



ENGINEERED FORMED TUBE SOLUTIONS

PRODUCT & HYDROFORMING TECHNOLOGY CATALOG

An engineering reference for formed tubes, material selection, CAE forming analysis and tooling development.



Contents

Organized around process fundamentals, materials and analysis, product applications, and RFQ information.

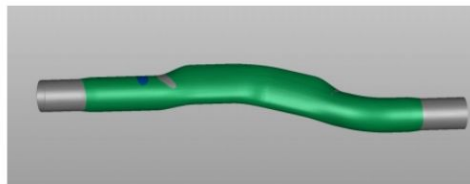
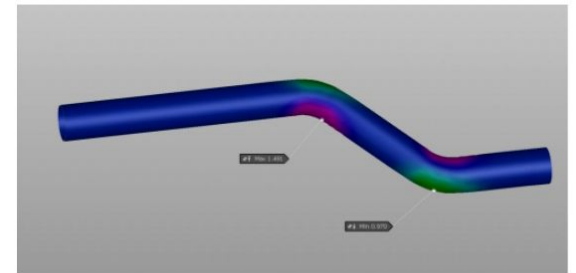
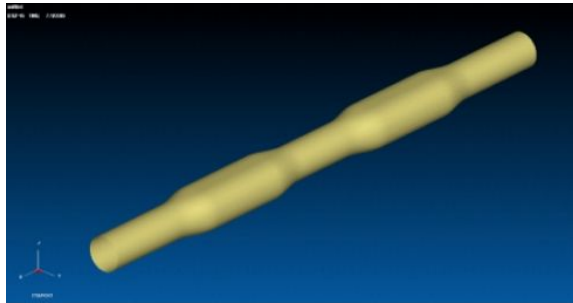
03-10**Hydroforming Technology****11-18****Applications & Automotive****19-24****Motorcycle & Cycling****25-29****Heat Exchange, Sanitary & Other Tubes****30-32****Selection, RFQ & Contact**

Hydroforming Fundamentals

Hydroforming uses controlled fluid pressure to expand a tube blank against a closed die cavity. Axial feed, pressure path and material flow must be set together to achieve the target geometry.

PROCESS PRINCIPLES

- 01 Closed die defines the outer form
- 02 Internal pressure expands the blank
- 03 Axial feed manages local thinning



Tube Hydroforming Process

A typical route covers blank preparation, preforming, die closing and sealing, pressure-and-feed control, calibration, trimming and inspection. Complex parts may combine fluid-assisted bending with local expansion.

01

Blank preparation

02

Bending or preforming

03

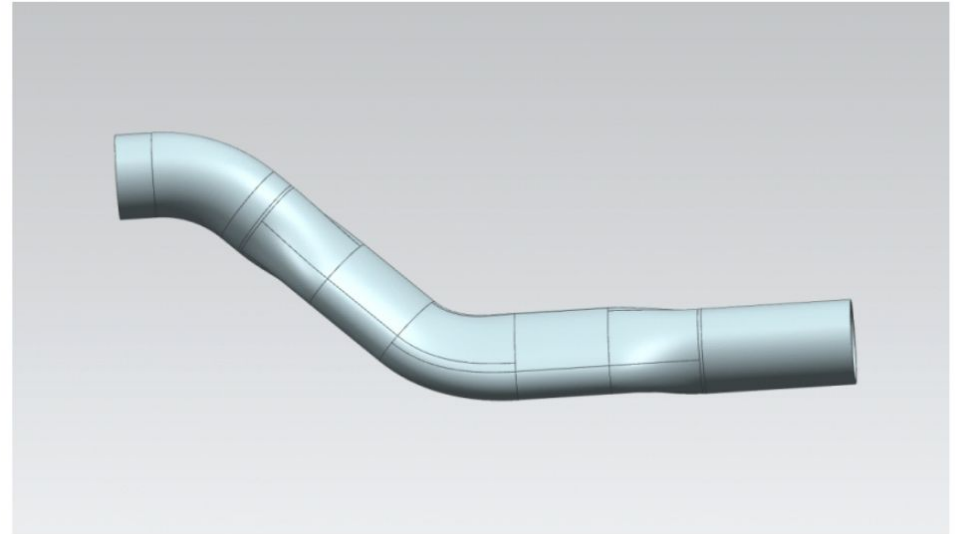
Die closing and sealing

04

Pressurization and axial feed

05

Calibration, trimming and inspection



Material Options: Aluminum, Stainless Steel & Steel

Material selection considers ductility, batch stability, surface quality, strength and compatibility with downstream operations. Grades are shown only as typical options identified in the source material.

