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Mechanical vibration — Evaluation of machine vibration by measurements on non-rotating parts —

Part 8: **Reciprocating compressor systems**

AMENDMENT 1

Vibrations mécaniques — Évaluation des vibrations des machines par mesurages sur les parties non tournantes —

Partie 8: Systèmes de compresseurs alternatifs

AMENDEMENT 1

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The committee responsible for this document is ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 2, *Measurement and evaluation of mechanical vibration and shock as applied to machines, vehicles and structures*.

A list of parts in the ISO 10816 series can be found on the ISO website.

Mechanical vibration — Evaluation of machine vibration by measurements on non-rotating parts —

Part 8: Reciprocating compressor systems

AMENDMENT 1

Clause 3, add the following definitions:

3.6
mainline piping
piping of which the small bore connections are branched

Note 1 to entry: Mainline piping can also refer to rotating machinery and pressure containing equipment like vessels or coolers.

3.7
small bore connection
SBC
branch connection on mainline piping, vessels or equipment that is DN 50 (NPS 2 inch) and smaller, including connections that have a branch pipe to mainline pipe ratio (branch ratio, see 3.8) of less than or equal to 10 %, and excluding connections that have a branch ratio greater than 25 %

Note 1 to entry: The small bore connection piping extends until the effect of the mainline piping vibration is negligible, which is typically the first support.

Note 2 to entry: Nominal diameters can be given either in mm according to ISO definitions (DN, see ISO 6708) or in inch according to ASA definitions (NPS), see Table 0.

Table 0 — Definition of small bore connection

			Mainline piping																				
	NPS inch		2	2,5	3	3,5	4	6	8	10	12	14	16	18	20	24	26	28	30	32	34	36	38	40
		DN mm	50	65	80	90	100	150	200	250	300	350	400	450	500	600	650	700	750	800	850	900	950	1000
Small bore piping	4	100																					
	3,5	90																					
	3	80																					
	2,5	65																					
	2	50																					
	1,5	40													Small bore connection								
	1	25																					
	0,75	20																					
	0,5	15																					

3.8
branch ratio
ratio of small bore connection nominal diameter to mainline piping nominal diameter

4.2, add the following text after the third paragraph:

For small bore connections, the difference between the highest and lowest vibration velocity value between two locations shall be measured because this determines the maximum cyclic stress values (see Annex E). The guidance values for acceptable overall vibration are for that reason based on the difference in vibration values measured on the two locations as defined in E.2.1. The correct phase between these two locations shall be taken into account.

4.3.1, add the following indent as the last one:

— small bore connections: see Figure E.1.

Table 1, change as follows:

1. *Change text in the "Description" column of the zone D row as follows:* Urgent correction to be performed or shutdown to be considered (see Notes 3 and 4).

2. *Replace in Note 3 the second indent by:*

— The measured vibration values of the small bore connections which are attached to the relevant main pipe system do not exceed the guidance values specified in Annex E. If, however, the vibration values exceed the guidance values, Note 4 is applicable.

3. *Add Note 4:*

NOTE 4 If the relative vibration velocity of the small bore connection exceeds the appropriate C/D vibration value (zone D), this does not, by definition, mean that a fatigue failure of the small bore connection will occur. The stress in a small bore connection is influenced by the geometry, connection type, weld details and quality, etc. For that reason, consideration to shut down the system is not necessary if the cyclic stress does not exceed the endurance limit. To prove this, the following actions are undertaken:

— Measure the actual cyclic stress at the critical points, in general the welds close to the mainline, with a strain gauge measurement and compare the cyclic stress with the fatigue limit of the weld.

or:

— Measure the difference of the vibration displacement time domain waveform (peak-to-peak displacement in mm) between the small bore connection and the mainline piping (relative vibration).

— Take geometry data on the small bore connection and mainline piping, including diameters, lengths and wall thickness.

— Conduct a fatigue analysis using the relative vibration displacement using proved analytical methods or finite element analysis and check if the maximum calculated cyclic stress does not exceed the endurance limit.

5.3.1, delete the last paragraph: "The values for the piping ..."

