



Extending the Life of Oil & Gas Exploration Equipment with DYNA-BLUE®



What is DYNA-BLUE®?

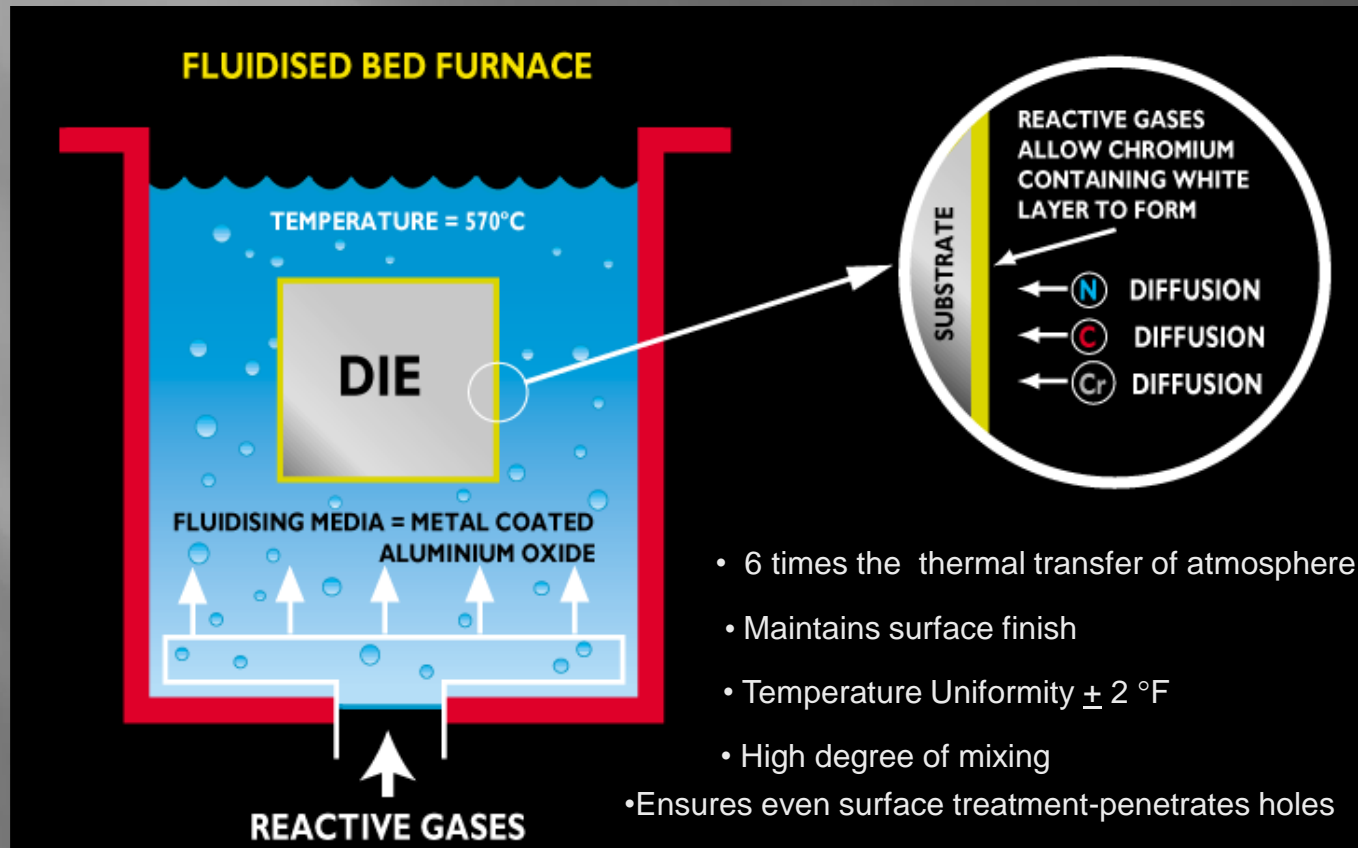
DYNA-BLUE is a low temperature, (typically 950° – 1060 ° F), thermal-chemical diffusion process that yields two metallurgical characteristics:

- 1) Epsilon Iron Carbonitride Compound layer that is composed of Nitrogen & Carbon and has a hardness of up to 75HRC. A typical compound layer for Fluid Ends is .001” – .002” depending upon the application and properties needed. The compound zone provides wear resistance as well as resistance to attack from H₂S gas as well as salt water, acids and other corrosive environments.
- 2) A nitrogen enriched diffusion zone 65+ HRC that supports the compound zone. A typical diffusion layer is produced from .010” to greater than .015”.