Aluminum alloys

3003 / 5052 / 6061 / 6063 / 6082

Automotive structures, bicycle frames, sports equipment and furniture structures

Austenitic stainless steel

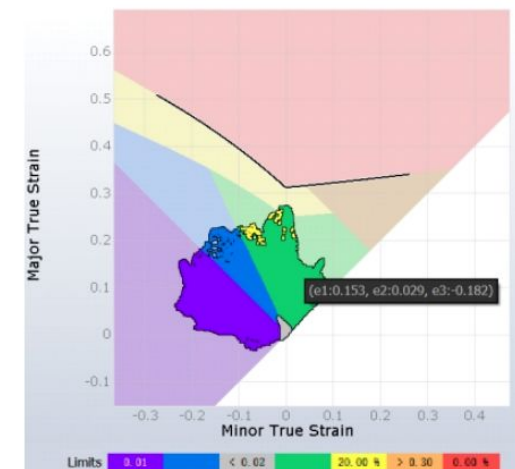
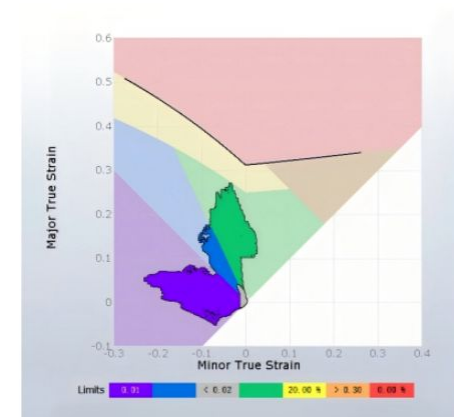
304 / 304L / 316 / 316L

Exhaust and silencer tubes, sanitary hardware, fittings and housings

Low-carbon and high-strength steels

Q235 / SPCC / SPCD / SPCE / SAE 1008 / 1010 / 1020

Chassis, suspension and general structures, with corrosion requirements addressed through material and surface treatment



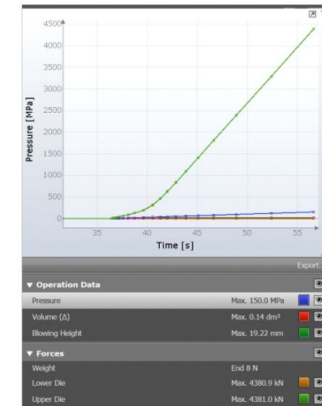
Material Options: Titanium & Copper Alloys

Titanium may suit formed tubes where mass and corrosion resistance are important. Copper and copper alloys combine useful thermal, electrical and forming properties. Thickness, temper and expansion ratio require validation against part geometry.

Commercially pure titanium and titanium alloys

TA1 listed in source material

Motorcycle exhaust tubes and corrosion-resistant formed tubes specified by drawing



Copper and copper alloys

T2 / H62 / H65 / H68 / QSn6.5-0.1

Heat-exchanger fittings, electrical connectors, sanitary hardware and decorative parts

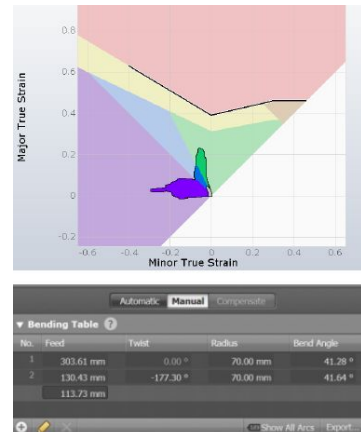


CAE Forming Analysis

Forming simulation compares blank geometry, pressure path, feed conditions and die geometry. Forming limits, thickness distribution and strain trends help identify potential splitting and wrinkling before tooling trials.

