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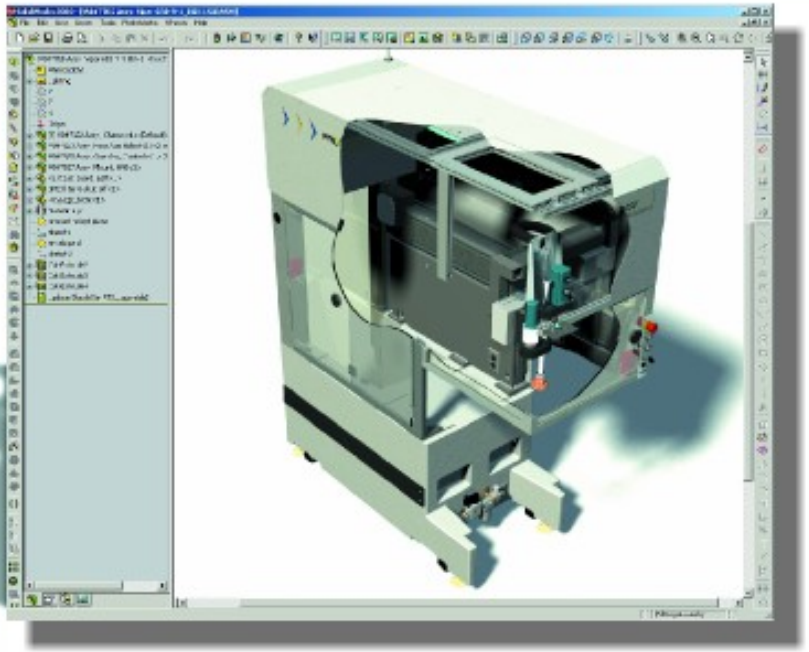
# Sheet-Metal Design Using SolidWorks

By
EGS India

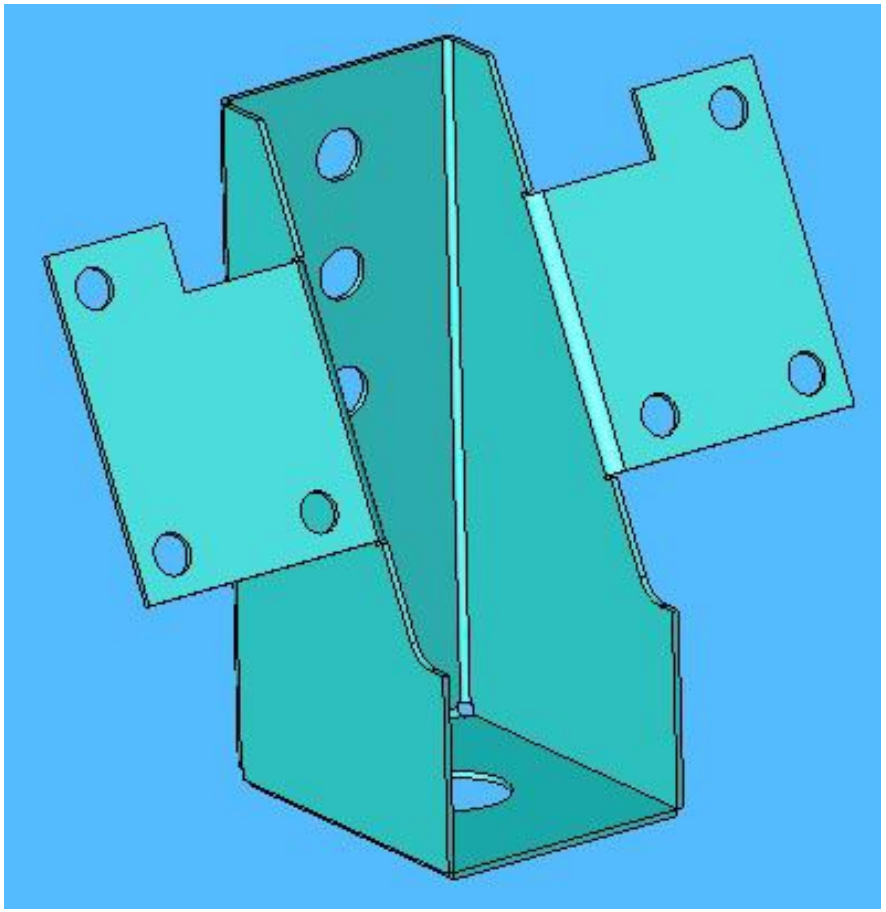
# Sheet Metal Capability

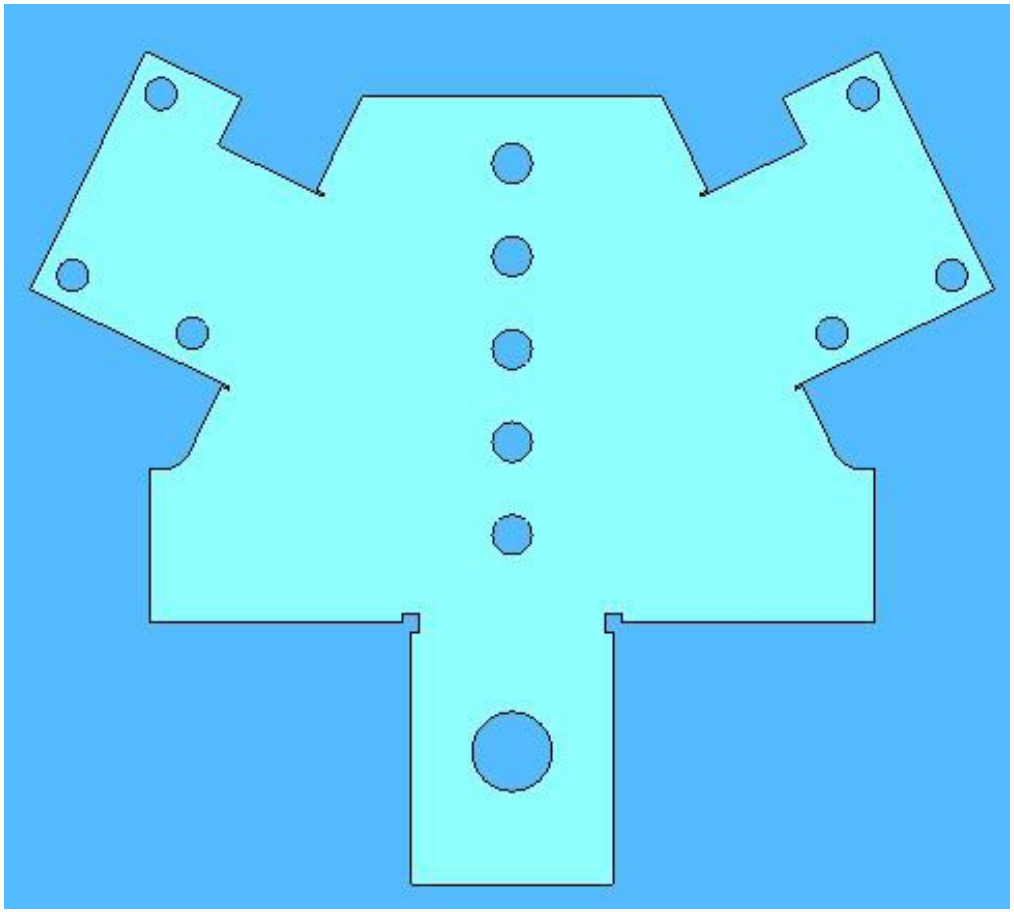
- Sheet Metal – Flexible Working Environment
- Blank Development
- Controlling Parameters
- Forming Tool
- Sheet Metal Design Tools
- Sheet Metal Assembly
- Drawing Creation

# Flexible Working Environment

- Sheet metal models can be designed in following methods:
  - Design sheet metal from flatten state
  - Design sheet metal from solid
  - Design sheet metal from surface
- Copy and Paste feature between multiple documents
- Drag and Drop facility
- Snap to place, smart mate technology
- Integration with standard Microsoft software's like MS-word, MS-Excel, Visual Basic,etc

# Blank Development





# Controlling Parameters

- Sheet metal Bend parameters can be controlled using following options:
  - Bend Table
  - Bend Allowance
  - Bend Deduction
  - K - factor

Bend allowance with a K-Factor is calculated as follows:

**BA=ΠI(R + KT) A/180**

where:

BA = bend allowance

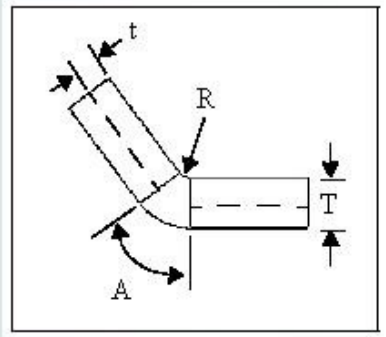
R = inside bend radius

K = K-Factor, which is t / T

T = material thickness

t = distance from inside face to neutral sheet

A = bend angle in degrees (the angle through which the material is bent)

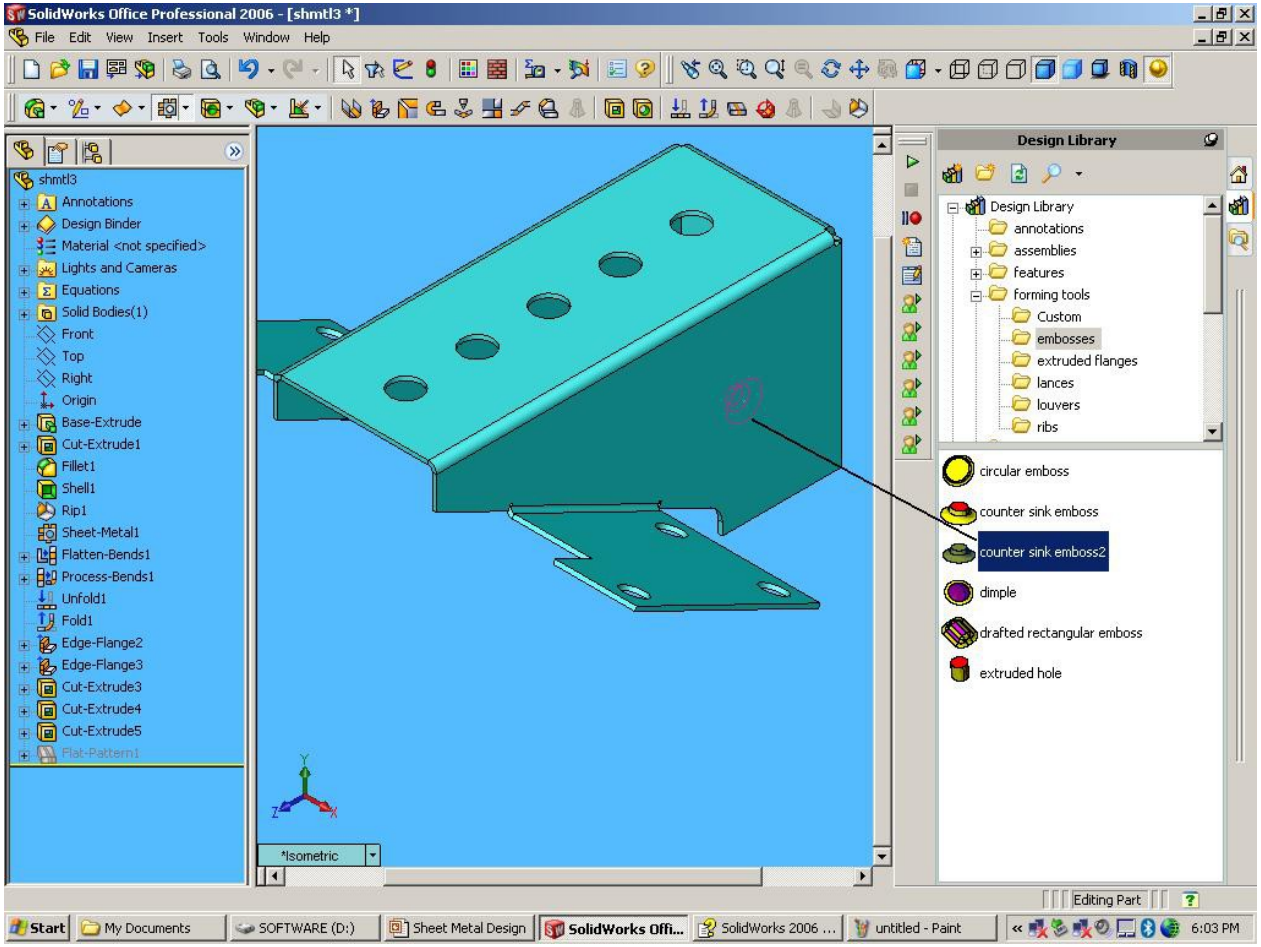


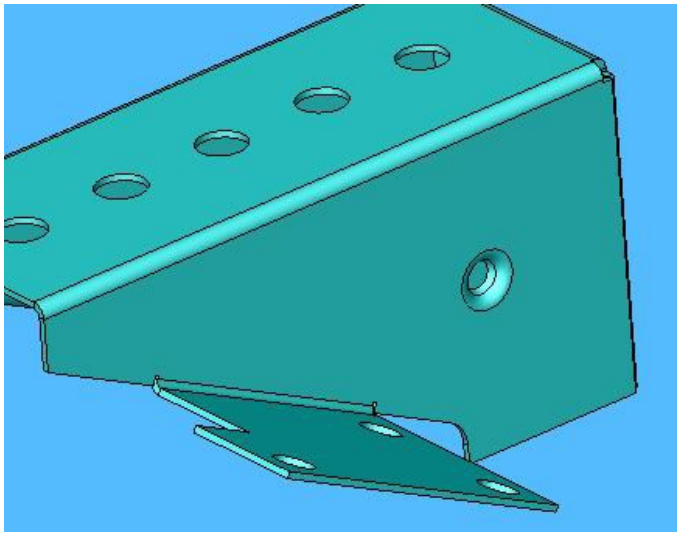

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Unit: | Inches | | | | | | | |
| 2 | Type: | Bend Allowance | | | | | | | |
| 3 | Material: | **Soft Copper and Soft Brass** | | | | | | | |
| 4 | Comment: | Values specified are for 90-degree bends | | | | | | | |
| 5 | **Radius** | **Thickness** | | | | | | | |
| 6 | | **1/64** | **1/32** | **3/64** | **1/16** | **5/64** | **3/32** | **1/8** | **5/32** |
| 7 | **1/32** | 0.058 | 0.066 | 0.075 | 0.083 | 0.092 | 0.101 | 0.118 | 0.135 |
| 8 | **3/64** | 0.083 | 0.091 | 0.1 | 0.108 | 0.117 | 0.126 | 0.143 | 0.16 |
| 9 | **1/16** | 0.107 | 0.115 | 0.124 | 0.132 | 0.141 | 0.15 | 0.167 | 0.184 |
| 10 | **3/32** | 0.156 | 0.164 | 0.173 | 0.181 | 0.19 | 0.199 | 0.216 | 0.233 |
| 11 | **1/8** | 0.205 | 0.213 | 0.222 | 0.23 | 0.239 | 0.248 | 0.265 | 0.282 |
| 12 | **5/32** | 0.254 | 0.262 | 0.271 | 0.279 | 0.288 | 0.297 | 0.314 | 0.331 |
| 13 | **3/16** | 0.303 | 0.311 | 0.32 | 0.328 | 0.337 | 0.346 | 0.363 | 0.38 |
| 14 | **7/32** | 0.353 | 0.361 | 0.37 | 0.378 | 0.387 | 0.396 | 0.413 | 0.43 |
| 15 | **1/4** | 0.401 | 0.409 | 0.418 | 0.426 | 0.435 | 0.444 | 0.461 | 0.478 |
| 16 | **9/32** | 0.45 | 0.458 | 0.467 | 0.475 | 0.484 | 0.493 | 0.51 | 0.527 |
| 17 | **5/16** | 0.499 | 0.507 | 0.516 | 0.524 | 0.533 | 0.542 | 0.559 | 0.576 |
| 18 | Comment: | **Extracted from Machinery Handbook - 26th Edition with permissi** | | | | | | | |
| 19 | Comment: | | | | | | | | |

| Gauge No. | Gauge(Thickness) | Available Bend Radius |
|---|---|---|
| 3 Gauge | 0.2391 | .25; .50; .75 |
| 4 Gauge | 0.2242 | .25; .50; .75 |
| 5 Gauge | 0.2092 | .25; .50; .75 |
| 6 Gauge | 0.1943 | .20; .25; .50; .75 |
| 7 Gauge | 0.1793 | .20; .25; .50; .75 |
| 8 Gauge | 0.1644 | .20; .25; .50; .75 |
| 9 Gauge | 0.1495 | .15; .20; .25; .50 |
| 10 Gauge | 0.1345 | .15; .20; .25; .50 |

# Forming Tools

- Forming tools can be created using regular Solid modeling and it can be saved in library. Whenever it needs, just drag and drop from library.

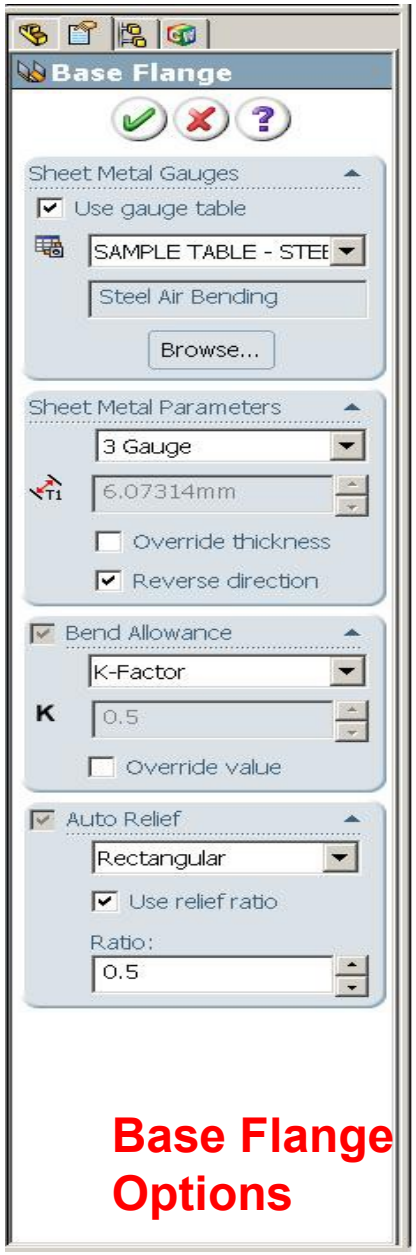


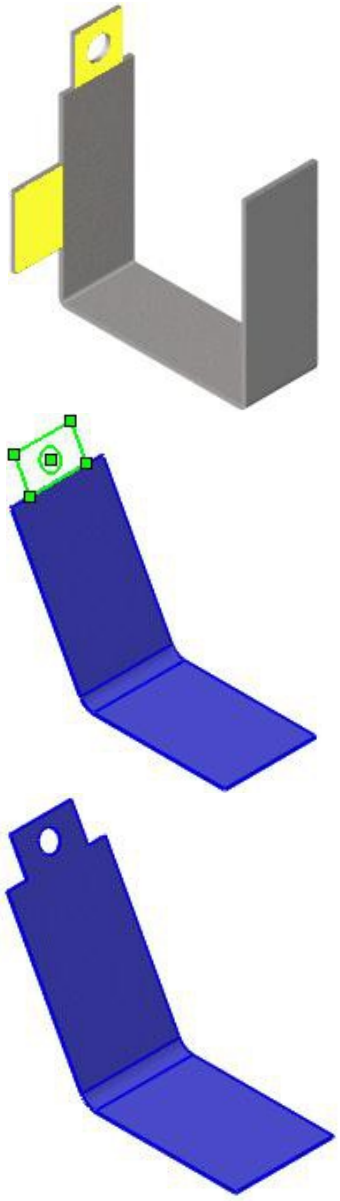
# Sheet metal Design Tools

- Base Flange
- Tab
- Edge Flange
- Miter Flange
- Hem
- Sketched Bend
- Closed Corner
- Flatten
- Jog
- Break Corner / Corner Trim
- Lofted Bends
- Fold / Unfold
- Rip
- Insert Bends
- Vent
- Fill Pattern
- Feature Library

