

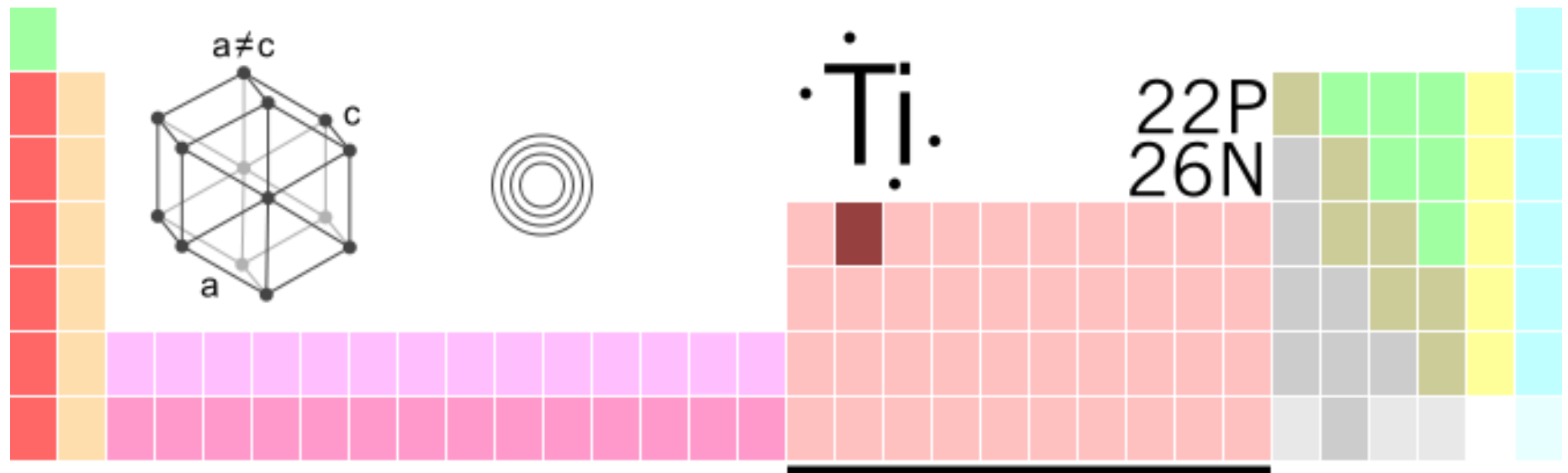
TITANIO Y SUS ALEACIONES

Julio Alberto Aguilar Schafer

Tabla periódica

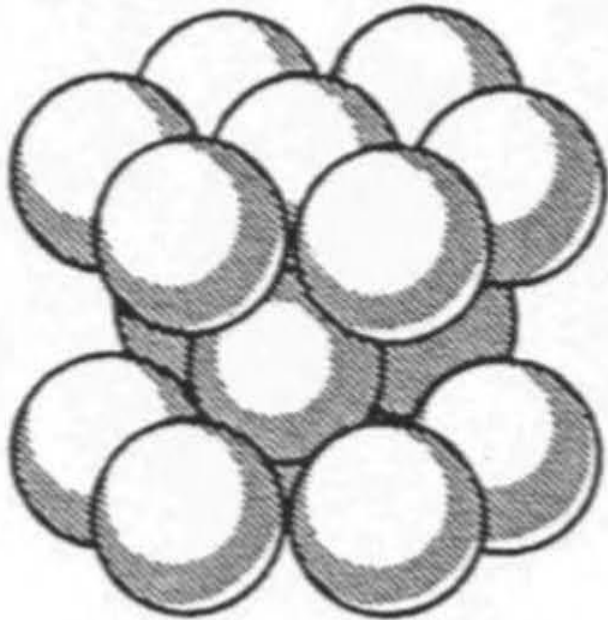
Periodic Table by Article Quality

★ 1 H Hydrogen																	★ 2 He Helium						
3 Li Lithium	4 Be Beryllium																	⊕ 5 B Boron	6 C Carbon	7 N Nitrogen	★ 8 O Oxygen	9 F Fluorine	⊕ 10 Ne Neon
11 Na Sodium	12 Mg Magnesium																	13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	⊕ 17 Cl Chlorine	⊕ 18 Ar Argon
19 K Potassium	20 Ca Calcium	⊕ 21 Sc Scandium	★ 22 Ti Titanium	⊕ 23 V Vanadium	⊕ 24 Cr Chromium	⊕ 25 Mn Manganese	26 Fe Iron	27 Co Cobalt	⊕ 28 Ni Nickel	29 Cu Copper	★ 30 Zn Zinc	31 Ga Gallium	★ 32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	⊕ 36 Kr Krypton						
37 Rb Rubidium	38 Sr Strontium	★ 39 Y Yttrium	⊕ 40 Zr Zirconium	★ 41 Nb Niobium	⊕ 42 Mo Molybdenum	★ 43 Tc Technetium	⊕ 44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	⊕ 52 Te Tellurium	53 I Iodine	★ 54 Xe Xenon						
⊕ 55 Cs Caesium	56 Ba Barium	57 * La Lanthanum	⊕ 72 Hf Hafnium	⊕ 73 Ta Tantalum	⊕ 74 W Tungsten	⊕ 75 Re Rhenium	⊕ 76 Os Osmium	★ 77 Ir Iridium	78 Pt Platinum	79 Au Gold	⊕ 80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	⊕ 86 Rn Radon						
★ 87 Fr Francium	88 Ra Radium	89 ** Ac Actinium	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Uut Ununtrium	114 Uuq Ununquadium	115 Uup Ununpentium	116 Uuh Ununhexium	117 Uus Ununseptium	★ 118 Uuo Ununoctium						
		* 58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	⊕ 66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium								
		** 90 Th Thorium	91 Pa Protactinium	★ 92 U Uranium	93 Np Neptunium	★ 94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium								