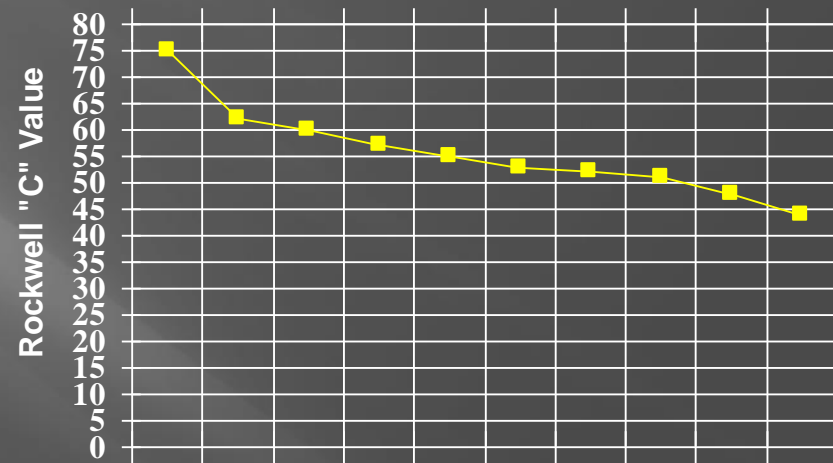
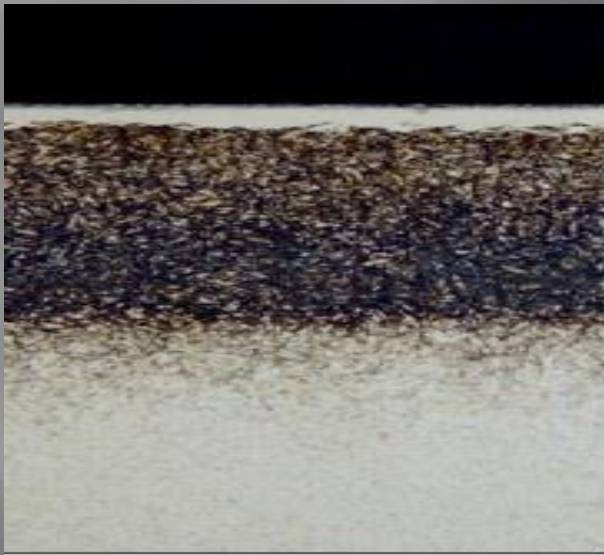
Fluidized Bed Furnaces

Fluidization is the term applied when making aluminum oxide or sand particles react like a liquid in a heat treating furnace. Process gases are introduced to the furnace through a diffusion plate, located in the bottom of the furnace. The gases are pressurized thus lifting and moving the sand scrubbing the part, thru cylinders, holes, bores with fresh reactive gases and provides uniform heating $\pm 2^{\circ}\text{F}$, thereby ensuring consistent metallurgical properties with 6 times the thermal transfer of atmosphere. The process is not inhibited by part geometry or blind holes and maintains finish.