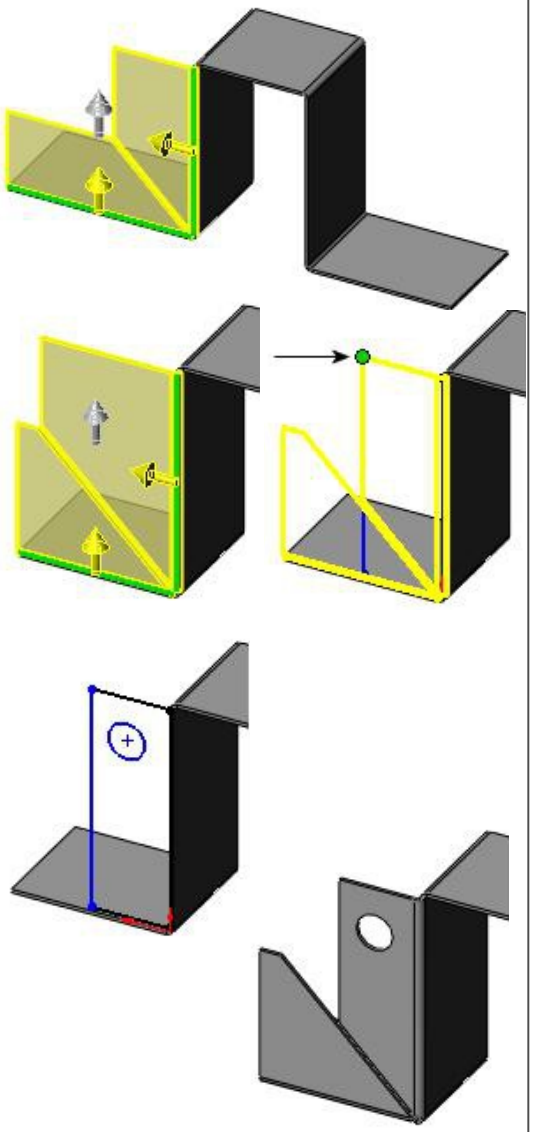
# Sheet Metal Flange Design – Wide variety of Options



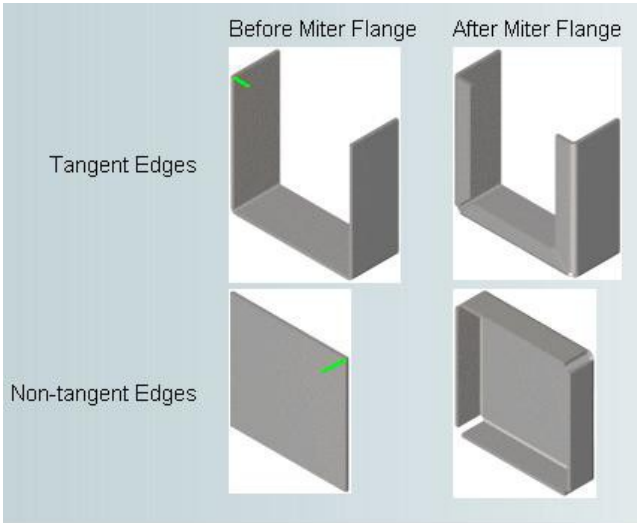

**Base Flange Options**



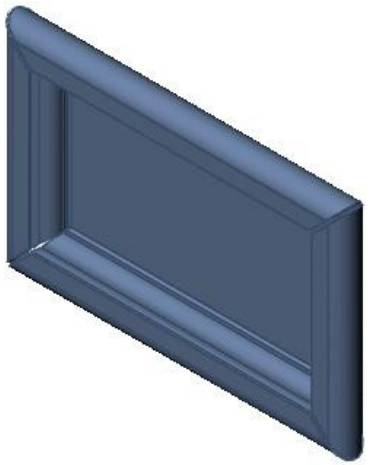
**Tab Options**



**Edge Flange Options**




**Mitre Flange Edge Options**



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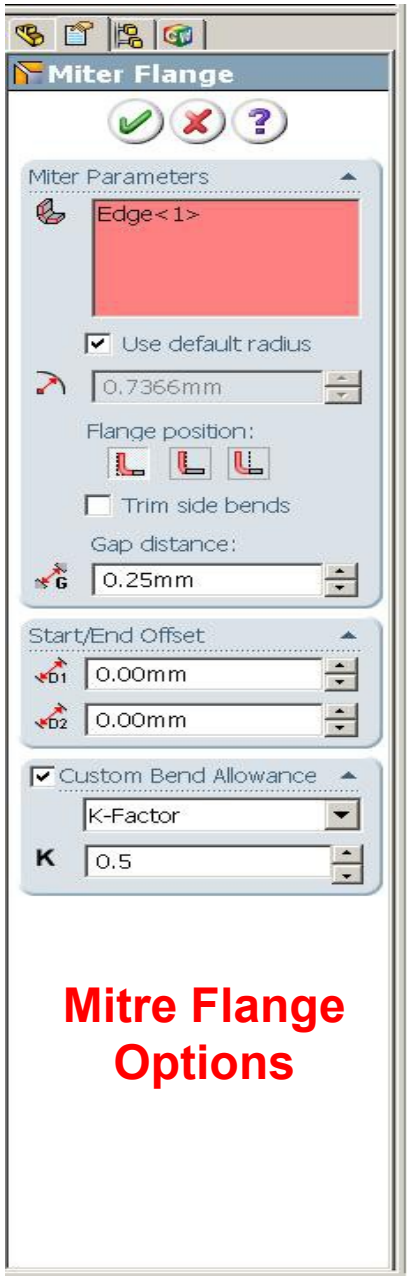
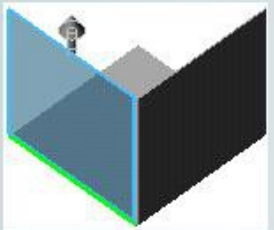
# Sheet Metal Flange Design – Bend Options

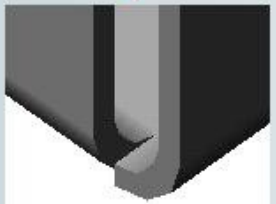



**Mitre Flange Options**

This is the preview of an Edge Flange feature. Notice the bend region of the blue preview touches the bend of the L-shaped base flange.

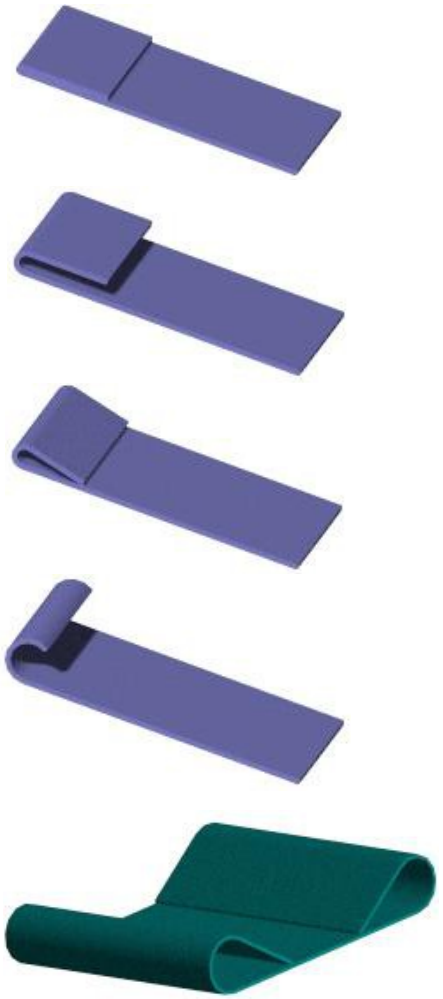


This is the end result without the **Trim side bends** check box.



This is the end result with the **Trim side bends** check box.

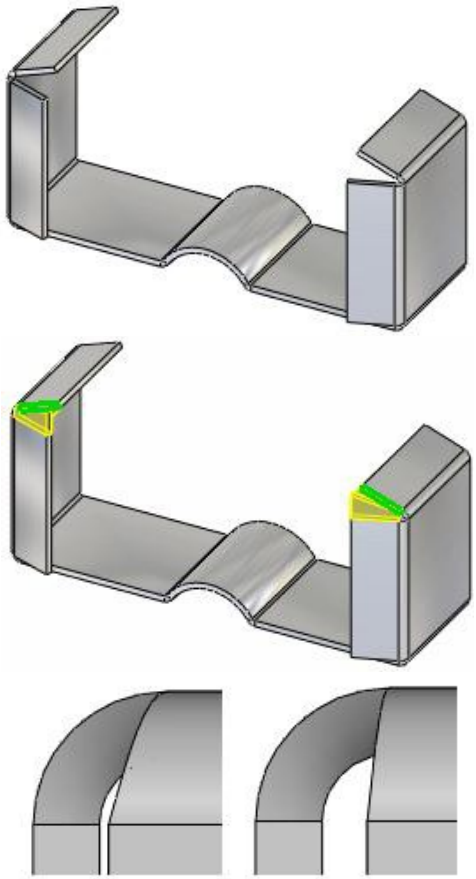
**Trim side Bend Options**



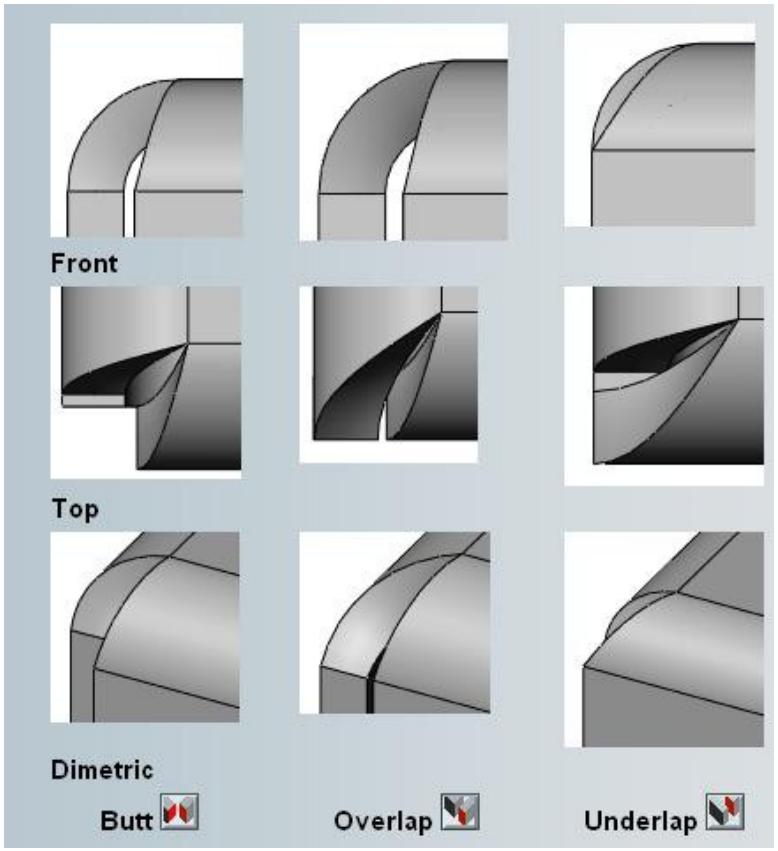
**Hem Options**

**Sketched Bend Options**

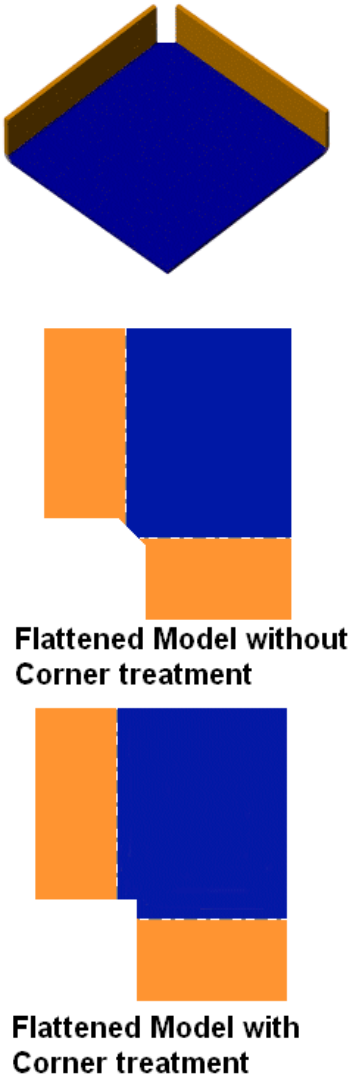
# Sheet Metal Flange Design – Corner Treatment




**Closed Corner Options**

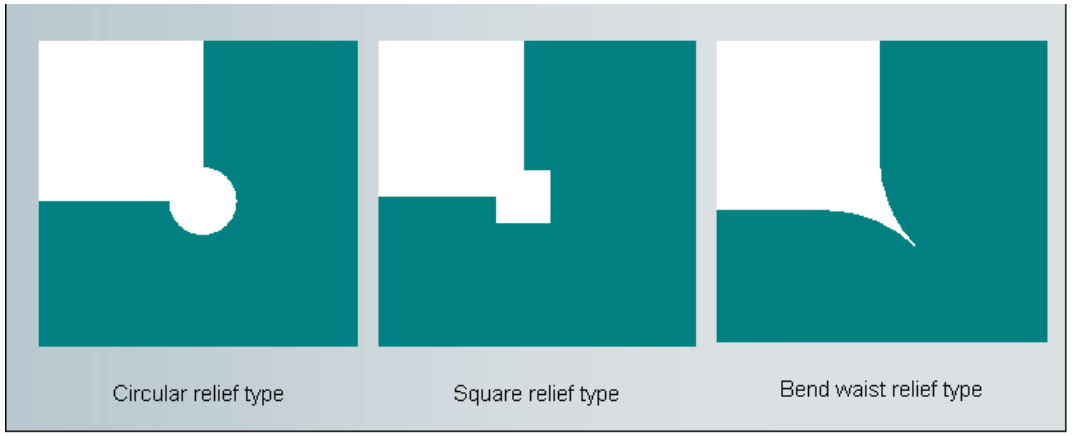



**Examples of corner types**

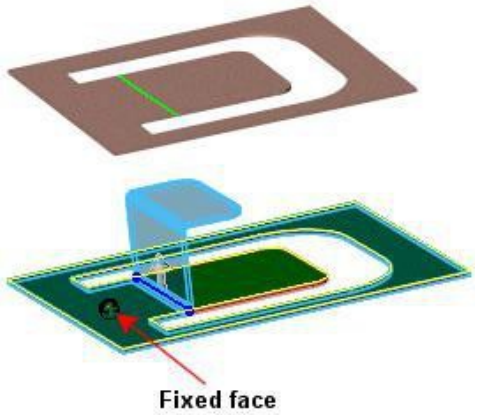



**Corner Treatment**

# Sheet Metal Flange Design – Trim & Jog Options




**Closed Trim Options**

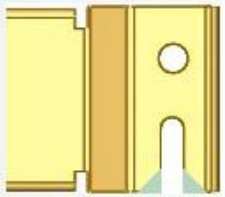




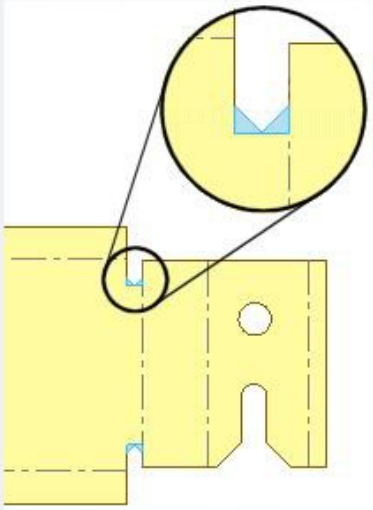
**Jog Offset Options**

**Jog Options**

# Sheet Metal Flange Design – Corner, Rip and Lofted Bends



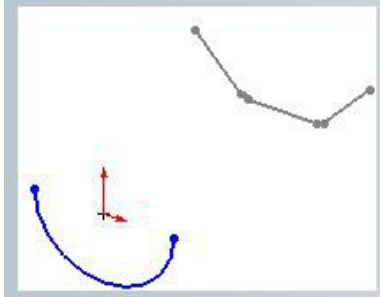
Preview of Break Corner/Corner-Trim



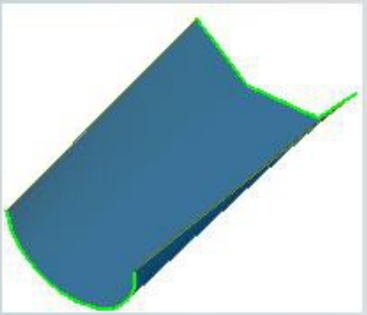
Preview of internal corners

**Chamfered Filleted**

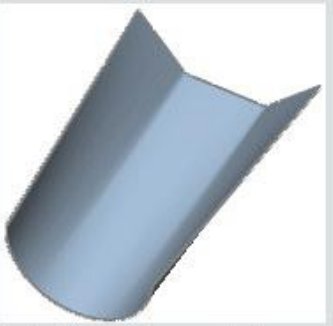
## Break Corner / Corner-Trim Options



Begin with two open profile sketches.

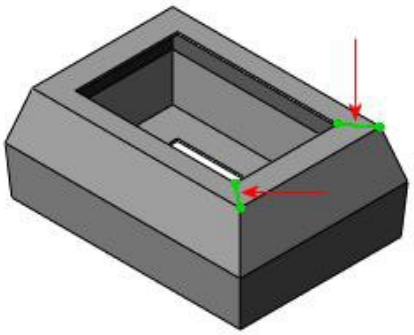


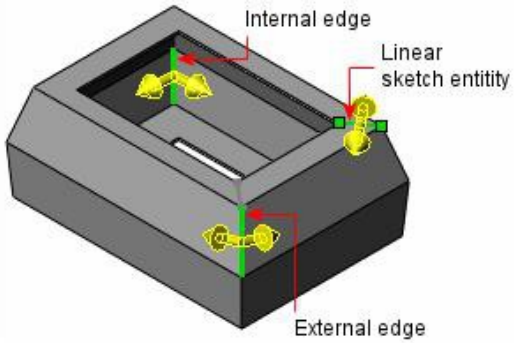
Use **Lofted Bends** to create a solid feature.

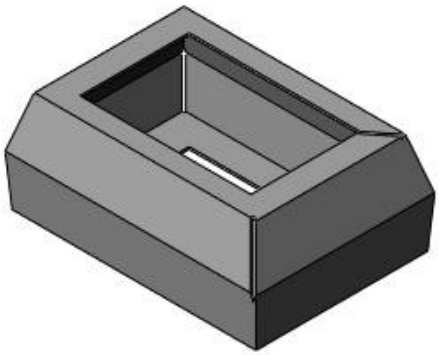


Lofted bend is complete.

