

## Everything You Need, No Matter Where You Are

Ken Kessler never had a hard time finding tools and supplies for his technicians at Grainger as a Service Manager for St. Paul, Minnesota based Harris Companies. However, that's not the case in Iraq.

So when Ken was recently activated to serve overseas as a member of the U.S. Naval Reserve, and couldn't access the proper tools, Grainger stepped in to help. Grainger sent Kessler's team a donation of much needed supplies. Grainger prides itself on being a convenient source for items HVAC Contractors use most, even in Iraq. See page 5 to learn more about Kessler and the Harris Companies.

### How can I get on the cover?

Send us a picture of you and your crew on the job, and you could find yourself featured on the cover of an upcoming issue. Send your photos to: **On the Job**, 510 College Avenue, Racine, WI 53403 or email: [contractor\\_marketing@grainger.com](mailto:contractor_marketing@grainger.com)

*High resolution digital photographs are preferred, but we can work with almost any clear, well-focused photo. Upon selection, we'll provide a Photography Release Form that you'll have to complete. Photos will not be returned. Employees of Grainger, its subsidiaries, affiliates and members of their immediate families or households are not eligible. You will be notified if your entry has been selected.*

**Ken Kessler, Harris Companies, and his U.S. Naval Reserve team proudly display their Westward tools.**

**October 2006**

## Safety – Welding & Cutting

# Don't Let Welding and Brazing Burn Away Your Profits

*Information courtesy of Lenox*

## Produce better results, save money and reduce risk of injury when using torches.

Whether your application calls for soldering, welding or brazing, following simple precautions when using a torch or carrying gas tanks minimizes risk to you and others on the job. Practicing correct welding and brazing techniques will make you more efficient, saving you money in the process by eliminating re-work and using less materials for the job.



**Bernzomatic Hand Torch**  
Grainger No. 3WA92

### Safety First

There are basic safety tips to keep in mind when using a torch:

- Use a heat resistant shield or a thermal shield gel to protect the surrounding area against fires and heat damage in close quarters or close to wires, walls, studs or other materials.
- Have an approved, inspected and working fire extinguisher of proper type and size readily available in the work area.
- Keep gas cylinders away from direct heat and the immediate work area.
- Always make sure tips are clean and free of dirt for maximum desired heat output.

### OSHA Regulations – Permissible Exposure Levels

Make sure to review and understand all regulations prior to using a torch. OSHA 1926.353 outlines standards for ventilation and protection in welding, cutting and heating for applications such as mechanical ventilation; welding, cutting and heating in confined spaces; using toxic materials; and inert-gas metal-arc welding techniques. There is also a new standard for Hexavalent Chromium (OSHA 1926.1126) that is intended to reduce the health risks associated with exposure to this toxic particulate that is released during welding, heating

and painting applications. Welders are the highest single worker group exposed.

### Transportation and Storage of Equipment

Reduce the potential for injury when transporting a gas cylinder:

- When cylinders are hoisted, they should be secured on a cradle, sling board or pallet.
- Cylinder valves should always be in the off position and all gas bled from the hose tips, regulator and handle before transporting.
- Cylinders moved in a truck, van, car or other powered vehicle should always be transported in the upright position. Always secure gas cylinders to the vehicle so they do not move or tip over during transport.
- Always close cylinder and regulator valves when transporting, when the cylinder is empty and when the work is complete.



**Brazing Torch**  
Grainger No. 4NE96



**Welding  
Cylinder Truck**  
Grainger No. 4ZJ12

Continued on page 2

**Continued from cover**

Acetylene gas, the most common type of fuel used for gas welding and brazing, is very volatile. The maximum allowable pressure for acetylene gas is 15 PSI. It's important to ensure all regulators and valves are in good working order. Replace worn regulators if the PSI rises higher than 15.

Using all brass piston regulators may extend the life and provide a consistent 15 PSI over a longer period than diaphragm regulators. An acetylene cylinder will work properly by opening the valve 1/4 to 3/4 of a turn. Never open the valve on an acetylene cylinder more than 1-1/2 turns. All other gas cylinders valves, except acetylene, can be opened fully to seal the cylinder back seal packing.

