

Overview

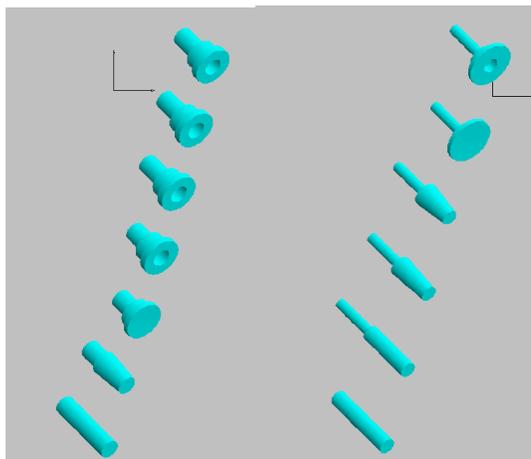
NAGFORM_SMART is a knowledge based software program for designing forging sequence of cold, warm and hot forged parts. It allows the user to capture manufacturing knowledge and use it to design progressions for similar parts in minutes.

The sequence designs created in NAGFORM can be quickly validated in NAGSIM.2D / NAGSIM.3D FEA simulation programs. With NAGFORM, the user can:

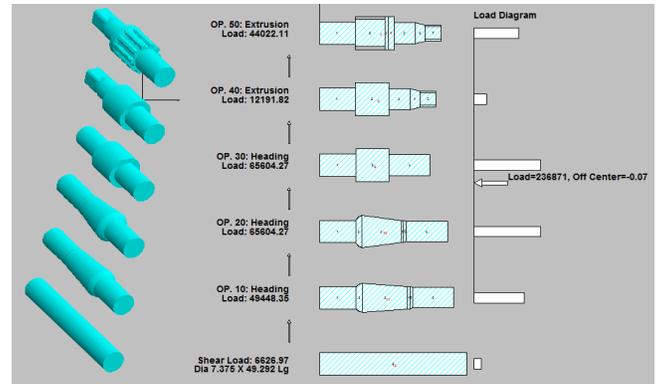
- Search the database to find similar parts and the knowledge available including sequence designs, lessons learnt, tool life etc. Prevent reinventing sequence design or spending hours to design a wrong forming sequence.
- Create personalized templates of designs and then use those to 'Zip through' progression design for similar 'Family of Parts'
- Before building the tooling based on the user's design, let the program determine alternative sequence designs with in minutes.

Uses

- Obtain alternative sequence designs for forming a part, in minutes.
- Create reusable sequence design templates of user's design.
- Save any automatic design as a template.
- Optimize and standardize designs.
- Search for knowledge on similar parts in 'Smart' database
- Select suitable machines to form a part.
- Create sequence designs for cold headers, cold formers, presses, hot formers and hot upsetters.
- Reduce number of operations required to form a part.
- Select optimal blank diameter.
- Obtain information on forming loads, pressures and deformation.
- Prevent designs that disobey the forming rules or overload the tools.
- Create analysis file for NAGSIM.2D / NAGSIM.3D for design validation
- Output sequence designs in DXF, STEP & Solidworks.
- Teach forming design to new personnel.



SEQUENCE DESIGN FOR HOT FORGED PARTS

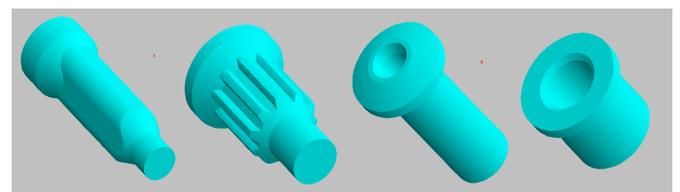
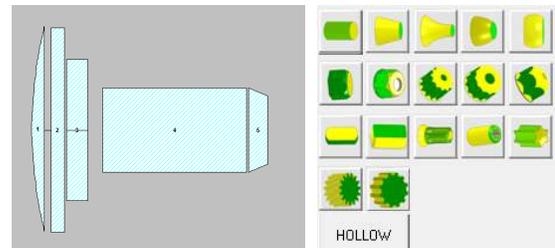


Limitations

NAGFORM is not a FEA simulation program. It can not predict metal flow defects and stresses in tools.

