

## Formability of the FreedomWear FX Plate:

Whenever possible, *FreedomWear FX Plate* should be formed with the weld beads aligned in the direction of rolling.

**Minimum Diameters** - The minimum recommended diameter to which *FreedomWear FX Plate* can be formed will depend on the thickness of the plate, the type of substrate and whether the bend is concave (*FreedomWear* facing on the inside) or convex (*FreedomWear* facing on the outside).

The table below shows typical minimum diameters for cold forming\* the *FreedomWear FX Plate*.

FreedomWear FX Plate	Nominal substrate thickness	Minimum Diameter Concave	Minimum Diameter Convex
Single layer overlays from 1/8"-1/4" (3.2-6.3mm)	3/8" (9.5mm)	10" (250mm)	16" (400mm)
Double layer overlays from 5/16"-3/8" (8.0-12.5mm)	1/2" (12.5mm)	16" (400mm)	18" (450mm)

\*At room temperature or with slight pre-heat to 300°F - 400°F (150°C - 200°C)



Concave forming puts the alloy facing into compression and the substrate into tension and has the effect on closing the stress relief cracks within the alloy facing. The high compressive strength of *FreedomWear FX* overlay combined with the ductility of the substrate allows for smaller diameters to be formed.

Convex forming has the effect of increasing and/or widening the stress relief cracks within the *FreedomWear FX* overlay. Experience shows that this should not present problems if the minimum recommended radius is not exceeded. Above this figure there is an increasing chance of spalling and crack propagation into the carbon steel substrate.

## Cutting, welding, machining, repair, and mounting of the FreedomWear FX Plate:

**CUTTING** - The high chromium content of *FreedomWear FX Plate* is incompatible with the use of oxy-fuel flame cutting processes. Plasma-arc is the generally preferred method of cutting. The quality of plasma cutting is excellent, in terms of both precision and cleanliness. Localized removal of the overlay material is possible using the Carbon-Arc/Air process.

**WELDING** - *FreedomWear FX Plates* can be welded to themselves or to any weldable substrate structural material using mild steel low hydrogen welding consumables, such as Freedom Alloys Sand Dune 486. Structural welding must be carried out on the mild steel side of the plate.

**MACHINING** - The composition, microstructure and hardness of *FreedomWear FX Plate* precludes the use of conventional methods of machining. Edges and surfaces may be ground with an abrasive disk.

**REPAIR** - Local repairs, or reconstruction of the overlay at the location of welded joints can be carried out using matching manual electrodes or corresponding tubular wires.

**MOUNTING** - PLUG and FILLET welding is the usual mounting method. A standard carbon steel stud can be welded on the back of the *FreedomWear FX Plate* using most types of stud welding equipment.

## Freedom ALLOYS Services

*FreedomWear FX Plates* are available in a range of thicknesses and a choice of overlay alloy/base plate combinations produced with either single or double pass overlay layers as appropriate for each service situation.

Freedom Alloys also offers custom cutting and fabrication of its *FreedomWear FX Plate* as a value added service to our customers. In addition, we can fabricate complete structures or liners based on your specifications. Freedom Alloys can also provide a custom hardfacing service to protect or refurbish a wide range of wearing components with varying alloy compositions.

**Freedom ALLOYS**

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Rev. 4/1/05

BF #92833

Freedom **ALLOYS**

# FreedomWear FX Plate™

Freedom Alloys is proud to introduce the latest in technologically advanced, pre-deposited, chromium-carbide wear plate - *FreedomWear FX Plate*! *FreedomWear FX Plate* has a unique metallurgical chemistry designed to provide maximum abrasion resistance combined with moderate impact resistance. These benefits are accomplished because *FreedomWear FX Plate* contains a matrix of maximum density primary carbide structures combined with a unique manufacturing process which allows for minimum dilution of the hardfacing layer. This process provides for maximum hardness throughout the thickness of the hardfacing overlay.

Since its introduction, *FreedomWear FX Plate* has proven to be a leading multi-purpose wear resistant alloy, providing a wide variety of desirable characteristics in numerous service applications and operating environments. All *FreedomWear FX Plate* is manufactured under strict quality controlled systems approved to ISO 9002 quality standards.