**Proper Soldering Technique**

The key to soldering a good joint is to bring the pipe and fitting heat up with your torch or heat source only to the melting temperature of the solder. It's important not to overheat the joint, as getting the joint red hot does not improve the solder flow. In fact, the flux will burn off at high heat and the solder will not adhere to the surfaces being joined. When soldering or brazing, the same basic steps should be followed, with the only differences being the fluxes, filler metals and amount of heat used. The following process outlines the basic requirements for consistently making a high quality soldered or brazed joint.

**Measuring and Cutting**

Accurately measure the length of each tube segment. If the tube is cut too short, it will not reach all the way into the cup of the fitting and a proper joint cannot be made. If the tube segment is cut too long, system strain may affect the service life. Cutting can be accomplished in a number of different ways to produce a satisfactory squared end: a disc-type tube cutter, a hacksaw, an abrasive wheel, or a stationary or portable bandsaw. The cut must be square to the run of the tube, and without deformities, so the tube will seat properly in the fitting cup.

**Reaming**

Ream all cut tube ends to the full inside diameter of the tube to remove the small burr created by the cutting operation. If this rough, inside edge is not removed by reaming, erosion/corrosion may occur due to local turbulence and increased local flow velocity in the tube.

**Cleaning**

The removal of all oxides and surface soil from the tube ends and fitting cups is crucial to proper flow of filler metal into the joint. Failure to remove them can interfere with capillary action and may lessen joint strength.

**Fluxing**

Apply a thin, even coating of flux with a brush to both tube and fitting as soon as possible after cleaning. Flux will dissolve and remove traces of oxide from the cleaned surfaces to be joined. It also protects the cleaned surfaces from re-oxidation during heating, limits corrosion and promotes wetting of the surfaces by the solder metal.

**Assembly and Support**

Insert tube end into fitting cup, making sure that the tube is seated against the base of the fitting cup. Remove excess flux from the exterior of the joint with a cotton rag. Support the tube and fitting assembly to ensure easy and complete flow around the entire circumference of the joint. Excessive joint clearance can lead to solder metal cracking under conditions of stress or vibration.

**Heating**

Begin heating with the flame perpendicular to the tube. The copper tube conducts the initial heat into the fitting cup for even distribution of heat in the joint area. Preheating should include the entire circumference of the tube in order to bring the entire assembly up to a suitable preheat condition. However, for joints in the horizontal position, do not preheat the top of the joint directly to avoid burning the soldering flux. The rising heat will adequately preheat the top of the assembly. Next, move the flame onto the fitting cup, sweeping the flame between the fitting cup and the tube a distance equal to the depth of the fitting cup.

**Applying Solder**

For joints in the horizontal position, start applying the solder slightly off-center at the bottom of the joint. When the solder begins to melt from the heat of the tube and fitting, push the solder straight into the joint while keeping the torch at the base of the fitting and slightly ahead of the point of the solder application. Continue this technique across the bottom of the fitting and up one side to the top of

the fitting. While soldering, small drops may appear behind the point of solder application, indicating the joint is full and cannot take any more solder. For joints in the vertical position, make a similar sequence of overlapping passes starting wherever is convenient.

**Cooling and Cleaning**

Allow the completed joint to cool naturally. Shock cooling with water may stress or crack the joint. When cool, clean off any remaining flux residue with a wet rag, and completed systems should be flushed to remove excess flux and debris.



**Welding Helmet**  
Grainger No. 2UE89



**Harley-Davidson® Welding Helmet**  
Grainger No. 2UE93

Protect your eyes with a variety of welding helmet shades. Available in shade numbers 3 thru 13.

**Common Mistakes**

- One of the most common mistakes made in soldering is holding the flame in one spot. The flame should be moved around to prevent the creation of a "hot spot." Overheating could burn the flux, destroy its effectiveness and prevent the solder from properly entering the joint.



**Failed Joint**

- Using an improper burn tip on an Air Acetylene or Air Propane/MAPP results in it melting or getting hot to the touch. Never try and cut corners by using a tip size that is too large for the size tube being soldered or brazed, or by turning down the gas to reduce the heat to the pipe. This causes the flame to burn inside the burn tip. Most manufacturers do supply charts and guides on their Web sites to help you choose the proper tip size for the application.
- Keep in mind Air Acetylene hoses cannot be used with the Air Propane/MAPP unit and visa versa. The Air Acetylene hoses have 3/8" fittings, are red and made of a different material, whereas the Air Propane hoses have 9/16" fittings and are black. The orifice on every torch and tip are matched to the size of the burn tip opening for maximum efficiency. If a burn tip size is changed, the matching orifice must be used or replaced.