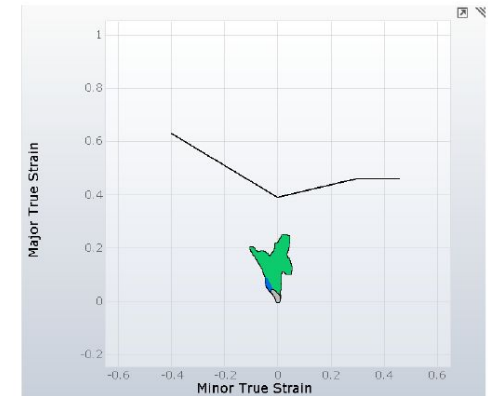
Split risk

Review local major strain against forming limits



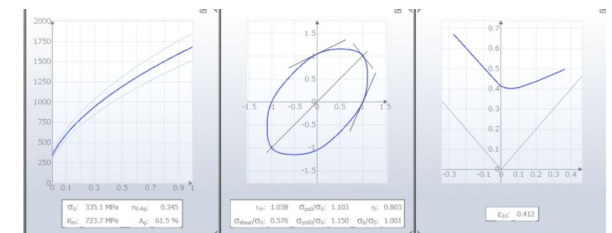
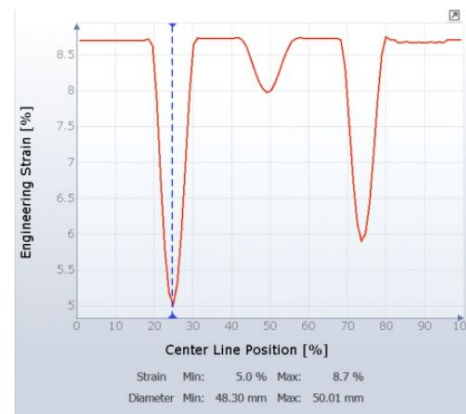
Wrinkle risk

Identify excess feed or local compression zones



Thickness distribution

Evaluate thinning and thickening trends

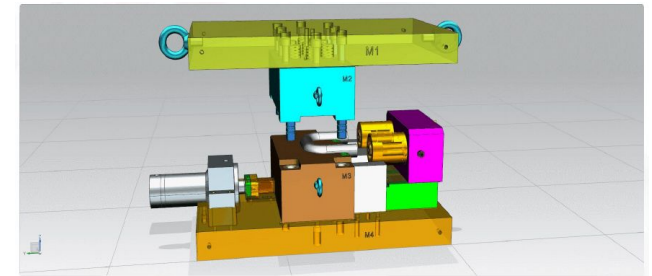
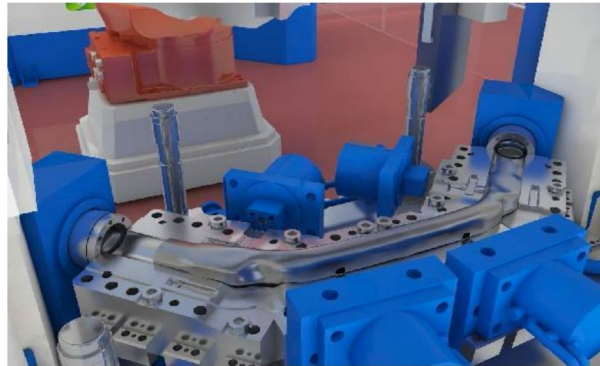


Defect Control & Tooling Development

The process window balances sealing, axial feed, internal pressure and friction. Tooling development starts with part data and parting strategy, then moves through CAE review, machining, tryout and correction.

