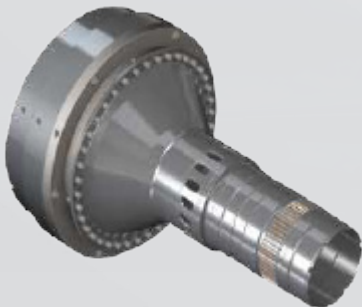
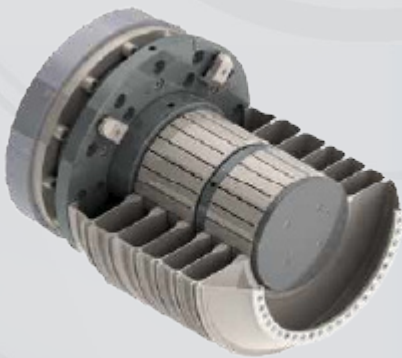


2025 EDITION



FORKARDT HARDINGE



Aerospace & Turbine Workholding



Forkardt Hardinge has offered solutions to the turbine industry worldwide. Forkardt's engineered products have held parts such as turbine blades, blisks, spools, AFT shafts, cones, nozzles, and rotors, for both large and small components manufacturers.

GAS POWERED ENERGY

The aerospace industry has advanced greatly in the design of the gas powered turbine engines.

Forkardt has developed tooling that has provided optimal results in the machining of components of the gas turbine engines.

- Compressor Rotors
- AFT Shafts
- Cones
- Spools
- Nozzles
- Blades

Forkardt is ISO registered and is capable of working closely with manufacturers to ensure that parts are machined to the exacting specifications required for safety and efficient operation.

HYDRO POWERED ENERGY

The hydro power industry requires components to be reliable and able to hold up under the extreme pressure of a hydro-based environment.

Forkardt can provide workholding designs to assist in the manufacturing these components in an effective and efficient manner.

- Turbine Blades
- Valves
- Shafts
- Rotors
- Stators

Forkardt can design tooling to conform to the tight casting and machining specifications required, and is ISO registered.

WIND POWERED ENERGY

As the size and complexity of wind turbines grow, so do the manufacturing requirements costs.

Forkardt specializes in the engineering of workholding for machining the components of the rotor hub, gearbox, drive train, pitch and yaw systems.

- Hub
- Nose Cone
- Pitch Brake Disks
- Bearings
- Shafts
- Gears
- Housings

Forkardt can design tooling to conform to the tight casting and machining specifications required, and is ISO registered.

COMPRESSOR ROTOR DISCS

This application was for machining compressor rotor disc forgings for operations 20 & 30, turn face and bore. Machining was done on an Okuma V80 and Hwacheon 550. The customer wanted to greatly reduce changeover and set up time. Engineering decided an ID Grip Collet Chuck would be the best fit. Both the collets and the locators had slotted mounting holes for easy changeover, and the chucks were fitted with the Tru-Change system. Customer also requested set-up rings for all parts, with a reversible ring style to combine similar diameters and minimize the number of rings required.

The tooling was not allowed to mark the part, and needed to clamp to clear machining requirements within $\pm .002 \text{ } \varnothing$. Drain holes were to be provided in the chuck to provide for the coolant to exit, and clearance for a lift device was required. These parts would be auto-loaded.

OPERATION 20 - TURN OD, FACE & BORE ID



ID Grip
Collet Chuck
No Part



ID Grip
Collet Chuck
With Part

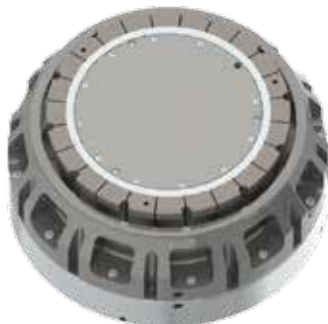


ID Grip
Collet



Compressor
Rotor Disk

OPERATION 30 - TURN OD, FACE & BORE ID



ID Grip
Collet Chuck
No Part



ID Grip
Collet Chuck
With Part



ID Grip
Collet



Compressor
Rotor Disk

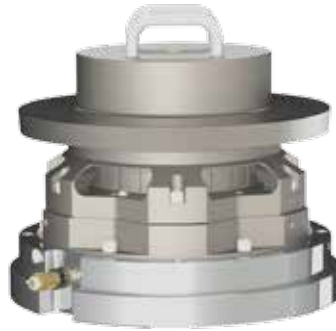
COMPRESSOR BLISKS

This application was for machining Stage 2 Blisks in an airfoil blade mill operation. Machining was done on an OMV HSC 1400 Hi-Speed Milling Machine. The salesman discussed this ID Grip Collet chuck with spring clamp/ air release to grip on a 10.162" diameter part ID and to pull back against the adjacent .691" wide face. There was also a requirement for a cover to sit on opposite 1.635" face, 0.152" max from the 10.162" diameter. The cover was to be held manually via a 3/4-10 threaded rod that would be threaded into the fixture face.

