

IronTite Products Inc.

Crack Detection & Repair

Instruction Manual & Parts List



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Introduction

The Irontite crack repair system is a cold repair process for repairing cracks in castings by adding metal and moving the metal in the casting to close the crack.

The basic crack repair process involves:

1. Detection of the crack - including determining the location of the crack.
2. Relieving the stress in the casting in the area of the crack.
3. Adding and moving metal in such a manner as to close off the crack.
4. Refinishing the surface of the repaired casting.

This cold crack repair process does not in any way subject the casting to high temperatures of a welding process, nor does it alter the heat treated characteristics of the casting.

Cracks in metal castings are the result of stress or strain in some part of the casting. This stress or strain finds a weak point in that section of the casting and causes the casting to separate at the weak point.

Such stress or strain may develop from:

1. The casting having been subjected to pressure or temperature changes before it was properly aged, or
2. Having been subjected to excessive heat or cold, or
3. Subjected to too rapid a change in the temperatures.

Whatever may have caused the stress, and in turn the crack, the important job is to relieve the stress at the point of the crack, close off the crack and resurface the casting.

The first step in the repair process is detecting the crack.

Detection of the crack involves not only finding that a crack exists, but also determining its exact location and marking the entire crack for subsequent repair.

The cracks may be detected:

1. By using a magnet and magnetic powder for ferrous materials,
2. By the use of dye penetrant, or
3. By pressurizing the head or block with a pressure tester and applying a bubble solution.

Magnetic Crack Detection

Electro Magnet

Each Kit Contains:

The Power-Pak Electro Magnet, 115V or 230V
1-Pound can of Magnetic Powder
Powder Spray Bulb
Handy Tool Box

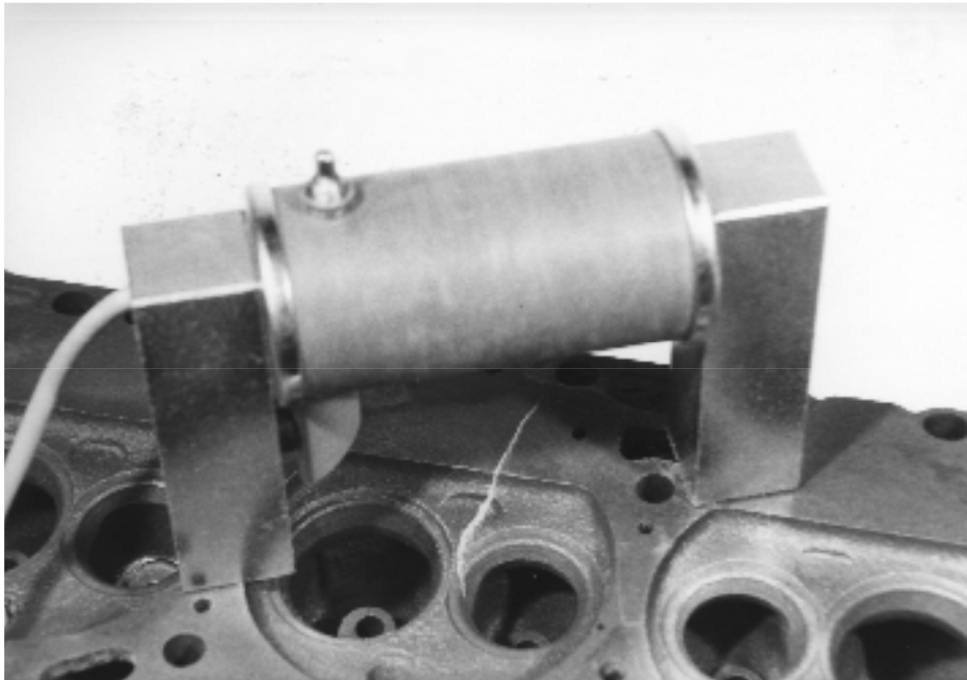
INSTRUCTIONS

1. Clean the surface of the casting to be checked. Remove all oil, grease or other dirt from the surface of the casting. Leave it dry.
2. Plug the magnet input cord into a nearby convenient electric outlet. Make certain that the magnet cord is properly grounded and keep the unit away from water or other liquids when in use.
3. Position the magnet on the surface of the casting and activate the magnet with the push-button switch.
4. Using the powder spray bulb filled with magnetic powder, dust or "drift" the magnetic powder onto the surface of the casting between the two poles or "legs" of the magnet.