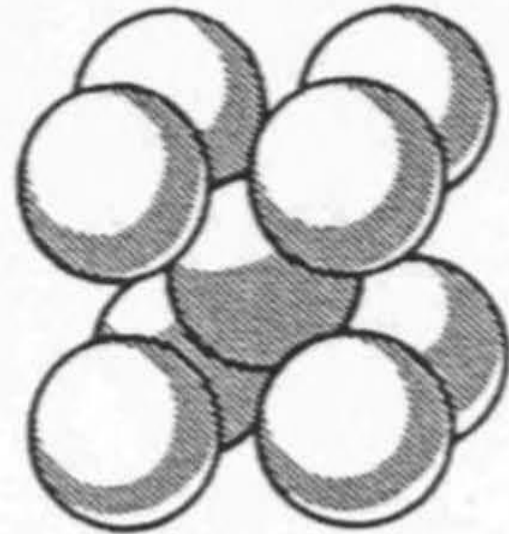


Transformación Alotrópica 880°C

β -Transus



Hexagonal compacta
Fase α -HCP



BCC
Fase β

ALEACIONES β

Omitir la formación de fase ω

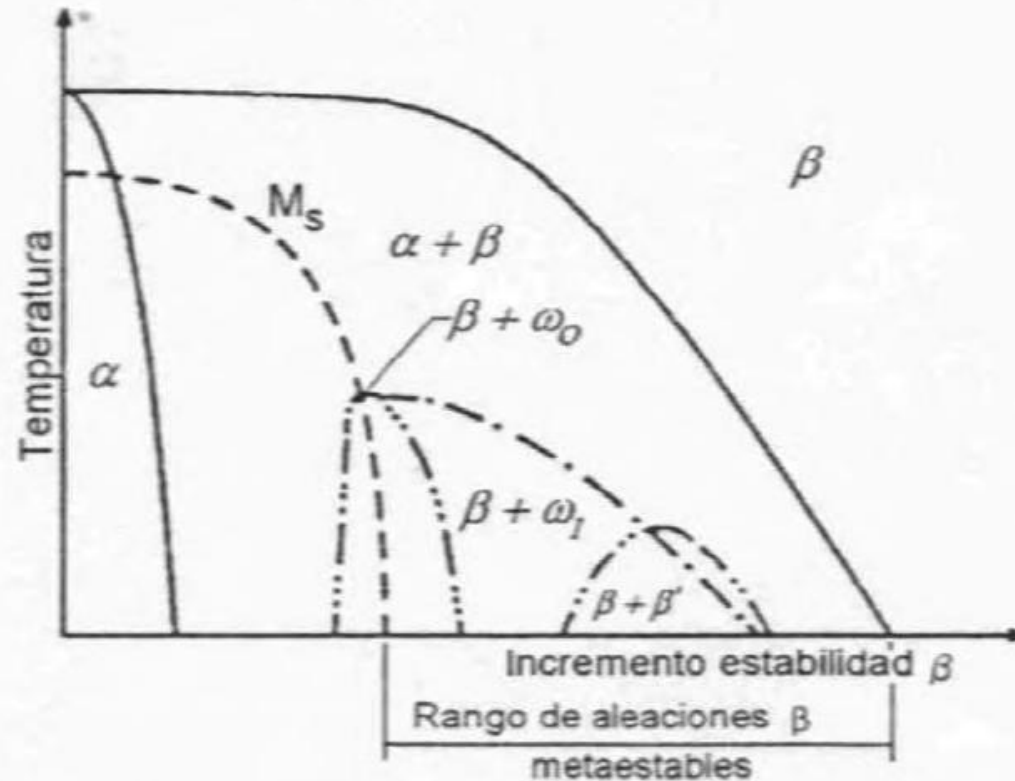


Fig. 2.11 Tratamientos térmicos en aleaciones β

Ti-13V-11Cr-3Al

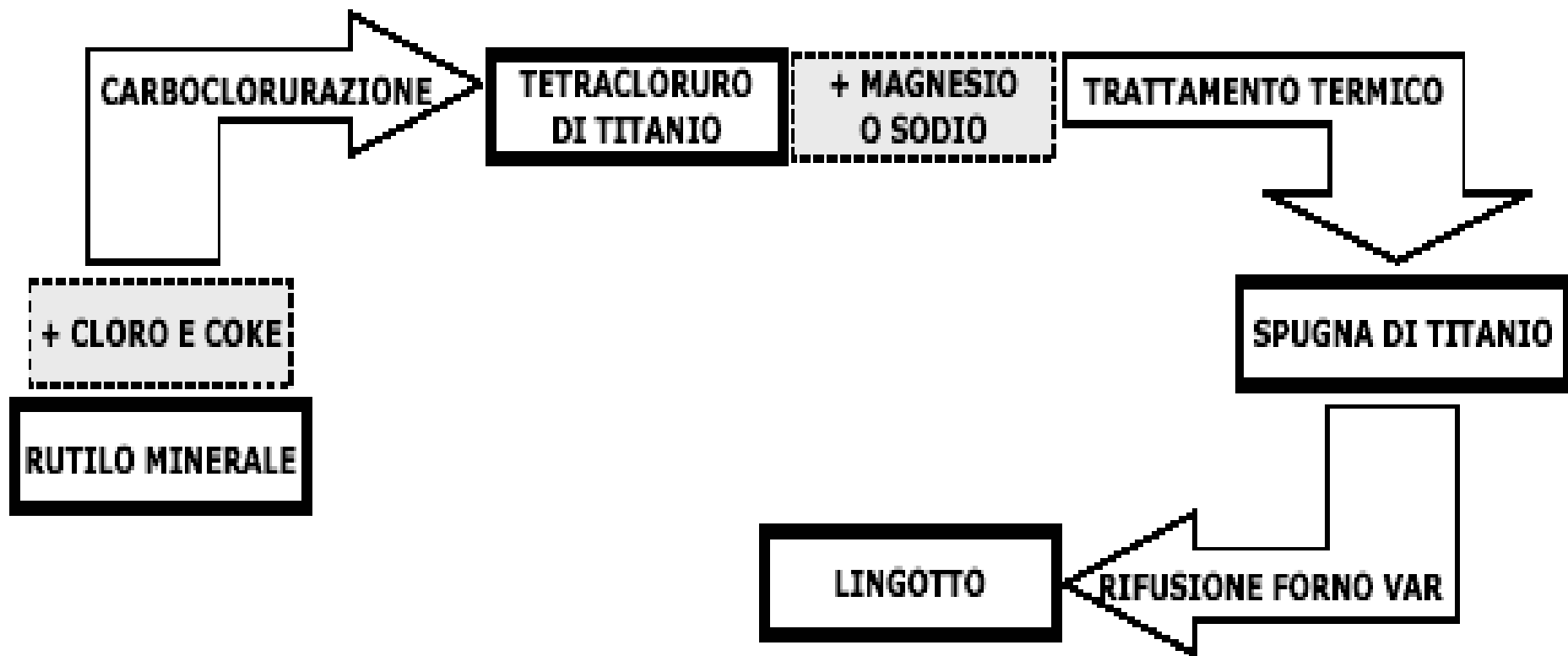
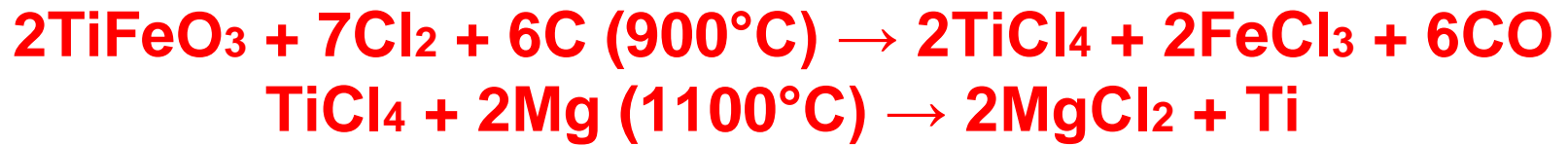
Ti-8Mo-8V-2Fe-3Al [Ti-8823]

Ti-15V-3Sn-3Cr-3Al [Ti-15-3-3-3]

Minerales de Titanio

Se encuentra como óxido en minerales:

- **Ilmenita** (FeTiO_3)
- **Rutilo** (TiO_2)
- **Esfena** ($\text{CaO} \cdot \text{TiO}_2 \cdot \text{SiO}_2$)



Aplicaciones

- En aleaciones como sustituto del aluminio
- Aleado con aluminio y vanadio en aeronáutica
- Motores a reacción
- En ingeniería aeroespacial
- En medicina
- Industria alimenticia