## Benefits of using FreedomWear FX Plate:

*FreedomWear FX Plate* is beneficial whenever you need to hardsurface large areas in the shortest amount of time and with a minimum amount of labor. Because *FreedomWear FX Plate* lasts far longer than ordinary wear plate, it reduces the downtime spent on replacing ordinary wear plates.

- Prolonged Service Life
- Moderate Impact Resistance
- Diverse Applications
- Locally Repairable
- Excellent Abrasion Resistance
- Increased Productivity
- Available in Range of Thickness, Overlay, and Base Plate Combinations
- Reduced Downtime
- Improved Efficiency
- Designed for Elevated Temperatures up to 450°C (1200°F)

## Typical properties of undiluted FreedomWear FX Plate alloy:

The following properties refer to the *FreedomWear FX Plate* alloy, **undiluted** by base material (substrate). These properties may differ from the properties of actual overlay deposits on a particular substrate.

- |   |   |                                       |                         |
|---|---|---------------------------------------|-------------------------|
| 1. <b>Microstructure</b>                  | Hyper-Eutetic with M <sub>7</sub> C <sub>3</sub> primary chromium carbides in an austenitic eutectic matrix | 6. <b>Abrasion resistance</b>         | Excellent               |
| 2. <b>Type of alloy</b>                   | Iron based  | 7. <b>Impact resistance</b>           | Moderate                |
| 3. <b>Group of alloys</b>                 | High chromium iron  | 8. <b>Stress Relieving Cracks</b>     | Yes - up to 20 per foot |
| 4. <b>Nominal composition (undiluted)</b> | 5.4% C, 3.5% Mn, 34% Cr   | 9. <b>Typical service temperature</b> | Up to 450°C (1200°F)    |
| 5. <b>Typical hardness range</b>          | 55-60 Rc  | 10. <b>Typical plate size</b>         | 90" x 117"              |
|   |   | 11. <b>Machining</b>                  | Only grinding           |
|   |   | 12. <b>Flame cutting</b>              | No                      |

## FreedomWear FX Plate is superior because:

**CHEMISTRY** - To make a superior wearplate requires the right combination of alloys which provide the right combination of characteristics needed in real life service applications. *FreedomWear FX Plate* is made with a high chromium iron containing about one-third chromium, about 5% combined carbon, and 3.5% manganese. This unique combination of alloys provides excellent abrasion resistance with moderate impact protection. This chemistry has proven highly successful in many diverse applications.

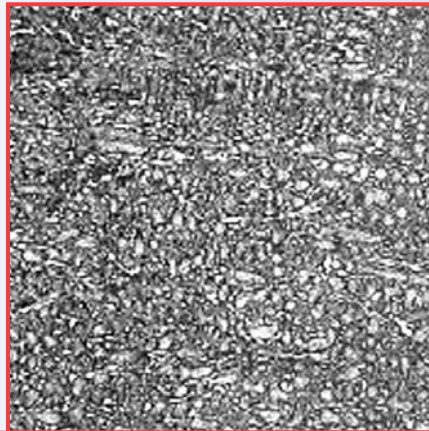
**CARBIDES** - The material that gives high chromium iron alloys their ability to resist abrasion is the formation of primary carbides from a chemical compound of chromium, iron, and carbon, or chromium iron carbide, also called simply chrome carbide. Since pure chromium carbide is prohibitively expensive for large area protection, *FreedomWear FX Plate* uses a mixed carbide of both chromium iron and chromium in the compound to produce its excellent abrasion resistance.

**HARDNESS** - *FreedomWear FX* overlay alloy comprises a composite of chromium iron carbides in a matrix of a chromium iron carbon alloy. The hardness of primary chromium iron carbides is the equivalent of 1700HV compared with, for example, a typical workshop steel file, which has a hardness of 600HV. Generally the hardness of *FreedomWear FX* alloys is 55-60HRC.