DYNA-BLUE Surface Treatments

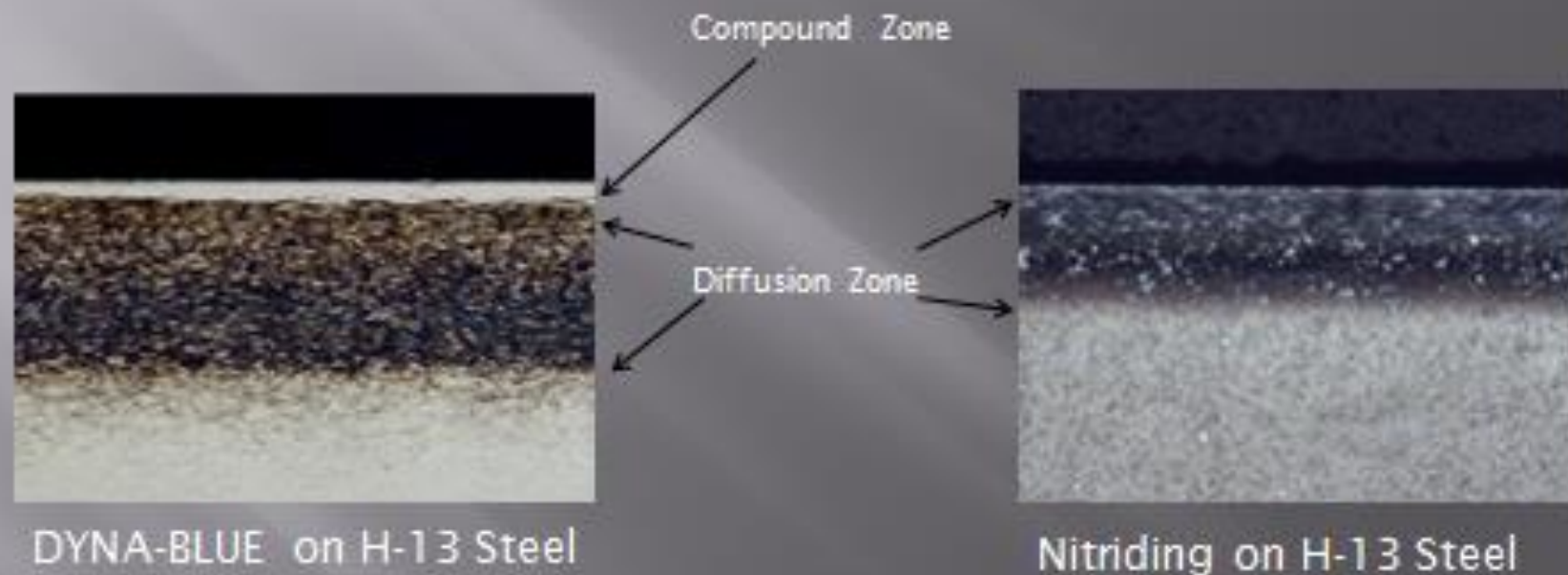


Microstructure and Microhardness Graph



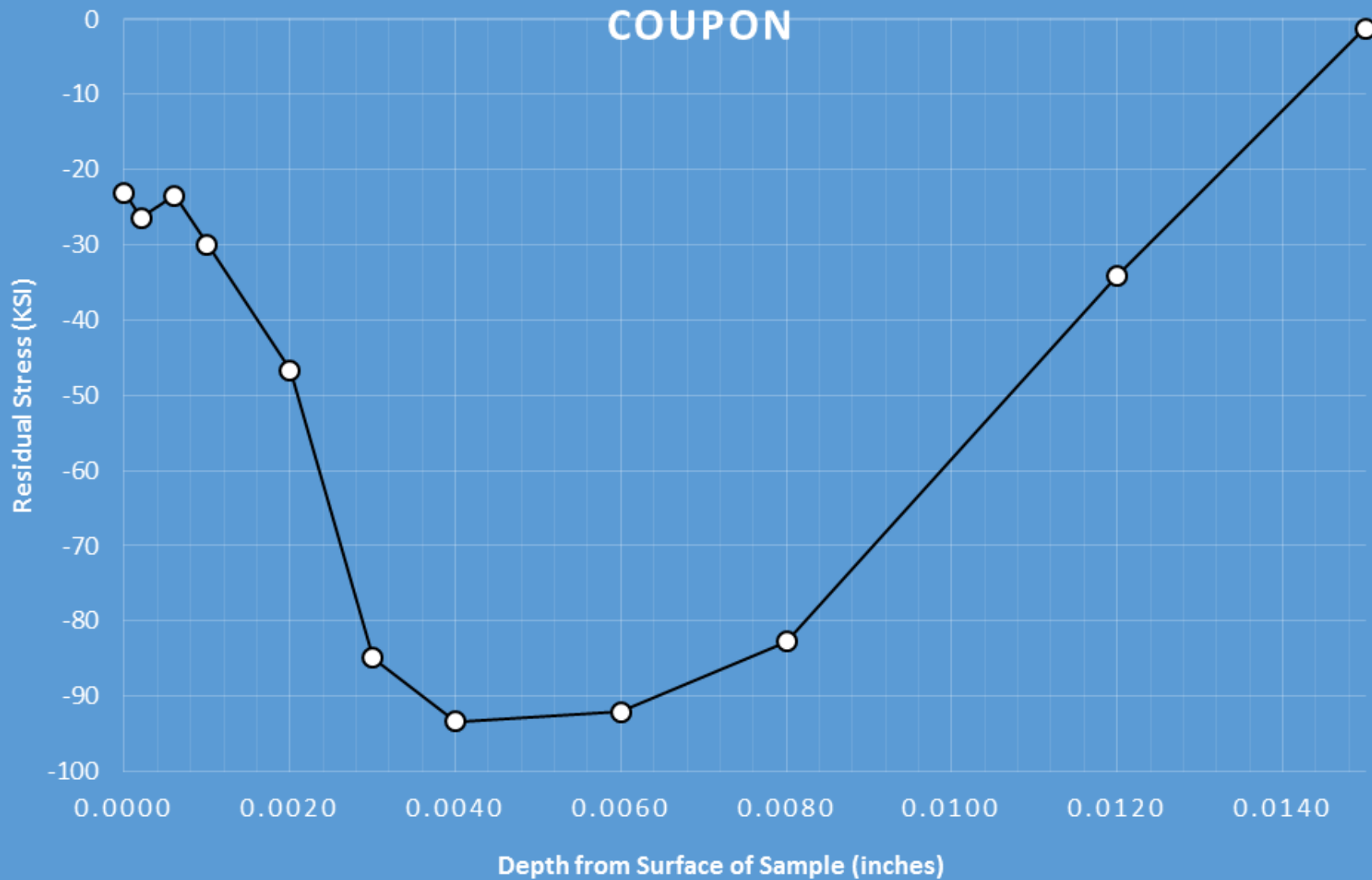
The picture on the left shows .001" compound (white) layer supported by a nitrogen rich (dark) diffusion zone. The graph on the right exhibits a typical microhardness traverse on 4330V with a DYNA-BLUE 7E10 cycle. The first value is 75 at .0005" with each descending value equal to .001".