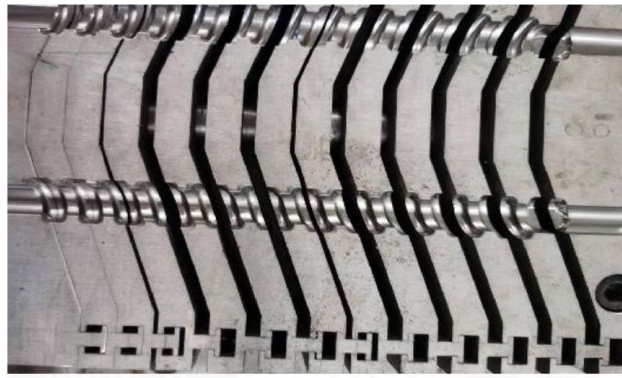
● End leakage

Review seal design and tube-end dimensions



● Local splitting

Adjust pressure/feed path and review material temper



● Wrinkling or folding

Tune preform, friction and axial feed

Engineering Value of Hydroforming

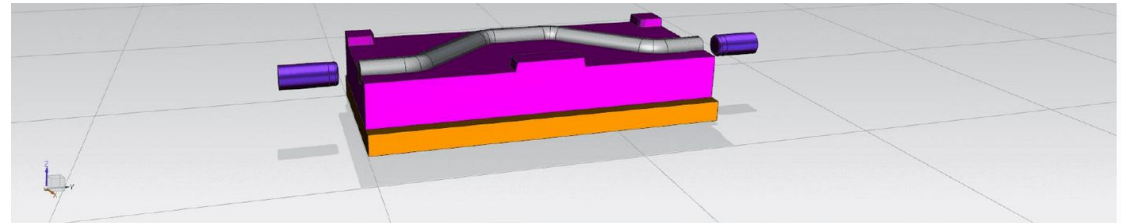
For suitable parts, hydroforming can integrate complex bends, variable sections or local reinforcement into one tubular component. Actual benefits depend on geometry, material, volume and downstream operations.

Part integration

May reduce joints between multiple tube segments

Section flexibility

Supports round, oval, flattened and other shaped sections

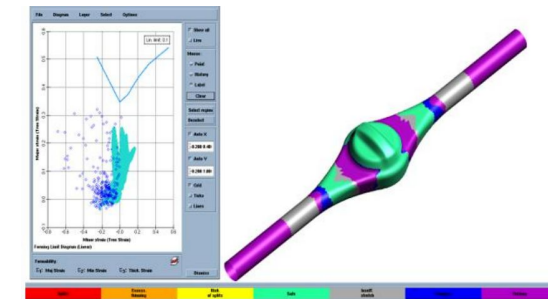
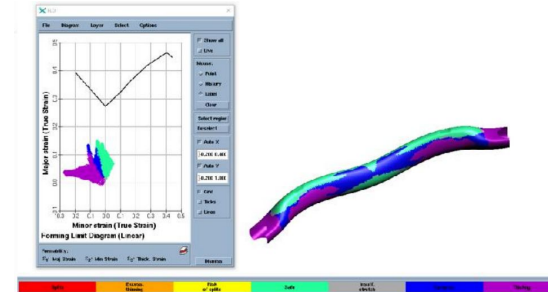


Dimensional consistency

Die calibration helps manage outer geometry and interfaces

Downstream simplification

May reduce welding, correction and assembly where feasible



Hydroforming vs. Welded Fabrication

The two routes should be compared against geometry, annual demand, material formability, weld requirements and tooling investment. Hydroforming is not automatically the better route for every component.



WELDED ROUTE



HYDROFORMED ROUTE

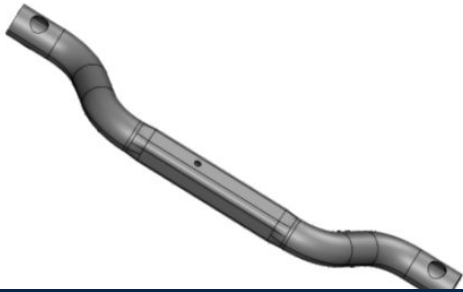


FORMED BEND

CRITERION	HYDROFORMING	WELDED FABRICATION
Part architecture	Suited to integrated tubes, variable sections and local features	Suited to standard tube segments or frequently changing structures
Joining	Can reduce selected joints and welds	Builds geometry through cutting, fixturing and welding
Tooling	Requires dedicated die, sealing and pressure-path development	Typically uses cutting, bending and welding fixtures
Route decision	Driven by forming feasibility and integration value	Driven by standard sections, flexibility and lower tooling threshold

Product Application Overview

The catalog covers automotive, motorcycle, cycling, heat-exchange, sanitary/decorative and other formed-tube applications. Images illustrate typical structures and manufacturing approaches, not named customer programs.