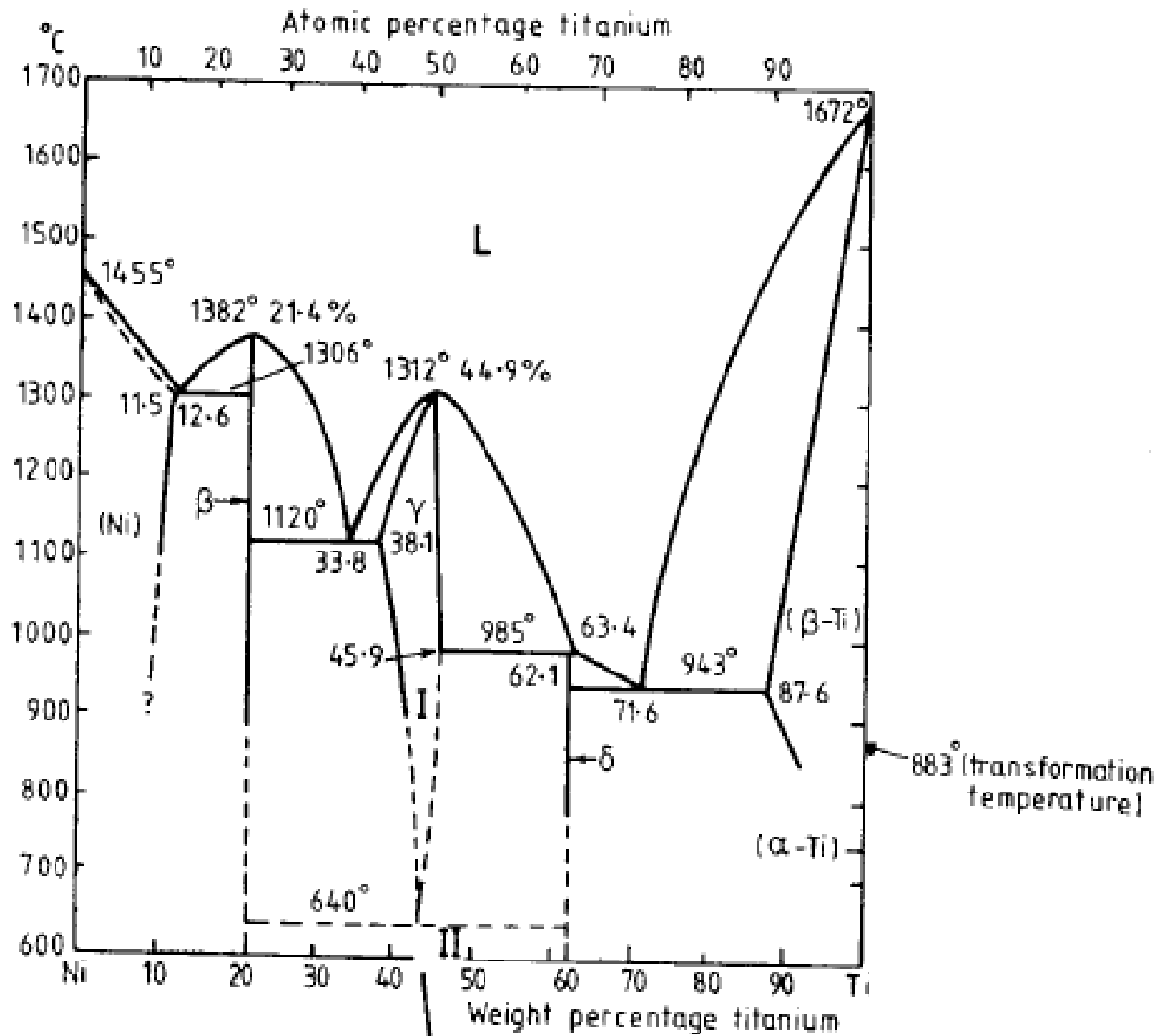
Aplicaciones

- Plantas de desalinización
- En metalurgia
- Pigmentación
- Chips de ordenadores
- Creación de polímetros
- Gemas

Aleaciones comunes

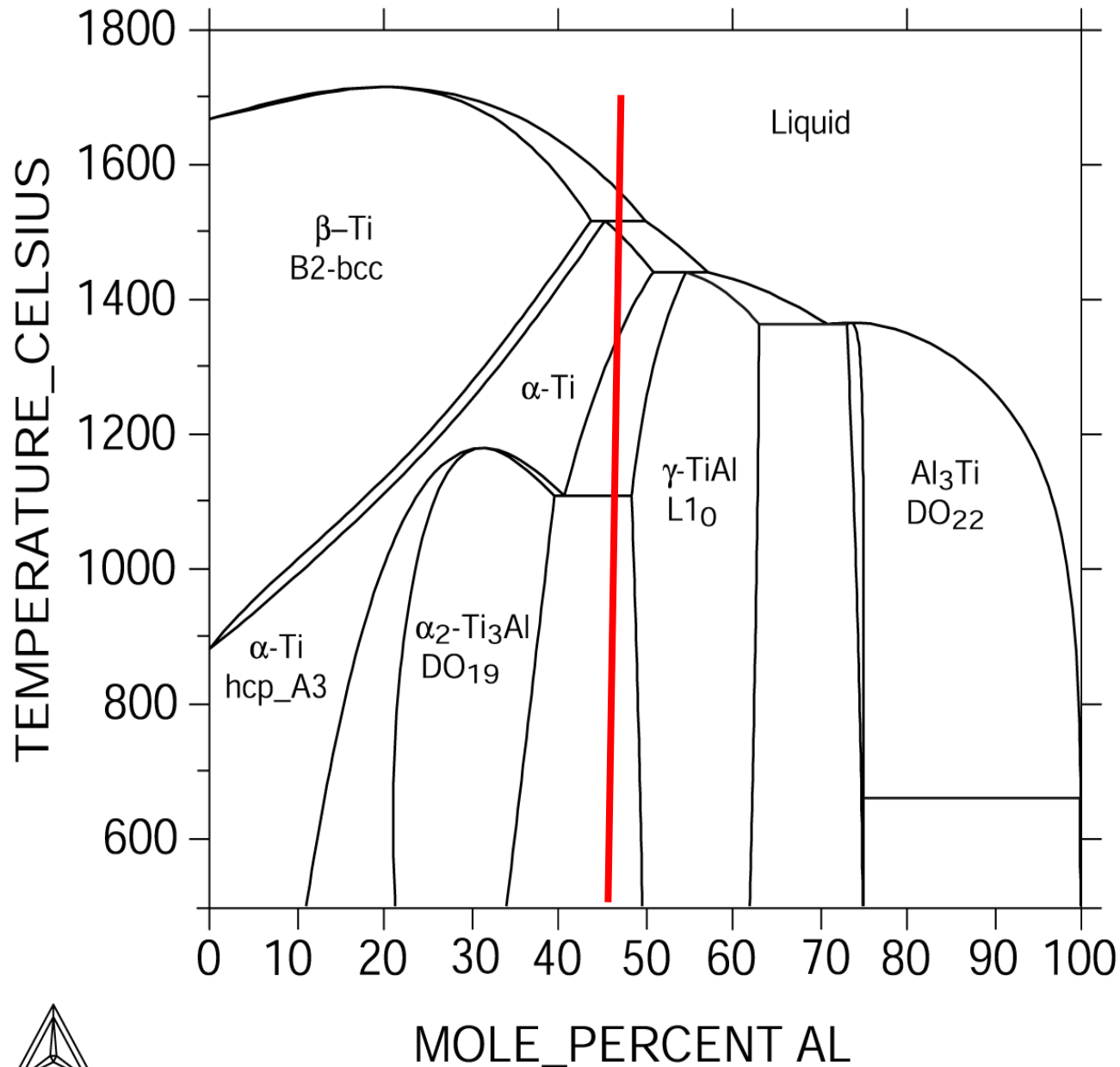
- Titanio, aluminio y vanadio
- Ferroc carbono titanio
- Cuprotitanio
- Mangano titanio
- Titanio, aluminio y berilio
- Titanio, cobre y níquel
- Nitrurotitanio