## Lofted Bend

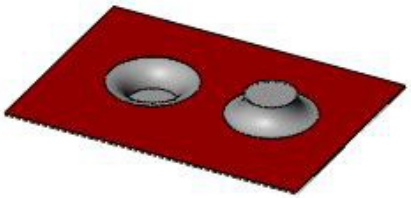




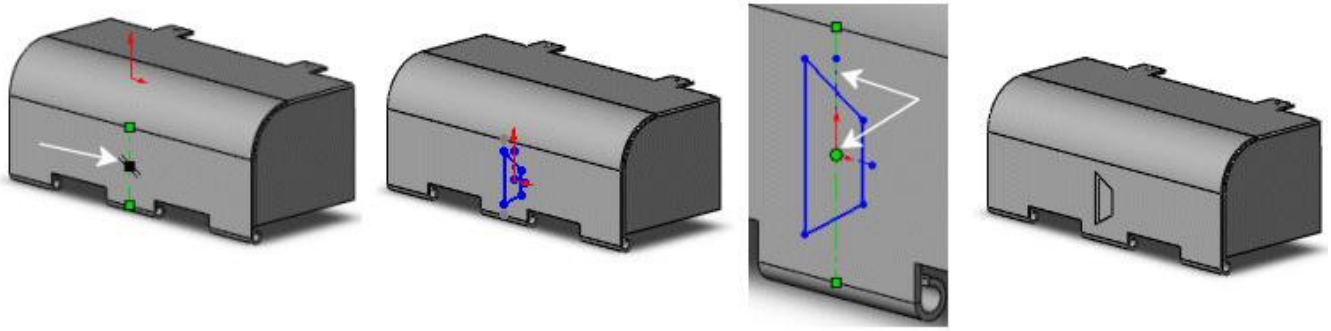



## Rip Feature

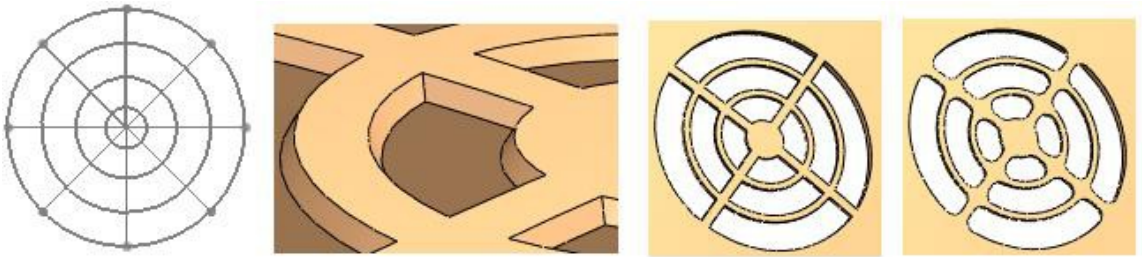
# Sheet Metal Flange Design – Forming Tools & Incorporating Library Features



## Forming from Design Library

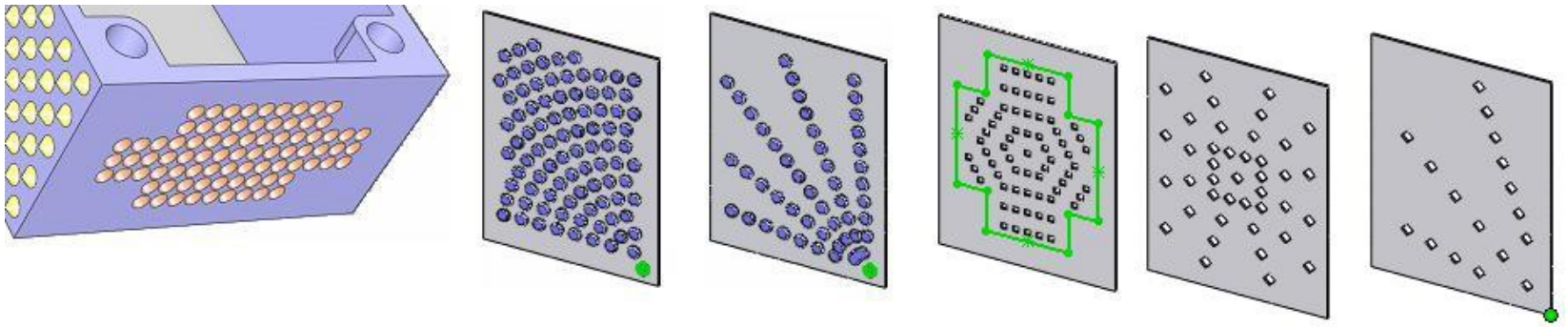


## Positioning Forming Tools



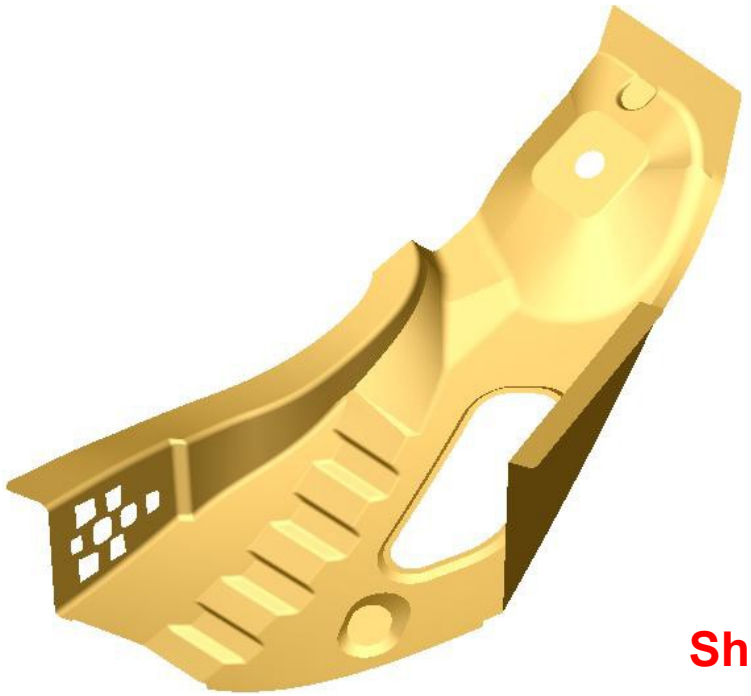
## Vent Formation

# Sheet Metal Flange Design – Patterning & Surfacing



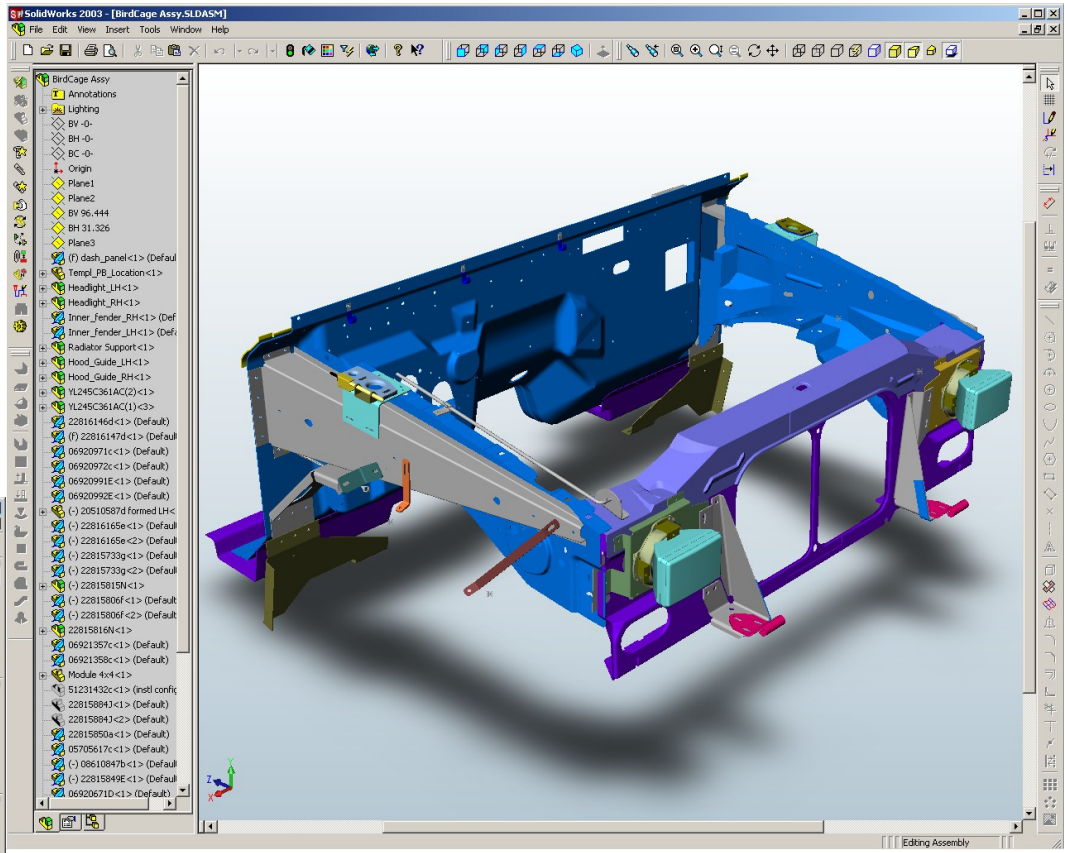
**Fill Pattern Options**

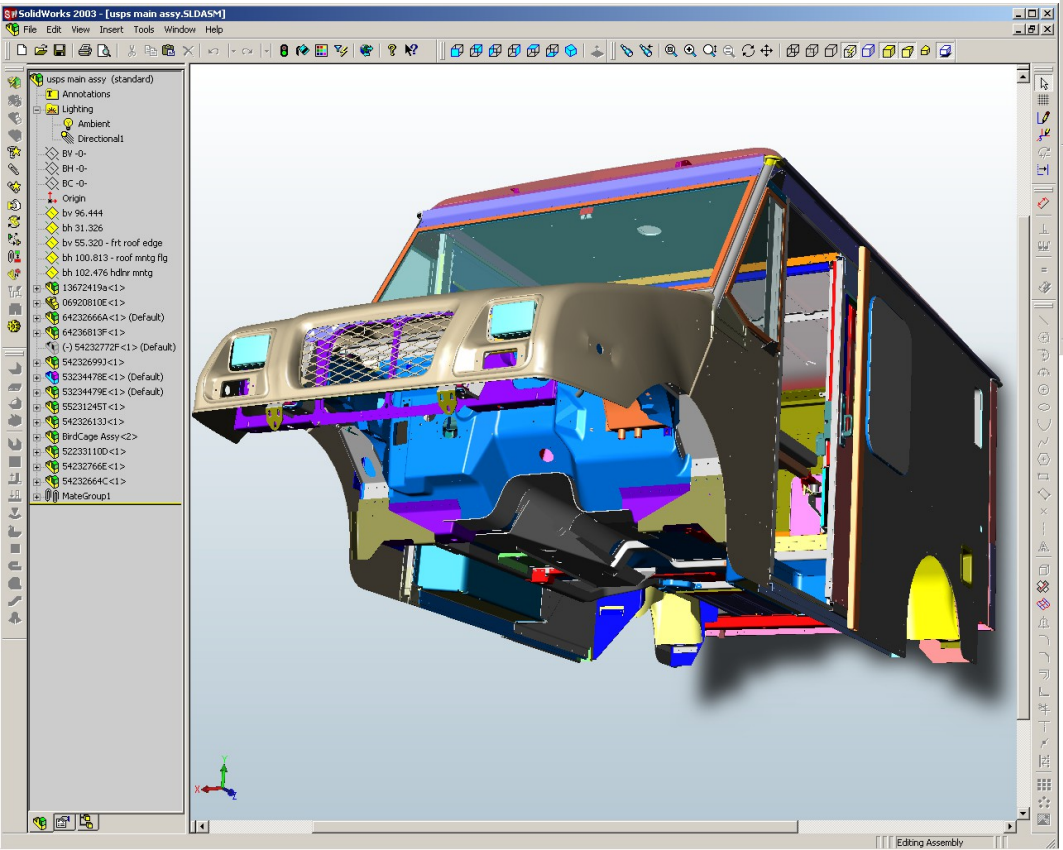
**(Size, Shape of hole and distribution)**



**Sheet Metal examples with Surfaces**

# Sheet Metal Examples

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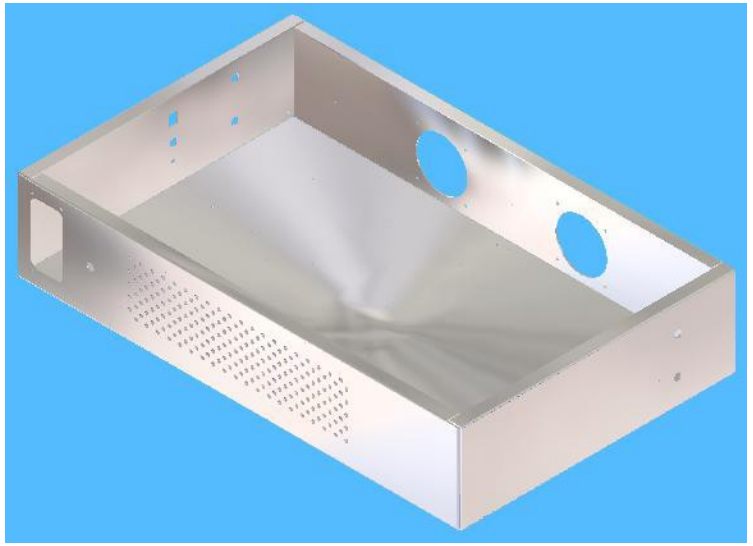
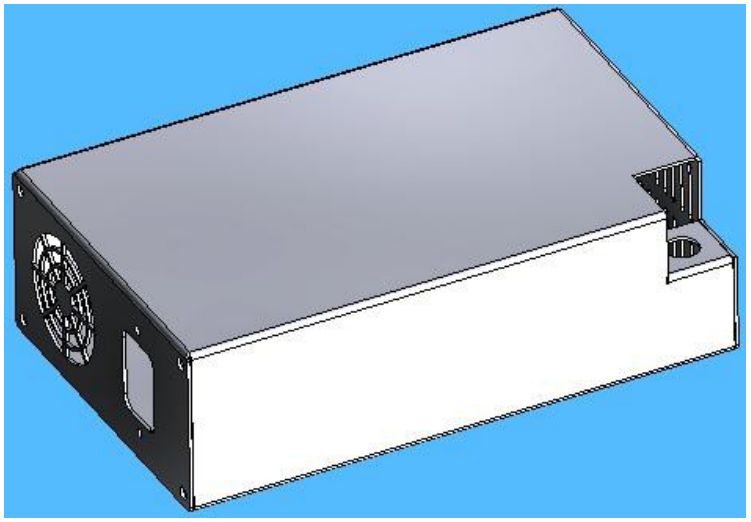
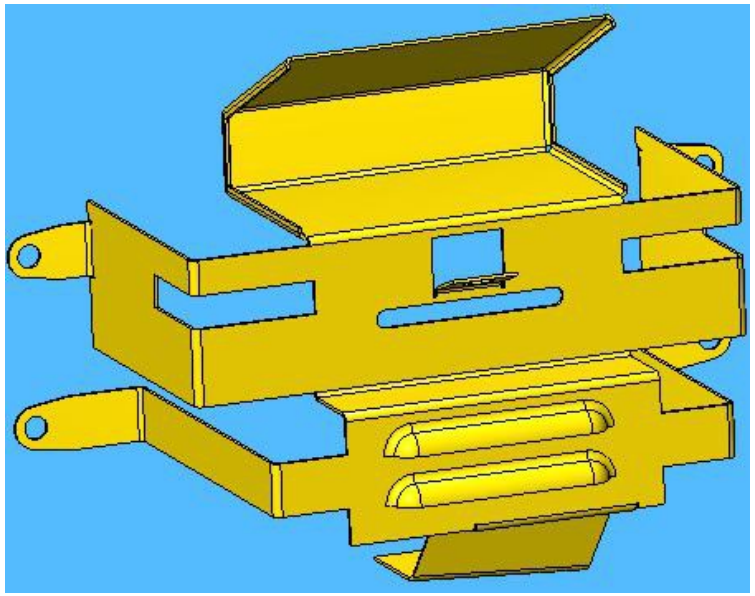
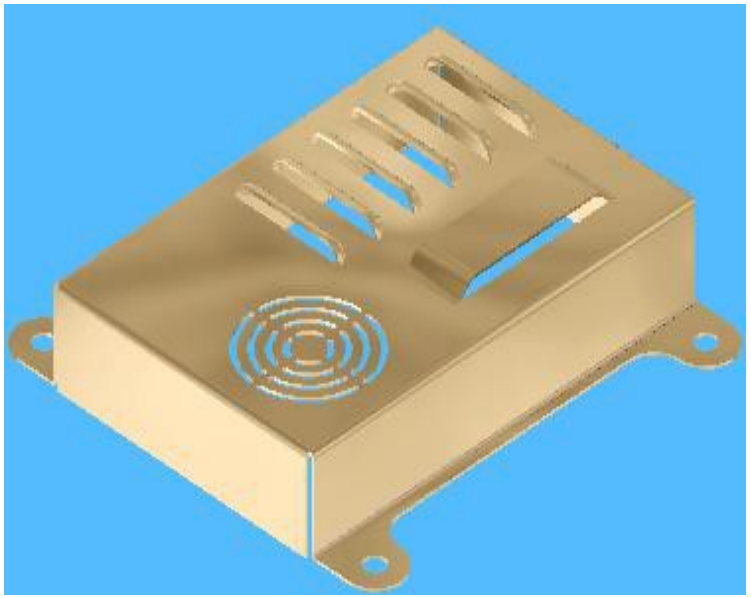
# Sample Components





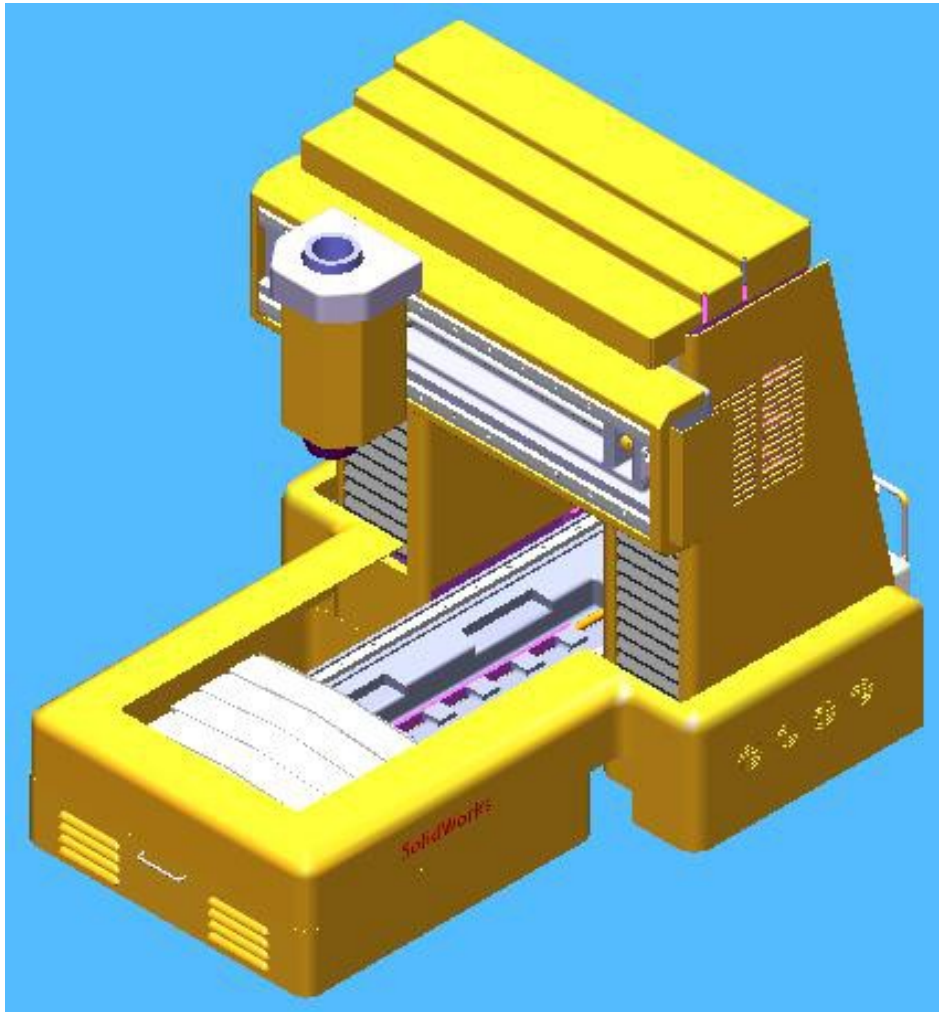


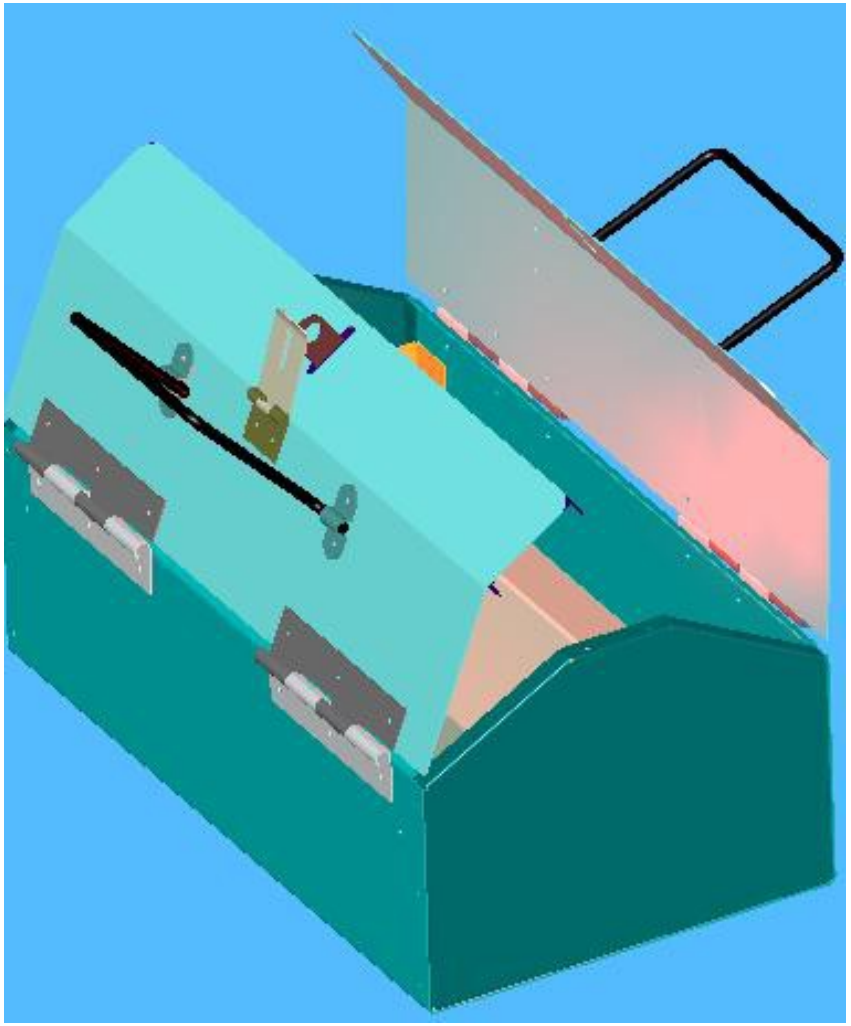


# Sheet metal Assembly

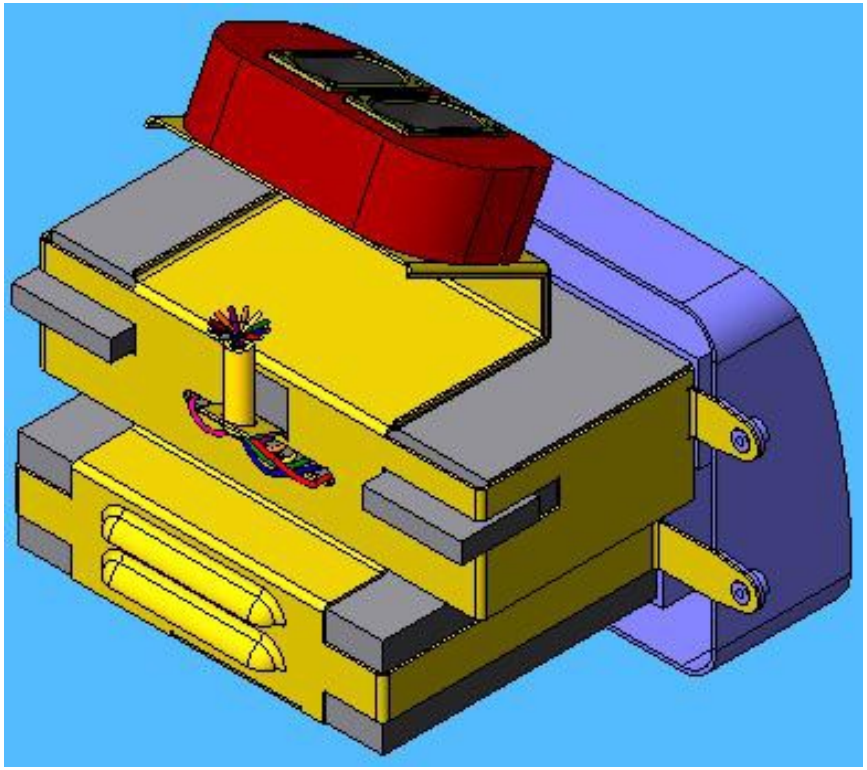
- Bottom up approach
- Top Down approach
- Smart mate technique
- Smart fasteners
- Smart Component
- Physical Simulation
- Interference Detection
- Part / Assembly Library
- Exploded View
- Mass and CG Calculations