Automotive

12-18



Motorcycle

19-21



Cycling

22-24



Heat-exchanger tubes

25



Sanitary & decorative

26



Other formed tubes

27-29

Automotive Chassis Load-Bearing Components

Crossmembers, torsion beams and rails balance structural stiffness, interfaces and packaging space. High-strength steel routes require validation of ductility and springback behavior.

High-strength steel



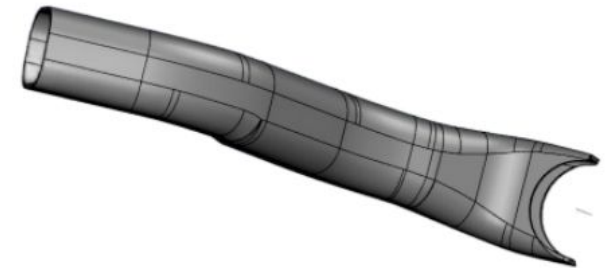
Chassis crossmember

High-strength steel



Torsion beam

High-strength steel



Frame rail component

Suspension Links & Crossmembers

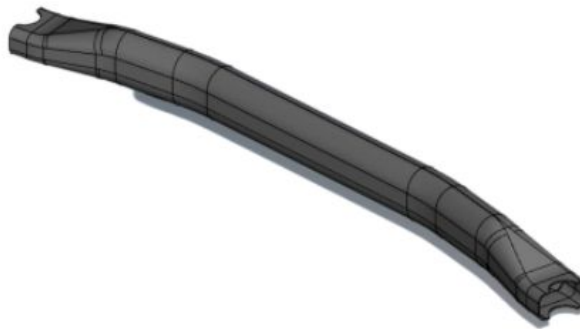
Control arms and front/rear crossmembers provide attachment points, locate suspension geometry and transfer loads. The forming route must be reviewed with interface tolerances, hole locations and joining strategy.

High-strength steel



Formed control-arm component

High-strength steel



Front crossmember

High-strength steel



Rear crossmember

Rear Axle, Subframe Beam & Formed Bend

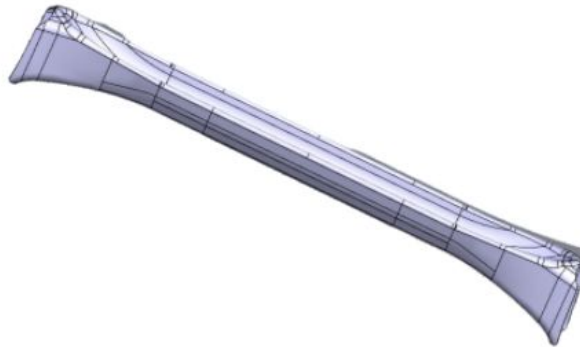
Rear-axle and subframe-beam sections must be developed around load paths, connections and packaging constraints. Formed bends place greater emphasis on flow routing, interfaces and thickness distribution.