The magnet creates a magnetic field in the casting, running from one pole to the other. If there is a crack in the casting between the two poles, it breaks the field and draws an accumulation of magnetic powder, sharply outlining the crack.

Since the magnetic powder reacts this way only between the poles of the magnet, it is necessary to move the magnet around on the surface of the casting to check the area for other cracks and to show the full extent of any crack.

5. When the magnetic powder shows the existence and location of a crack, the crack should be completely marked so it can be easily identified later for the repair.



NOTE: This magnetic crack detection process can be used only on the types of castings subject to magnetic charges. It cannot be used on aluminum castings.

DYE PENETRANT CRACK DETECTION

With dye penetrant crack detection, penetrant dye is used to show the existence and the location of the crack. This is especially helpful for aluminum castings which do not react to magnetic detection.

INSTRUCTIONS

1. Thoroughly clean the surface of the casting which is to be checked. It should be free of oil, grease and moisture.
2. Spray the surface of the casting with the penetrant - Kwik-Chek #1. Allow time for the penetrant to dry - usually about 3 minutes (more time in colder weather).
3. Spray the same surface of the casting with the remover - Kwik-Chek #3. Immediately rinse with water and wipe clean and dry.
4. Shake the Kwik-Chek #3 Developer until the agitators rattle and then spray the surface with a very light coating.
5. As the thin coat of developer dries, cracks and porosity on the surface of the casting will show up in red lines or dots.

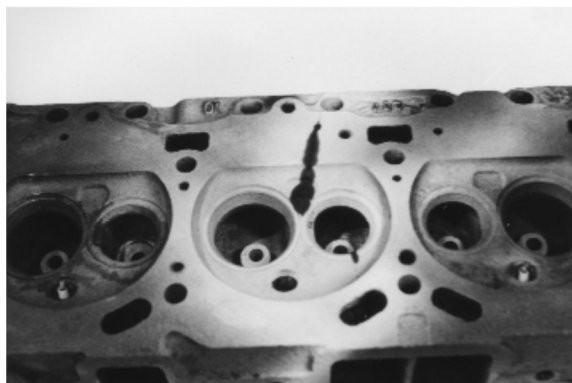
Kwik-Chek Kit (Part No. 400-1310-01)



Includes:

- | | |
|---------------------|-------------|
| # 1 - Dye Penetrant | 400-1320-01 |
| # 2 - Remover | 400-1320-02 |
| # 3 - Developer | 400-1320-03 |

CAUTION: THE PROPELLANT IN THE KWIK-CHEK CANS IS EXTREMELY FLAMMABLE. When storing or using the cans, keep them away from all flames and extremely hot areas. Review the Material Safety Data Sheets.



PRESSURE TESTER CRACK DETECTION

For castings that can be subjected to internal air pressure, such as water-cooled engine heads and blocks, the most comprehensive method of detecting the existence of cracks in castings is by using a pressure tester.

With this method, the ports on the castings are closed off and the casting is subjected to approximately 50-60 pounds of air pressure. The surface of the casting is then sprayed with a bubble solution. Cracks in the casting permit the air to escape and bubble up as the solution is sprayed on the casting.

This is particularly suitable for detecting cracks in castings around valve seats, where it is not practical to use the magnetic crack detection process.

To operate a pressure tester, it is necessary to close off the port and heater outlets in order to allow the desired pressure to be set inside the head. Once the crack is detected, mark the crack for later repair.

REFER TO THE PRESSURE TESTER MANUFACTURER FOR CORRECT TEST PROCEDURES.