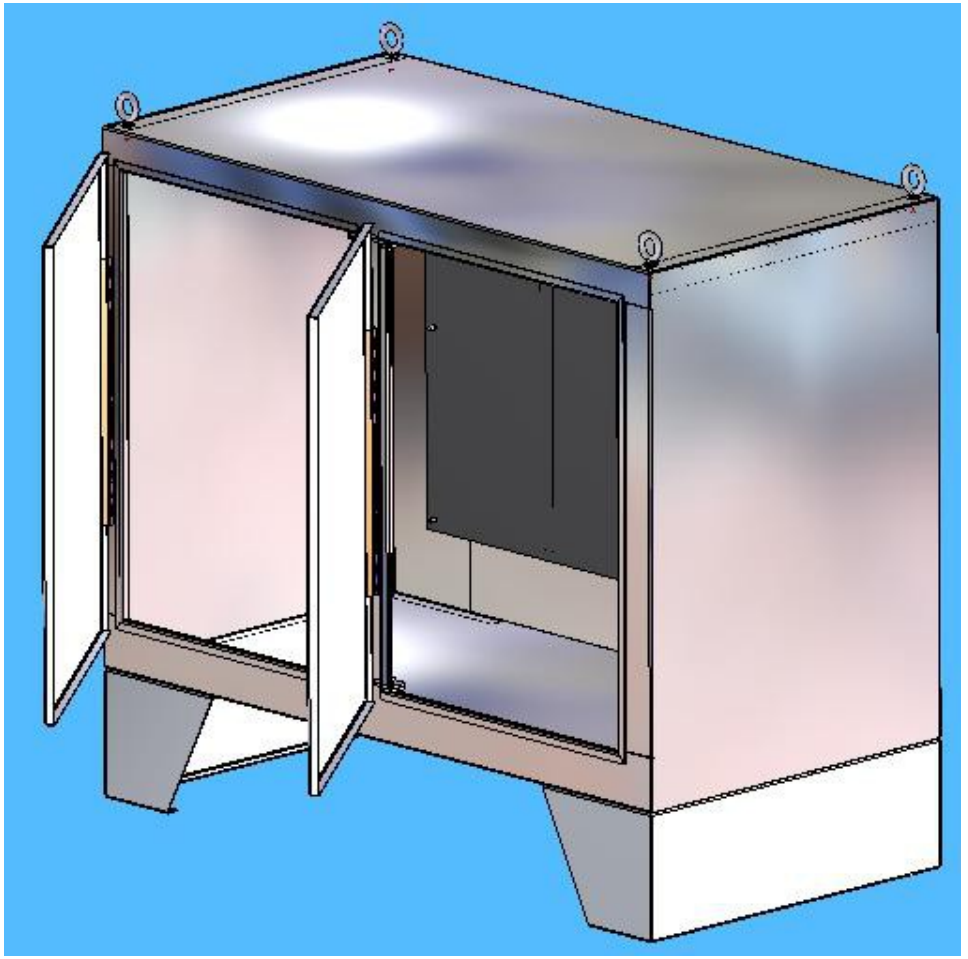
# Sample Assembly



# Sample Assembly

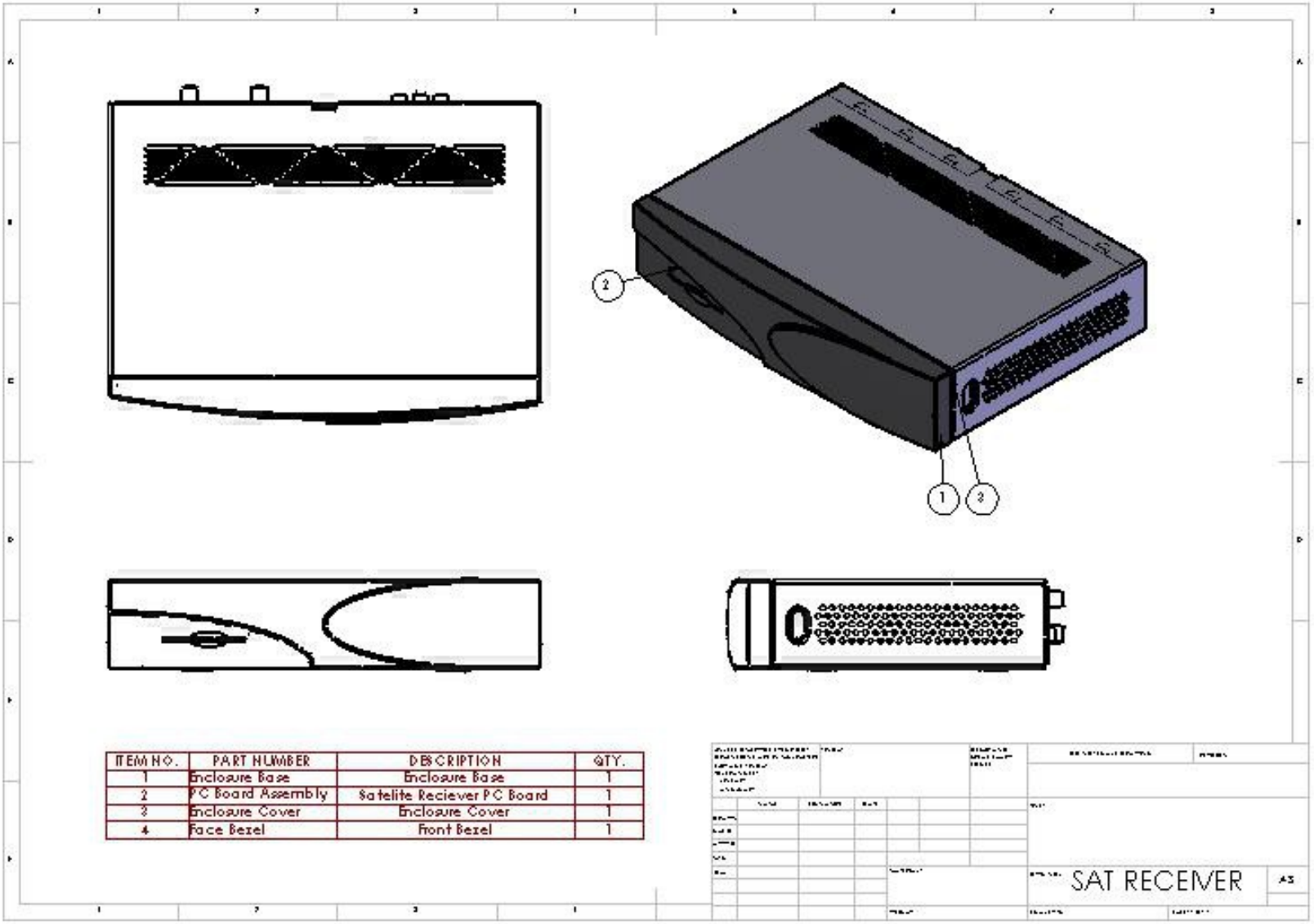




# Drawing Creation

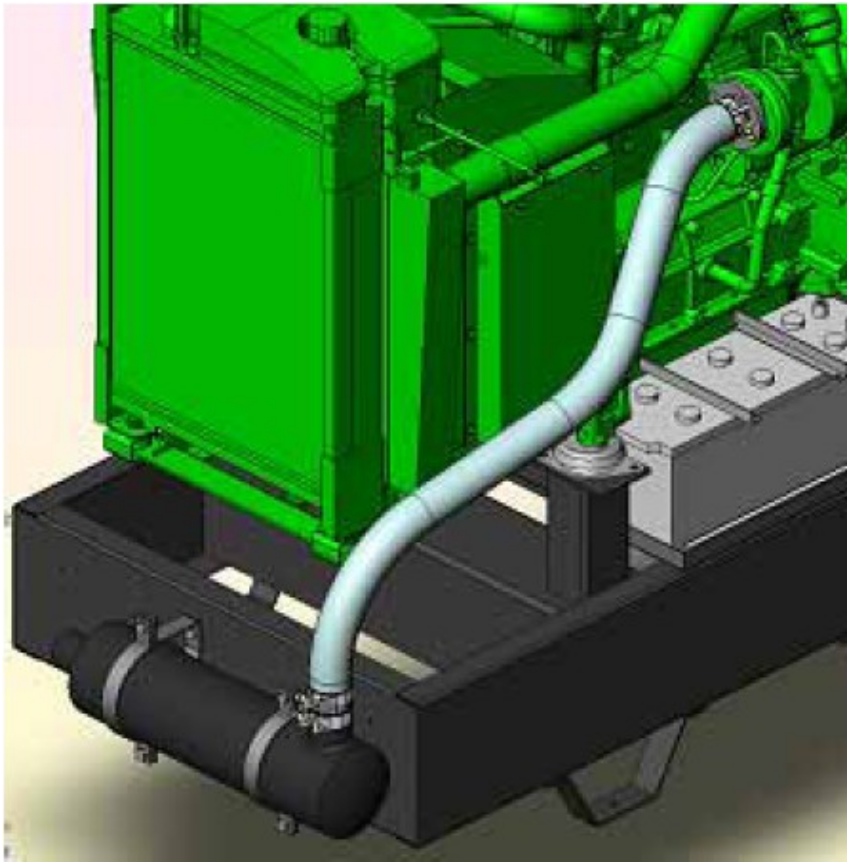
- Bi-Directional Associativity
- Flatten view with bend lines and bend notes
- Automated BOM Generation, export it as text and excel formats
- Automated Ballooning
- Exploded View
- Alternate Position view
- Automated Drawing Templates
- Save as pdf, dwg, dxf, tiff, jpeg and
- Draw Compare
- Design Checker
- Annotation Library

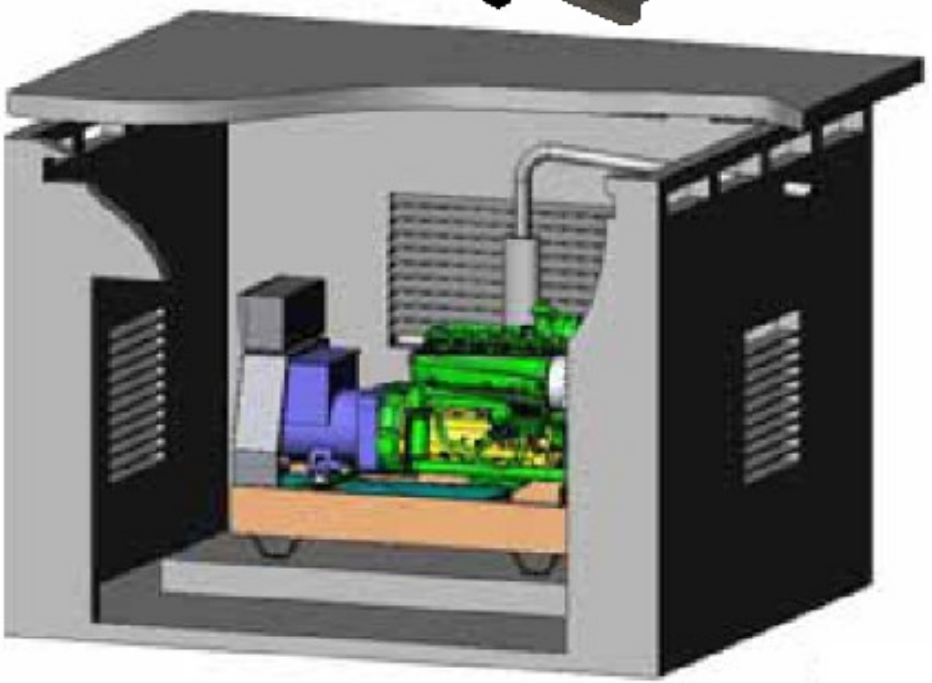
# Sample Drawing




| ITEM NO. | PART NUMBER | DESCRIPTION | QTY. |
|---|---|---|---|
| 1 | Enclosure Base | Enclosure Base | 1 |
| 2 | PC Board Assembly | Satelite Reciever PC Board | 1 |
| 3 | Enclosure Cover | Enclosure Cover | 1 |
| 4 | Face Bezel | Front Bezel | 1 |

# Sheet Metal Customer References





ABAMOTOR ENERGIA

**SolidWorks** used in Designing Sheet-metal Enclosures

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# Sheet Metal Customer References

## 2. GENERATING SET MAINTENANCE

Generating set description.(Fig 01)

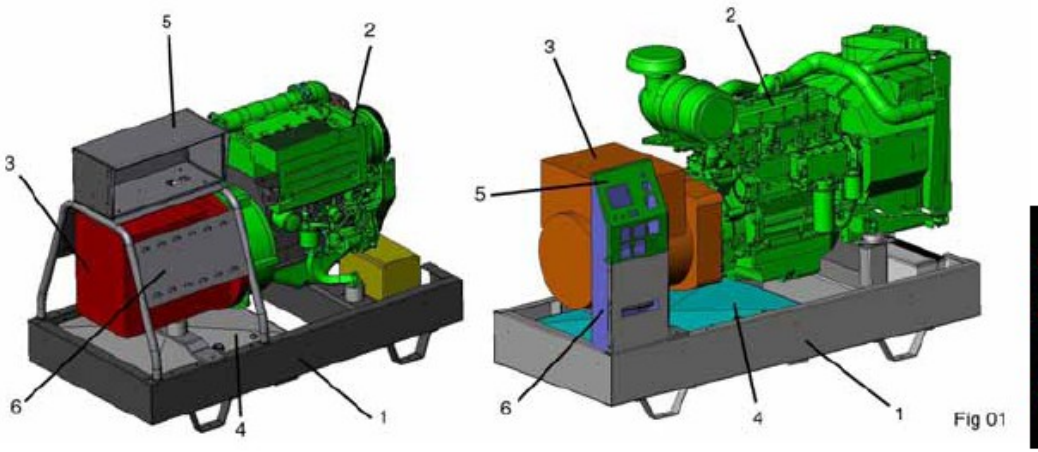



Fig 01

English

1. Frame
2. Engine
3. Alternator
4. Fuel tank
5. Control board
6. Control board support

Mains points for maintenance of frame and associate components (Fig 02)

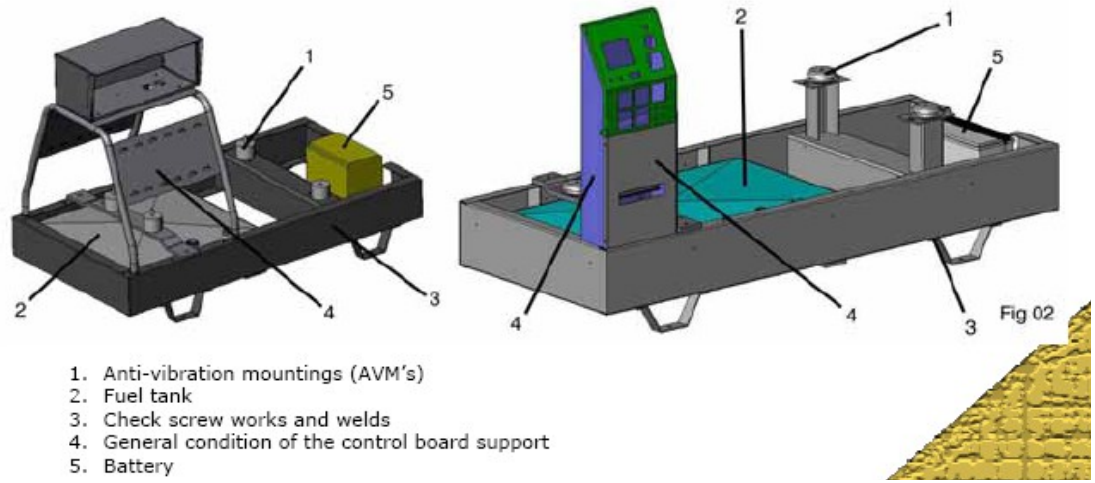



Fig 02

1. Anti-vibration mountings (AVM's)
2. Fuel tank
3. Check screw works and welds
4. General condition of the control board support
5. Battery

ABAMOTOR ENERGIA

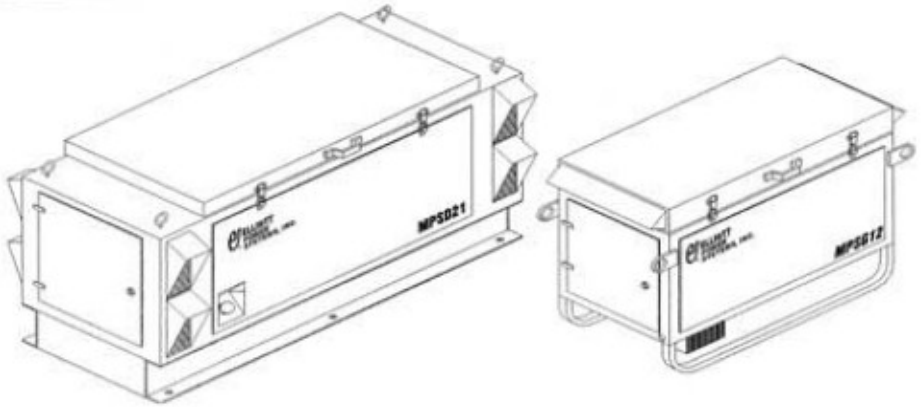
Installation manuals are developed using SolidWorks

www.egsindia.com

# Sheet Metal Customer References


| MODEL # | MPSG10 | | MPSG12 | | MPSD12 | MPSD17 | MPSD21 |
|---|---|---|---|---|---|---|---|
| FUEL TYPE | PROPANE VAPOR | NATURAL GAS | PROPANE VAPOR | NATURAL GAS | NO. 2 DIESEL | NO. 2 DIESEL | NO. 2 DIESEL |
| ELECTRICAL STANDBY SURGE OUTPUT RATING | 9.6 KW | 8.6 KW | 12 KW | 10.8 KW | 12 KW | | |
| CONTINUOUS STANDBY ELECTRICAL OUTPUT | 8.2 KW | 7.4 KW | 10.8 KW | 9.7 KW | 10.4 KW | 17 KW | 21KW |
| VOLTAGE | 120/240 | 120/240 | 120/240 | 120/240 | 120/240 | 120/240 | 120/240 |
| AMPERAGE | 80/40 | 70/35 | 100/50 | 90/45 | 100/50 | 141/71 | 175/88 |
| ENGINE MFG. | KOHLER-18 | KOHLER-18 | KOHLER-25 | KOHLER-25 | LOMBARDINI | LOMBARDINI | LOMBARDINI |
| ENGINE HP @ RATED R.P.M. | 17HP @ (3600) | 14HP @ (3600) | 23HP @ (3600) | 18HP @ (3600) | 17.7 HP @ (3600) | 28.56HP @ (1800) | 36.72 HP @ (1800) |
| ENGINE DISPLACEMENT | 624 CC | 624 CC | 725CC | 725CC | 671CC | 2068 CC | 2068 CC / TURBO |
| CYLINDERS | 2 | 2 | 2 | 2 | 2 | 4 | 4 |
| COOLING SYSTEM | AIR | AIR | AIR | AIR | AIR | WATER | WATER |
| FUEL CONSUMPTION AT FULL LOAD | 10 (4.5) lbs./hr (kg./hr.) | 155 (4.4) CFH(cu.m./hr) | 12.5 (5.6) lbs./hr (kg./hr.) | 194 (5.5) CFH(cu.m./hr.) | 1.1 (4.2) US gal/hr (Litre/hr) | 1.90 (7.2) US gal/hr (Litre/hr) | 2.24 (8.5) US gal/hr (Litre/hr) |
| SOUND LEVEL @ 23 FT, 7 M, NO LOAD | 63 dBA | 63 dBA | 63 dBA | 63 dBA | 66.7 dBA | 68.5dBA | 68.5 dBA |
| DRY WEIGHT lbs. (kg.) | 551 (250) | | 557 (253) | | 683 (310) | 1322 (600) | 1322 (600) |
| DIESEL TANK CAPACITY US gal (litre) | | | | | 7.1 (27) | 24 (92) | 24 (92) |
| BASIC FOOT PRINT L x W x H | 43.5 x 21.25 x 36.5 | | 43.5 x 21.25 x 36.5 | | 43.5 x 21.25 x 36.5 | 70.25 x 27 x 37.5 | 70.25 x 27 x 37.5 |
| STANDARD FEATURES INCLUDE: | | | | | | | |
| SOUND ATTENUATED WEATHERPROTECTIVE ENCLOSURE | | | | | | | |
| BATTERY CHARGER | | | | | | | |
| MAIN LINE CIRCUIT BREAKER | | | | | | | |
| EXHAUST MOUNTED SPARK ARRESTING SCREEN | | | | | | | |
| STANDARD COLOR # HAL 7035 LIGHT TURBO GRAY | | | | | | | |
| MPSD17 & MPSD21 HAVE GLOW PLUGS AND A BLOCK HEATER FACTORY INSTALLED | | | | | | | |

ELLIOTT POWER SYSTEMS, INC.