Q235, cast steel or drawing-specified steel



Rear axle housing

High-strength steel



Subframe bearing beam

304 or 409 stainless steel

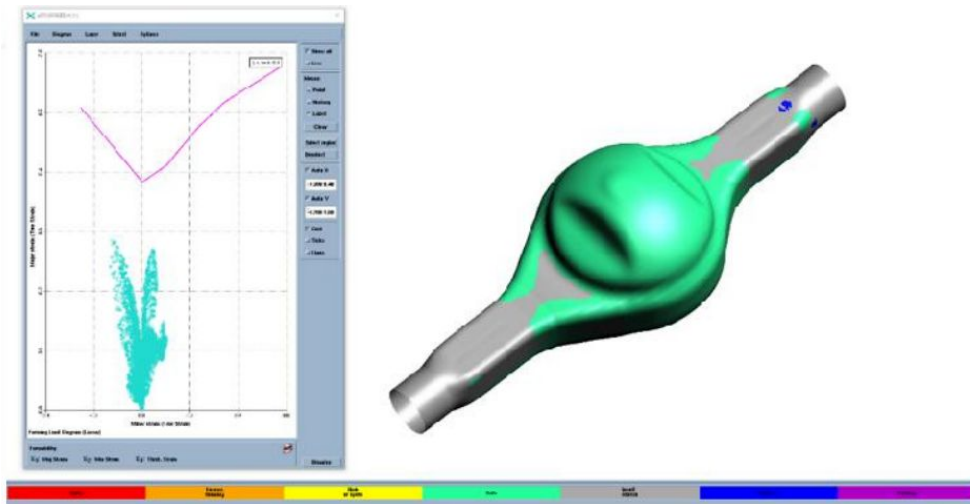


Automotive formed bend

Automotive Axle-Housing Forming Analysis

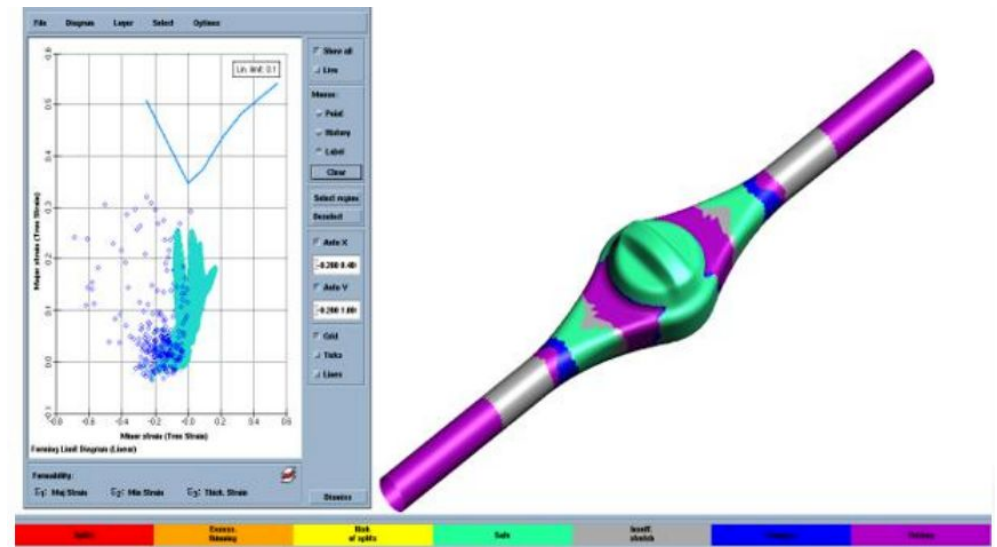
Axle-housing analysis examines local filling, thickness change and loading path. Process feasibility should be reviewed in conjunction with structural loads, material data and downstream interface requirements.

Drawing-specified formable steel



Tubular axle housing

Drawing-specified formable steel



Tubular axle housing

Formed Tubes for Intake & Exhaust Systems

Intake and exhaust tubes often combine tight bends, non-round sections and multiple interfaces. Route development should cover trimming, tube-end forming and the selected joining operations.

Stainless steel or drawing-specified
heat-resistant material



Intake/exhaust formed tube

Stainless steel or drawing-specified
heat-resistant material



Intake/exhaust formed tube

Material grade selected for the specified
temperature, corrosion exposure and drawing
requirements



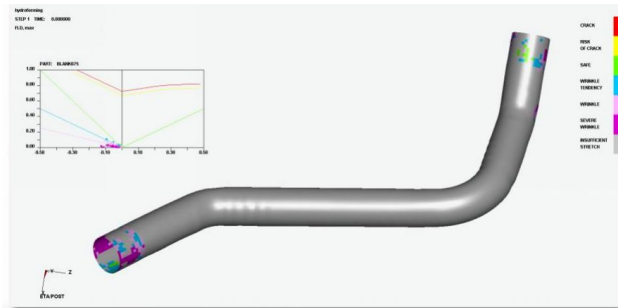
Automotive hot/cold-end tube

Aluminum Intercooler & Turning Tubes

Aluminum intercooler tubes can combine 3D bending, preforming and hydraulic calibration. CAE is used to review section distortion after bending, wrinkle risk and remaining expansion capacity.