Diagrama Ti-Ni



Superalación TiAl



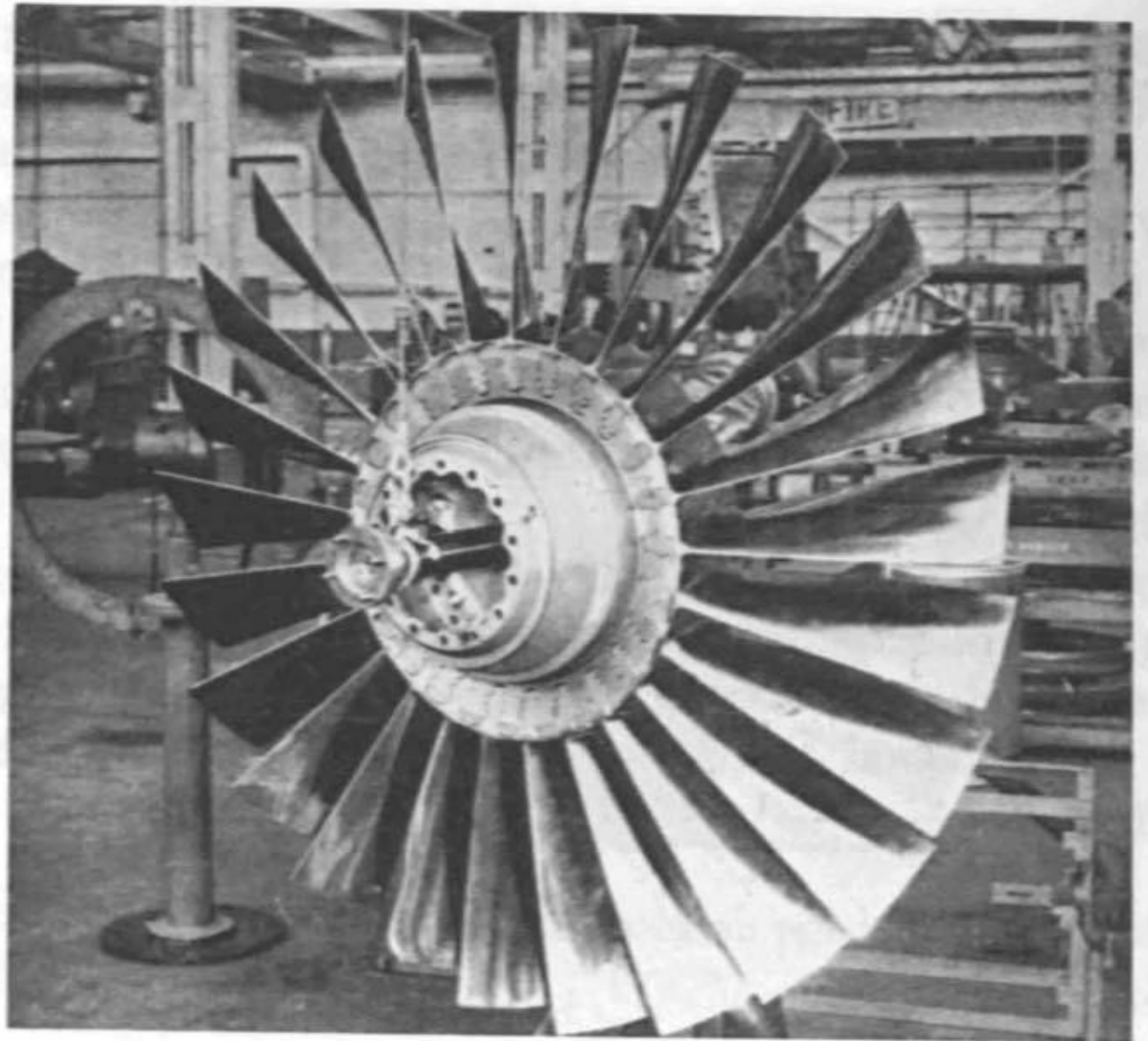


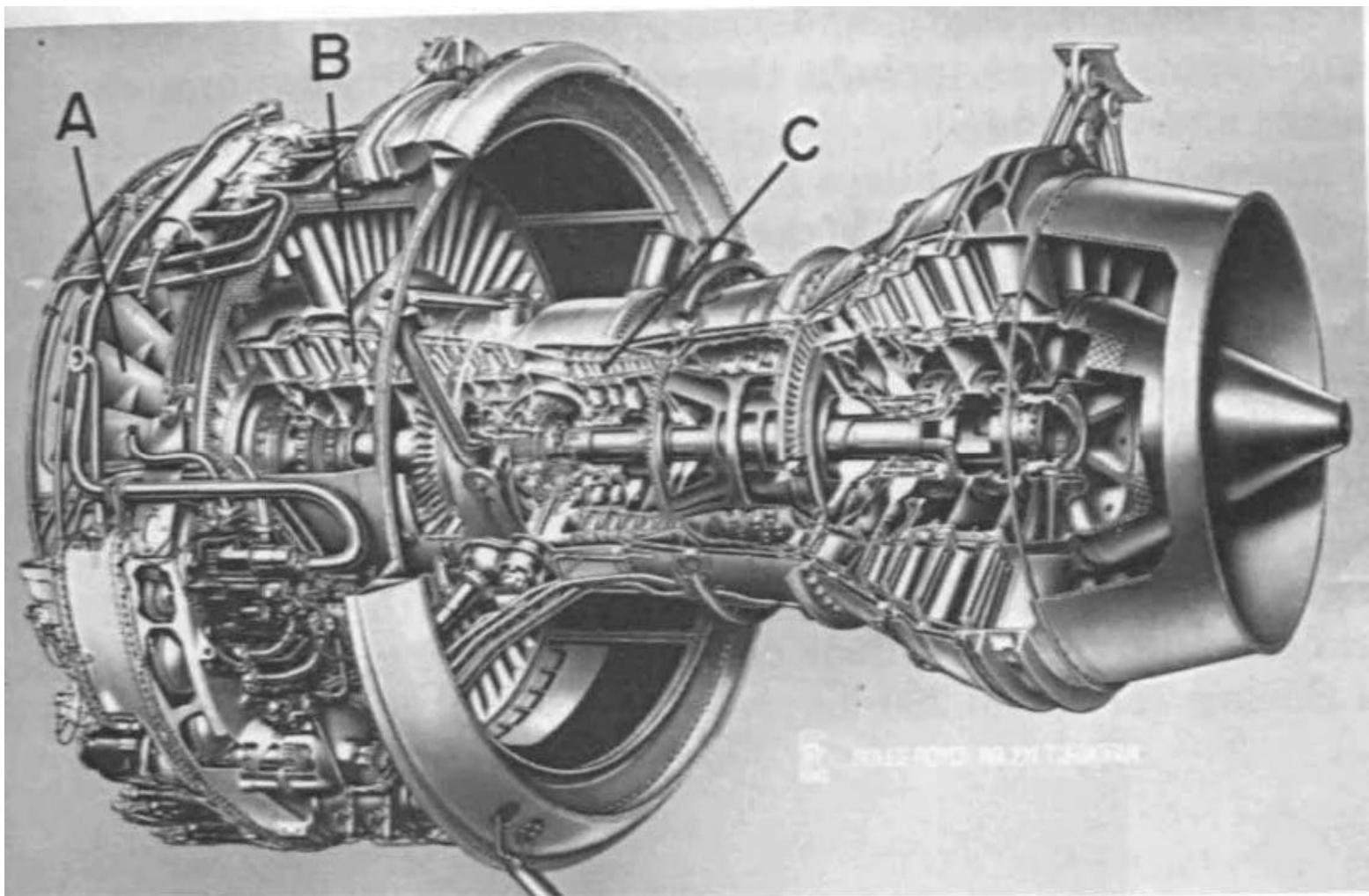
**Ti-Al45-Nb8-C0.2-
B0.2:
ERDA-Messung
[at%]**