REPAIRING THE CRACK

Tools for Repairing the Crack:

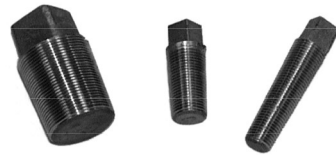
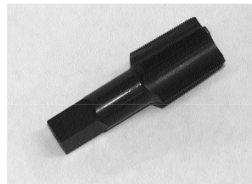
Ironite Tapered Plugs

Ironite Standard Drills

Ironite Tapered Reamers

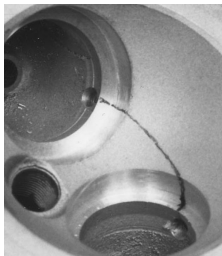
Ironite Tapered Taps

(see Product Listings at the end of this Manual)



GENERAL INSTRUCTIONS

1. The first step is to stop or "capture" the crack - make certain the limit of the crack is determined.
2. At the end of the crack, drill a hole suitable for the installation of an A-200 or A-235 plug.
3. Retest the area to see if the crack runs beyond the hole.
4. Repeat this process until the crack does not run beyond the hole.



Marked Crack



Drill Holes for Plugs



"Capture" the Crack



Cut Off Plugs



Peen Plugs

NOTE: The particular technique or method used in repairing the crack varies depending on the location and accessibility of the crack, thickness of the metal, etc. Experience will develop the most suitable technique for the operator to use.

This manual will describe some of the most commonly used techniques which will point the way for an operator to develop his best approach to repairing cracks.

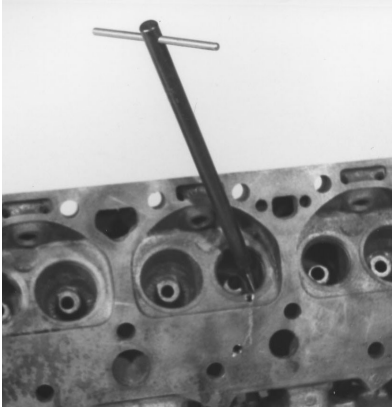
Whatever technique is used, one of the most important parts of the repair process is the peening of the tops of the plugs after they have been installed and cut off down near the surface of the head or block.

TECHNIQUE ONE

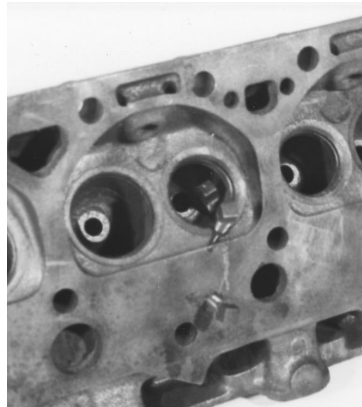
Installing tapered plugs along the line of the crack in areas of the casting that are subject to high pressure and temperatures.

One of the best examples of this type of crack is in the valve seat area of the head. In this instance, the plugs are installed at angles to the casting surface, not perpendicular to the surface. In addition, they are installed in an overlapping fashion.

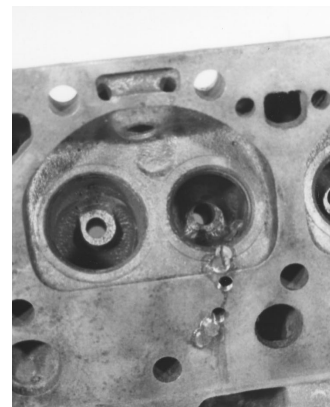
1. A plug hole is drilled, reamed and tapped and the plug is fully torqued into place.
2. Cut off the excess part of the plug before the next hole is started. This permits locating the next plug so it will overlap the preceding plug at the surface and below the surface.
3. Here, where the metal is thick, after drilling, the hole needs to be taper reamed before tapping. This helps give the tapered tap a reasonable life.