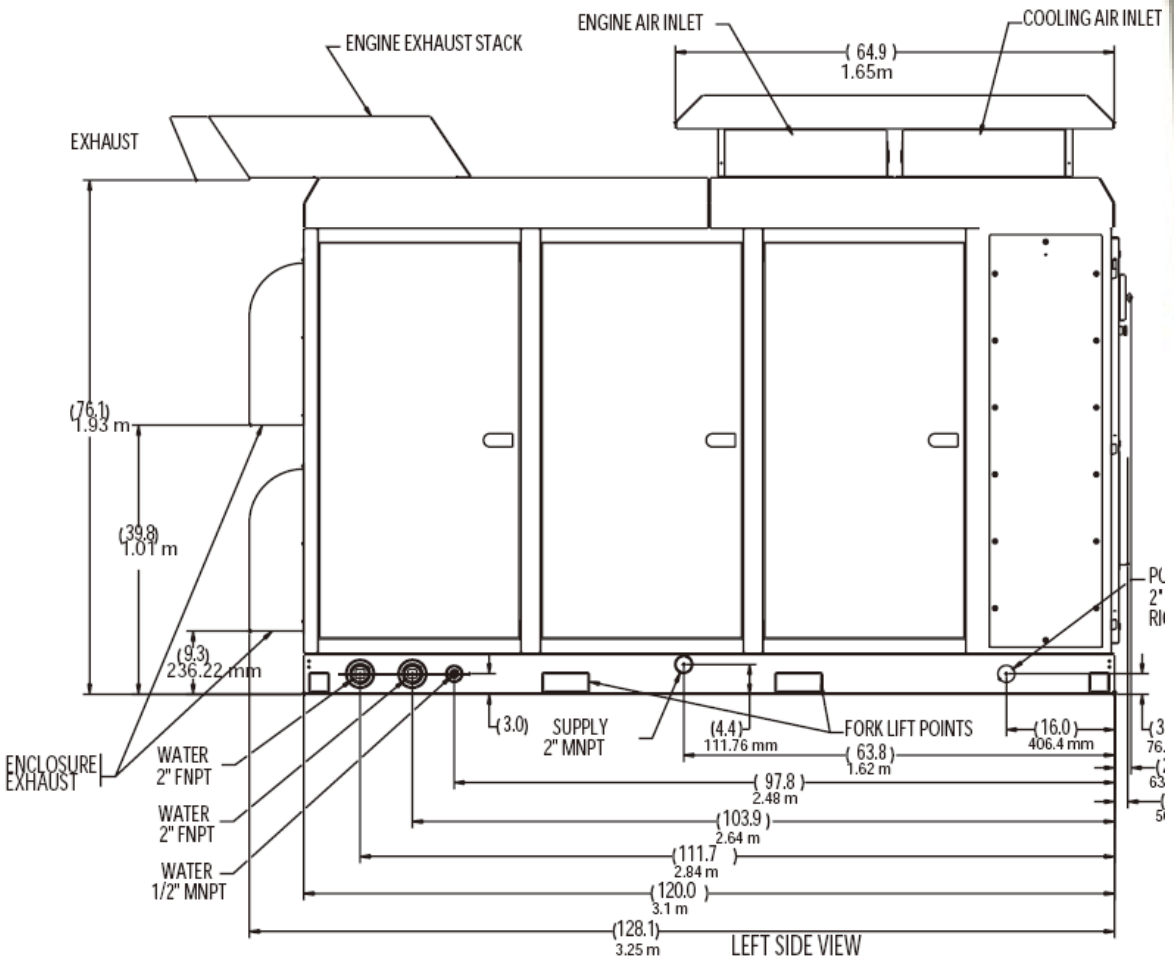



**SolidWorks** is used for Sheet Metal Design

Configurations used for flexible design

# Reference in Power Generator Equipment

ELLIOTT MICROTURBINES
EBARA GROUP

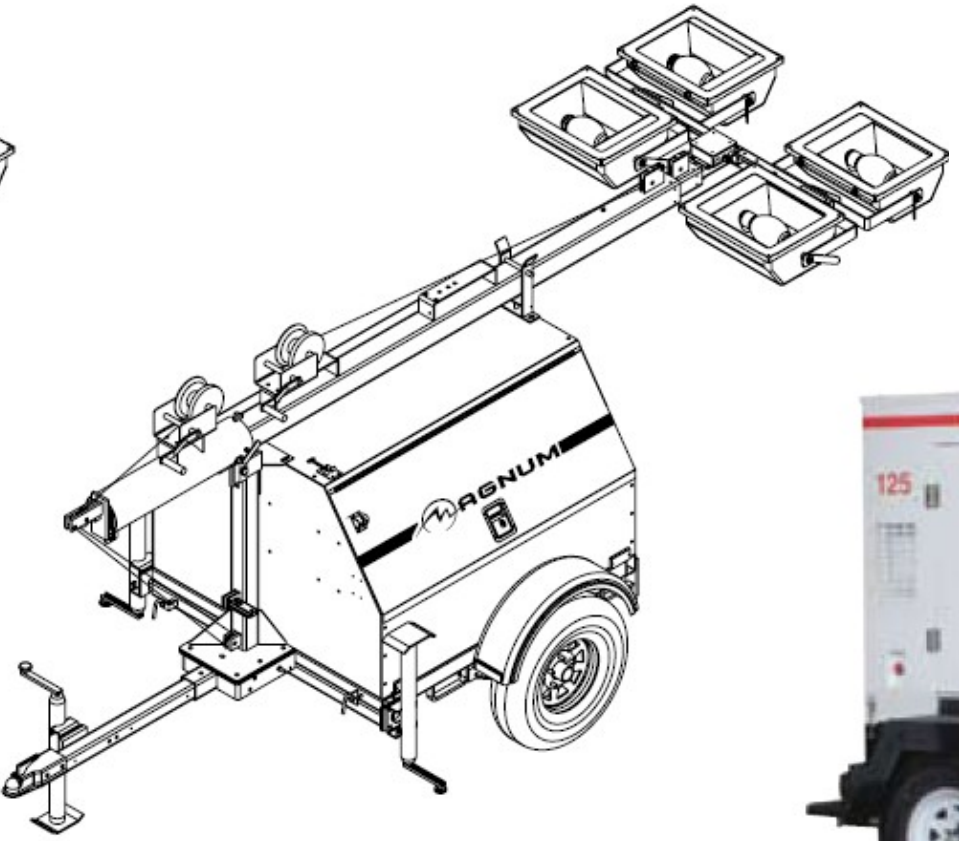



SolidWorks is used for Generator Set design at Elliott

Generation of Layout drawings in SolidWorks

www.egsindia.com

# SolidWorks Customer References




4000 Series

AGNUM


MODEL MMG125

Leverages on SolidWorks 3D for Design and Downstream requirements

www.egsindia.com

# References in Power Generator Equipment



Bredenoord
DE ZEKERHEID DIE U BELOOFT

aggreko

**SolidWorks Customers**

www.egsindia.com

# SolidWorks Sheet Metal Design References

ADVANCED®
Diesel Engineering Ltd.

Advanced Diesel Engineering uses SolidWorks to design canopies as shown

# SolidWorks in Use




STEMAC
GRUPOS GERADORES
YOUR ENERGY SOLUTION

SolidWorks Sheet Metal Design
in Real-World Applications

# Reference in Power Generator Equipment


REAGAN EQUIPMENT COMPANY

PRAMAC GROUP POWER ENGINEERING

Users of SolidWorks for Enclosure and Control Panel designs

www.egsindia.com

# Reference in Power Generator Equipment

AIR MOBILITY COMMAND

## Power-Plus DCGS3040

***30 kW, Tactical Quiet Generator Set***
***400 Hz, Diesel Engine Driven, Skid Mounted***

**The Power Plus DCGS3040 Digital Controlled Generator** is a portable, skid-mounted, self-contained unit ruggedly constructed with a proven reputation for long, trouble-free operation. The diesel engine is fully compliant with EPA emissions limits. All units are provided with digital controls, instruments and accessories necessary for operation as a single unit or in parallel with other units of the same type and rating. All components including the generator and controls have been engineered for minimum maintenance. The unit is skid-mounted and fully enclosed with an integral fuel tank and auxiliary fuel input hose and valve. This unit is the commercial equivalent of the DOD Model MEP-815B.

*Standard Features*

- *Rugged Construction*
- *Digital Instrumentation*
- *Fully Instrumented*
- *Military Standard Design*
- *Digital Controls*
- *Fully Protected Circuitry*
- *High Reliability*

***SPECIFICATIONS***

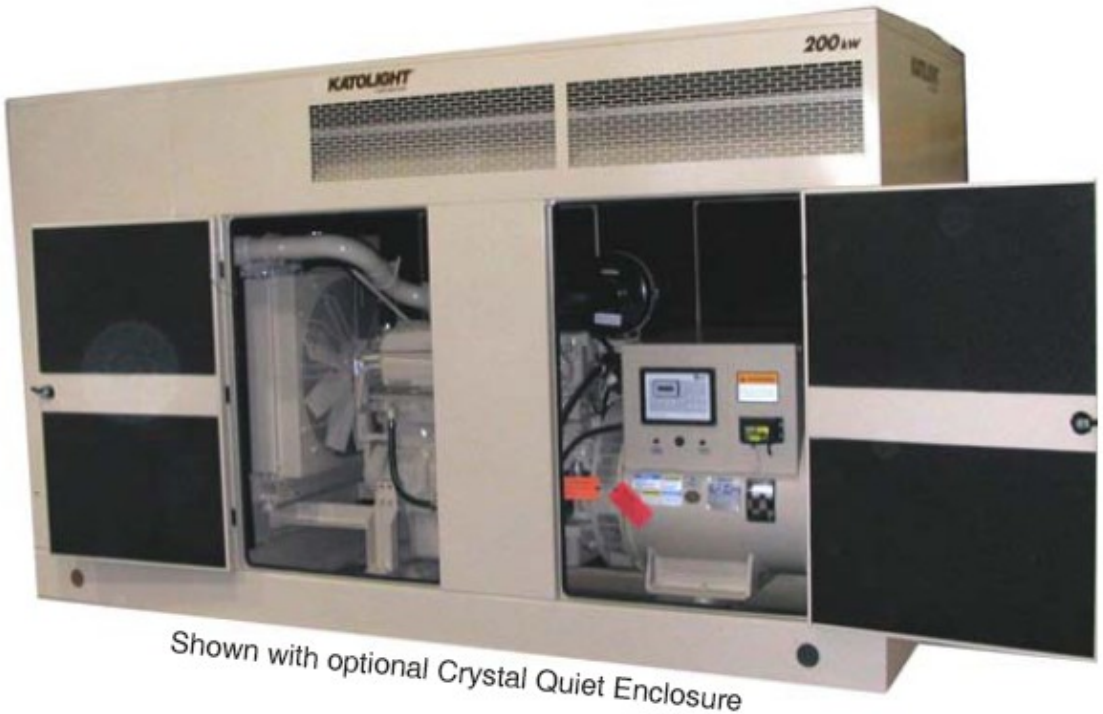
***MODEL TYPE:*** Power Plus DCGS3040 Skid-Mounted, Self-Contained, Militarized, Portable, Brushless, Diesel Engine Driven Generator Set with Integral Digital Controls and 8-hr. Onboard Fuel Capacity

L3 communications
Westwood
MC II Electric

A SolidWorks customer in Generator Set application

www.egsindia.com

# Reference in Power Generator Equipment



Shown with optional Crystal Quiet Enclosure


STEPHILL® GENERATORS

Power System Solutions
KATOLIGHT® CORPORATION

**SolidWorks Customers**

**SolidWorks is # 1 in Production**

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Engineering Global Solutions
Evolution thro' Knowledge

# Sheet-Metal Customer Reference

- Zero Zone, Inc. is a leading manufacturer of display coolers, freezers, and refrigerated merchandizing cases. For years, company engineers used AutoCAD® to design its products. In 1997, according to project engineer Owen Warr, Zero Zone hired an engineer intern who had experience using the SolidWorks® 3D mechanical design system.
- "The intern asked to use SolidWorks on the project he was assigned," Warr recalls. "Within months, the amount and quality of his work was a real eye-opener. In one week, he was able to design a complete product with four different-sized variations. We were impressed with the intern's effort and realized that 3D modeling could provide significant advantages over 2D."
- "SolidWorks provides the sheet metal functionality we need," says Mr. Owen Warr. "We make extensive use of this functionality in combination with configurations. SolidWorks has been very responsive in adding new features. We believe SolidWorks is one of the best design packages out there for handling sheet metal."


## Results using SolidWorks:

Shortened design cycle by 66 percent
Increased sales by 335 percent
Reduced ECO process by 85 percent
Cut number of prototypes by 78 percent

# Sheet-Metal Customer Reference

## Creactive designs Chiller Cabinet for Syspal Ltd.

Creactive Design's work for Syspal Ltd. is a great example of how using SolidWorks native data to communicate saved time and money. Syspal, the UK 's number one supplier and manufacturer of stainless steel and aluminium products, won the contract to supply Chiller Cabinets to the company Bombardier for the refurbishment of the GNER Mark IV railcar rolling stock. Bombardier Transportation is the global leader in the rail equipment, manufacturing and servicing industry.

Lead times were very tight so Syspal commissioned Creactive Design, an award winning product design consultancy, to design the new cabinet. Creactive was commissioned in large part because they were experienced SolidWorks users, therefore able to provide files that would be native to Syspal's in-house SolidWorks system. This would make it much easier to meet the tight delivery time. **Creactive's use of SolidWorks reduced time to market by at least 20 percent**.

The assembly was based around stainless steel and aluminum fabrication and the development program **exploited the sheet metal functions of SolidWorks to the full**. Having agreed upon details such as bend allowances and notching parameters to suit Syspal's manufacturing equipment, the sheet metal parts were laser profiled directly from the flat patterns generated in SolidWorks.

Creactive, enabled by SolidWorks, was able to complete Syspal's commission with great success. The design program was completed in 4 weeks from being briefed and included the creation of 81 unique parts, 17 sub-assemblies and 65 associated production drawings.

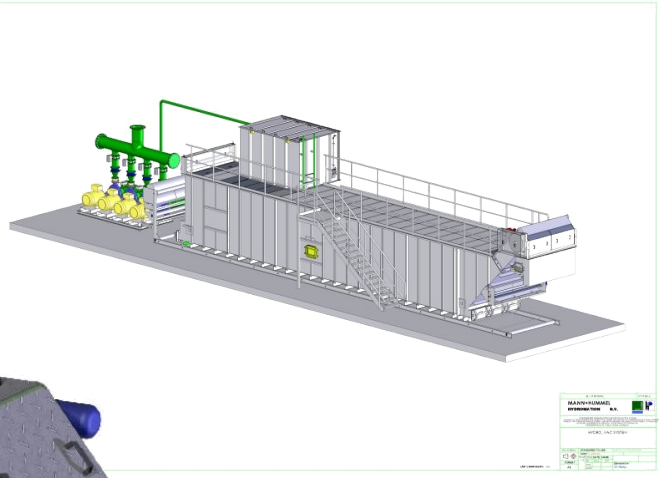
# Customer Story of Migrating from Autodesk Inventor

Mann + Hummel Hydromation is the leading producer of automated coolant filtration and swarf (metal chips) handling systems for use with industrial processes involving high-speed metal cutting. The company designs, constructs, and installs its systems in large manufacturing plants for a range of customers, including major automobile manufacturers. Mann + Hummel Hydromation used Autodesk Inventor® 3D design software to develop its systems until 2003.

While attending a trade show, company representatives saw a quick demonstration of the SolidWorks® 3D mechanical design system in 2003 and began evaluating the software for implementation, according to Dirk Novak, CAD coordinator. “We were particularly interested in how SolidWorks handled large assemblies, which are used heavily in the
development of our coolant filtration and swarf handling systems,” he says.

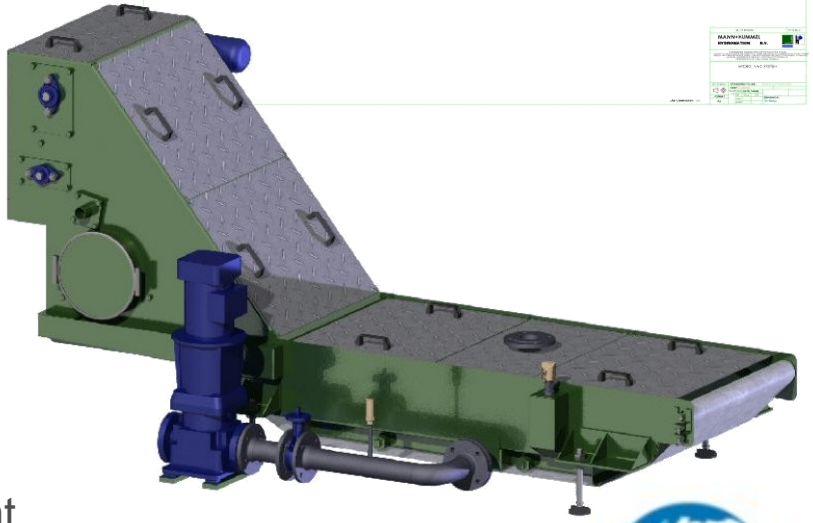
Novak asked his local SolidWorks reseller, Cadmes Belgium, for a complete demonstration. “**When I saw SolidWorks configuration capabilities, I was impressed by the power and flexibility of the software, and realized we needed those capabilities to energize our product development effort,” notes Novak. “We also saw the potential for using SolidWorks sheet-metal capabilities and the SolidWorks Routing package for further automating systems development**.”

“After we saw the capabilities of SolidWorks software, we believed we could realize a range of productivity improvements by implementing SolidWorks across the board for all new product development,” Novak adds.