Ti	47.9
Al	43.6
Nb	7.5
C	0.2
B	0.2
O	1.2
N	0.06
H	0.4



APLICACIONES



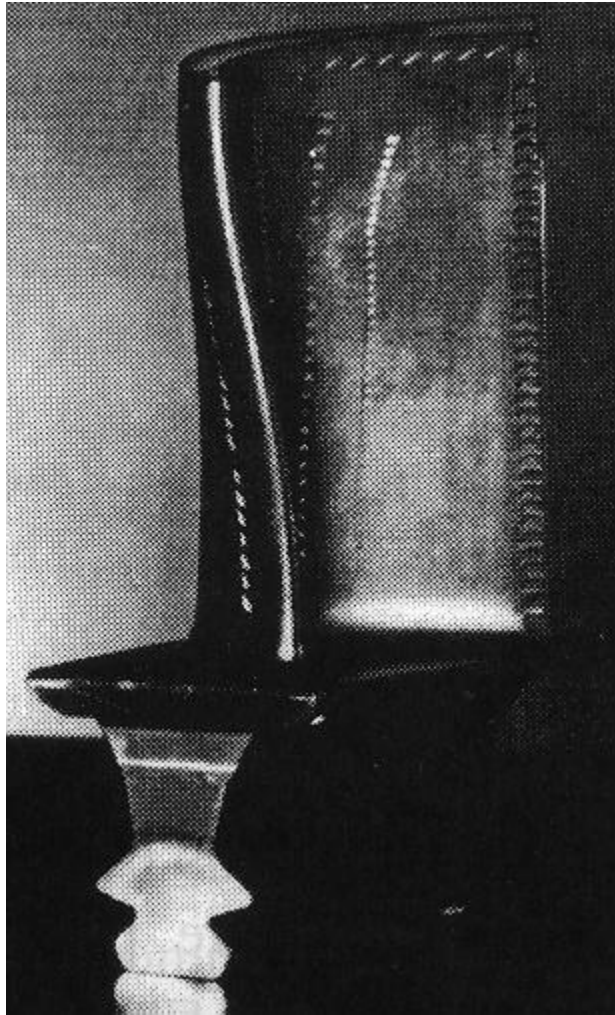


**Sección de un modelo de una
turbina a gas. (Rolls Royce RB 211)**

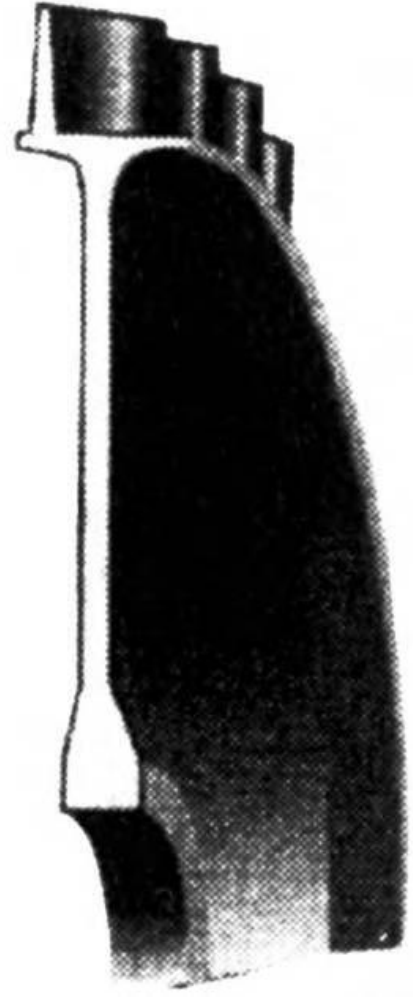
A. Álabes

B. Compresor de baja presión

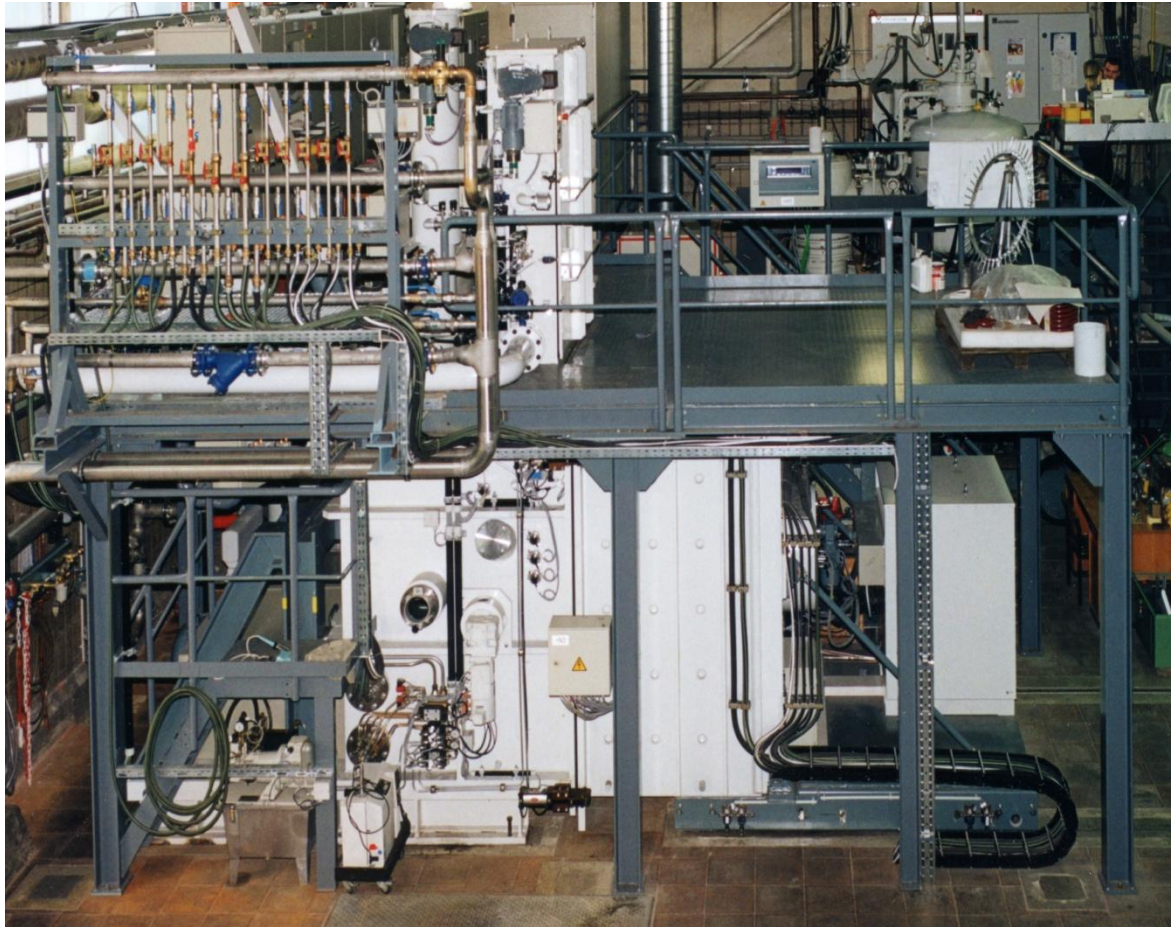
C. Compresor de presión intermedia



Area of Fretting



Pilotanlagen zur Serienfertigung von TiAl-Bauteilen



- **Jahreskapazität:**

600.000Stk

- **Platzbedarf:**