Drill & Tap for Plugs



"Capture" the Crack
(Plugs at each end)



Continue to Fill in with Plugs



Cut Off and Peen the Plugs



Remove Excess Plug Material



Refinish Surface like New

4. Cut off the installed plugs (with a small coping or other saw) and peen the tops of each plug

NOTE: The peening process is extremely important. It helps close the threads at the surface of the casting.

When peening, always peen away from the center of the plug. In the peening process, the position control of the air hammer is most important. It provides the necessary control over the direction of the ends of the peening tools.

TECHNIQUE TWO

Repairing cracks in readily accessible areas of a casting not subject to high pressure and high temperature, where the metal is relatively thin.

Here, the object is to close the crack with either a series of plugs down the line of the crack or alternate plugs on opposite sides of the crack, supplemented with a thorough peening of the crack itself.

1. After the crack is carefully outlined, drill and tap holes along the line of the crack about 1/4" to 1/2" apart.

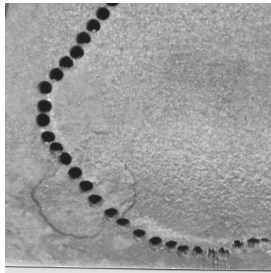
NOTE: Where the material is less than 1/4" thick, it is not necessary to taper ream before taper tapping it.

2. Capture the crack at each end

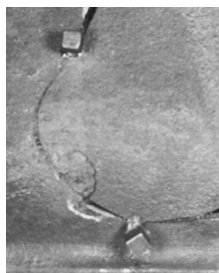
3. Torque the plugs in concurrently so that none of them will be loosened as other plugs are torqued in.

4. Cut the plugs off about 1/16" above the surface and peen them, always peening from the center of the plug outwardly toward the thread in the plug.

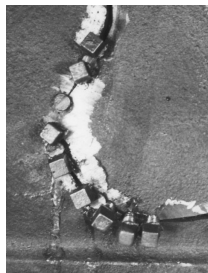
5. Peen the crack itself, peening inwardly toward the center of the crack.



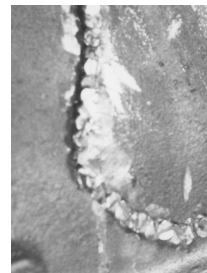
1 – Drill & Tap



2 – "Capture"
Crack



3 – Fill with
Plugs



4 – Cut Off &
Peen Plugs



5 – Resurface

Alternately, the plug holes can be drilled and tapped in a lacing fashion on opposite sides of the crack. Torque the plugs in concurrently and then cut them off. Peen the plugs and the crack in the same manner as above.

This process, in addition to closing the crack with additional metal and with peening the crack, develops a resistant elasticity in the metal which helps keep the crack closed.

THE IMPORTANCE OF PEENING IN CRACK REPAIR CANNOT BE OVEREMPHASIZED.

GENERAL INFORMATION

The examples described in this manual are crack repair techniques intended only to illustrate various approaches to the process of closing a crack in a casting. They can serve as guides in the process of repairing many different types of cracks in many different types of castings - industrial as well as engine castings.

The most important factors in closing the crack are the adding of metal by torquing in the tapered, threaded plugs and the moving of the metal through the peening process.

NOTE: A tapered tap is cutting the full length of the tap, so if the metal is very thick, the hole must be first reamed with a tapered reamer if the tap is to have a reasonable life.

Even when the hole is reamed with a tapered reamer, it is necessary to use the proper amount of downward pressure with the tapered tap. For certain larger taps used in repairing and replacing the injector seat areas in heavy duty diesel engine heads, Irontite has developed lead screw nuts and arbors. To apply the lead screw principle, give just the right amount of downward pressure on the tap.

NOTE: A good tapping fluid should be used at all times with the tapered tap. Irontite recommends TAP-O tapping compound. TAP-o does not contain oil or carbon tetrachloride.

Irontite tapered plugs and tapered taps are designed so there will be a tight thread-to-thread fit when the plugs are torqued into position. When torqueing in the plug, as an added assurance of a leak-proof fit, dip the plug in Irontite's **Ceramic Seal** just before torqueing it in. This will help close any porosity that may be present in the threaded hole of the casting. **Ceramic Seal** is recommended because, being fluid it will spread evenly on the threaded plug as it is torqued in.