**MATRIX MICROSTRUCTURE** - Next to chemistry, the microstructure of the matrix alloy overlay is the most important characteristic of a superior wearplate. An ideal microstructure contains a dense matrix of needle-like primary carbide structures. See micrographs below:

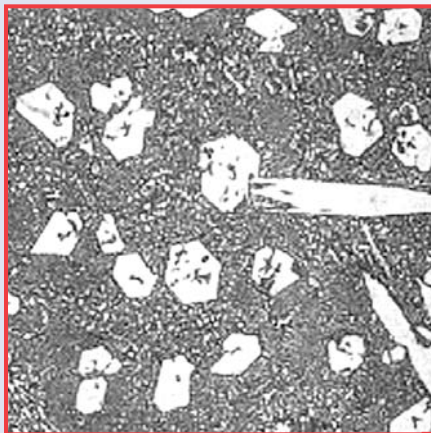
*This micrograph shows a matrix microstructure of less than optimum composition in which there are no visible primary carbide structures. Much of the chromium content is visible as white specks in the matrix. Lesser carbides appear as round or fish bone structures.*

200x MAGNIFICATION  
AVERAGE HARDNESS HRC 51.375



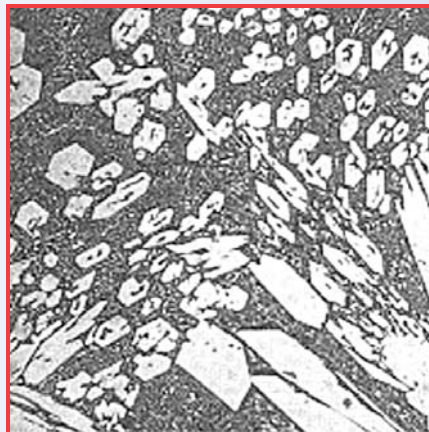
*This micrograph shows a matrix microstructure with a better primary carbide development. White primary carbide structures are easily distinguished from the dark matrix, however the density of the primary carbides within the matrix material is only marginally acceptable. This microstructure is typical of standard chromium carbide wearplate.*

200x MAGNIFICATION  
AVERAGE HARDNESS HRC 55.8



*This micrograph of the FreedomWear FX sample shows the maximum density of primary carbide structures within the matrix. The matrix microstructure creates an alloy with maximum wear resistance without excessive brittleness. There is still ample matrix material to hold the primary carbides in place.*

200x MAGNIFICATION  
AVERAGE HARDNESS HRC 59.8



## Industrial applications for FreedomWear FX Plate:

- Aggregate Industry
- Aluminum Plants
- Brick Manufacturing
- Cement Industry
- Chemical Industry
- Coal Mining
- Dredging Operations
- Earth Moving
- Fiberglass Insulation
- Glass Industry
- Mining
- Power Plants
- Pulp & Paper Plants
- Quarrying
- Refineries
- Scrap Steel Recycling
- Steel Mills
- Sugar Mills
- Tunneling

### Typical fields of application:

- Auger flights
- Bottom ash screws
- Catalyst feed nozzles
- Chain conveyor wear plates
- Chopper hoods
- Chutes and decks of all types and sizes
- Coal mill classifier cones
- Crusher liners
- Cyclones
- Fan blade and housing liners
- Feed pipes and lift pipes
- Grizzly and breaker bars, etc.
- Hopper liners
- Pulverized fuel systems
- Pump shells and pump impellers
- Riser lines
- Suction and discharge dredge pipes
- Shovel bucket wear liners
- Screw conveyors
- Vibratory feeders

PART NO.	THICKNESS INCHES* <i>FreedomWear FX ON BASE PLATE</i>	PLATE SIZE	DESCRIPTION	PLATE WEIGHT	WT. PER
10397	3/4" (0.375 on 0.375)	90" x 117"	Double overlay hard facing bead direction run with 117" dimension	2238 lbs.	30.60
10398	1/2" (0.250 on 0.250)	90" x 117"	Single overlay hard facing bead direction run with 117" dimension	1492 lbs.	20.40
10399	3/8" (0.125 on 0.250)	90" x 117"	Single overlay hard facing bead direction run with 117" dimension	1119 lbs.	15.30

\*Due to minimal dilution zone, actual nominal fractional thickness may vary with process center.

## ESTIMATED SERVICE LIFE

### LOWEST COST PER UNIT WEAR OUTPUT

*FreedomWear FX Plate* has up to 20 times the service life as compared to common A.R. plates and ordinary steels.