Table 2 through Table 4, add an additional row for the small bore connections as follows:

Table 2 — Summary of overall constant vibration displacement values for different compressor system parts

Compressor system part	r.m.s. vibration displacement values for horizontal compressors mm			r.m.s. vibration displacement values for vertical compressors mm		
	Evaluation zone boundary			Evaluation zone boundary		
	A/B	B/C	C/D	A/B	B/C	C/D
Foundation	0,032	0,048	0,072	0,032	0,048	0,072
Frame (top)	0,084	0,127	0,191	0,084	0,127	0,191
Cylinder (lateral)	0,139	0,207	0,310	0,170	0,255	0,382
Cylinder (rod)	0,170	0,255	0,382	0,139	0,207	0,310
Dampers	0,202	0,302	0,454	0,202	0,302	0,454
Piping	0,202	0,302	0,454	0,202	0,302	0,454
Small bore connection	See Table E.1					

Table 3 — Summary of overall constant vibration velocity values for different compressor system parts

Compressor system part	r.m.s. vibration velocity values for horizontal compressors mm/s			r.m.s. vibration velocity values for vertical compressors mm/s		
	Evaluation zone boundary			Evaluation zone boundary		
	A/B	B/C	C/D	A/B	B/C	C/D
Foundation	2,0	3,0	4,5	2,0	3,0	4,5
Frame (top)	5,3	8,0	12,0	5,3	8,0	12,0
Cylinder (lateral)	8,7	13,0	19,5	10,7	16,0	24,0
Cylinder (rod)	10,7	16,0	24,0	8,7	13,0	19,5
Dampers	12,7	19,0	28,5	12,7	19,0	28,5
Piping	12,7	19,0	28,5	12,7	19,0	28,5
Small bore connection	See Table E.2					

Table 4 — Summary of overall constant vibration acceleration values for different compressor system parts

Compressor system part	r.m.s. vibration acceleration values for horizontal compressors m/s^2			r.m.s. vibration acceleration values for vertical compressors m/s^2		
	Evaluation zone boundary			Evaluation zone boundary		
	A/B	B/C	C/D	A/B	B/C	C/D
Foundation	2,5	3,8	5,7	2,5	3,8	5,7
Frame (top)	6,7	10,1	15,1	6,7	10,1	15,1
Cylinder (lateral)	10,9	16,3	24,5	13,5	20,1	30,2
Cylinder (rod)	13,5	20,1	30,2	10,9	16,3	24,5
Dampers	16,0	23,9	35,8	16,0	23,9	35,8
Piping	16,0	23,9	35,8	16,0	23,9	35,8
Small bore connection	See Table E.3					

5.3.3, replace the heading by: "Vibration values for horizontal compressors"

5.3.4, replace the heading by: "Vibration values for vertical and V-type compressors"

Replace the text by:

For vertical and V-type compressors, larger vibration values in lateral direction than in the rod direction of the cylinder are allowed since vertical and V-type compressors are in general more flexible in the lateral direction than a horizontal compressor.

Annex C

After the first sentence, add: Unless the compressor manufacturer has guidance values for the vibration velocity and acceleration magnitudes for the relevant compressor, the guidance values of Table C.2 and Table C.3 can be used.

In Table C.3 change 20 m/s^2 *to* 16,9 m/s^2.

Add Annex E:

Annex E
(normative)

Small bore connections (SBC)

E.1 General

This annex describes procedures and guidelines for the measurement and classification of mechanical vibration of small bore connection (SBC) piping.

Small bore connection often refers to a cantilevered pipe appendage with a lumped mass attached to it, such as a relief valve on a pipe nipple, vents or drains on pulsation bottles, or level gages on scrubbers.

Although the vibration of the mainline pipe or vessel may be acceptable, the vibration can be magnified for the SBC, depending on the geometry of the cantilevered attachment. If the SBC is resonant, the vibration can be amplified as much as 30 times higher or more than the process piping. At these high amplitudes, the risk of SBC failure is very high.

The vibration values are defined primarily to classify the vibration of the SBC piping and to avoid fatigue failure. The difference between the highest and lowest vibration velocity values, including the correct phase difference, determines the maximum cyclic stress value. The guidance values for acceptable overall vibration are for that reason based on the difference in vibration values of the two locations as defined in E.2.1 (relative vibration values). The measurements shall be carried out on two locations.

E.2 Locations and directions of measurements

E.2.1 Location

The difference in vibration measurements shall be taken on the small bore connection at the point of highest vibration (i.e. the anti-node point) and the connection of the small bore connection on the mainline piping. The highest vibration is typically the closed point in the small bore connection (e.g. closed valve, end flange, pressure safety valve) or at a point in between the mainline piping and the first pipe support. The measuring locations for typical small bore connection configurations are shown in Figure E.1.

E.2.2 Direction of measurements

The measurements should be carried out in the three mutually perpendicular X, Y and Z directions.