**Reduce the cost of re-work by avoiding these common mistakes while on the job.**

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**Metal Joining Definitions**

Each technique is designed for specific applications.



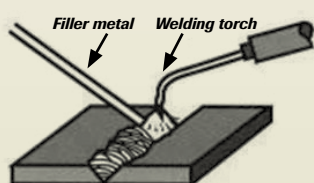
**Soldering** uses a joining metal (solder) to connect two like or dissimilar metals. The melting point for solder is under 800° F.



**Welding** uses high heat to melt two like metals together. Welding is generally used when complete fusion is required, and where warping and distortion are not an issue.



**Brazing** uses a joining metal (brazing rods – usually a silver alloy) to connect two dissimilar metals. The melting point for brazing rods is higher than 800° F. Brazing is generally used when a high tensile strength is desired, and the melting point of the metals is higher than that of the brazing.



# Relax The Back

Information courtesy of Ergodyne

**Proper lifting techniques help you reduce lower back pain.**



As most technicians and construction workers know, a typical day on the job site involves constant bending, squatting and lifting – actions that can place a tremendous amount of strain on the back. In fact, nearly all back injuries are caused from repetitive lifting, bending, twisting and turning activities instead of from a single episode. Since the physical demands of the job aren't going away, your best defense is to practice correct lifting techniques and select proper back support available from Grainger.

## Selecting the Right Back Support

Nearly 85% of all reported back injuries occur in the lower back area. Grainger's variety of back supports provide lower back and abdominal support, and are an excellent cost-effective supplement to help prevent back injuries. Wearing back supports also serve as useful reminders to use proper body mechanics when lifting.

- Check for a design that conforms to the body ensuring a comfortable, secure fit. Back supports should sit below the navel and fit snugly on the hips.



**Deluxe Back Support**  
Grainger No. 5T541



**Universal Back Support**  
Grainger No. 1UM53



**Handcart/truck**  
Grainger No. 5Z081

**Handcart/truck**  
Grainger No. 6W855

- Check for an adjustable two-stage closure that allows the user to tighten the support during lifting activities and loosen when in a non-lifting position.
- Check for an internal gripping mechanism, which reduces ride-up and helps keep the back support in place. It's best if these materials are non-conductive so the support can be used in a variety of applications and work settings.
- Check to make sure the materials are breathable and machine washable.
- Check the material specifications for overall durability. Hook-and-loop closures, elastic band and other critical components will break down, reducing function and increasing long-term cost.
- Check out a back support company's credibility, resources and product line.

## Proper Lifting Techniques

Repeatedly bending, lifting and twisting places strain on your back. Practicing proper lifting techniques will go a long way toward protecting yourself from painful injuries.

- Size up the load. Test it to see if you can lift it safely. Can you get a good grip on it? Good handholds (cut-outs, handles) will make the load easier to lift. Make sure the load is balanced in your hands.
- Get as close to the load as possible before lifting. If possible, slide the load towards you before picking it up. If the load is large and cannot be placed between your knees as they are bent, bend at the hips and waist with your knees relaxed. It is more important to keep the load close than it is to bend your knees.
- Make sure your footing is secure. Do not lift objects that obscure vision and footing.
- Do not twist while lifting! Move your feet so that they point in the direction of the lift as you turn.
- Lift smoothly, but not slowly. Do not jerk the load.
- Try to avoid lifting from the floor or above shoulder level. Items to be handled should be between knee and shoulder height.
- Have another person help you lift large loads.
- If you have a lot of lifting to do during the day, try not to do it all at once. Alternate lifting with lighter work to give your body a chance to recover.
- Use the same principles when lowering or placing the load after lifting. Put it down carefully.
- Try to avoid carrying the load more than 10 feet without getting mechanical assistance. Use a cart or hand truck.

### Want to learn more?

Go online to [grainger.com/contractor](http://grainger.com/contractor) or contact your Grainger Representative for additional information on the featured products and other items including Hand Trucks and Carts.