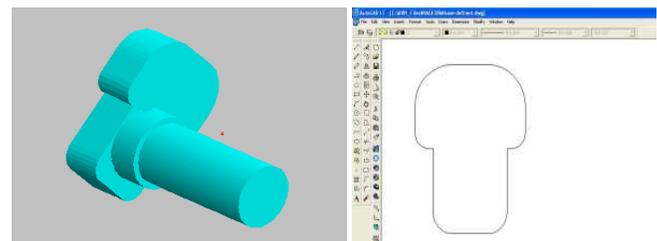
Create Part Model Using Primitives

In NAGFORM, Geometric model of a part or a preform is constructed by joining simple building blocks called primitives. All the primitives are defined by certain dimensions. The primitives are then joined together to form a union / part model. Based on the part dimensions and material, the program determines the Volume, Surface Area, and Weights. Many complex parts can be created and designed using these primitives.



User Defined Primitives

The users can create their own primitives by creating a part in .DXF format and importing it into NAGFORM. The primitives once imported can be reused and scaled.



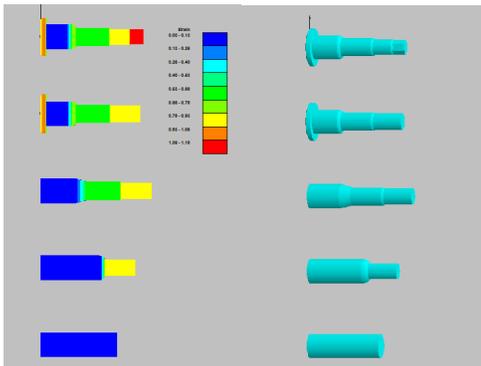
PART CREATED WITH USER DEFINED PRIMITIVE

USER DEFINED PRIMITIVE IMPORTED FROM AUTOCAD

Automatic Designs of Forming Progressions

NAGFORM utilizes a combination of design logic, knowledge based rules and simplified analyses to determine a forming progression automatically in minutes.

In general, there is more than one forming sequence by which a part can be formed. The number of designs depends upon the constraints such as part geometry, material being formed, allowed number of operations and wire size. NAGFORM has its own design logic to determine various possible ways to form a part. Because the program looks for all possible designs and applies its logic without fail, NAGFORM can determine design concepts that even an experienced designer may overlook.



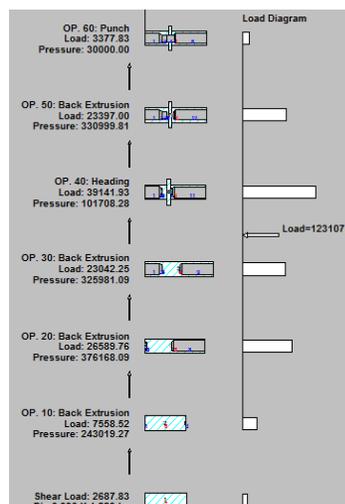
Design Helper

The “Design Helper” is a diagnostic tool that helps the user get a progression design when no design can be found through standard forming rules. It determines the extent to which certain rules need to be modified to get a sequence design.



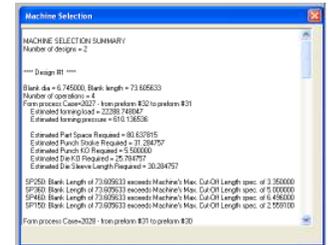
Template Designs for ‘Similar Parts’ or ‘Family of Parts’

For any part that is similar to a template in the database, NAGFORM can follow the template design/session files to create forming progressions in minutes. The users have the capability to create their own reusable template designs.



