*INITIAL_HYDROSTATIC_ALE

Purpose: When an ALE model contains one or more regular (not reservoir-type) ALE parts (ELFORM=11 and AET=0), this command may be used to initialize the hydrostatic pressure field in the regular ALE domain due to gravity. The *LOAD_BODY_(OPTION) keyword must be defined.

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

Multi-material Layers Group Cards. Repeat card 2 as many times as the number of AMMG layers present in the model.

Card 2	1	2	3	4	5	6	7	8
Variable	NID	MMGBL0						
Type	I	I						
Default	none	none						

VARIABLE	DESCRIPTION
ALESID	ALESID is a set ID defining the ALE domain/mesh whose hydrostatic pressure field due to gravity is being initialized by this keyword. See Remark 2 and 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.
NID	Node ID defining the top of an ALE fluid (AMMG) layer.
MMGBLO	AMMG ID of the fluid layer immediately below this NID. Each node is defined in association with one AMMG layer below it. See Remark 3.

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. **Limitations on Element Formulation.** The keyword applies only to the regular ALE parts with ELFORM = 11 and AET = 0 on the *SECTION_SOLID and *SECTION_ ALE2D cards (not reservoir-type). This keyword cannot be used to initialize reservoir-type ALE parts (AET = 4). Also, ramping functions are not supported, so the loading is done in one step at $t = 0$. For initializing reservoir-type ALE domain, please review the *ALE_ AMBIENT_HYDROSTATIC keyword.

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. If we want to prescribe initial hydrostatic pressure for all the elements inside the structured mesh, we can certainly use that PART ID. But if we only want to do that to some elements, we have to generate a solid set which contains those structured ALE elements. It is done by using the *SET_SOLID_GENERAL keyword with SALECPT option. And then use STTYPE=2 (solid element set ID) option.

Example:

Model Summary: Consider a model consisting of 2 ALE parts, air on top of water.
H1 = AMMG1 = Air part above.
H2 = AMMG2 = Water part below.

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$...|....1....|....2....|....3....|....4....|....5....|....6....|....7....|....8
$ (non-ambient) 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 -------> 1722        ----------------------------------------
$                                       Air above   = PID 1 = H1 = AMMG1 (AET=0)
$ TOP OF 2nd LAYER -------> 1712        ----------------------------------------
$                                       Water below = PID 2 = H2 = AMMG2 (AET=0)
$ BOTTOM --------------------------------------------------------------------------
$...|....1....|....2....|....3....|....4....|....5....|....6....|....7....|....8
*INITIAL_HYDROSTATIC_ALE
$   ALESID     STYPE     VECID      GRAV     PBASE
        12         0        11   9.80665  101325.0
$      NID    MMGBLO
      1722         1
      1712         2
*SET_PART_LIST
        12
         1         2
*ALE_MULTI-MATERIAL_GROUP
         1         1
         2         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
```