*ALE_AMBIENT_HYDROSTATIC

Purpose: When an ALE model contains one or more ambient (or reservoir-type) ALE parts (ELFORM=11 and AET=4), this command may be used to initialize the hydrostatic pressure field in the ambient ALE domain due to gravity. The *LOAD_BODY_{OPTION} keyword must be defined. The associated *INITIAL_HYDROSTATIC_ALE keyword may be used to define a similar initial hydrostatic pressure field for the regular ALE domain (not reservoir-type region).

Card 1	1	2	3	4	5	6	7	8
Variable	ALESID	STYPE	VECID	GRAV	PBASE	RAMPTLC		
Type	I	I	I	I	I	I		
Default	none	0	none	0	0	0		

Card 2	1	2	3	4	5	6	7	8
Variable	NID	MMGBL						
Type	I	I						
Default	None	none						

VARIABLE	DESCRIPTION
ALESID	ALESID defines the reservoir-type ALE domain/mesh whose hydrostatic pressure field due to gravity is being initialized by this keyword. See Remark 4.
STYPE	ALESID set type. See Remark 4. EQ.0: Part set ID (PSID), EQ.1: Part ID (PID)), EQ.2: Solid set ID (SSID).
VECID	Vector ID of a vector defining the direction of gravity.
GRAV	Magnitude of the Gravitational acceleration. For example, in metric units the value is usually set to 9.80665 m/s^2.

VARIABLE	DESCRIPTION
PBASE	Nominal or reference pressure at the top surface of all fluid layers. By convention, the gravity direction points from the top layer to the bottom layer. Each fluid layer must be represented by an ALE multi-material group ID (AMMGID or MMG). See Remark 1.
RAMPTLC	A ramping time function load curve ID. This curve (via *DEFINE_CURVE) defines how gravity is ramped up as a function of time. Given GRAV value above, the curve's ordinate varies from 0.0 to 1.0, and its abscissa is the (ramping) time. See Remark 2.
NID	Node ID defining the top of an ALE fluid (AMMG) layer.
MMGBL	AMMG ID of the fluid layer immediately below this NID. Each node is defined in association with one AMMG layer below it. See Remark 4.

Remarks:

1. **Pressure in Multi-Layer Fluids.** For models using multi-layer ALE Fluids the pressure at the top surface of the top fluid layer is set to PBASE and the hydrostatic pressure is computed as following

$$P = P_{\text{base}} + \sum_{i=1}^{N_{\text{layers}}} \rho_i g h_i \,.$$

2. **Hydrostatic Pressure Ramp Up.** If RAMPTLC is activated (i.e. not equal to "0"), then the hydrostatic pressure is effectively ramped up over a user-defined duration and kept steady. When this load curve is defined, do not define the associated *INITIAL_HYDROSTATIC_ALE card to initialize the hydrostatic pressure for the non-reservoir ALE domain. The hydrostatic pressure in the regular ALE region will be initialized indirectly as a consequence of the hydrostatic pressure generated in the reservoir-type ALE domain. The same load curve should be used to ramp up gravity in a corresponding *LOAD_BODY_(OPTION) card. Via this approach, any submerged Lagrangian structure coupled to the ALE fluids will have time to equilibrate to the proper hydrostatic condition.

3. **Limitation on EOS Model.** The keyword only supports *EOS_GRUNEISEN and *EOS_LINEAR_POLYNOMIAL, but only inthe following two cases,

$$c_3 = c_4 = c_5 = c_6 = 0, \qquad E_0 = 0$$

$$c_4 = c_5 > 0, \qquad c_1 = c_2 = c_3 = c_6 = 0, \qquad V_0 = 0.$$

4. **Structured ALE usage.** When used with structured ALE, PART and PART set options might not make too much sense. This is because all elements inside a structured ALE mesh

are assigned to one single PART ID. In the Structured ALE case, we should generate a solid set which contains those ALE boundary elements we want to prescribe hydrostatic pressures on. It is done by using the *SET_SOLID_GENERAL keyword with SALECPT option. And then use the STYPE=2 option (Solid element set ID).

Example:

Model Summary: Consider a model consisting of 2 ALE parts, air on top of water.

H3 = AMMG1 = Air part above

H4 = AMMG2 = Water part below

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$...|....1....|....2....|....3....|....4....|....5....|....6....|....7....|....8
$ ALE materials (fluids) listed from top to bottom:
$
$ NID AT TOP OF A LAYER SURFACE         ALE MATERIAL LAYER BELOW THIS NODE
$ TOP OF 1st LAYER -------> 1681        ---------------------------------------
$                                       Air above   = PID 3 = H3 = AMMG1 (AET=4)
$ TOP OF 2nd LAYER -------> 1671        ---------------------------------------
$                                       Water below = PID 4 = H4 = AMMG2 (AET=4)
$ BOTTOM -------------------->          ---------------------------------------
$...|....1....|....2....|....3....|....4....|....5....|....6....|....7....|....8
*ALE_AMBIENT_HYDROSTATIC
$   ALESID     STYPE     VECID      GRAV     PBASE   RAMPTLC
        34         0        11   9.80665  101325.0         9
$      NID    MMGBL
      1681         1
      1671         2
*SET_PART_LIST
        34
         3         4
*ALE_MULTI-MATERIAL_GROUP
         3         1
         4         1
*DEFINE_VECTOR
$      VID        XT        YT        ZT        XH        YH        ZH       CID
        11       0.0       1.0       0.0       0.0       0.0       0.0
*DEFINE_CURVE
         9
               0.000               0.000
               0.001               1.000
              10.000               1.000
*LOAD_BODY_Y
$     LCID        SF    LCIDDR        XC        YC        ZC
         9   9.80665         0       0.0       0.0       0.0
$...|....1....|....2....|....3....|....4....|....5....|....6....|....7....|....8
```