AIRFOIL BLADE MILL OPERATION



ID Grip
Collet Chuck
Without Part



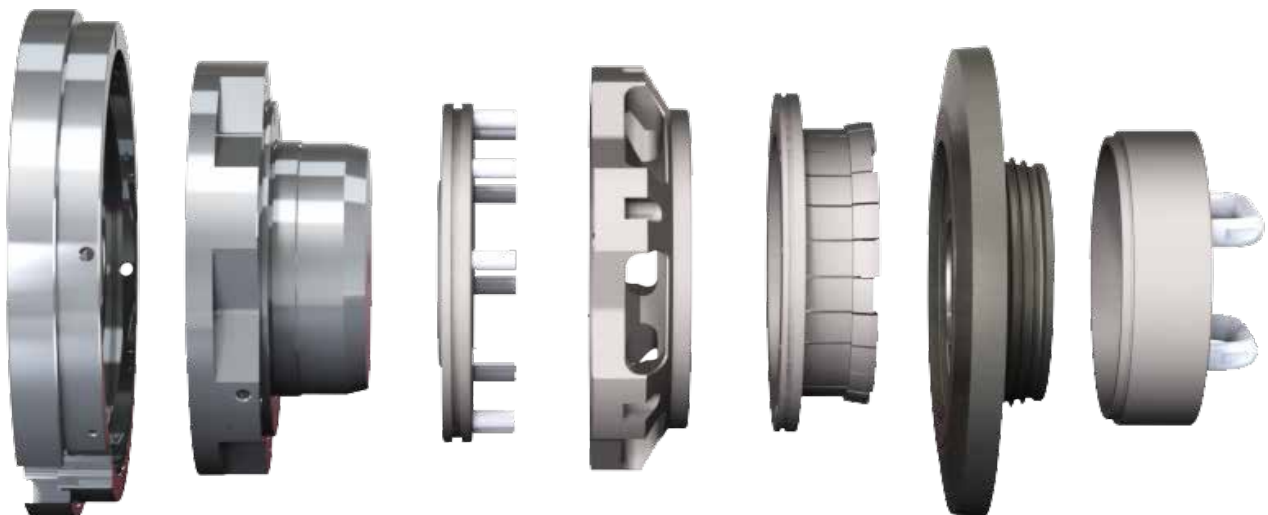
ID Grip
Collet Chuck
With Part



ID Grip
Collet



Stage 2
Blisk



COMPRESSOR BLISKS

The part in this application was initially being held in a manual fixture during testing. Part is a Stage 5 Blisk. Salesman discussed a pull back ID collet chuck to grip on 4.421" ID and end locate on opposite side. The collet chuck to be supplied with adjustable Tru-Change carrier plate for changing out fixtures. It was required to incorporate both radial and axial adjustment.

The fixture was to provide clearance under the Blisk for a drilling operation, to be manually orientated to start. The 4" dimension must be kept for a subsequent honing operation, where the tool/brush requires the 4" height to fully pas through the part.

After the part is drilled t it will be removed and then re-chucked for a subsequent mill operation. A removable orientation pin was required to re-align the part. A tolerance of +/- .003" is required.