Microstructure of DYNA-BLUE vs Nitride

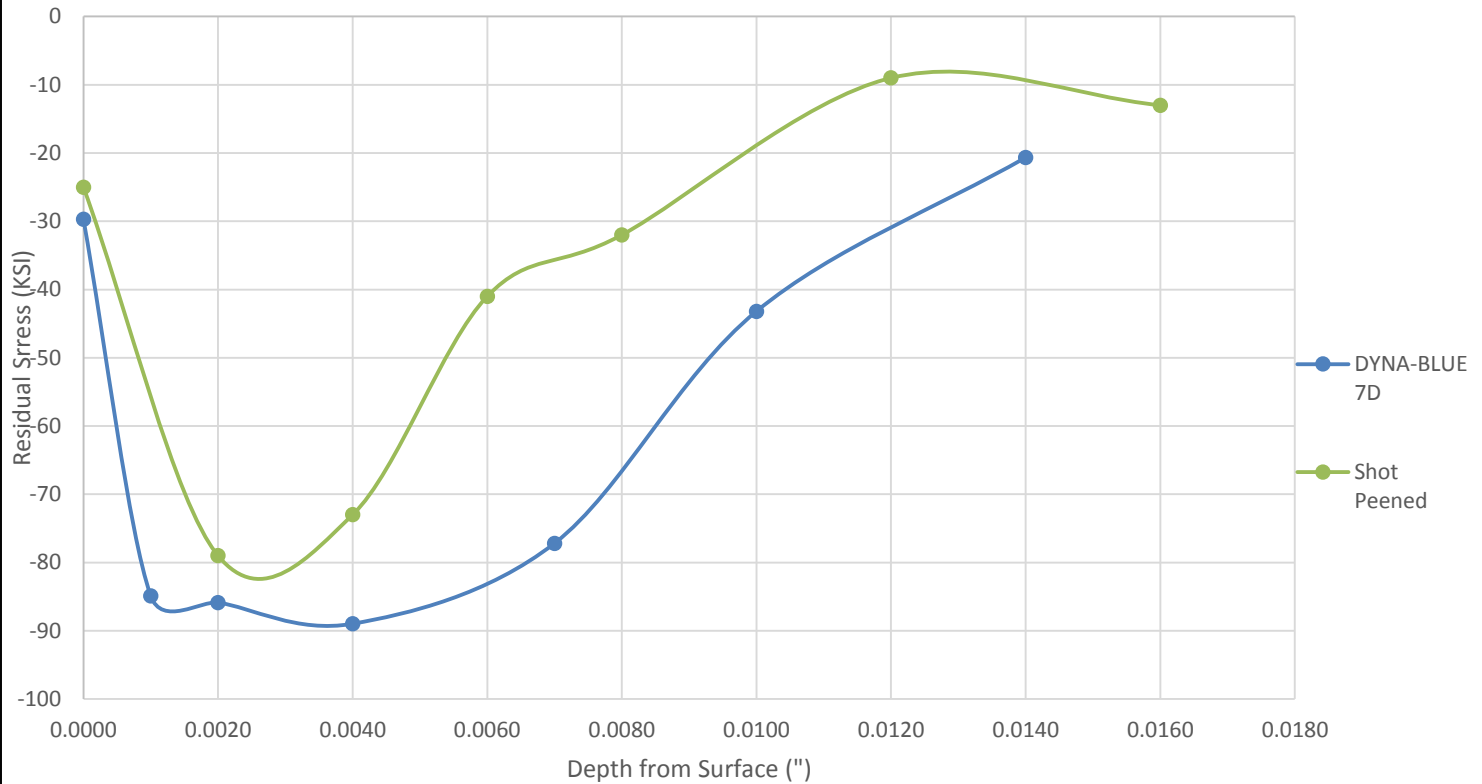


The DYNA-BLUE process provides a hard wear resistant 75+ HRC compound layer supported by a nitrogen rich diffusion layer that nitriding does not which increases wear resistance up to 10 times more than Nitriding