IRONTITE CRACK REPAIR SEALANTS

Irontite developed two types of professional grade cooling system sealants to supplement the crack repair process. In fact, these sealants can be used effectively with or without a repair.

IRONTITE CERAMIC SEAL

As part of its overall crack repair process, Irontite recommends **Ceramic Seal**. When properly applied, **Ceramic Seal** leaves a fine ceramic coating on the inside of the casting, closing porosity and the inside of minor cracks.

In conjunction with crack repair work, **Ceramic Seal** is applied to the casting after the repair process is complete to give the repair a finishing touch and the added assurance the crack is sealed.

INSTRUCTIONS

1. The head or block is remounted on the pressure tester and the water ports are sealed so the casting can be pressurized.
2. After pressurizing the head or block and confirming the high quality of the Irontite repair job, secure the outlet and return hoses on a circulator to opposite ends of the head or block.
3. Activate the circulator and circulate Irontite **Ceramic Seal** through the casting at the temperature supplied by the circulator.
4. After circulating the **Ceramic Seal** for a period of 15-30 minutes, close off both the outlet valve and the return valve.
5. Depress the air pressure button, holding it down for a few seconds and then releasing it. This pressure forces the ceramic seal in the casting into any cracks or porosity in the interior of the casting.
6. Turn the head over, open the circulator return valve and press the air pressure button for only a few seconds. This will force the remaining liquid **Ceramic Seal** back into the circulator tank.
7. Remove the casting and set it to one side allowing the Ceramic Seal in the interior of the casting to cure.

After a period of time, the **Ceramic Seal** will cure on the inside of the casting and will serve as an additional seal to the crack. The time required for the seal to set or cure will vary depending on temperature and humidity.

IRONTITE ALL WEATHER SEAL

This is a general purpose sealant used in automobile cooling systems while there is anti-freeze or coolant in the system. **Just shake it up, pour it in the radiator and drive on.**

All Weather Seal is widely used and effectively takes care of many small leaks - quickly and easily.

NOTE: When using Irontite **Ceramic Seal**, it is MANDATORY that the cooling system be cleaned first to make certain that any anti-freeze or coolant is flushed out and the system is clean. **Ceramic Seal IS NOT COMPATIBLE WITH ANTI-FREEZE OR COOLANT.** Combining them in the cooling system will clog the cooling system.

Tools, Equipment and Supplies

Kwik-Chek Dye Penetrant

DESCRIPTION

Kwik-Chek Kit

#1 Penetrant Dye

#2 Dye Remover

#3 Developer

PART

400-1310-01

400-1320-01

400-1320-02

400-1320-03



Bubble Solutions for Pressure Testing

DESCRIPTION

Bubble Solution - 8oz.

Bubble Solution - 1/2 Gal.

PART

400-1420-08

400-1420-32



Magnetic crack detection

DESCRIPTION

Electro Magnet Kit - 115V

Electro Magnet Kit - 230V

Mini-Magnet with Vial of Powder

Magna Ray Permanent Magnet

Spray Bulb

PART

400-1110-01

400-1112-30

400-1110-04

400-1110-02

400-1210-01



Magnetic powder

DESCRIPTION

WHITE

1 lb. Can

5 lb. Can

10 lb. Can

25 lb. Can

400-1220-16

400-1220-80

400-1221-60

400-1224-00

GOLD

1 lb. Can

5 lb. Can

10 lb. Can

25 lb. Can

400-1225-16

400-1225-80

400-1226-60

400-1229-00

GREY

1 lb. Can

5 lb. Can

10 lb. Can

25 lb. Can

400-1230-16

400-1230-80

400-1231-60

400-1234-00



Ductile Iron Threaded Plugs - Automotive

DESCRIPTION	Qty	PART #
A-155	100/Box	401-2101-55
A-200	100/Box	401-2102-00
A-235	100/Box	401-2102-35
A-235 1/2	100/Box	401-2102-36
B-1	50/Box	401-2103-27
C	25/Box	401-2104-20
C-1	25/Box	401-2104-21
D	25/Box	401-2104-90
D-1	25/Box	401-2104-91
E	25/Box	401-2105-90