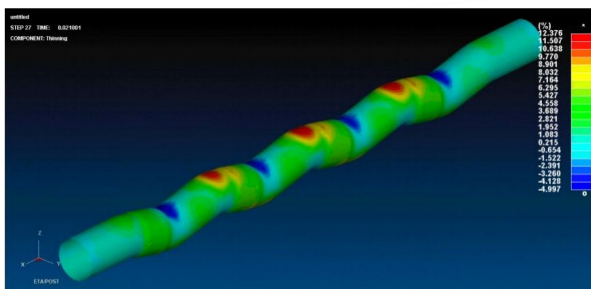
Aluminum intercooler tube



Aluminum intercooler tube



Aluminum intercooler tube



Fluid-assisted turning tube



Fluid-assisted turning tube

Automotive Bellows, Converter Shells & Mixed Tubes

Bellows, converter shells and mixed formed-tube assemblies have materially different process requirements. RFQs should state temperature, corrosion, flexibility, joining and inspection needs for each part.



Automotive bellows tube



Converter shell



Mixed automotive formed tube



Mixed automotive formed tube



Mixed automotive formed tube

Stainless Steel Motorcycle Exhaust Tubes

Motorcycle exhaust tubes must accommodate bends, section changes and interfaces within compact packaging. Stainless steel selection should match temperature, corrosion and finish requirements.

304 stainless steel



Motorcycle exhaust tube set

304 stainless steel



Exhaust shell

304 stainless steel



Exhaust elbow

Aluminum Rear Swingarm & Titanium Exhaust Tube

Rear swingarms and exhaust tubes call for different material and forming routes. Aluminum structures emphasize local thinning and interfaces; titanium exhaust tubes require careful review of bending, forming and downstream joining.

6061 aluminum alloy



Aluminum motorcycle rear swingarm

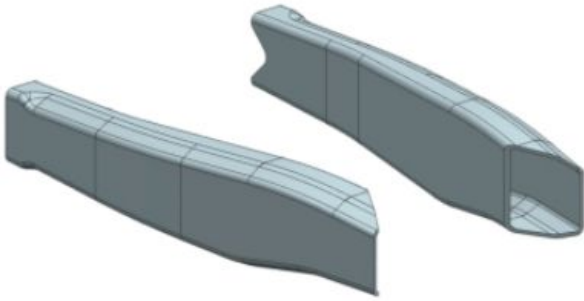
Titanium alloy



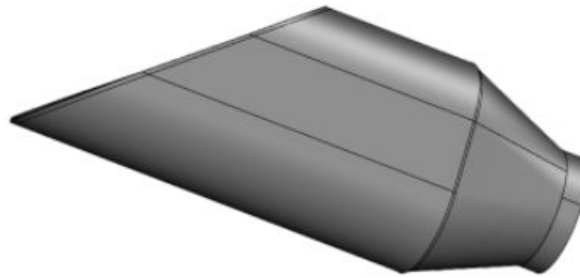
Titanium motorcycle exhaust tube

Motorcycle Exhaust, Silencer & Intake Tubes

Motorcycle systems can include exhaust shells, elbows, tips, silencer tubes, intake tubes and separate formed structural members. Each part needs its own material, interface and inspection definition.



Aluminum motorcycle rear fork



Motorcycle exhaust shell



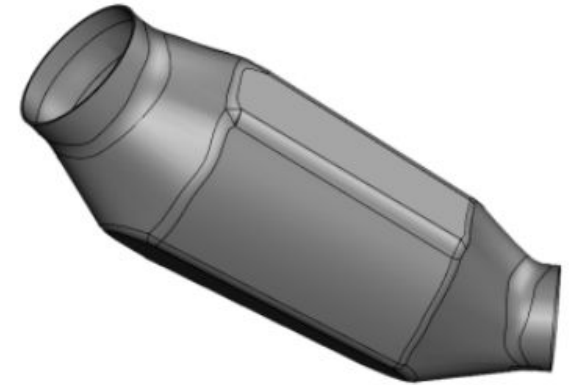
Motorcycle exhaust elbow



Motorcycle exhaust tip



Motorcycle silencer tube



Motorcycle intake tube

Hydroformed Bicycle Frame Tubes

Bicycle frame tubes can use variable sections and local surfaces to suit geometry, welded interfaces and packaging. Aluminum routes require review of temper, bend flattening and post-forming wall thickness.

Aluminum alloy



Bicycle frame formed tube

Aluminum alloy



Cycling rear-fork formed tube

Aluminum Front Forks & Battery Tubes

Front forks and battery tubes focus on structural connections, packaging space and enclosure sections. The part review should cover weld interfaces, hole locations, tube ends and finishing requirements.

