

SCOPE

- I 1.1 This practice covers the calculation of surge forces for fluidized solids process vessels and support structures which are subject to surge vibration.
- I 1.2 **An asterisk (*)** indicates that additional information is required. If a job is contracted, this additional information is furnished in the Job Specification.

DEFINITIONS

- I 2.1 **Surge vibration** is defined as movement induced by the action of fluidized solids contained in process vessels and piping.
- I 2.2 **Surge forces** as used herein are equivalent static lateral forces that account for the dynamic loads generated by surge vibration.
- I 2.3 **Normal surge forces** are those corresponding to the maximum fluid-bed height and density in the process vessels and piping during normal operation of the unit.
- I 2.4 **Abnormal surge forces** are those corresponding to the most severe combination of fluid-bed height and density in the process vessels and piping during startup or upset of the unit.
- I 2.5 **Support structures** are defined as any structure supporting or laterally connected to the process vessel, including access structures, such that surge vibrations are transmitted to it by the process vessel.
- I ↗ 2.6 **Symbols used in this practice** are defined below. All terms are expressed as force in consistent units unless noted otherwise.

C = Weight of fluidized solids specified for a single vessel for a particular design operating condition.

S = Total surge force applied to a single vessel and its support structure.

S_v = The portion of S applied directly to the vessel.

S_s = The portion of S applied directly to the support structure.

DESIGN

- R 3.1 **Surge forces** shall be **applied to** the full length of the **process vessel and** to any portion of the **support structure** extending above the support base of the vessel skirt.
- R ↗ 3.2 **The total surge force, S**, applied to a single process vessel and its support structure for selected process units is as follows:

TYPE OF PROCESS UNIT	S
Flexicoking	0.15 C
Fluid Coking	0.15 C
Gas Conversion FBSG	0.15 C
Flexicracking	0.075 C
Fluid Catalytic Cracking	0.075 C

- I ↗ 3.3 **Weight, C**, of fluid-solids to be used for calculating surge shall be as follows, unless specified otherwise:
 - a. For normal surge force: C is the maximum weight of fluid-solids in a single vessel and associated piping during normal operation.
 - b. For abnormal surge force: C is the maximum weight of fluid-solids in a single vessel and associated piping during abnormal (startup or upset) conditions resulting in the most severe combination of fluid-bed height and density in the vessel.
- R 3.4 **The total surge force, S**, shall be divided between the vessel and the portion of the support structure extending above the base of the vessel skirt according to their relative weights.
- R ↗ 3.5 **The surge force, S_s** , shall be distributed over the portion of the support structure located above the base level of the vessel support according to the tributary mass weighted by its height above the vessel support level. The surge force for the structure shall not exceed 20 percent of the total surge force, S.

R ♦ 3.6 **The surge force S_v** for the vessel shall be calculated as follows:

$$S_v = S - S_s$$

Its distribution over the height of the vessel shall be according to the tributary mass weighted by its height above or below the support level of the vessel.

R ♦ 3.7 **The total number of levels** used to distribute the surge forces shall be sufficient to represent the vertical weight and stiffness distribution of the vessel and of the support structure. The number of levels on the vessel shall not be less than the total height of the vessel divided by its largest outside diameter.

R 3.8 **Surge forces** shall be considered to act in any **horizontal direction** that causes the largest stresses, overturning moments, or deflection.

R 3.9 **Surge forces** applied to the vessel and to the support structure shall be considered to act **simultaneously in each of the following combinations**:

- The surge forces on the vessel and on the support structure acting in the same direction.
- The surge forces on the vessel acting in the opposite direction of the surge forces on the support structure.
- The surge forces on the support structure and on the vessel above the skirt acting in the opposite direction of the surge forces on the vessel below the skirt to produce the maximum base rotation.

R 3.10 **Relative stiffness** of the vessel, the support structure, and vessel to support structure connections shall all be considered when determining how the surge forces are transmitted between the vessel and the support structure.

R 3.11 **If two or more vessels are supported by or connected to a common support structure**, all surge forces shall be considered to act simultaneously. However, only feasible combinations of fluid-bed height and density which could simultaneously occur in all the vessels for a particular normal or abnormal condition shall be considered.

Revision Memo

9/68
6/78
6/84
12/92
6/97

Original Issue of Basic Practice
Revision 1
Revision 2
Revision 3

Revision 0 - Original Issue of International Practice

Complete editorial revision and reorganization of IP to eliminate "how to" equations from old **Par. 2.6, 3.5, 3.6** and **3.7**. **Par. 3.2** deleted S for FIOR process, added **Par. 3.3** to clarify weight factor, added **Par. 3.7** to clarify vessel level basis.

Old	New
3.2	Deleted
3.3	3.2
	3.3 (new)
3.5	3.5
3.6	3.6
3.7	Combined with 3.5
	3.7 (new)
3.8	3.8
3.9	3.9
3.10	3.10
3.11	3.11

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