Process, Power and Marine Division
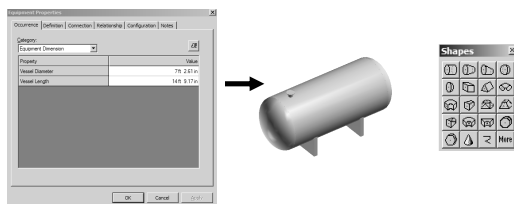
Equipment Task

INTERGRAPH

What is SmartPlant/Equipment

INTERGRAPH

- SmartPlant Equipment is an integrated equipment modeling environment that provides:
- Parametric/Non-parametric Equipment Placement
- Modeling of equipments using primitive shapes or equipment components


What is SmartPlant/Equipment

INTERGRAPH

- Equipment is a custom assembly that contains members (nozzles, shapes, equipment components, etc..)
- Graphical representation of an Equipment can be created using:
  - Visual Basic (Geometry Type Functions)
  - 3rd party software – SAT format (Solid Edge v-16)
- Aspects: Physical, Insulation, Maintenance, and so on …
- Ports available:
  - Piping port
  - Ducting port
  - Cabletray port
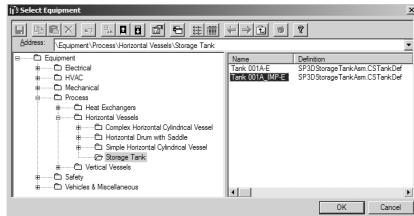 - Conduit port
  - Cable port
  - Foundation Port
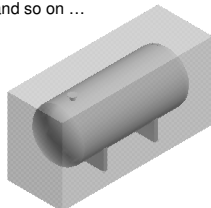
Equipment Task

Place Equipment Command

• The place equipment command activates the Select Equipment dialog box (Catalog Browser) that **provides access to equipment items that have been defined in the Reference Data**
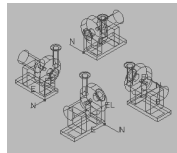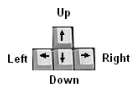

Equipment Task

Place Equipment Command

• The arrow keys on the keyboard are to be used to rotate, and set the axis of rotation for any equipment object that supports a local coordinate system. These keys should work on initial placement of an object, as well as subsequent editing of objects

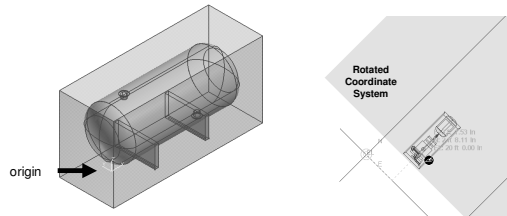• Up Arrow - change active axis in the recurring sequence of X, Y, Z

Equipment Task

Place Equipment Command

• Use active coordinate system during placement
• Equipment is placed using Symbol Origin by default

Equipment Task

Place Equipment SmartStep Ribbon Bar

| HorizontalRotatingEqpADvr-E ▼ | Parallel ▼ | Xₓ | ⊞ | ⊞ | Offset: 2 ft .00 in | Name: E-001 | System: UNIT 1 ▼ |

↑ Name   ↑ Parent System

Equipment Task

PinPoint Tool
- Provides coordinate inputs to the active command
- x,y,z coordinates are relative to Target Point
- Dynamically displays the coordinate/distance values
- Lock the coordinate/distance values

| ▪X | ⊕ | ᵏⁿ | % | ⊞ | Coordinate system: CS_0 ▼ | ᵏ₄ | ⊕ ⊕ | Step ▼ | E: 🔒 "GPX2"+10.00 ▼ | N: 🔒 0.00 mm ▼ | EL: 🔒 0.00 mm ▼ |

Target Point →

Equipment Task

PinPoint Tool
- Use the [F] keys to lock the coordinates from the cursor's location
- Supports of mathematical operations and reference plane names

Reposition Target [F12]

Set Target to the origin of the current coordinate system

| ▪X | ⊕ | ᵏⁿ | % | ⊞ | Coordinate system: CS_0 ▼ | ᵏ₄ | ⊕ ⊕ | Step ▼ | E: 🔒 "GPX2"+10.00 ▼ | N: 🔒 0.00 mm ▼ | EL: 🔒 0.00 mm ▼ |

Display on/off current values [F9]

Relative Tracking

Toggle between rectangular /spherical.