BALANCE/TIP MILL AND DRILL HOLES



ID Grip
Collet Chuck
Without Part



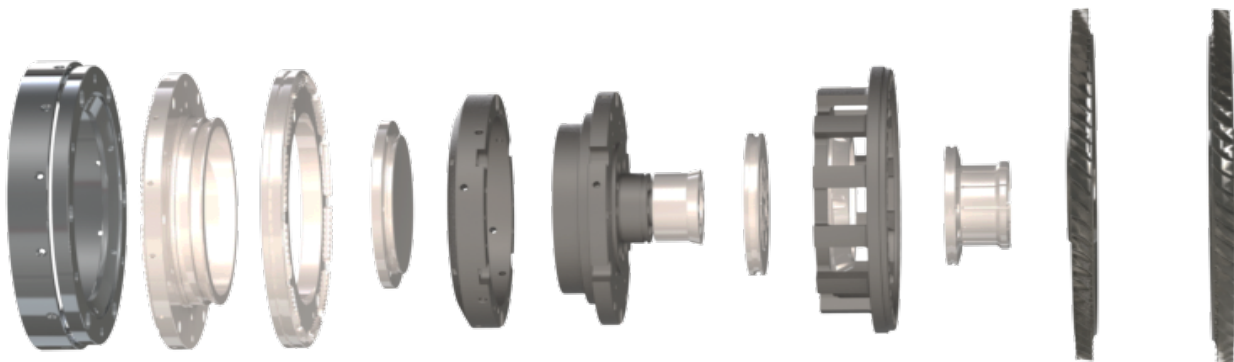
ID Grip
Collet Chuck
With Part



ID Grip
Collet



Stage 5
Blisk



AFT SHAFT

In this application, each finished stage will be separately inertia welded to the finished AFT shaft. After each stage is welded onto the shaft, an OD operation takes place before the next stage is welded on. The shaft assembly will be removed and replaced at least 4 times.

The salesman quoted a HI/LO OD Grip Collet Chuck. The chuck will grip on an 11.280" diameter and will end locate on the adjacent surface. A stabilizer plate was offered to pilot in the stage 4 part once all stages are welded complete. This plate will pilot in the upper most diameter of the stage 4 part and act as a stabilizer when a finished OD turn takes place on the completed 4 to 7 stages. The stabilizer plate will be attached to the HI/LO collet assembly by way of a threaded rod through the plate and down to the collet chuck assembly.

SHAFT TURNING FOR STAGE INERTIA WELDING PROCESS



OD Grip
Collet Chuck
No Part



OD Grip
Collet Chuck
With Part



OD Grip
Collet



AFT
Shaft

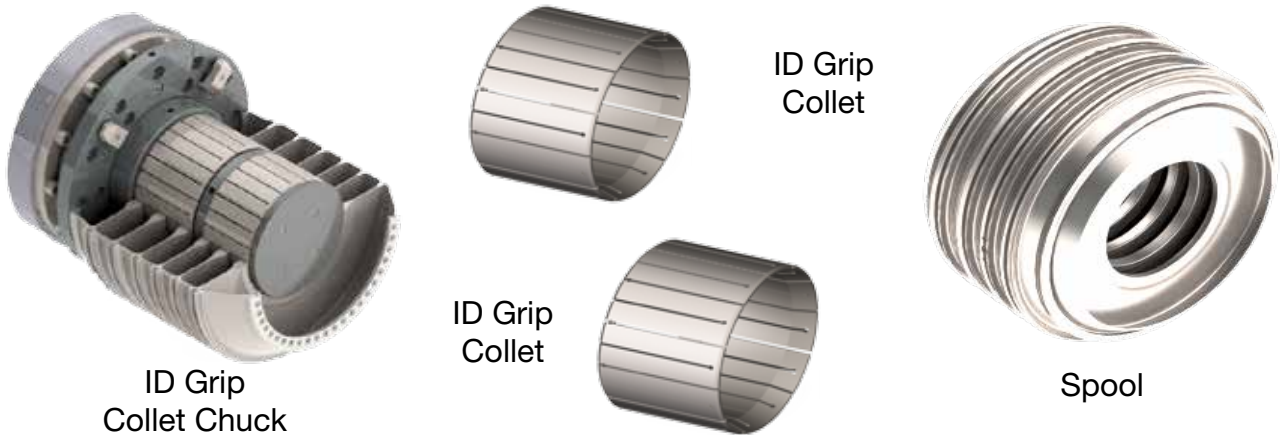


SPOOL

Customer was looking for an alternative to the hand-actuated mandrel system they were currently using. Existing fixture height needed to be maintained to avoid tooling issues. The process was to turn, groove and drill forgings varying from 7.995" to 8.605" ID. These parts will be machined on a Mazak Integrex 50.

An ID Grip double collet chuck was quoted with spring actuation and air release to reduce set up times. The salesman also discussed the Tru-Change system to further reduce set-up time and provide interchangeability.