Machine Selection

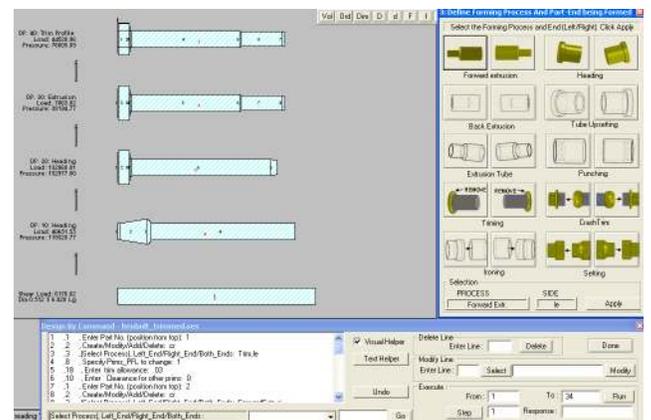
The automatic sequence design provides a machine selection summary showing the machines that may be used for a particular sequence design. The user can populate the machine database in NAGFORM using a simple form.



User Defined Progressions – “Design by Command”

“Design by Command” (DCM) allows the user to create their custom design separate from Auto Design. The user defined progression can be saved as a reusable template (session) file. Progression for similar parts can be obtained in a couple of minutes using these templates. Process information such as estimated forming load, pressure, strain, percent reduction etc. are automatically generated for user’s design. DCM is ideal for automating and standardizing forging sequence designs of product lines such as Fasteners (Standard and Special) as well as cold formed parts such as spark plugs. To create the sequence design for any other part of different dimensions, modify the reusable part and create the sequence using DCM. Advantages of automating sequence design using DCM:

- Consistent Design without any human error.
- No variations in Design due to Manual Calculations.
- Reduces skill required for creating Sequence Designs.
- Design checked for obeying Forming Rules by Design Template.
- Reduces Time to Create Designs from hours to minutes



Manual Design

In addition to automatic design, NAGFORM has a separate module for creating a forming progression manually. Using computer aided techniques, the user can quickly and easily construct a forming sequence according to his/her concept. The designer can also start from a NAGFORM generated design and modify it.

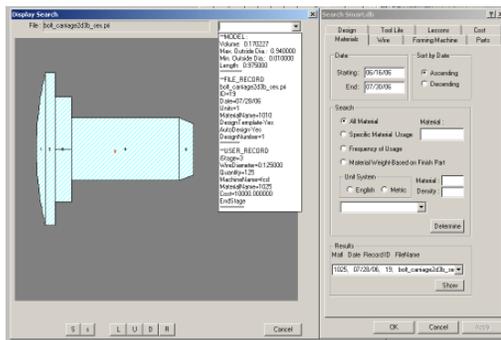
'Smart' Database

NAGFORM contains a database feature and analysis module called 'Smart' Database. The module allows the user to retain manufacturing knowledge and keep a database of parts, progressions, materials, forming machines etc. Following are some objectives of 'Smart' Database and its Analysis Module:

- Create and maintain a historic database of parts designed, quoted and manufactured
- Capture and retain the knowledge gained from experience
- Improve sequence design, quoting and manufacturing processes.
- Eliminate duplication of effort.
- Reduce print-to-part time.

Some of the features include:

- Search for Similar Parts (Part Features, Part Length, Wire Size)
- Search for design - Existing auto or manual designs for current or similar parts.
- Material Usage
- Wire Size Usage
- Forming Machine Usage
- Tool Life for Similar Parts
- Cost - Quoted and Manufactured
- Lesson learnt on similar parts



Tooling Design Components

The 'Tooling Design' section of NAGFORM helps to reduce the time required to design and draft tooling components and assemblies. This module contains two main features:

- Auto Design/Drafting of Standard Tooling Components
- Design of Tooling Assemblies

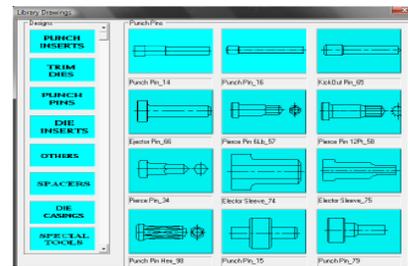
Auto Design/Drafting of Standard Tooling Components - Using NAGFORM, the user can quickly create drawings of a number of standard tooling components such as

- Die Inserts
- Punch Inserts, Pins
- Trim dies / punches
- Spacers – fillers
- Die/ Punch casings