Step values

E lock [F6]

N lock [F7]

EL lock [F8]

Slide 1

Equipment Task

SmartSketch

• SmartSketch is the mechanism to automatically find special points when the command is looking for a point
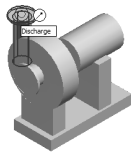
Center point	
Parallel	
Perpendicular	
Angle	
Reference axis aligned	
Point on plane	
Offset	
Intersection	
Divisor point	
Point on element	
Key point	
Add to stack	

Slide 2

Equipment Task

SmartSketch

• The system finds Key point and Point on geometry whenever you move the cursor over those points
• System uses only those points (stored in the stack) and check for linear relationship points against every object in the workspace

GraphicView:1 - Looking NE (45° from N) and 35° Down

Slide 3
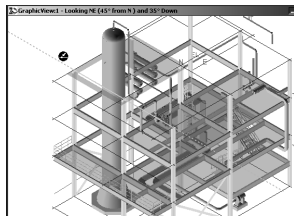
Equipment Task

SmartSketch Options

• Point on curve
  - 3D lines
  - 3D Arcs
• Point on surface
  - 3D Planes
  - 3D Projections
  - 3D Revolutions
  - 3D Cones
  - Ruled Surfaces & B-Splines
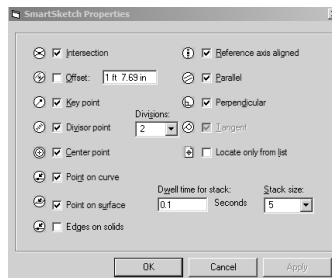
SmartSketch Properties

Intersection   Reference axis aligned
Offset: 1 ft 7.69 in   Parallel
Key point   Perpendicular
Divisor point   Divisions: 2   Tangent
Center point   Locate only from list
Point on curve
Point on surface   Dwell time for stack: 0.1 Seconds   Stack size: 5
Edges on solids

OK   Cancel   Apply

Equipment Task

SmartSketch
- SmartSketch Lock Constraint
  When SmartSketch is being used, a middle mouse click will lock the
  currently active smartsketch constraint

  - Middle mouse button
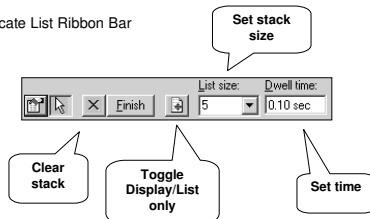 - Ctrl –L keys

---

Equipment Task

SmartSketch
- User will have two options on what objects are located by SmartSketch
  - Locate on Display List
  - Locate on List Only
- Control –D Keys
- SmartSketch Locate List Ribbon Bar

Set stack size

List size: 5   Dwell time: 0.10 sec

Clear stack

Toggle Display/List only

Set time

Equipment Task

Common Move command
- Linear SmartSketch points are enabled in the move command. This functionality
  allows easy movement along major axis/ or parallel to other objects

Plane: Name: 41P-101   System: Plant1

Move To
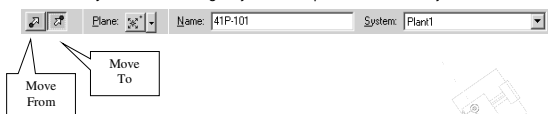
Move From

- The origin of the item is used by default as
  the *Move From* point

Equipment Task

Place Equipment SmartStep Ribbon Bar

- Relationships/Constraints

  Add constraints to further positioning the Equipment

  Positioning relationships (constraints):

  - Mate
  - Align
  - Connect
  - Minimum Distance (E-W, N-S, Vertical)
  - Parallel
  - Mate to Tangent Plane