COMPRESSIVE RESIDUAL STRESS OF DYNA-BLUE P20 COUPON



Residual Stress of 4330V DYNA-BLUE 7D vs Shot Peened



Corrosion Resistance

Test Type: Salt Fog (MIL-STD-810G 509.5)

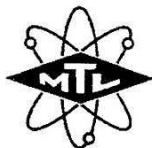
Test Procedure/Preparation

The test specimens were placed in a salt fog chamber set at $35\pm 2^{\circ}\text{C}$ with a salt concentration of 5% for 24 hours. After the first 24 hours, the specimens were removed and dried at room temperature for 24 hours. The process was repeated (24 hours of salt followed by 24 hours at room temperature).



M11779 Dynablue w/ NITROWEAR 1

- No rust observed after 48 hours in salt fog.

**MIDWEST TESTING LABORATORIES, INC.**

1072 WHEATON • PHONE (248) 689-9262 • TROY, MICHIGAN 48063
FAX (248) 689-7637

ORIGINAL REPORT OF ANALYSIS

DYNAMIC METAL TREATING #713
7784 RONDA DRIVE
CANTON TWP., MI 48187

MTL#3L772 (PG. 1 OF 1)
DATE RECEIVED: 8/4/98
DATE COMPLETED: 8/24/98
BY: ED LESTERSON
P.O. # 2132

SAMPLE OF: 6 pc.
SAMPLE NO. OR DESCRIPTION:

SPECIFICATION REQUIRED: B117

SALT SPRAY:

Six (6) samples tested were subjected to 126 hour neutral salt spray testing per ASTM B117.

Dyna Blue - 3 pieces 5% base metal corrosion
1 piece > 10% base metal corrosion

409 Stainless - 1 piece 5% base metal corrosion
1 piece > 10% base metal corrosion

*Sample returned to Dynamic Metal Treating, Inc for evaluation.

THIS DOCUMENT CAN ONLY BE REPRODUCED IN FULL.

We certify the above analysis to be the true results on the designated samples.
MIDWEST TESTING LABORATORIES, INC.

Edward Lester
Director of Laboratory
ID# 100258 EXPIRATION 01/2000



Benefits of DYNA-BLUE ®

- 1- Resists wear (75+ HRC surface) 2-10 times longer than QPQ, gas/ion-nitriding/chrome plating.
- 2-Penetrates holes, bores, pockets uniformly which Nitride Furnaces cannot as they are “line of sight”
- 3-Corrosion resistance-2-3 times better corrosion resistance compared to Stainless Steel-resists attack from hydrochloric acid, salt water, corrosive environments.
- 4- Increased Fatigue Resistance.
- 5-Increased Compressive Residual Stress to resist cracking.
- 6- Increased lubricity-reduces coefficient of friction.
- 7- Reduces erosion from abrasive environments such as sand.
- 8- No flaking since the process is a diffusion process and not a coating.
- 9- Capacity 77”x110” - up to 30,000 lbs.
- 10- Low dimensional variation, less than .0002” growth.
- 11-Overnight service available
- 12-Non-Toxic & Non-Hazardous

DYNA-BLUE Case Study

A drilling operation was getting 300–600 pump hours on their nitrided Fluid Ends in a high pressure Fracking operation. Fluid Ends were experiencing fatigue cracks and extreme wear (washout) from the sand and hydrochloric acid used. New Fluid Ends were treated with DYNA-BLUE and pump life was increased to 1200–1600 hours.

Conclusion

1. **DYNA-BLUE 75+ HRC provides much better wear resistance than Stainless Steels (17-4 is 42-49 HRC) and Gas or Ion Nitriding at 60-65 HRC.**
2. **DYNA-BLUE provides better resistance to corrosion and attack from harsh environments such as H₂S, salt water and others than Stainless Steels or Nitriding.**
3. **DYNA-BLUE penetrates holes, bores, cylinders that Gas or Ion Nitride cannot.**
4. **DYNA-BLUE is much less cost than Stainless Steel.**
5. **DYNA-BLUE turnaround time is 1-2 days and can be done overnight if required.**
6. **Pump life is extended by 3-5 times, 1200-1600 hours have been reported**
7. **DYNA-BLUE is cost effective-Stainless steel is not!!**