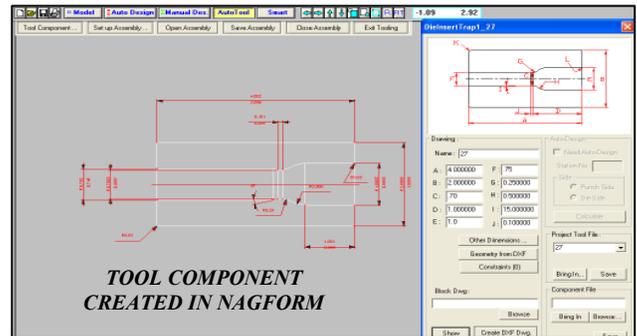
The user simply enters a few critical dimensions of the tooling component and the program instantaneously generates a fully dimensioned and scaled '.DXF Drawing'. The user can set

constraints on the dimensions of the tool to maintain desired standards. The program also has a search feature that allows the user to search for similar tools. 3D models of the tool components can be created automatically in SolidWorks using the NAGFORM-SolidWorks Interface. A 'STEP' file is created for importing 3D geometry in 3D CAD systems such as Inventor, Pro-E and SolidWorks.

Design/Drafting of Tooling Assemblies (In Development) - In NAGFORM, the capability to create assemblies of a multi station tooling for forming cold forged parts has been added. The procedure allows the user to create assemblies by bringing in different tool components. Once the tools are assembled and modified as needed, drawings of individual components and the assembly can be created with a few clicks of the buttons.

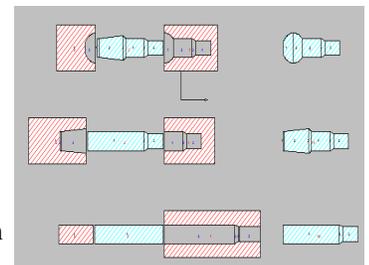


STANDARD TOOL COMPONENTS



Generic Tooling for FEA Simulation

For the sequence designs obtained through NAGFORM's logic, 'Generic' tooling can be created automatically. This generic tooling can be used to simulate the forming operation in a FEA program such as 'NAGSIM.2D' and 'NAGSIM.3D'.

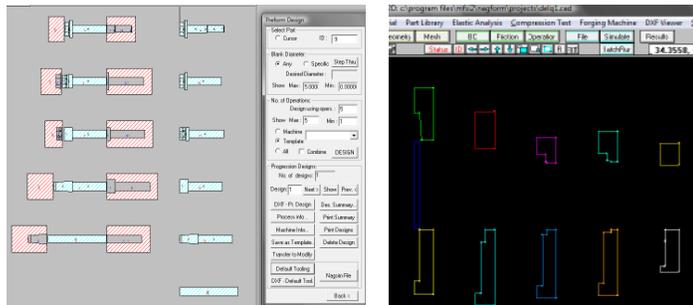


Integration with NAGSIM.2D and NAGSIM.3D

In NAGFORM, simulation files for NAGSIM.2D and NAGSIM.3D can be automatically created for any selected part progression generated in Auto Design. For NAGSIM.2D, a single file is created for the whole progression whereas for NAGSIM.3D, one file is created for each selected station of the progression.

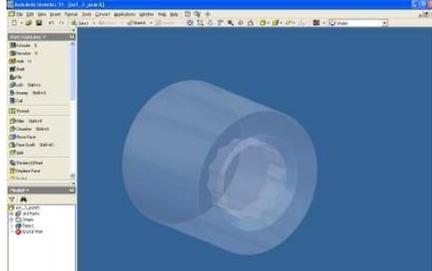
For NAGSIM.2D, simulation file for up to six stations progression can be created. To simulate, the user opens this file in NAGSIM.2D, meshes the parts and begins simulating. It takes only couple of minutes to go from NAGFORM's design concept to NAGSIM.2D simulation.

For NAGSIM.3D, NAGFORM creates the simulation file without the part and tool models. The user can either import the tool drawings from a 3D CAD system or use the 'STEP' file created by NAGFORM. The user can also use the NAGFORM-SolidWorks interface to create 3D models of the default tools in SolidWorks.