Equipment Task

Place Equipment SmartStep Ribbon Bar

Positioning Relationship   Steps   Offset distance

Delete Relationship

- Set the Positioning Relationship
- Shows the last relationship added in the relationship combo box

---

Equipment Task

Positioning Relationships

- Mate Relationship
  - Between planar surface and planar surface
  - Surface Normal vectors point to each other
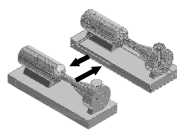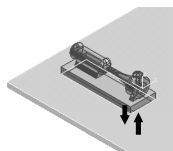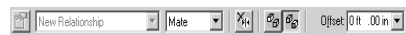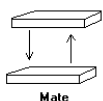
Mate

Equipment Task

Positioning Relationships

- When the equipment is placed into the active workspace the default surface is automatically constraint to a surface selected in the workspace
- If the equipment does not have a default surface defined, then the system uses an imaginary plane whose normal is along the local coordinate z-axis of the equipment symbol (origin)
- Use Quick Pick toolbar to help you select the surface
- When highlight surface for relationship, show surface direction vector
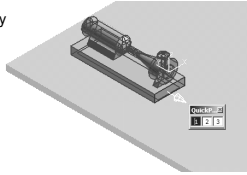
---

Equipment Task

Positioning Relationships

- Align Relationship
  - Between planar surface and planar surface
  - Surface normal vectors point in the same direction
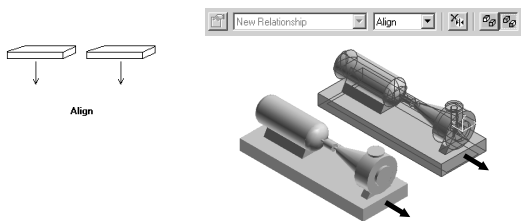
Align

Equipment Task

Positioning Relationships

- Mate/Align Relationship
  - When you select cylindrical objects, the system uses the axes to create the relationship
  - Make the two axes collinear
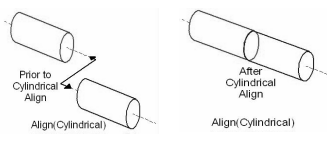
Prior to Cylindrical Align

After Cylindrical Align

Align(Cylindrical)

Align(Cylindrical)

Equipment Task

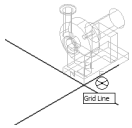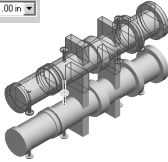INTERGRAPH

Positioning Relationships
- Connect Relationship
  - Forces a port on an equipment to be coincident with a port on another equipment

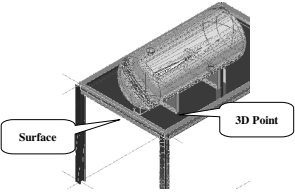 - Implicit move command

Equipment Task

INTERGRAPH

Positioning Relationships
- Minimum Distance Relationships (E-W, N-S, Vertical)
  - Between 3D points and planar surface (example: 3D plane entities, slabs, etc)

Surface   **3D Point**
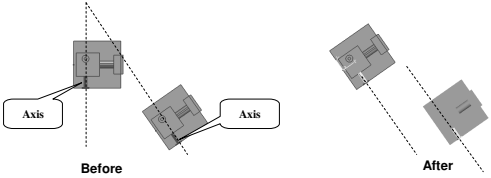
Equipment Task

INTERGRAPH

Positioning Relationships
- Parallel Relationship
  - Only rotate the selected equipment to create the constraint

Axis   **Axis**

Before   **After**

Equipment Task

INTERGRAPH

Positioning Relationships
• Mate to Tangent Plane Relationship
  - constraint the equipment between a tangent plane created at the intersection of a user-defined vector and a selected surface
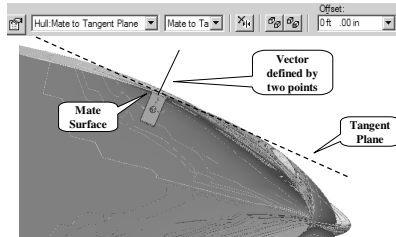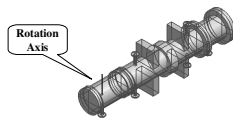
Equipment Task

