Moderately Dirty	-	15-40	15-40	15-40	15-25
	Very Dirty	-	>40	>40	>40	>25
B&W (Mechanical Method Determination) ⁷	No Cleaning Required	-	<10	<10	<10	<10
	Consider Cleaning	-	10-12	10-12	10-12	10-12
	Clean	-	>12	>12	>12	>12
EPRI (Mechanical Method Determination) ⁸	No Cleaning Required	<10	<7	<7	<5	<4
	Consider Cleaning	10-30	7-23	7-23	5-15	4-14
	Clean	>30	>23	>23	>15	>14
EPRI (Solvent Method Determination) ⁸	No Cleaning Required	<12	<11	<11	<10	<9
	Consider Cleaning	12-30	11-25	11-25	10-20	9-20
	Clean	>30	>25	>25	>20	>20
DNFM (Solvent Method Determination) ⁹	Clean Surfaces	<25	<25	<25	<25	<15
	Moderately Dirty Surfaces	25-40	25-40	25-40	25-40	15-25
	Very Dirty Surfaces	>40	>40	>40	>40	>25
Industry Practice ⁵		10-20	8-10	8-10	8-10	4-5

Figure 1 (metric units) (REVISED)
Boiler Cleanliness Criteria - Relationship of Deposit Loading Measurement to Cleanliness or Chemical Cleaning Recommendation Status

Boiler Pressure Operating (MPa)		Deposit Loading Quantity Measurement (mg/cm ² ; for all practical purposes 1 mg/cm ² = 1 g/ft ²)				
		8.6-12.4	12.4-17.9	12.4-17.9	17.9-22.0	>22.0
Boiler Type			Drum Type	Subcritical Units Once-Through	Subcritical Units Once-Through	Supercritical Units Once-Through
Source	Status					
Combustion Engineering (Solvent Method Determination) ¹	Clean	-	<15	<15	<15	<15
	Moderately Dirty	-	15-40	15-40	15-40	15-25
	Very Dirty	-	>40	>40	>40	>25
B&W (Mechanical Method Determination) ⁷	No Cleaning Required	-	<10	<10	<10	<10
	Consider Cleaning	-	10-12	10-12	10-12	10-12
	Clean	-	>12	>12	>12	>12
EPRI (Mechanical Method Determination) ⁸	No Cleaning Required	<10	<7	<7	<5	<4
	Consider Cleaning	10-30	7-23	7-23	5-15	4-14
	Clean	>30	>23	>23	>15	>14
EPRI (Solvent Method Determination) ⁸	No Cleaning Required	<12	<11	<11	<10	<9
	Consider Cleaning	12-30	11-25	11-25	10-20	9-20
	Clean	>30	>25	>25	>20	>20
DNFM (Solvent Method Determination) ⁹	Clean Surfaces	<25	<25	<25	<25	<15
	Moderately Dirty Surfaces	25-40	25-40	25-40	25-40	15-25
	Very Dirty Surfaces	>40	>40	>40	>40	>25
Industry Practice ⁵		10-20	8-10	8-10	8-10	4-5

REFERENCES

1. K.L. Atwood, G.L. Hale, "A Method for Determining Need for Chemical Cleaning of High-Pressure Boilers", Proceedings – American Power Conference, Vol. 33, 1971, p 710-720.
2. ASTM D3483-83(1999), "Standard Test Methods for Accumulated Deposition in a Steam Generator Tube", ASTM International.
3. "Standard Test Method for Measuring Deposit Mass Loading ("Deposit Weight Density") Values for Boiler Tubes by the Glass-Bead Blasting Technique", NACE Standard TM0199-99, Item No. 21236, NACE International, Houston, TX, 2003.
4. ASTM D887-82(2003), "Standard Practice for Sampling Water-Formed Deposits", ASTM International.
5. "Evaluation of Boiler Tube Deposit Mass Loading (Deposit Weight Density) Methodology", NACE International Publication 7H100, Item No. 24206, NACE International, Houston, TX, 2000.
6. E.C. Wackenhuth, J.P. Engle, H.C. Crutchfield, J.W. Siegmund, W.E. Chesney, N.B. Miller, Manual on Chemical Cleaning of Fossil-Fueled Steam Generation Equipment, Electric Power Research Institute, Palo Alto, CA, CS-3289, January 1984, p 6-11 to 6-19.
7. Steam/its generation and use. 40th edition. Editors: Steven C. Stultz and John B. Kitto. The Babcock & Wilcox Company, Barberton, OH, USA, 1992, p 42-14 to 42-15.
8. R.B. Dooley. W.P. McNaughton, Boiler Tube Failures: Theory and Practice, Volume 1: Boiler Tube Fundamentals, Electric Power Research Institute, Inc., Palo Alto, CA, TR-105261-V1, 1996, p 4-1 to 4-12.
9. D.N. French, Metallurgical Failures in Fossil Fired Boilers, Second Edition; John Wiley & Sons, 1993, p 372–375.
10. M.J. Esmacher, J.M. Jevic, T.M. Laronge, K.A. Shelby, D.A. Shifler, "Evaluation of Boiler Tube Deposit Weight Density Methodology", Corrosion '97, Paper 97454, NACE International, Houston, TX, 1997.
11. "Physical Constants of Inorganic Compounds; Number i159," CRC Handbook of Chemistry and Physics, 63rd Edition, Editors: R.C. Weast, M.J. Astle, CRC press, Inc. Boca Raton, FL, USA, 1982, p B-109.