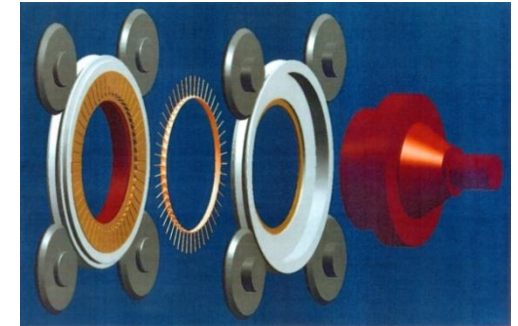
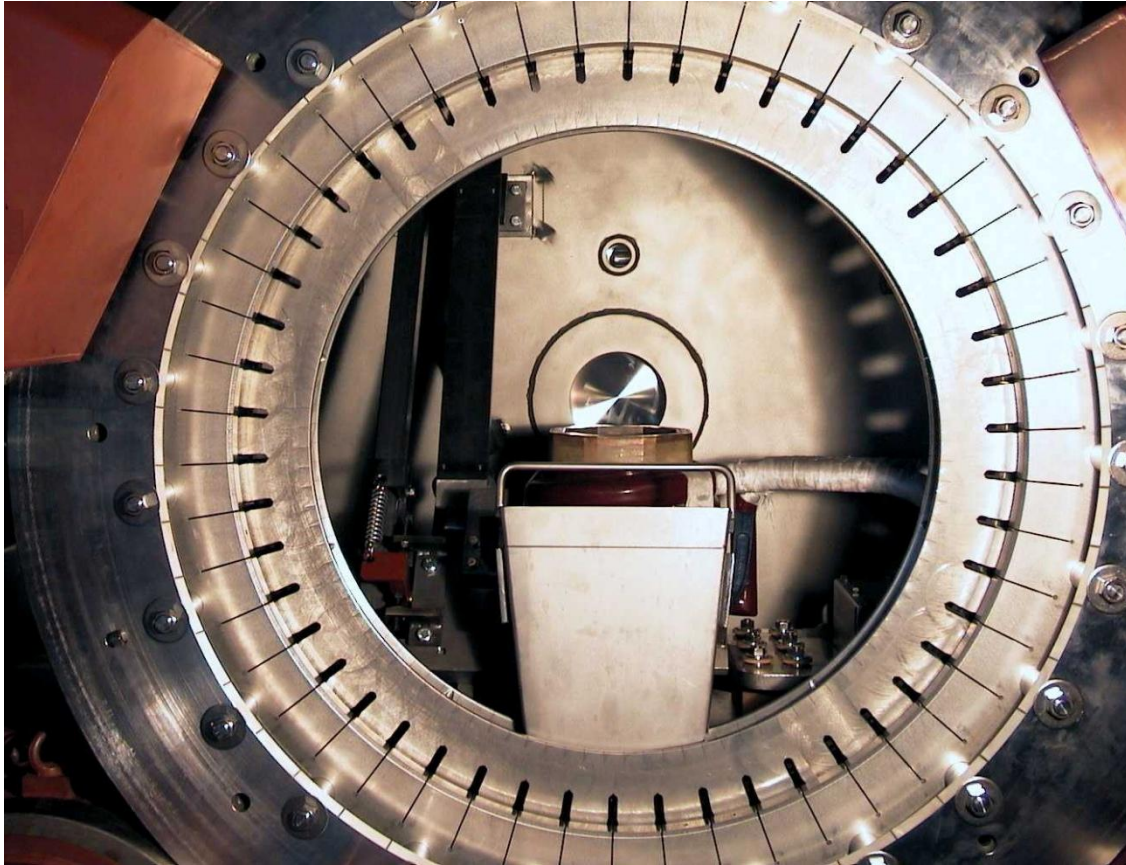
150qm

- **Anschlussleistung:**

1MW

- **Betrieb:**
- **1 Person**

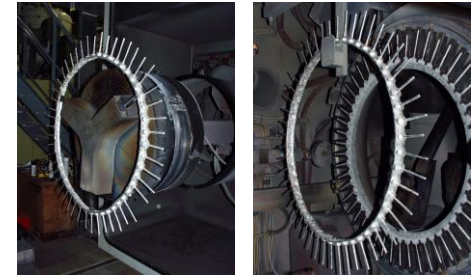
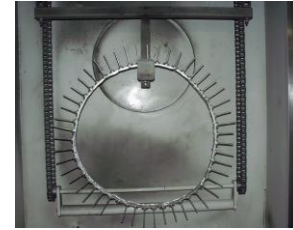
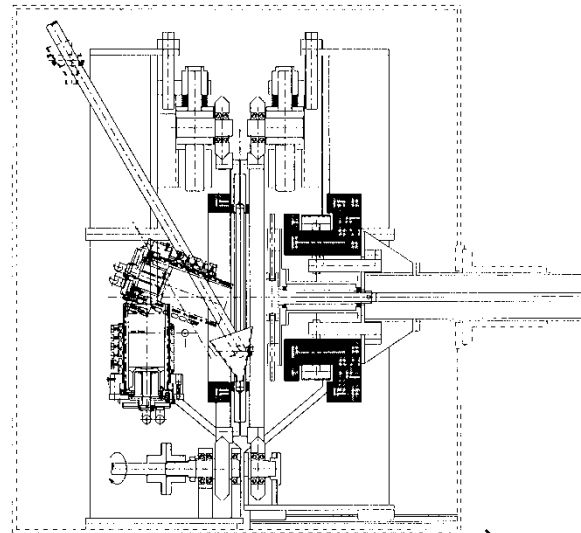
Pilotanlagen zur Serienfertigung von TiAl-Bauteilen



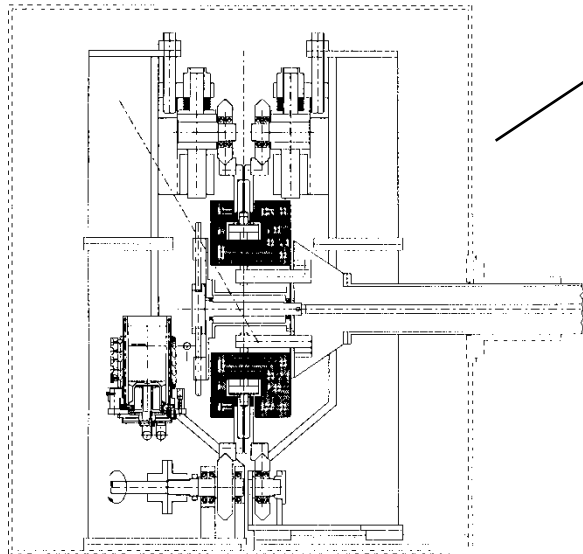
- **2teiliges Kokillengießrad**
- **Automatischer Betrieb**
- **50 Ventile**
- **30 min Einrichtzeit**