Ductile Iron Threadless Pins - Automotive

DESCRIPTION	Qty	PART #
TPD	100/Box	401-2301-00
TPC	100/Box	401-2301-25
TPA	100/Box	401-2302-00
TPB	50/Box	401-2302-89

Ductile Iron Plugs - Diesel

DESCRIPTION	Qty	PART #
C-1 Special	Each	452-2604-24
D-1 Special	Each	452-2604-94
E-1 Solid	Each	452-2605-91
E-1 Special	Each	452-2605-94
G Solid	Each	452-2607-80
G-3 Drilled	Each	452-2607-83
G-4 Drilled	Each	452-2607-84
GO Solid	Each	452-2608-40
GO-3 Drilled	Each	452-2608-43
GO-4 Drilled	Each	452-2608-44
GO Short	Each	452-2608-55
R Solid	Each	452-2607-86
R-2 Drilled	Each	452-2607-87
H Solid	Each	452-2610-80
H-2 Drilled	Each	452-2610-82
H-4 Drilled	Each	452-2610-84
HO Solid	Each	452-2611-40
HO-2 Drilled	Each	452-2611-42
HO-4 Drilled	Each	452-2611-44

Ductile Iron Plugs – Diesel (cont)

DESCRIPTION	Qty	PART #
J Solid	Each	452-2613-13
J-2 Drilled	Each	452-2613-14

Diesel Ductile iron Plugs - Caterpillar

DESCRIPTION	PART #
3/4 - 12 Standard Caterpillar Plug	452-2615-24
7/8 - 12 Standard Caterpillar Plug	452-2615-44
1 - 12 Standard Caterpillar Plug	452-2615-64
1-1/4 - 12 Standard Caterpillar Plug	452-2615-84

Diesel Ductile iron Plugs - Caterpillar

DESCRIPTION	PART #
3/4 - 12 Oversize Caterpillar Plug	452-2615-28
7/8 - 12 Oversize Caterpillar Plug	452-2615-48
1-1/8 - 12 Oversize Caterpillar Plug	452-2615-78

HSS TAPERED REAMERS

DESCRIPTION	Plug Type	PART #
HSS Tapered Reamer	A-200/A-235	407-5202-35
HSS Tapered Reamer	B-1	407-5203-27
HSS Tapered Reamer	B-1/8	407-5203-86
HSS Tapered Reamer	C, C-1, C-1 Special	407-5204-20
HSS Tapered Reamer	D, D-1, D-1 Special	407-5204-90
HSS Tapered Reamer	E, E-1, E-1 Special	407-5205-90
HSS Tapered Reamer	G	407-5207-80
HSS Tapered Reamer	H	407-5210-80
HSS Tapered Reamer	HO	407-5211-40
HSS Tapered Reamer	J	407-5213-10

HSS TAPERED TAPS

DESCRIPTION	Plug Type	PART #
HSS Tapered Tap	A-155	407-5301-55
HSS Tapered Tap	A-200	407-5302-00
HSS Tapered Tap	A-200 TN	407-5302-01
HSS Tapered Tap	AL-200	407-5302-03

HSS TAPERED TAPS (cont)

HSS Tapered Tap	A-235	407-5302-35
HSS Tapered Tap	A-235 TN	407-5302-36
HSS Tapered Tap	AL-235	407-5302-38
HSS Tapered Tap	B-1	407-5303-27
HSS Tapered Tap	AL - B-1	407-5303-30
HSS Tapered Tap	B-1/8 (CS)	407-5303-86
HSS Tapered Tap	C, C-1, C-1 Special	407-5304-20
HSS Tapered Tap	D, D-1, D-1 Special	407-5304-90
HSS Tapered Tap	E, E-1, E-1 Special	407-5305-90
HSS Tapered Tap	G	407-5307-80
HSS Tapered Tap	R w/Pilot Hole	407-5307-86
HSS Tapered Tap	GO	407-5308-40
HSS Tapered Tap	H	407-5310-80
HSS Tapered Tap	HO w/ Pilot Hole	407-5311-41
HSS Tapered Tap	J & J-2 Drilled	407-5313-10