## Correction

On The Job®, July 2006

"What Does Torque Rating Really Mean?" page 15.

### Performance Ratings

The ability of a device to produce work is measured by the formula:

$$\text{Speed} \times \frac{\text{Torque}}{\text{K}} = \text{Power}$$

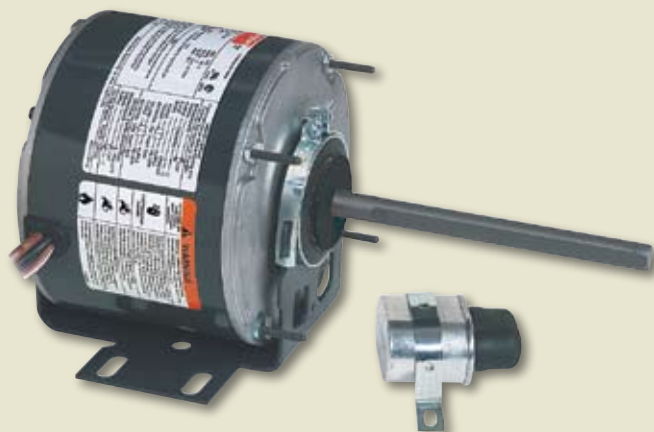
- **Speed** is how fast the drill turns (revolutions per minute)
- **Torque** is the force the drill produces to turn an object
- **K** is a constant and varies depending on the units used to measure torque
- **Power** equals the amount of work completed in a given period of time

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# Get Up To Speed On Motor Selection

Understanding guidelines for selection can help you make replacement decisions more quickly.



**Condenser Fan Motor**  
Grainger No. 3M265



**Three-Phase Motor**  
Grainger No. 5N318



**Direct Drive Blower Motor**  
Grainger No. 4M097

There's more to selecting a motor than meets the eye. Motors typically are grouped into three categories.

**General-purpose motors** are designed around industry standards and feature standard operating characteristics.

**Definite-purpose motors** are designed to meet specific application requirements with specific standards. Pump motors would be one example of a definite-purpose motor.

**Special-purpose motors** are designed around a specific application and must meet specific requirements. A vacuum motor is a prime example.

When selecting a motor, the three primary factors to think about are: Performance, Electrical and Mechanical considerations.

## Performance

Performance considerations include motor type (shaded pole, permanent split capacitor, split phase, capacitor start, three-phase), horsepower, speed, and service factor. In some applications more than one motor type may work. In other applications an exact replacement will not be found, but a similar motor with slight differences in mechanical and electrical features will provide reliable operation.

## Electrical

Electrical considerations include power, phase and voltage. These criteria must be an exact match to the existing unit in the replacement motor. Insulation class and nameplate amperage are also electrical considerations but do not need to be an exact match. **A good rule of thumb for the installer is to get a match as close as possible.** It's okay for the replacement motor to have a lower nameplate amperage value. Should the replacement motor have a higher value, checking the ability of the electrical system to handle the added load is recommended.

Insulation class (Class A, B, F and H) refers to the thermal capacity of the materials used in the construction of the motor. Most motors used in today's HVAC applications are Class B designs. Contractors may come across a motor with a Class A rating, which is typically found in older motor designs. In general, it's okay to interchange Class A insulation systems with Class B insulation systems. You should give careful consideration and review when substituting a Class F or Class H rated motor in an application that used a Class B rated motor.

## Mechanical

Mechanical considerations are further divided into three separate areas: Frame Size, Enclosure and Bearing System.

### Frame Size

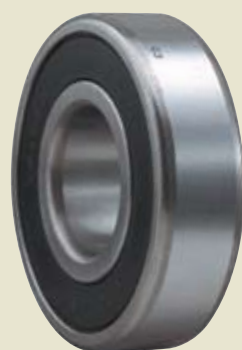
The National Electrical Manufacturers Association (NEMA) has developed industry standards on frame size for general- and definite-purpose motors, including motor mounting dimensions, shaft dimensions and any special callouts. Contractors should match the designated nameplate frame rating and then check the replacement motor's overall dimensions to make sure it will fit in the application. **It is important to remember the NEMA frame size has no reference to the motor's overall size.**

### Enclosure

A motor's enclosure refers to its protective design and its ability to protect windings, bearings and other internal components. There are two basic enclosure designs: open and enclosed. Open motors allow a free exchange of air to help control the motor's operating temperature, whereas enclosed motors prevent a free exchange of air. It is not uncommon to see both open and enclosed motor applications in HVAC applications. If the environment is somewhat clean, an open-type design for indoor applications is common, while enclosed designs are used primarily in outdoor applications. Dirty and dusty environments will use enclosed or enclosed fan cooled motors. Dirt and moisture must be kept from entering a motor. If the application exposes a motor to these conditions, then consider upgrading the motor's enclosure. Remember, it's always best to match the original motor's enclosure.