Pilotanlagen zur Serienfertigung von TiAl-Bauteilen

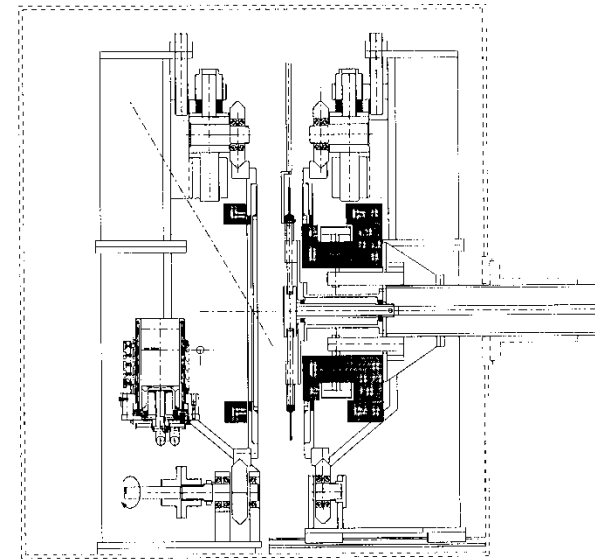
Gießen



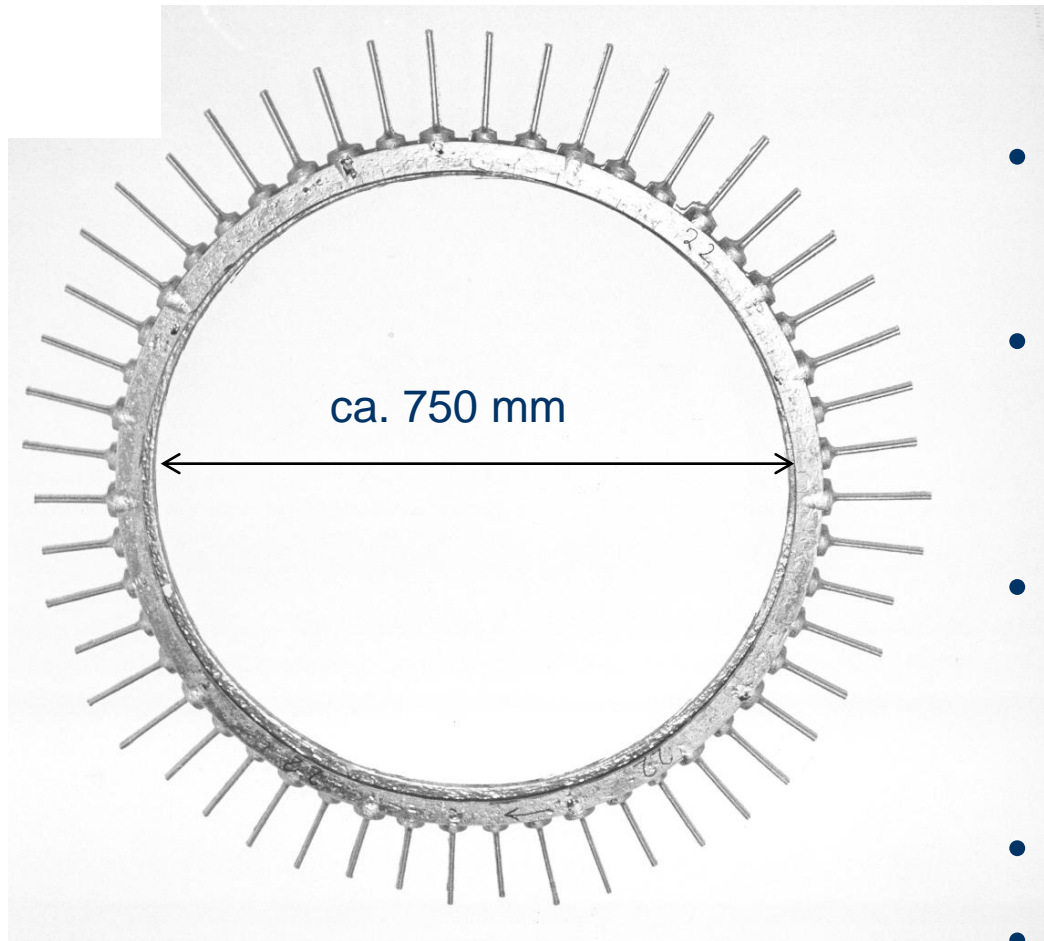
Heizen



Produktionsschema



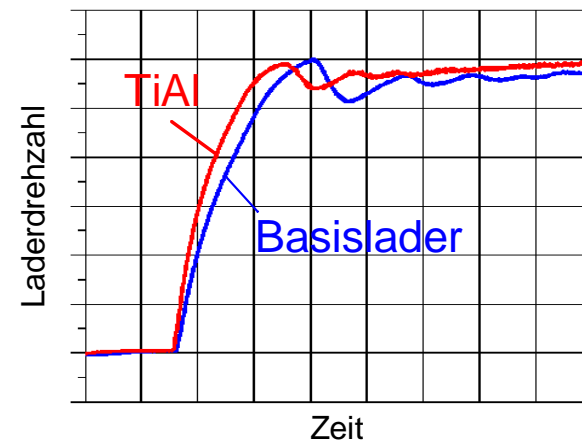
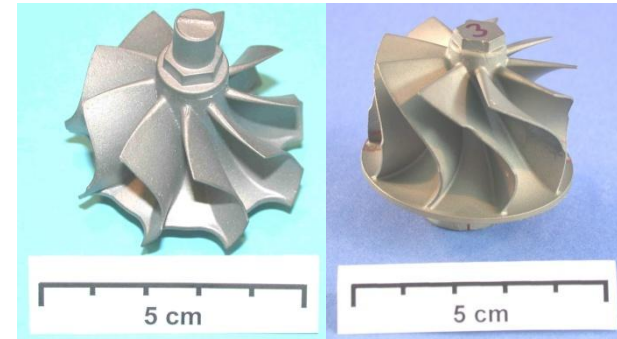
Pilotanlagen zur Serienfertigung von TiAl-Bauteilen



- **TiAl-Gießkranz**
- **10 verschiedenen Ventilgeometrien von**
- **AUDI, BMW, FORD, OPEL, VW**
- **Schaft-Ø = 5-7mm**
- **Ventillänge= 80 – 120 mm**

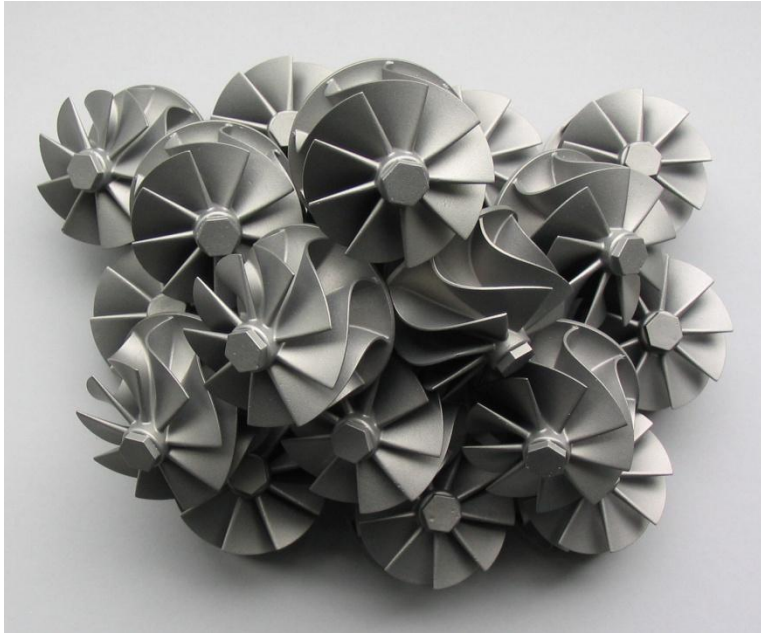
Schleudergussverfahren für TiAl – Feingussbauteilen