INTERGRAPH

Rotate Equipment
• Use the Rotate Equipment Command

• Use the Common Rotate Command

Equipment Task

INTERGRAPH

Rotate Equipment
• Identify/Change Rotation Axis
• If the Equipment is constraint, only one choice is displayed (Perpendicular to the constraint plane)

Equipment Task

Rotate Equipment
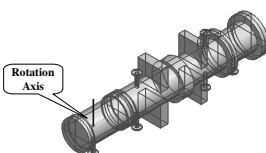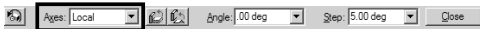
• Change the Rotation Point

The rotation point is the first foundation port of the equipment by default. If no foundation port exists, the origin of the equipment (local coordinate system origin) becomes the default point of rotation

Axes: Local   Angle: .00 deg   Step: 5.00 deg   Close

Axis direction: Up/Down   Angle: 0.00 deg   Step: Close

Equipment Task

Rotate Equipment

• Reference on Rotation Object and Reference on Stationary Object steps

Axis direction: Up/Down   Angle: 0.00 deg   Step: Close

These steps allow user to define two reference lines by selecting a surface, plane, or nozzle axis and then system calculates the angle between these lines

3d Projection

Nozzle axis

Equipment Task

Place Designed Equipment Command

• The place designed equipment command activates the Select Equipment Type dialog box (Catalog Browser) that provides access to the designed equipment hierarchy

Select Equipment type

Address: \Equipment\Process\Horizontal Vessels\Horizontal Drum with Saddle

- Equipment
  - Electrical
  - HVAC
  - Mechanical
  - Process
    - Heat Exchangers
    - Horizontal Vessels
      - Complex Horizontal Cylindrical Vessel
      - Horizontal Drum with Saddle
      - Simple Horizontal Cylindrical Vessel
      - Storage Tank
    - Vertical Vessels
  - Safety
  - Vehicles & Miscellaneous

OK   Cancel

Slide 1

Equipment Task

INTERGRAPH

Place Equipment Component Command

- The place equipment component command activates the Select Equipment Component dialog box (Catalog Browser) that provides access to the equipment component hierarchy

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Slide 2

Equipment Task

INTERGRAPH

Place Designed Equipment Component Command

- The place designed equipment component command activates the Select Equipment Component Type dialog box (Catalog Browser) that provides access to the designed equipment component hierarchy

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Slide 3

Equipment Task

INTERGRAPH

Catalog Equipment vs Designed Equipment

- A catalog equipment simply becomes a programmatically defined designed equipment
- A catalog equipment can be designed once is placed

Designed Equipment   Catalog Equipment

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Equipment Task

Equipment Properties Page
• Occurrence Tab

Equipment Task

Equipment Properties Page
• Definition Tab

Equipment Task

Equipment Properties Page
• Connection Tab

Equipment Task

Equipment Properties Page

• Relationship Tab

Equipment Task

Equipment Properties Page

• Configuration Tab

Equipment Task

Equipment Properties Page

• Notes Tab

Equipment Task

INTERGRAPH

Shapes
- Customize palette
- One-click placement
- Activate Shape Reference step
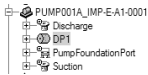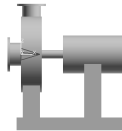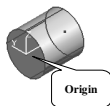- Arrow keys for rotate during placement

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Equipment Task

INTERGRAPH

Shapes
- Place Shape using Symbol Origin by default
- Shape (Datum Shape)
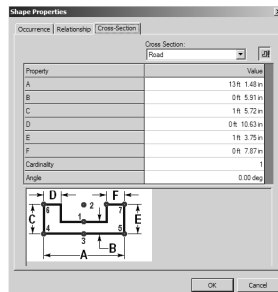- Catalog Equipments and Equipments Components come with datum shapes