### Bearing System

Ball and sleeve are two basic bearing designs. At one time sleeve bearing motors provided some cost savings as opposed to ball bearing designs, but that may not always be the case in today's market. Bearing and lubrication technology has improved so much through the years that the service life of the two motors are basically the same.



**Bearing**  
Grainger No. 6L026

In fact, Contractors can usually interchange bearing systems when looking for a replacement motor.

**Keep in mind for fractional HVAC applications of less than one horsepower, a sleeve bearing design works best if the application is sensitive to noise.** Additionally, ensure the lubrication matches the manufacturer's specifications, and do not overfill when relubricating. This can cause a siphoning condition, which can result in the bearing system losing its oil. Sleeve bearing designs tend to run quieter than ball bearing designs. In fan applications, the air noise will typically mask any bearing noise; blower applications may be a little more sensitive to noise.

## Selection and Installation Tips

- The capacitor rating should never be changed without first checking with the manufacturer. Increasing the capacitor value strengthens the motor, but will also increase the current and temperature, possibly to the point of overheating. On the other hand, reducing the capacitor value weakens the motor, possibly to the point it may not be able to start the load.



**Capacitor**  
Grainger No. 2GE74

- When installing a poly phase or three-phase motor it is always important to check the power between each leg. The output power of a three-phase motor can be substantially decreased if the voltages at each leg are not equal. On a three-phase system the voltages between legs 1-2, 2-3 and 1-3 should be very close. A variation of 20% between the legs can reduce motor output by as much as 25%.
- Proper alignment of a motor in its application will extend the life of the motor and the equipment it's driving. Improper alignment will not only lead to shortened bearing life but can contribute to noise, vibration and loss in system performance.

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On The Job® A Quarterly Publication for Professional Contractors by Grainger®

Continued on page 5

- Always inspect the foundation or base where the motor is mounted to make sure it is sound and offers proper, level support. If the application is a direct drive, it's necessary to make sure the driven device is sitting level as well. Check motor height to the driven device by carefully aligning the coupling yokes to see if the height matches. Once the height is proper, connect the motor to the driven device by the coupling assembly and rotate the shaft by hand, paying attention to the coupling and uneven gaps as it is rotating. Uneven gaps indicate misalignment and adjustments need to be made.
- Connect motor per its nameplate diagram – voltage and frequency should match the motor nameplate ratings. Motors will typically operate within specifications plus or minus 10% of nameplate voltage.
- All wiring should comply with National Electric Code and local codes. Under-sized wiring will limit a motor's performance and life.
- Although most motors can be mounted in many positions, drip proof motors must be mounted in the horizontal position to meet the enclosure standards.
- Always mount a motor to a secure rigid or flat surface.
- Sleeve bearing motors should be mounted with oil ports up and accessible.
- Use a straight edge to check for proper alignment on belt applications. Adjust belt tension to about 1/2" of belt deflections when hand finger force is applied halfway between the pulleys.



**Slotted Shim Assortment**  
Grainger No. 5GE51



**Belt Tension Checker**  
Grainger No. 3HX33

### Want to learn more?

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## Success Story

# Linc<sup>®</sup>-ing Up For Success

## Harris Companies continue to build their HVAC service business through Linc and Grainger



**Harris employees pictured from left to right: Jerry Reiter, Warehouse/Tool Coordinator; Bob Swanger, Vice President and General Manager; Kevin Zweifelhofer, Sales Engineer/Account Executive/Project Engineer; and Lisa Linell, Operations Manager.**

Six years ago Harris Companies were at a crossroads with their business. The question: "Do we stay in the construction business as a full line, single-source Mechanical Contractor, or do we branch into the service side of things?"