Jobber Length Drills

DESCRIPTION	Plug Type	PART #
6/64 HSS Drill	A-155	407-5101-55
11-64 HSS Drill	A-200 & TPA Pins	407-5102-00
13/64 HSS Drill	A-235	407-5102-35
5/16 HSS Drill	B-1	407-5103-27
11/32 HSS Drill	B-1/8	407-5103-86
25/64 HSS Drill	C, C-1, C-1 Special	407-5104-20
15/32 HSS Drill	D, D-1, D-1 Special	407-5104-90
9/16 HSS Drill	E, E-1, E-1 Special	407-5105-90

Extension Drills

DESCRIPTION	Plug Type	PART #
11/16 HSS Extension Drill	A-200	407-5132-00
16/64 HSS Extension Drill	A-235	407-5132-35

TAPPING COMPOUND AND NEVER-GALL

DESCRIPTION	Size	PART #
TAP-O Tapping Compound	8 oz.	468-9920-08
TAP-O Tapping Compound	1/2 Gallon	468-9920-64
TAP-O Tapping Compound	5 Gallon	468-9926-40
Never Gall Compound	1 Pound	468-9950-16
MicroFinish Tap & Lube	8 oz.	468-9910-08



CRACK REPAIR KITS

DESCRIPTION	QTY	PART #
K-210 Crack Repair Kit (Starter)		411-5902-10
Includes the following Items in a handy Tool Box:		
A-235 Iron Plugs (Automotive)	1	401-2102-35
13/64 HSS Drill (A-235)	1	407-5102-35
HSS Tapered Reamer (A-200/235)	1	407-5202-35
HSS Tapered Tap (A-235)	2	407-5302-35
Carbide File I/S (Oval)	1	408-5413-14
Coping Saw, New Style	1	411-5811-10
Coping Saw Blades, New Style	1	411-5811-11
Heat Tabs 255° – 260° (100/Pkg)	1	411-5811-81
Devcon Adhesive	1	411-5811-82
Ceramic Seal (Pint)	1	468-9120-16
TAP-O (8oz.)	1	468-9920-08

Plug Installation Tools

R Plug Tool - Ratchet Tip	1	411-5821-20
Heat Tabs 255° - 260°	100/Pkg	411-5811-81
Heat Tabs 220° - 235°	100/Pkg	411-5811-90
Devcon Adhesive	Tube	411-5811-82



Engine & Cooling System Additives

CERAMIC SEAL

Finish the crack repair job by circulating Ceramic Seal internally to seal any part of the crack that may still be separated on the inside of the casting.

Ceramic Seal

DESCRIPTION	Size	PART #
Ceramic Seal	Pint	468-9120-16
Ceramic Seal	Gallon	468-9121-28
Ceramic Seal	5 Gallon	468-9126-40



ALL WEATHER SEAL

Seals leaks and cracks in the cooling system

- Prevents anti-freeze leakage
- Fast-Acting; Non-Corrosive; Non-Clogging
- Recommended for use with any Anti-freeze or Coolant
- Lubricates Water Seals

All Weather Seal

DESCRIPTION	Size	PART #
All Weather Seal	Pint	468-9130-16



THORO FLUSH - THE PERFECT CLEANER

- Protects and cleans the engine cooling systems
- Leaves them free from rust, sludge and grease
- Extends the life of the cooling system

Thoro Flush

DESCRIPTION	Size	PART #
Thoro Flush	Pint	468-9110-16



The 3-Pack (Trifecta)	1 Pint of Each Thoro Flush Ceramic Seal & All Weather Seal	468-9190-16
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