**Mann + Hummel Hydromation chose to migrate to SolidWorks software, installing 15 seats, because of its large assembly, configuration, and sheet-metal design capabilities.**

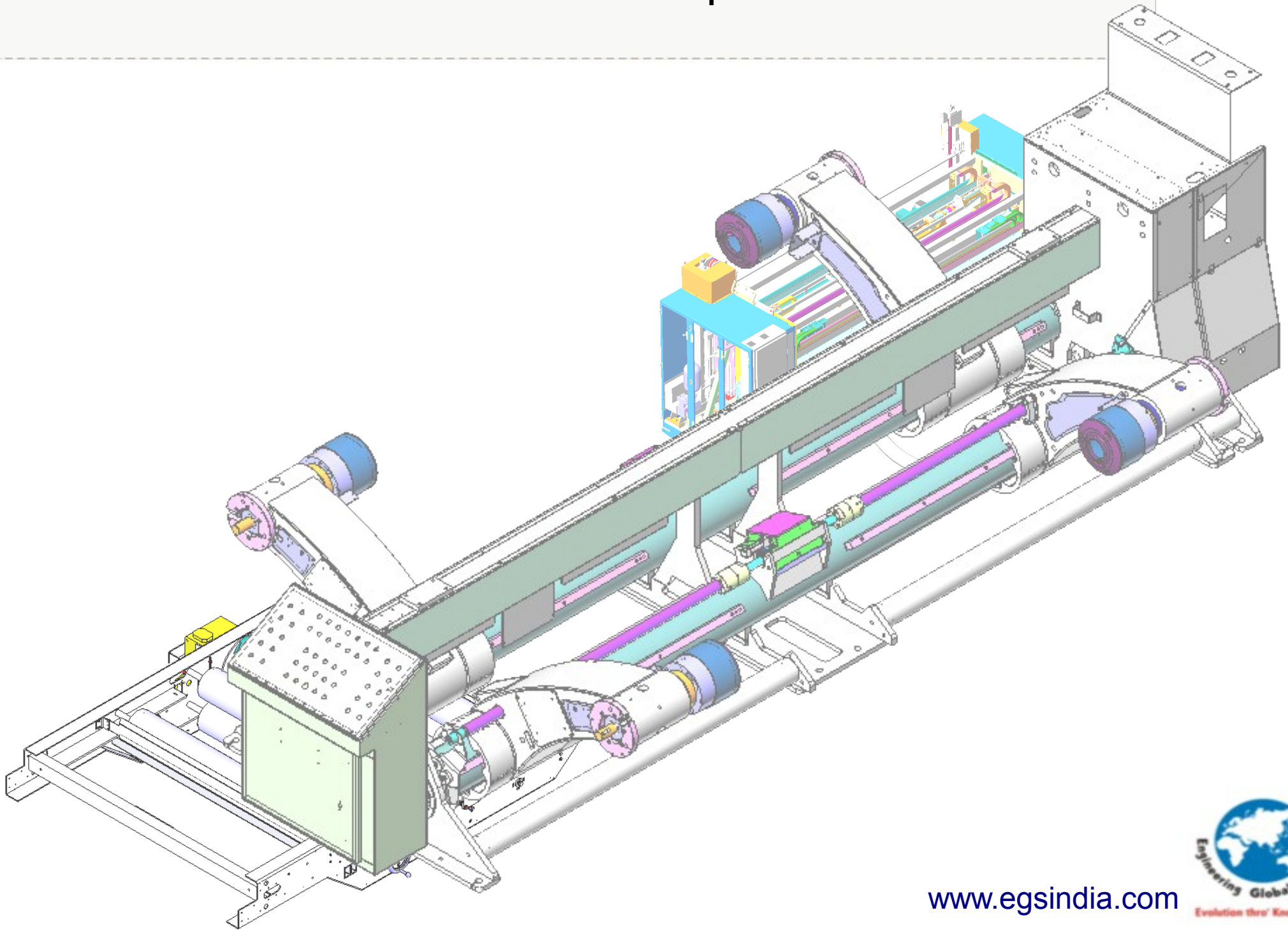
The company wanted to tap the software’s performance power, robust application program interface (API), and versatility. The company also uses SolidWorks Routing software for routing cables, wiring, and piping throughout its custom-designed cooling and filtration systems.



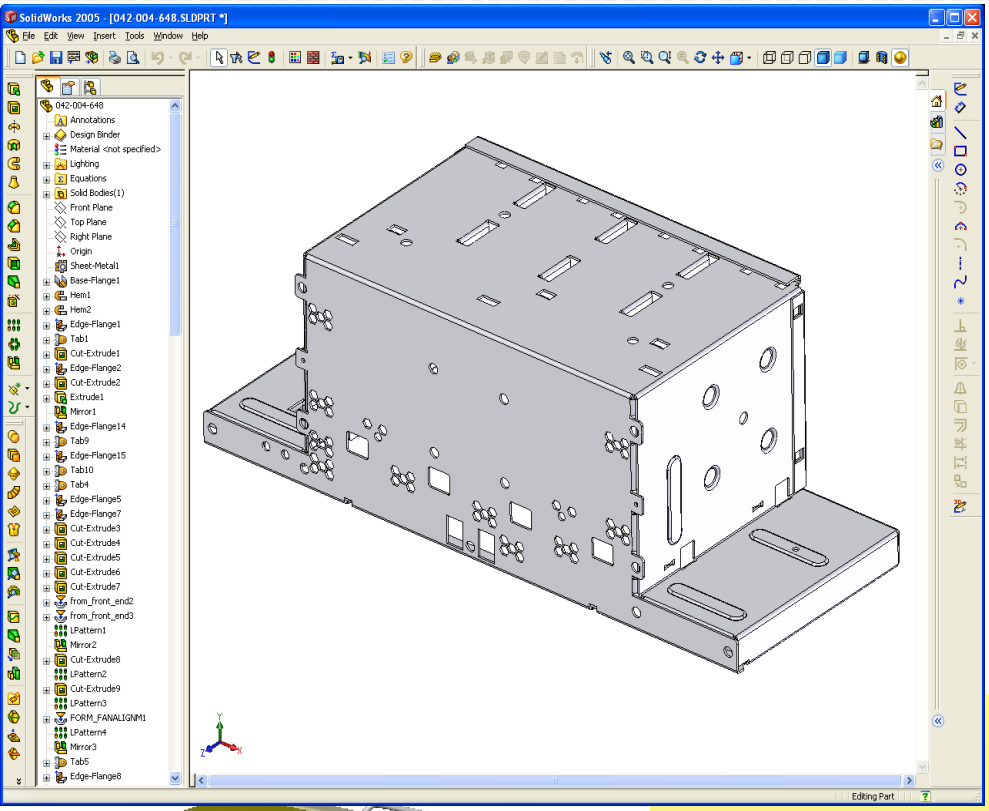
## Results using SolidWorks:

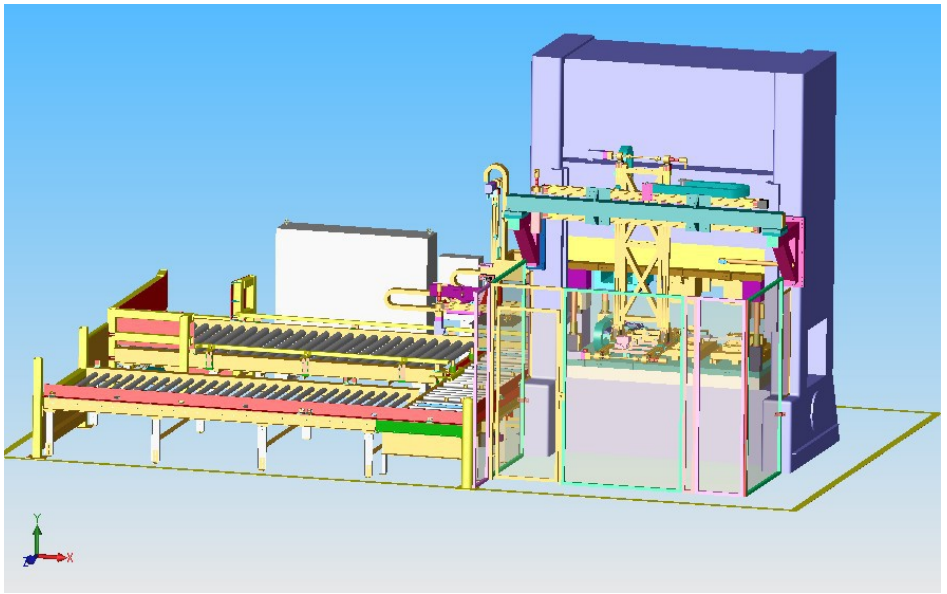
- Reduced design cycles by more than 30 percent
- Shortened time required to make design changes by 90 percent
- Improved quality and minimized design errors
- Enhanced design communications with existing & prospective customers

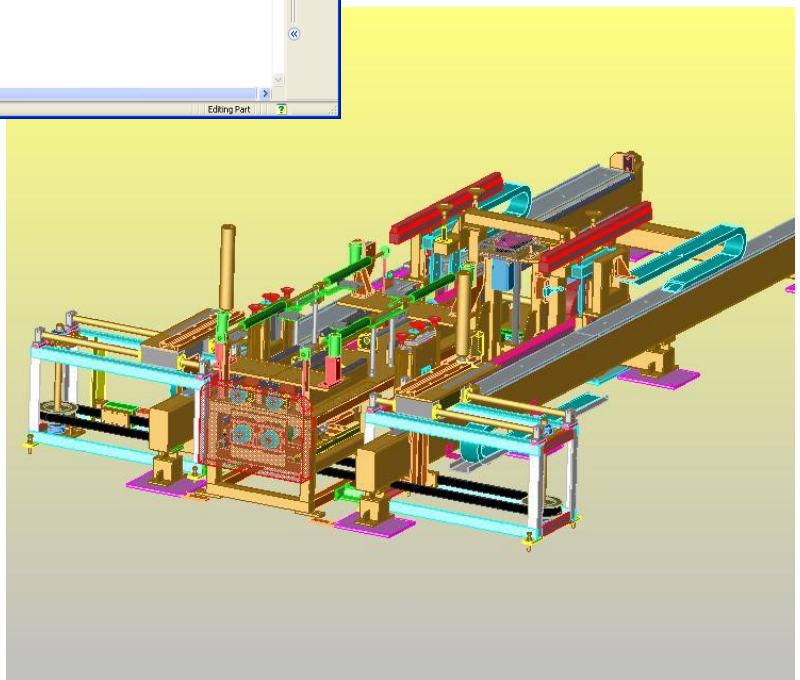
# Sheet Metal Examples



# Sheet Metal Examples



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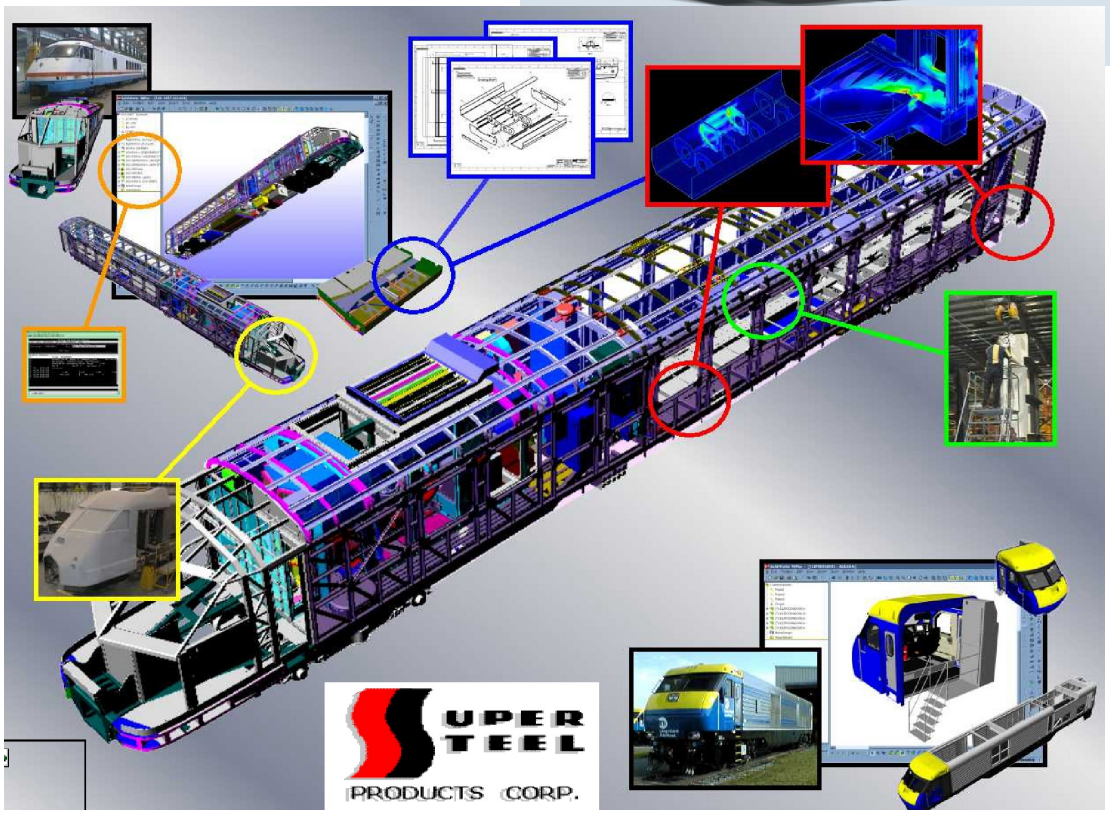
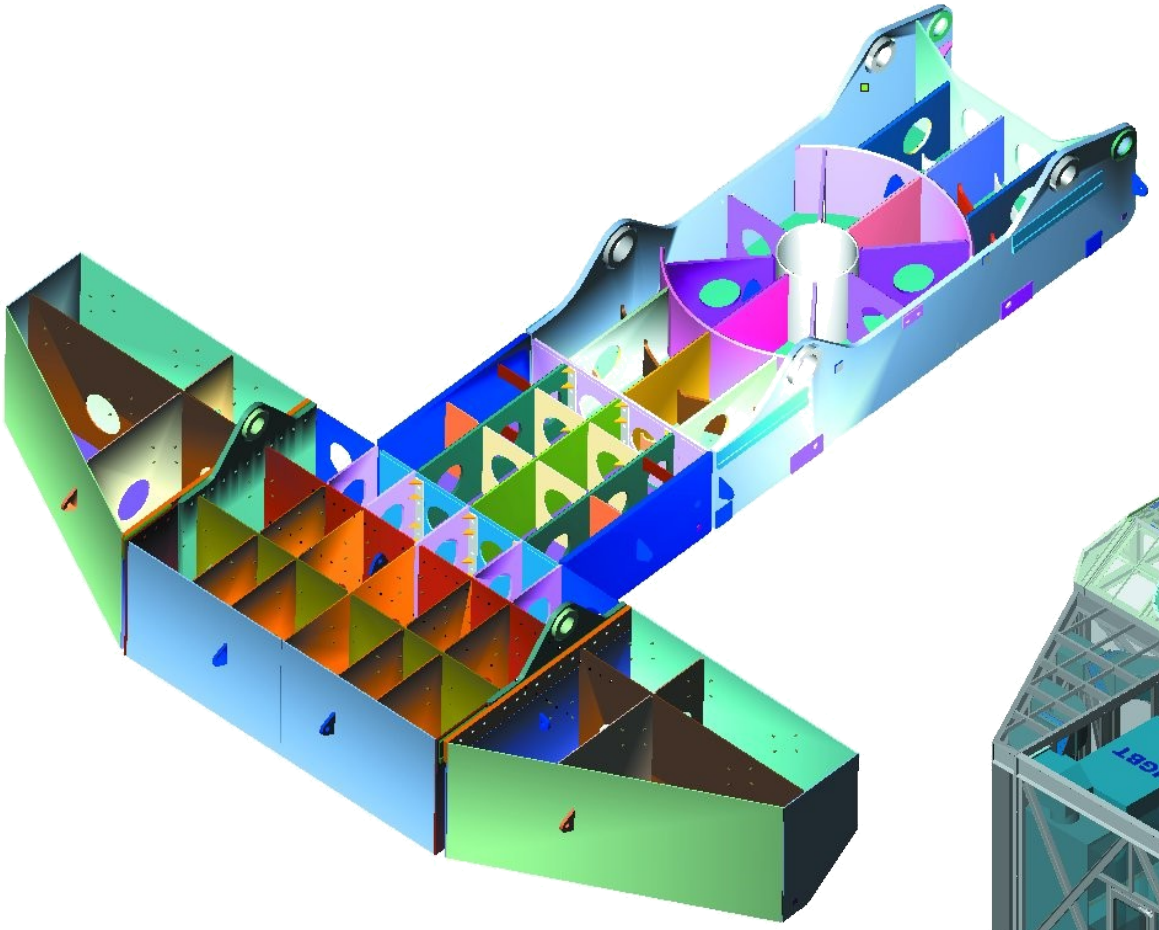
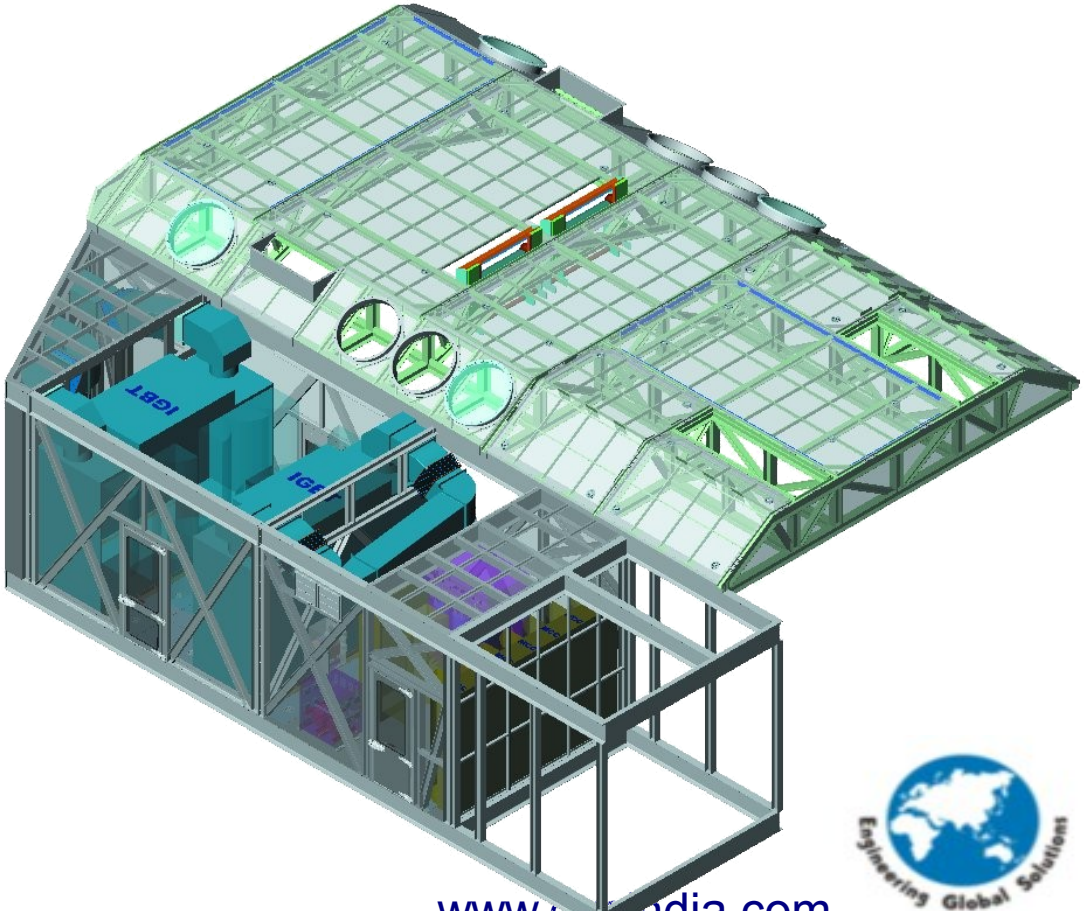
# Sheet Metal in action