Aluminum alloy



Aluminum bicycle front fork

Aluminum alloy



E-bike battery tube

E-Bike Frames & Formed Tube Sets

E-bike frame design must accommodate the battery, wiring, drive system and structural interfaces. Tube geometry can be refined during concept development through CAE and sample validation.

Aluminum alloy



E-bike frame tube set

Aluminum alloy or drawing-specified material



Custom cycling formed tube

Aluminum alloy or drawing-specified material



Custom cycling formed tube

Heat-Exchanger Threaded Tubes

Threaded tubes use controlled wall profiles for heat-exchange applications. Thread geometry, diameter, wall thickness, material, interfaces and test conditions should be specified on the drawing and validated against the service conditions.

Copper, copper alloy or drawing-specified material



Heat-exchanger threaded tube

Copper, copper alloy or drawing-specified material



Heat-exchanger threaded tube

Copper, copper alloy or drawing-specified material



Heat-exchanger threaded tube

Copper, copper alloy or drawing-specified material



Heat-exchanger threaded tube

Sanitary & Decorative Formed Tubes

Decorative elbows and faucet bends combine section accuracy, bend appearance, interfaces and surface finish. Stainless steel routes can reserve process allowance for brushed, polished or other finishes.



Decorative handrail elbow



Decorative handrail elbow



Decorative handrail elbow



Stainless steel faucet U-bend



Stainless steel faucet U-bend

General Formed & Bent Tubes

General formed tubes may combine local expansion on straight tubes, multi-bend routing and tube-end calibration. Process review starts from the 3D centerline, section changes, minimum bend radius, wall thickness and tolerances.

Drawing-specified formable tube material



Locally expanded straight tube

Material selected according to the drawing and service conditions



Multi-bend formed tube

Shaped Sections & Formed Samples

The sample set illustrates combinations of bending, expansion, flattening, local reduction and tube-end forming. Feasibility depends on complete part data, material properties and the tooling parting strategy.

Stainless steel, aluminum alloy, steel or drawing-specified material



Shaped-section tube

Part material as specified on the drawing; die material selected for the forming conditions



Hydroforming die and sample

Part material as specified on the drawing; die material selected for the forming conditions



Hydroforming die and sample

High-Strength Steel Automotive Wheel Rims

For high-strength steel automotive wheel rims, material selection, main-section geometry and reinforcement ribs should be reviewed as an integrated forming concept. CAE can be used to review feature filling, local thinning and the forming window; it does not replace structural validation.

High-strength steel



High-strength steel automotive wheel rim

Material & Application Index

This index maps typical materials to the application areas presented in the catalog. Final selection should consider strength, corrosion, temperature, forming limits, finish and cost requirements.

MATERIAL	TYPICAL APPLICATIONS	PAGES
Aluminum alloys	Intercooler tubes, bicycle frames, front forks, rear swingarms and battery tubes	17, 20, 22-24
Stainless steel	Intake/exhaust tubes, silencer tubes, exhaust tips, sanitary and decorative bends	16, 18-21, 26
Low-carbon and high-strength steels	Chassis crossmembers, torsion beams, rails, control arms, axle housings and reinforced parts	12-15, 29
Titanium alloys	Motorcycle exhaust tubes and drawing-specified corrosion-resistant formed tubes	6, 20
Copper and copper alloys	Heat-exchanger fittings, electrical connectors, sanitary and decorative parts	6, 25

Custom RFQ Checklist

Complete part data supports an efficient review of material, process route, tooling scope and inspection plan. If the data set is incomplete, available drawings and critical functional requirements can be submitted for an initial review.

● 2D/3D drawings

Dimensioned and toleranced PDF plus STEP or other 3D data where available

● Material and temper

Grade, standard, supply condition, tube diameter and wall thickness

● Function and service conditions

Load, temperature, pressure, corrosion, fatigue, sealing or appearance requirements

● Interfaces and downstream operations

Holes, tube ends, welding, trimming, heat treatment and surface finishing

● Quantity and project stage

Prototype, pilot or production demand, target timing and revision status

● Quality and inspection

Critical dimensions, inspection methods, sample approval and documentation needs



Contact Jayu

Send drawings, material requirements and service conditions for an initial review of formed-tube and hydroforming requirements.

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