TURN, GROOVE AND DRILL



FORE AND AFT SPINNERS

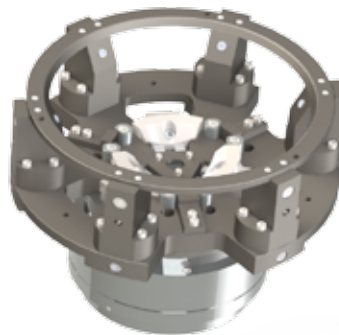
This project required workholding to accommodate operations 10, 30, 40, and 60 on an AFT Spinner, and operations 10, 20, 30, and 50 of a Fore Spinner. Machining was to be done on a Hwacheon VT550-2SP Twin Spindle CNC Lathe and an OKK VT9000 Vertical Machining Center.

The workholding provided for this project included UBL centralizing ball lock chucks, Rim-Lok ID and OD grip arbor assemblies, and the Tru-Change receiver system. The UBL would set up for OD chucking and would include jaws, inserts and end locators to grip a forged part. The Rim-Lok chucks would be equipped with air to release through a quick connect coupling, springs and support ring with Teflon pads to provide friction plate lockout. The parts could not be marked or scratched. JO-Blocks were provided with the Rim-Lok product to allow the same chucks to be used for various parts.

The Tru-Change receiver system was provided to facilitate faster changeover of chucks between operations.



3 Jaw UBL chuck
With part
ID Grip



3 Jaw UBL chuck
Without part



AFT Spinner
Op 10



Rim-Lok Collet Chuck
With part
ID Grip



Rim-Lok Collet Chuck
Without part



AFT Spinner
Op 30



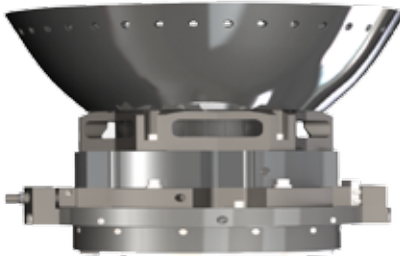
Rim-Lok Collet Chuck
With part
ID Grip



Rim-Lok Collet Chuck
Without part



AFT Spinner
Op 40



Rim-Lok Collet Chuck
With part
ID Grip



Rim-Lok Collet Chuck
Without part



AFT Spinner
Op 60



3 Jaw UBL chuck
With part
OD Grip



3 Jaw UBL chuck
Without part



FORE Spinner
Op 10



Rim-Lok Collet Chuck
With part
ID Grip



Rim-Lok Collet Chuck
Without part



FORE Spinner
Op 20



Rim-Lok Collet Chuck
With part
ID Grip



Rim-Lok Collet Chuck
Without part



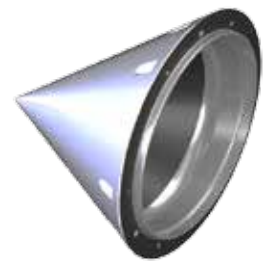
FORE Spinner
Op 30



Rim-Lok Collet Chuck
With part
ID Grip



Rim-Lok Collet Chuck
Without part



AFT Spinner
Op 40



Rim-Lok Collet Chuck
With part
OD Grip



Rim-Lok Collet Chuck
Without part



AFT Spinner
Op 50

REAR SHAFT

This application clamps each part on a shuttle outside of a grinding machine. The ring formed shuttle would accommodate the part on a datum using the holes on the part. The mandate was to clamp the part in a free state, without any distortion. The part will be radially centered on the shuttle outside of the grinding machine by indicating the outside diameters at both ends of the part while finding best average run-out, approximately between 0.0002" and 0.001".

Two different shuttles are required to accommodate three part types. Each shuttle side facing the part would be designed to accommodate a curvic coupling adapter, allowing the shuttle to be clamped horizontally in the grinding machine. The requirement is to achieve TIR of less than 0.0002"

A pneumatic fixture and tru-change system was designed for this project.

GRIND



Pneumatic
Fixture with
Tru-Change
And Part



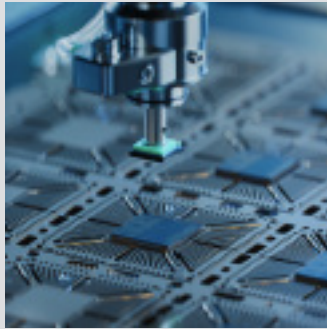
Pneumatic
Fixture with
Tru-Change
No Part



Rear Shaft



Forkardt Hardinge, a solution for every industry



833-791-9681
FORKARDTHARDINGE.COM
SALES@FORKARDTHARDINGE.COM

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