Datum Shape

Origin

PUMP001A_IMP-E-A1-0001
- Discharge
- DP1
- PumpFoundationPort
- Suction

Equipment Task

INTERGRAPH

Shapes
- Availability of Prismatic Shapes

Prismatic Shape

14

Equipment Task

INTERGRAPH

Shapes
- All surfaces (persisted) and edges are available on prismatic shapes

Prismatic Shape

Equipment Task

INTERGRAPH

Place Shape SmartStep Ribbon Bar
- Relationships/Constraints
  Add constraints to further positioning the shape
  Positioning relationships (constraints):
  - Mate
  - Align
  - Connect

Equipment Task

INTERGRAPH

Place Imported Shape from File Command
- This command imports the graphics from a SAT format file as the geometry for a shape
- ACIS Output File Format
- The geometry will be converted to G-type format in the model
- The shape's origin is defined by the coordinate system of the SAT file

Equipment Task

Place Nozzle Command

- All nozzles become First Class Business Object with their own identity. They are not nested outputs of the symbol
- Support occurrence properties for nozzles in catalog equipment
- Positioning relative to Equipment, Equipment Component and Shapes
- Ports are displayed in Workspace Explorer

Equipment Task

Place Nozzle Command

- Provide predefined nozzles (values) in catalog for placement

---

Equipment Task

Place Nozzle Command

Port Type:
- Piping Straight Nozzle
- Piping Elbow Nozzle
- Conduit port
- Cabletray port
- Cable port
- Hvac port
- Foundation port
- Pipe Port (No Added Graphic)
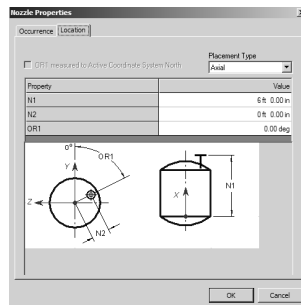- Hvac Port (No Added Graphic)

Equipment Task

Place Nozzle Command

Placement Type:
- Radial
- Axial
- Tangential
- Skew
- Offset Skew
- Position by Plane and Axis
- Position by Point

Equipment Task

Position and orientation properties
- Equipment, Shape and Nozzle
- Bearing readout from ACS North
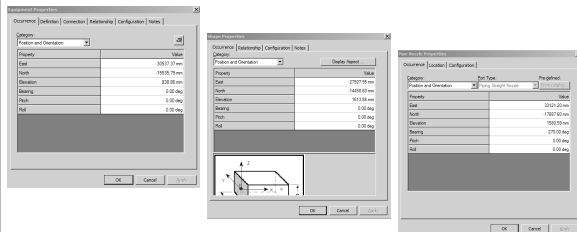
Equipment Task

Replace Equipment Command
- Exchanges a selected equipment or equipment component in the model for a different item from the catalog
- System keeps the position and orientation properties the same

Equipment Task

Manipulation Commands

Equipment Entities Manipulation
- Select Command
- Delete Command
- Undo Command
- Move Command
- Rotate Command
- Open the properties page
- Copy/Paste Command
- Mirror Copy command
- Paste and Restore command

Equipment Task

Summary - Modeling
- Catalog Equipments and Designed Equipments have the same structure and the same persistence
- Catalog Equipments can have optional members (managed by the CAD API)
- Catalog Equipments can have interactively added shapes, nozzles, Equipment components etc… just like Designed Equipments
- Designed Equipments have a symbol reduced to a single control point. Their parts are defined in the model
- Designed Equipments require a placement point at creation time
- Nozzles are filterable (but show/hide and style rules are not applicable)

Equipment Task

Summary - Modeling
- Equipment Components follow the same logic as Equipments
- Equipment Components cannot be placed standalone, they must have an Equipment as parent
- Equipment Components are Assemblies
- Equipment Components cannot have children Equipment Components
- Equipments cannot have children Equipments
- Constraint system works on homogeneous object types:
  - Equipment to Equipment
  - Shape to Shape (for siblings of an Equipment or Equipment component)
  - Equipment Component to Equipment Component (for siblings of an Equipment)