GENERIC TOOLING CREATED IN NAGFORM

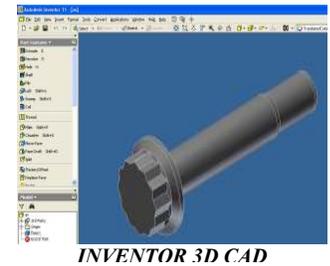
AUTOMATIC CREATION OF NAGSIM.2D FILE



STEP FILE FOR THE GENERIC TOOLING CREATED IN NAGFORM

'STEP' File Output

The NAGFORM results including part geometry, progression designs and tooling can be exported to a STEP file. The Step files can be opened in any 3-D drawing package such as SolidWorks, Pro-E and Inventor

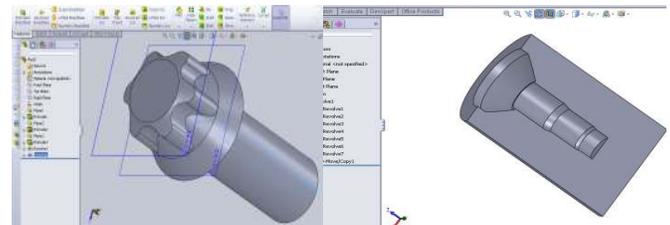


INVENTOR 3D CAD

NAGFORM SolidWorks Interface

The 'NAGFORM-SolidWorks Interface' toolbar allows the user to automatically generate '3-D SolidWorks' drawings of NAGFORM results. Following SolidWorks part drawings can be created from an existing NAGFORM Project (.pri) file:

1. Part Model Drawing
2. Entire Forging Sequence Drawing from Auto Design / Manual Design
3. Specific Preform Drawing of Auto & Manual Design
4. Default Tool Drawings



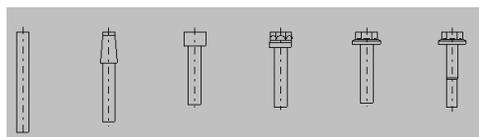
AUTOMATIC CREATION OF MODEL AND GENERIC TOOLS IN SOLIDWORKS

PART AND PROGRESSION DESIGN GENERATED IN NAGFORM

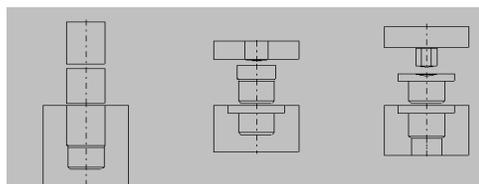
AUTOMATICALLY CREATED DRAWINGS IN SOLIDWORKS

DXF Input and Output

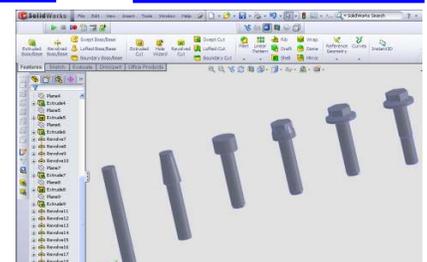
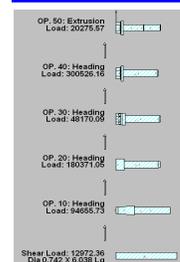
In NAGFORM, the geometry of parts can also be imported from DXF format from CAD systems such as AutoCad, SolidEdge etc. The results of NAGFORM's sequence designs and 'Generic' tooling can be saved in DXF format for input to other CAD systems.



DXF OUTPUT OF PROGRESSION DESIGN



DXF OUTPUT OF DEFAULT TOOLING



NAGFORM is available in the following versions:

- **NAGFORM STARTER:** Basic and least expensive version. It includes Part Models using Primitives and Manual Sequence Design.
- **NAGFORM LITE:** Intermediate Level in capabilities and cost. It includes Part Models, Manual and Auto Sequence Design
- **NAGFORM COMPLETE:** Complete Package with all the features described in this brochure
- **NAGFORGE:** NAGFORM_Complete capabilities specifically designed for the Hot Forging Industry.