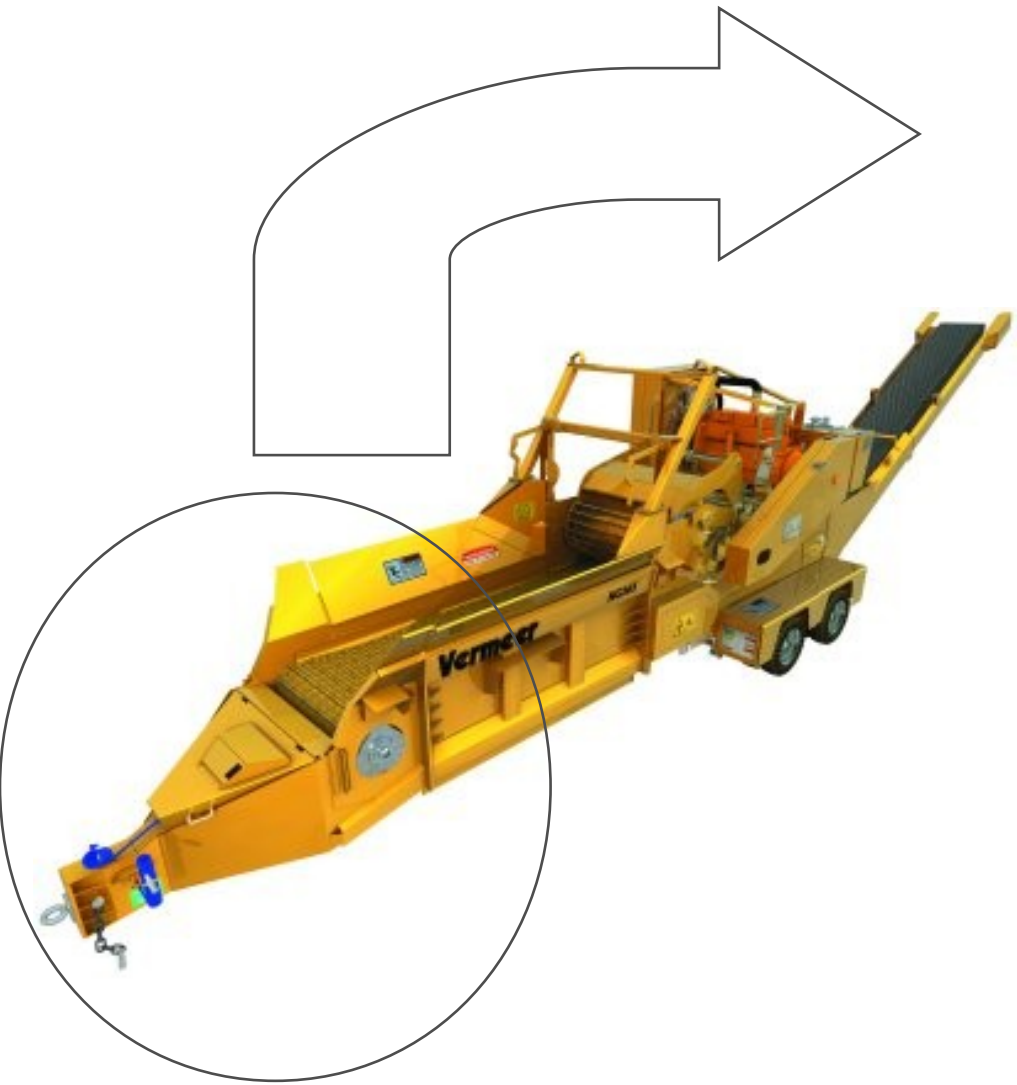


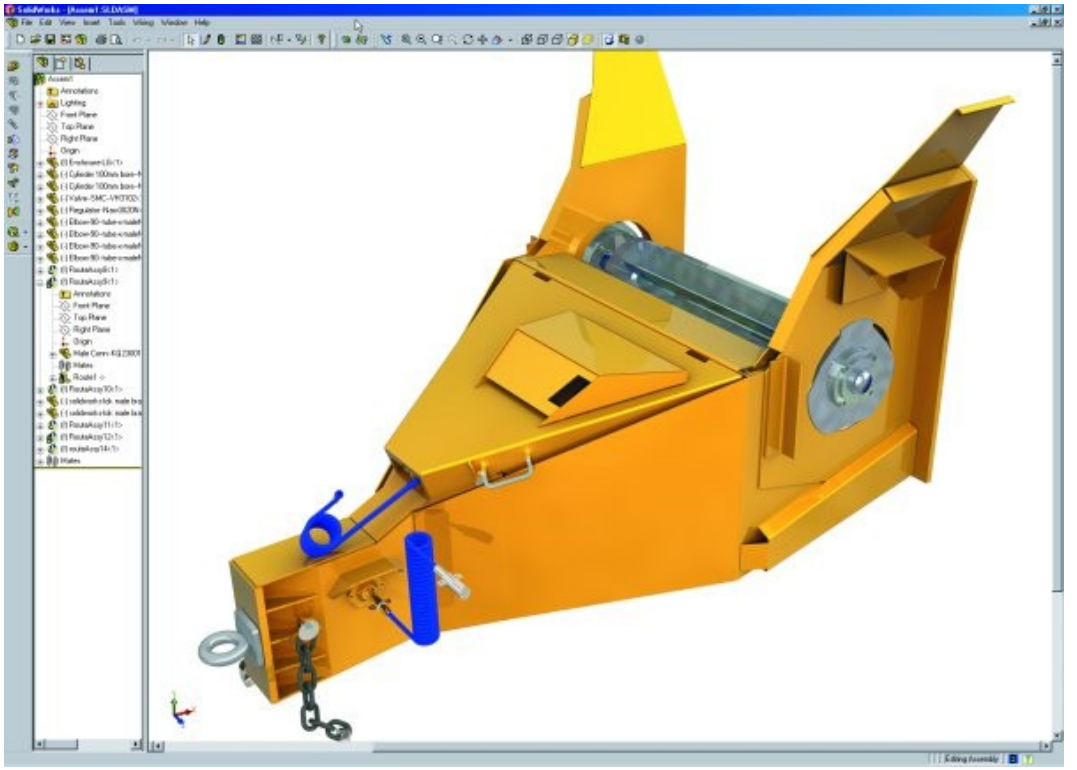
# Sheet Metal assemblies in complex shapes





# Fabricated Sheet metal design

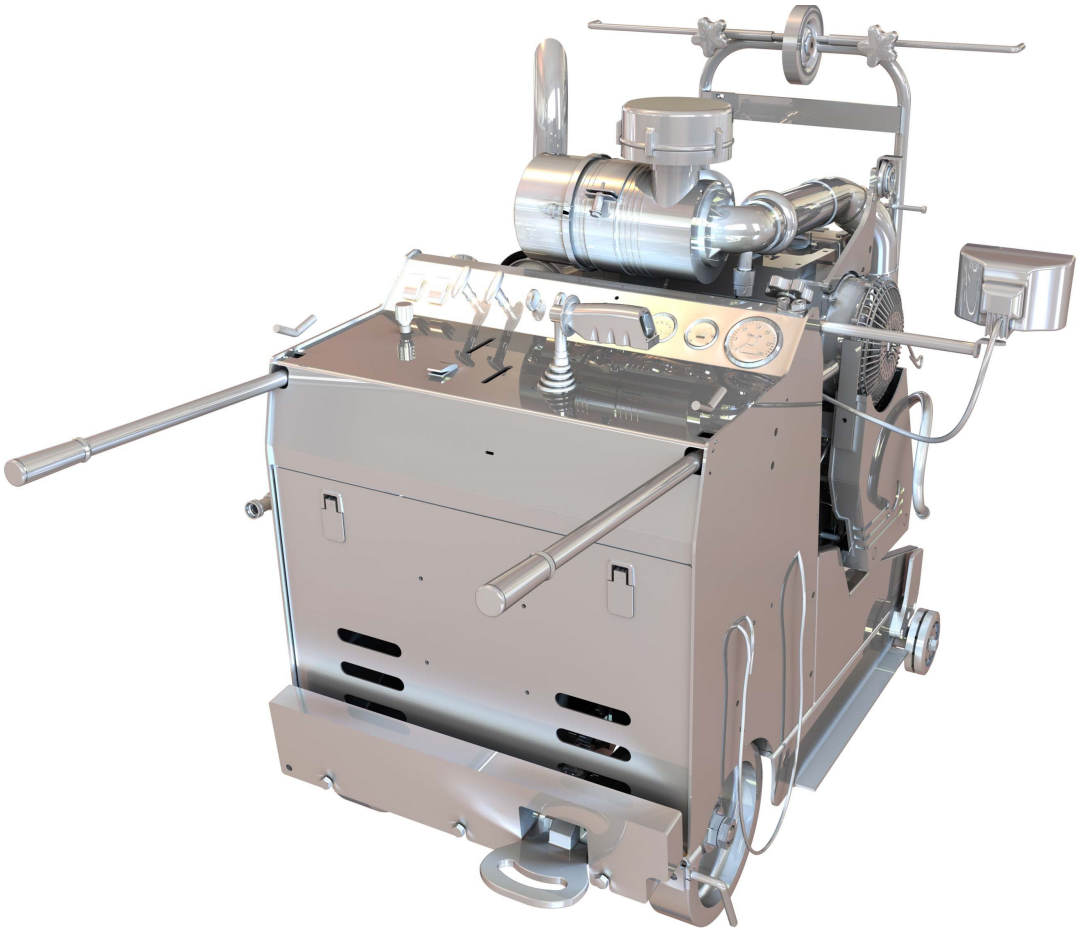


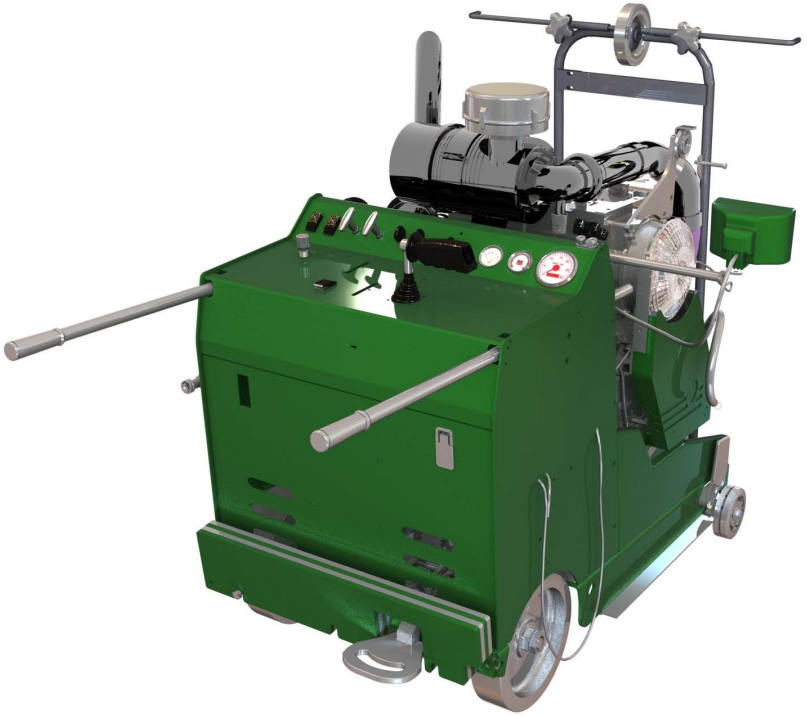



# SolidWorks Design in production

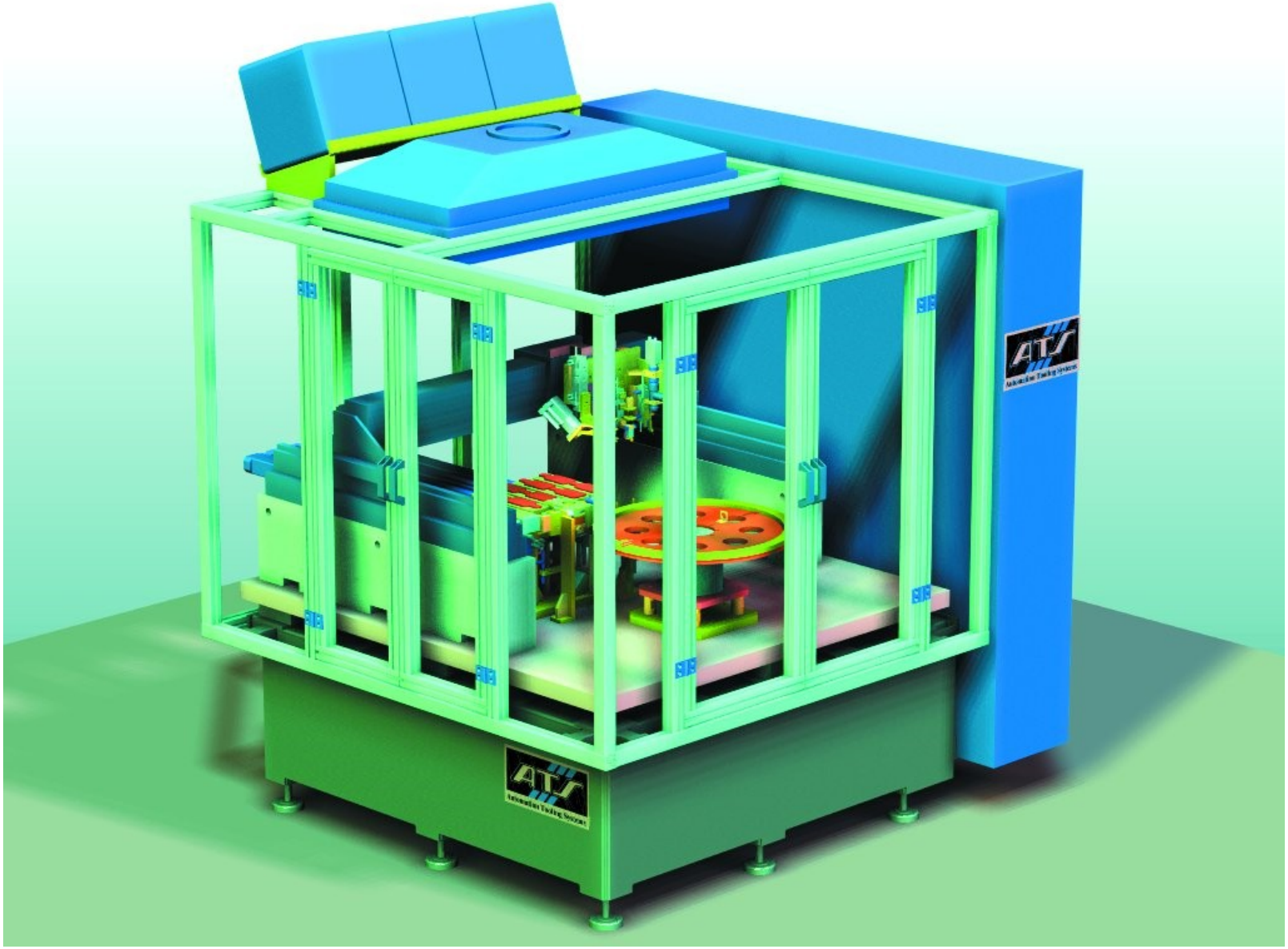

dia.com

# Sheet Metal Design Alternates in SolidWorks



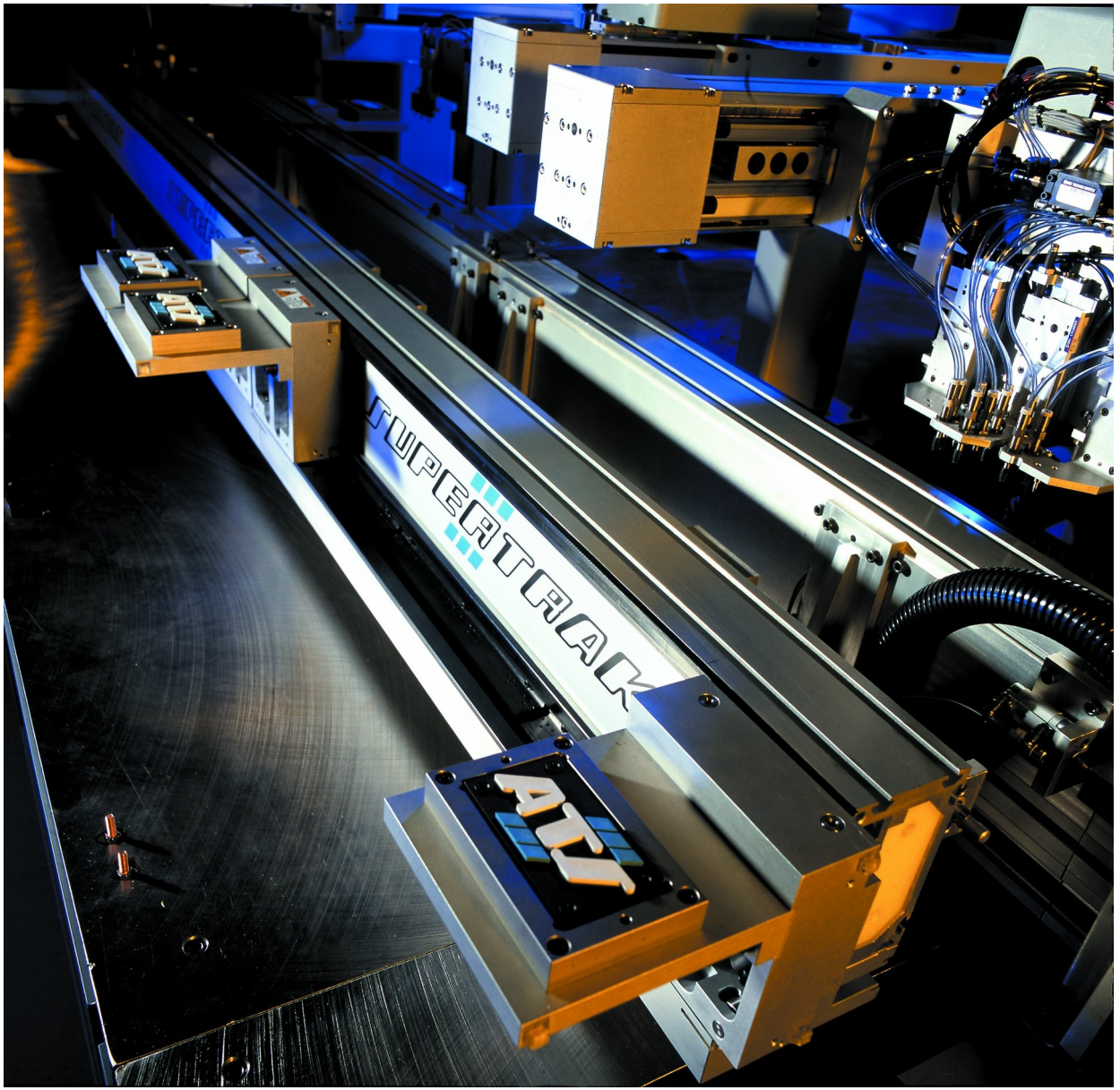


# Rendered in SolidWorks



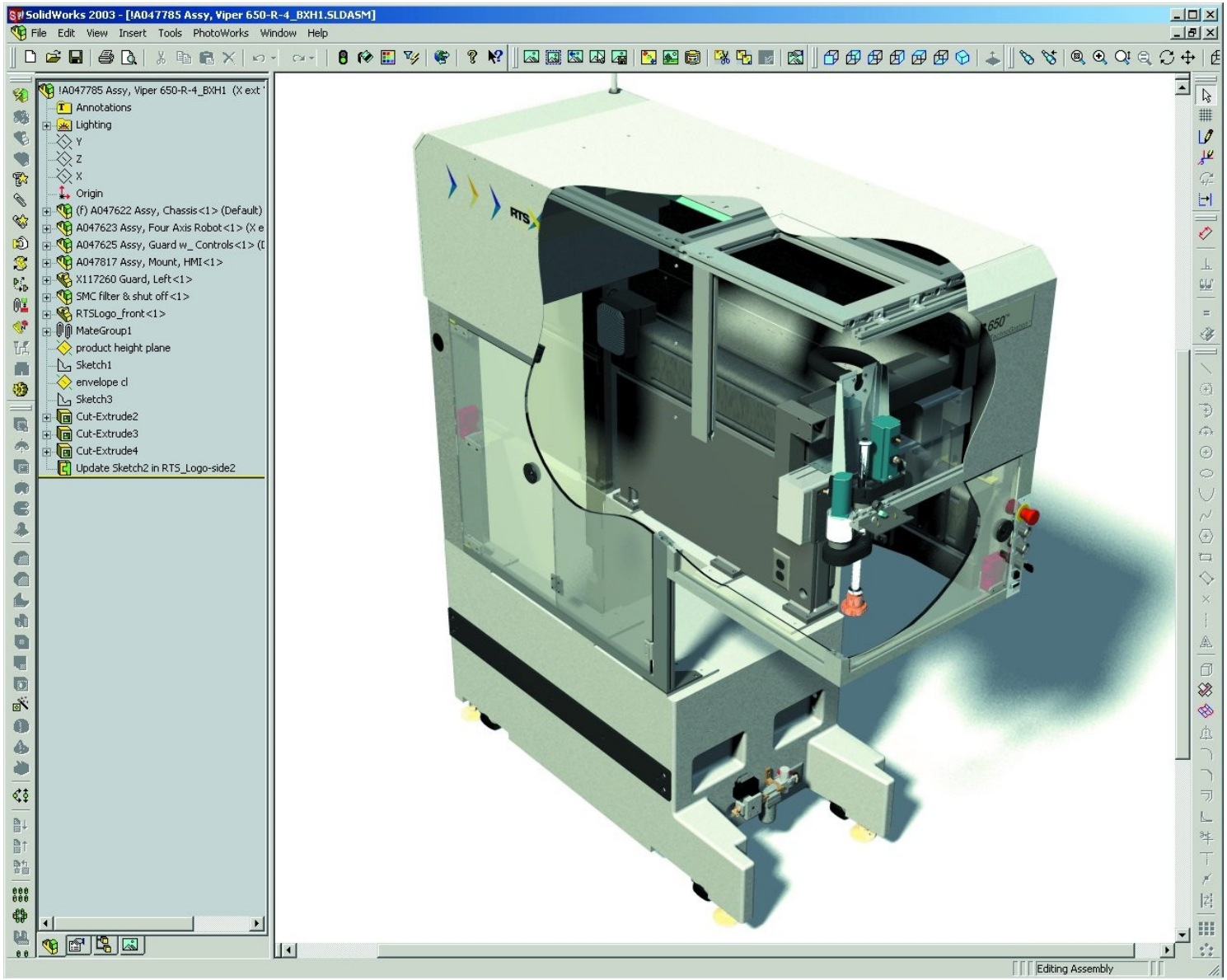
# Very Large Sheet Metal assembly in SolidWorks