- Abgasturboladerräder

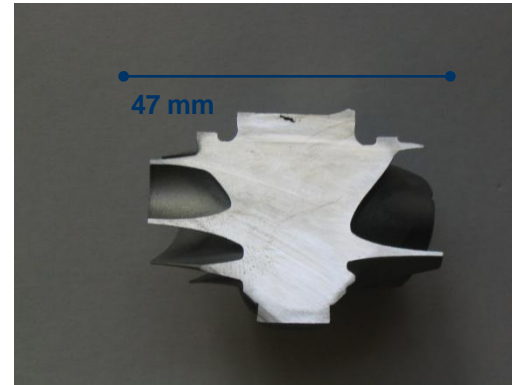


BMBF-Projekt DC, GFE, GKSS, ACCESS

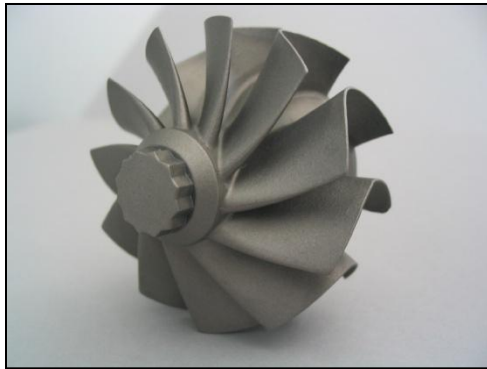
Schleudergussverfahren für TiAl – Feingussbauteilen



Diesel ATL TiAl TNBV5

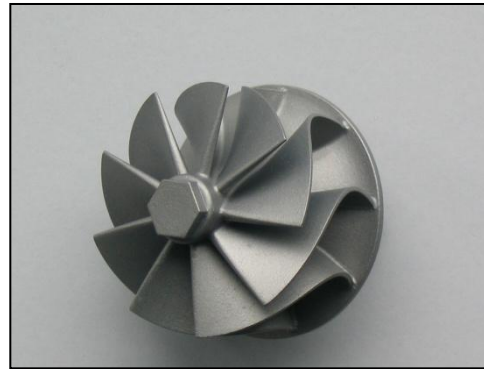


Schleudergussverfahren für TiAl – Feingussbauteilen



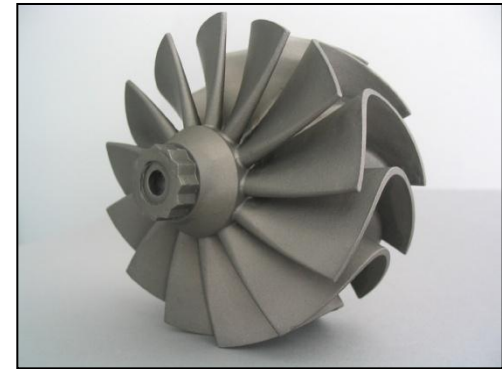
**ATL für Ottomotor
(PKW)**

Durchmesser: 46 mm
Bauteilgewicht: 60 g
Flügelstärke: 0.4 mm



**ATL für Dieselmotor
(PKW)**

Durchmesser: 47mm
Bauteilgewicht: 80 g
Flügelstärke : 0.7 mm



**ATL für Dieselmotor
(LKW)**

Durchmesser: 75 mm
Bauteilgewicht: 370 g
min. Flügelstärke : 1,7 mm

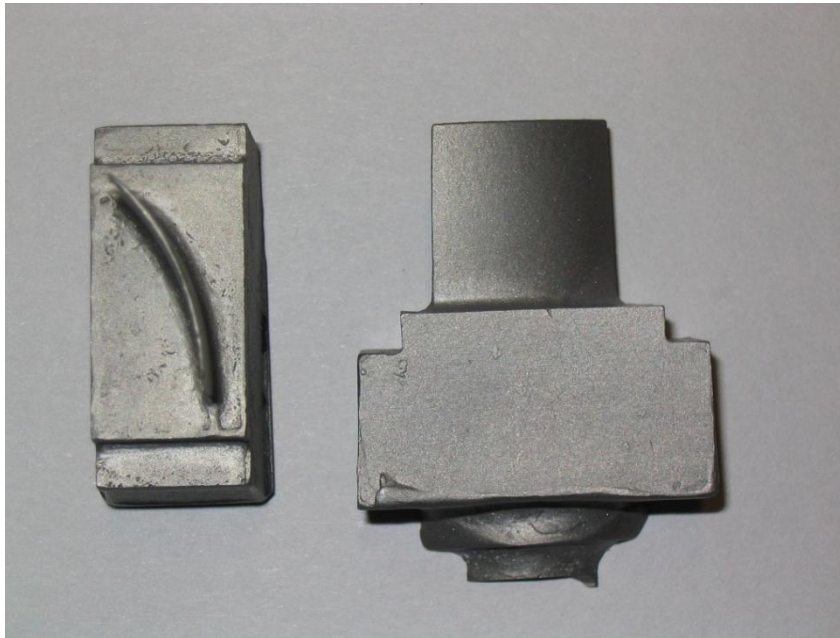
Schleudergussverfahren für TiAl – Feingussbauteilen



230 mm

ND-Turbinenschaufel aus TiAl

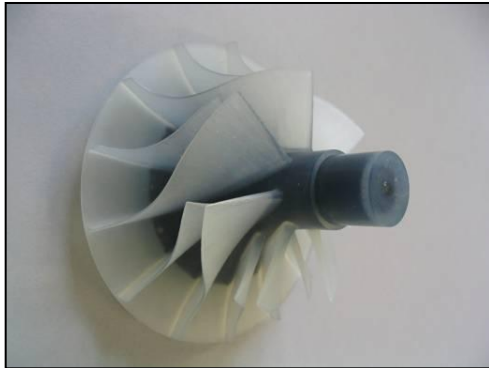
Schleudergussverfahren für TiAl – Feingussbauteilen



Statorblätter aus TNBV5 für Triebwerkskompressoren

Gewicht: 12 g
Blattstärke: 0,5 – 1 mm
Bauteildimension: 20x 20 mm

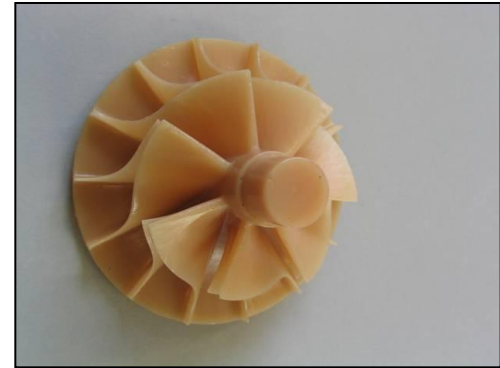
Schleudergussverfahren für TiAl – Feingussbauteilen



SLS - Modell



PU-Matrize



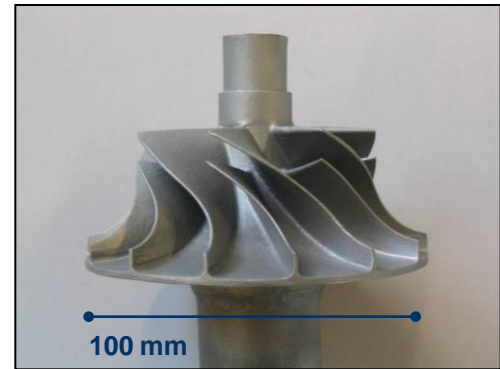
Wachsling



Formschale



Schleudergießanlage



Kompressorrad 350g TiAl