# Machine made of Sheet metal components

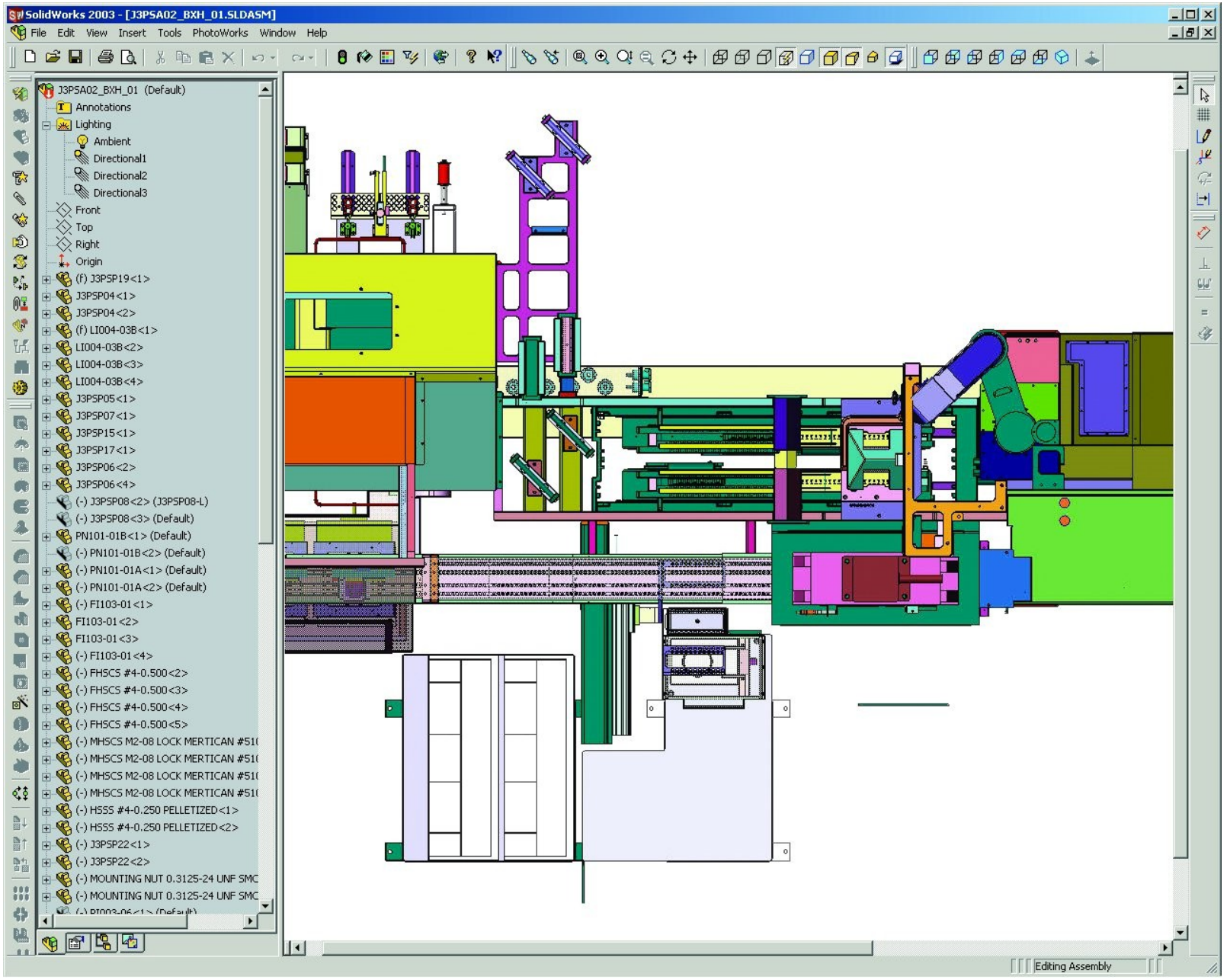


# Designed and Developed using SolidWorks

# Ergonomic sheet metal design in SolidWorks



# Sheet metal design in progress

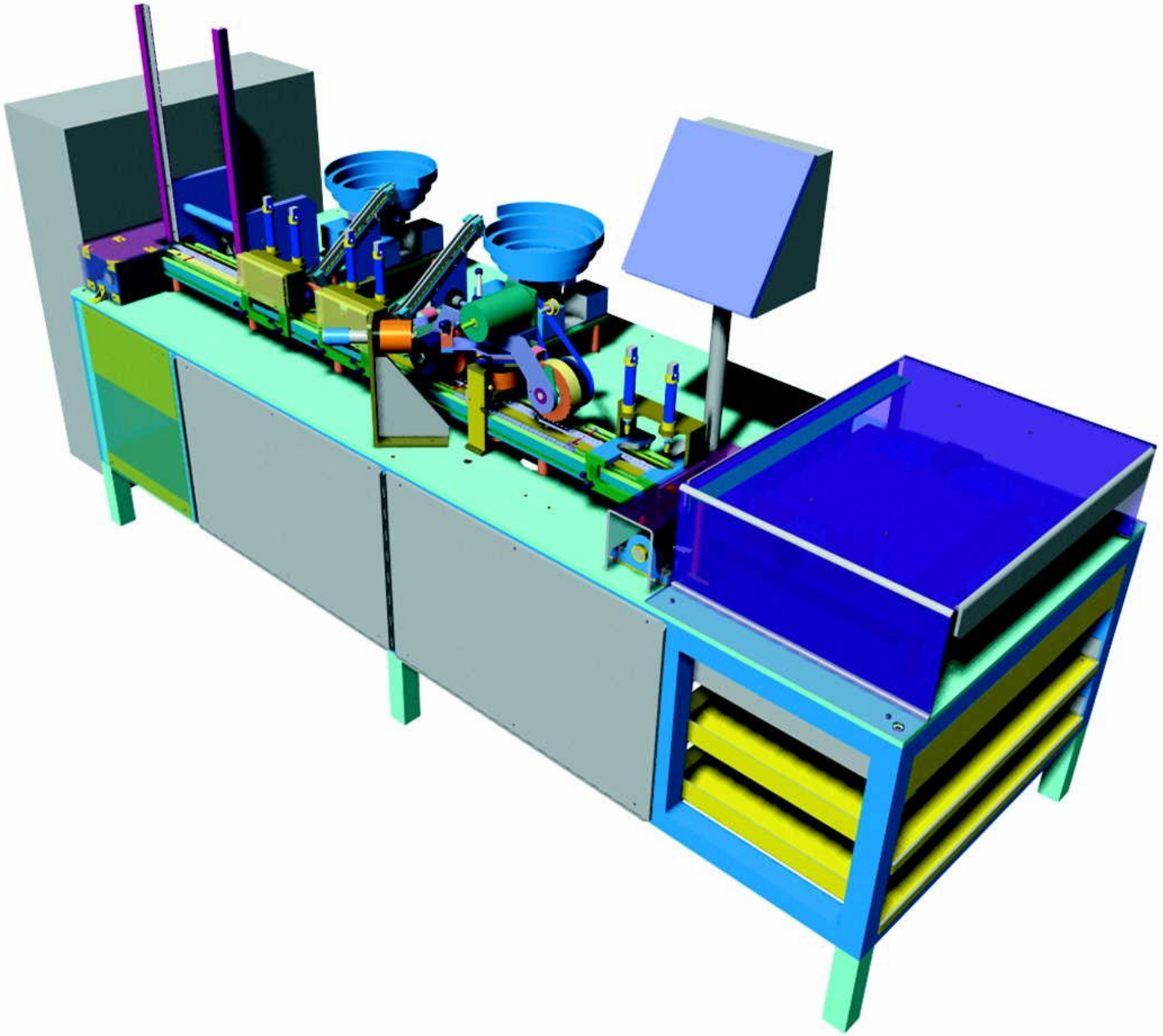


# New Product developing using SolidWorks Sheet Metal

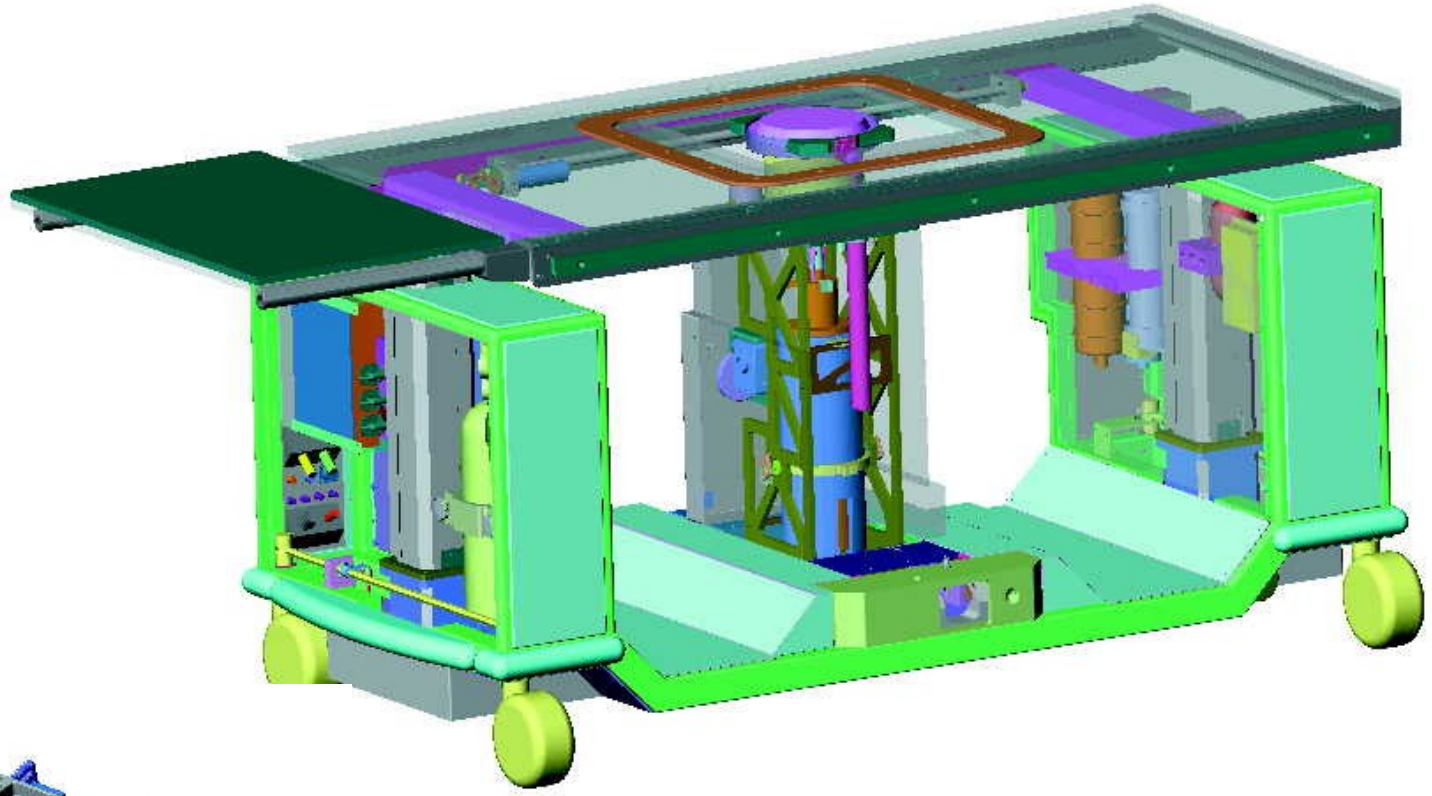
# Sheet metal in Cooler Display

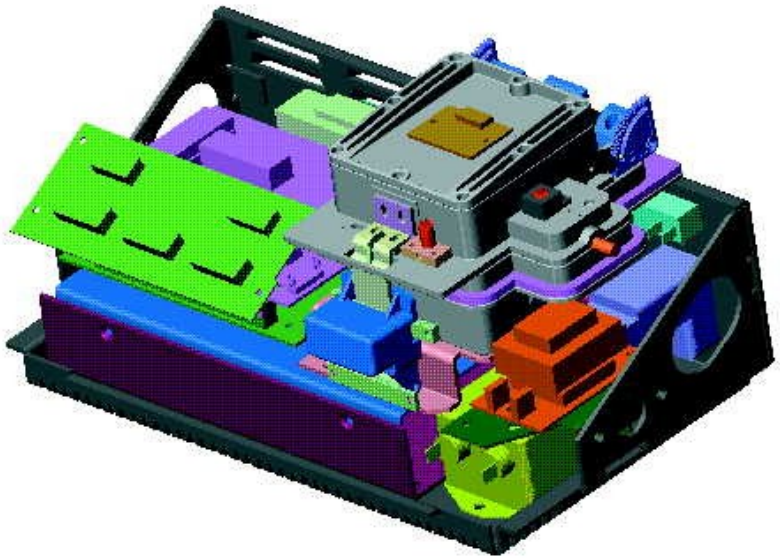
# Sheet metal in Machine Tool Application

# Sheet metal in batch processing

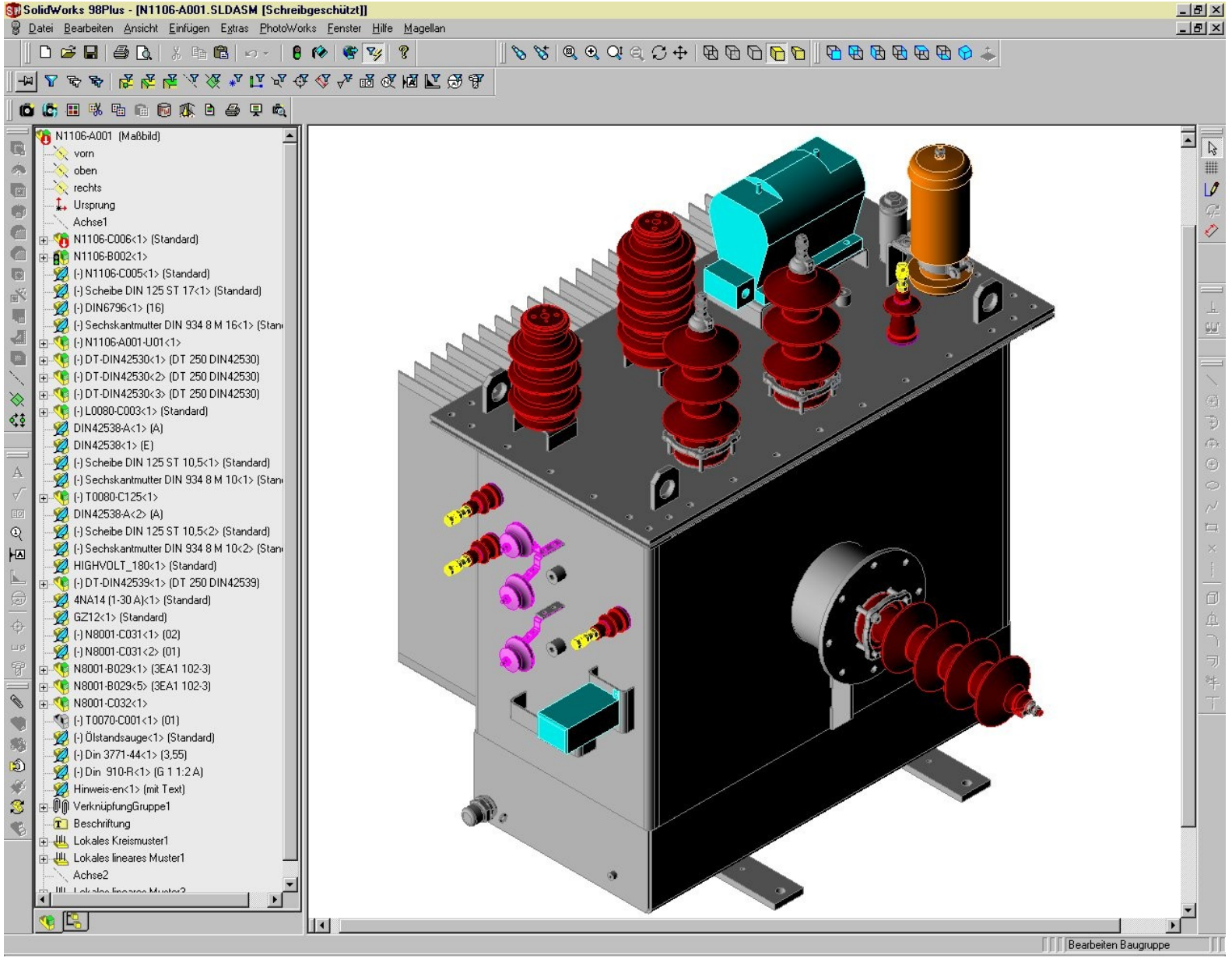


# Sheet metal internal in medical application





# Sheet metal in Switch gear application



# SolidWorks Everywhere in Sheet Metal

**PANS AND SINKS**
**JK Mold design**
**USA**

**STOVE**
**Comet Kato**
**Japan**

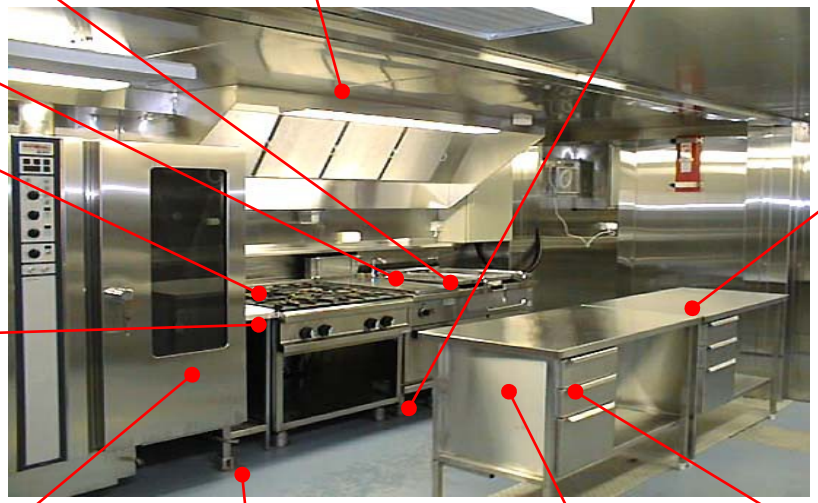
**VENTILATION**
**Advance Metal Products**
**Australia**

**FURNITURE**
**Teknion Furniture Systems**
**Canada**

**PLATE DISPENSER**
**Tom Stoddart**
**Australlia**

**COUNTERS**
**Abk Innovent**
**Netherlands**

**RANGES**
**Foster SPA**
**Italy**



**COOKING DRUMS**
**Tecnozim**
**Portugal**

**COOKING EQUIPMENT**
**Werner & Pfleidere**
**Germany**

**PULL DOWN SHELF**
**Knape & Vogt**
**USA**

**SCULLERY**
**Elkay Manufacturing Co.**
**USA**

**STOVE**
**Aliberinox**
**Spain**

**PIPES**
**Dinex**
**Latvia**

**COUNTERS**
**Arecov**
**Mexico**

**CABINETS**
**Distform**
**Spain**

www.egsindia.com

# SolidWorks Customers Worldwide

SOLIDWORKS

# Key Customer References in Japan


























www.egsindia.com

# Why Invest in SolidWorks?

- Proven Technology preferred by over 2 Million Users world-wide
- Protection and re-use of existing 2D CAD data
- Benefit by becoming a member of 3D Content Central and display your products for higher visibility in the world market
- Trusted technical support from EGS India, since 1993
- One-stop solution for changing needs
- Scope for new product development
- Communicate in 3D with Customers and Suppliers
- Standard 3D CAD Software used by manufacturing companies world-wide
- Safe investment with a Global Company with Extensive Presence in India

# Get Started Today

Authorized Reseller for SolidWorks since 1999

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'Design Towers' 16/32 Fifth St., Dr. Subbarayan Nagar, Kodambakkam

Chennai 600024 INDIA

Tel: 044-2480 3370 * 044-2472 1212

Fax: 044-24844227

E-mail: info@egs.co.in

Web: www.egsindia.com


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