"Harris is part of a MCAA (Mechanical Contractor Association of America) Peer Group and they basically told us to either get in or get out of the service business," said Bob Swanger, Vice President and General Manager, Harris Mechanical Service Division. "For years, Harris has been a leader and one of the larger construction companies in the area, but we were not focused on service, and if we were going to be a service company we needed to make a commitment to it. And if we weren't going to make a commitment to it we should get out and let somebody else do the work."

As a result, the St. Paul, Minnesota-based Harris Companies, which also owns HiMec Mechanical in Rochester, Minnesota and has a branch in Salt Lake City, Utah, made that commitment to the service business – a move that eventually led them to become part of the Linc Service<sup>®</sup> Network in the Twin Cities area, and develop a deeper partnership with Grainger.

The Linc Service Network is comprised of more than 120 independently-owned Mechanical

Contractors using the Linc System<sup>®</sup> to deliver HVAC service to commercial, industrial and institutional customers. Linc Service<sup>®</sup> Contractors offer a comprehensive range of HVAC services and preventive maintenance programs using a turnkey business operations system provided by the Pittsburgh and Atlanta-headquartered Linc Network, LLC. This premier group of Mechanical Contractors have access to the latest in technical and management training, computerized maintenance scheduling, cost control programs and other components to properly and profitably operate an HVAC service business.

Harris Companies began to take a closer look at becoming a part of the Linc Service Network at the urging of other peer group members. Their research determined that acquiring a Linc Service franchise would be the best way to manage and grow their business. Coincidentally, the existing Linc Service franchise in St. Paul was leaving the network, which made Harris Companies' decision to partner with Linc in 2001 an easy one.

Swanger said the Linc System makes it easy to manage and operate their HVAC service business so they can concentrate on their clients.

"One of the biggest benefits is that it allows you to focus your business and provide excellent service for the Customers by not having to reinvent a lot of the processes," he said.

One example of how the Linc processes benefited Harris Companies is when their Service Manager, was activated to serve overseas in the U.S. Naval Reserve. While the job of Service Manager is an extremely critical position at Harris Companies, losing Ken Kessler for an extended period of time was not devastating because of the processes outlined in the Linc Service program.

"Because of the Linc processes we were able to cover for his absence," said Swanger. "The processes remained the same when Ken left, so we were able to manage the business effectively despite

the loss of a key person. It was still painful to lose him, but the whole thing did not fall apart. For a lot of organizations losing a Service Manager would set them back for years."

Prior to his departure, Ken Kessler brought Grainger in to help better manage the inventory needs of the increased service business brought on by the relationship with the Linc Service program. In the beginning, there were some skeptics among Ken's team, but in the end, he was right!

"Grainger has really come a long way toward supplying us with product to help improve the profitability of our preventive maintenance program," said Lisa Linell, Operations Manager, Harris Mechanical Service Division. "Not only can I get my belts, filters, motors, tools, heaters and fasteners from Grainger, but I can also get custom-made filters delivered to meet my needs."

Harris Companies' service technicians are able to order all their parts for same-day pickup at the Grainger branch closest to their job, which saves everyone time and money. "The local Grainger branches go the extra mile to service us every day," commented Nick Czerian, Service Analyst.

"Grainger was very good in altering how they do things to conform to the way we do things," said Jerry Reiter, Warehouse/Tool Coordinator. "From our standpoint, we do everything for our Customers and it's nice to have it the other way around for a change. Our Customers are the focus of everything we do and it is nice to have a partner that has a similar philosophy."

Like most things in business the keys to success are establishing relationships and understanding your Customer – key areas that Grainger and Account Manager Peter Solum have proven with Harris Companies.

"If a Customer's system is down and they need a solution fast, we don't have time to leave a voice mail and wait until the next morning for someone to call us back. We need to get things done quickly and that's what Pete has done," Swanger said. "He's taken a program that's given us good cost and he's given us value added service to go with it. We've managed to get both and that's a huge advantage to us."

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# Diagnosing Hot Spots Can Lead To New Business

Information courtesy of Fluke

**Thermography used to be expensive, difficult, and primarily used by large industrial facilities and the military. These days, it's become much more affordable, easier to use, and more broadly applied. That means your customers have heard of it.**



It's a very impressive technology. Since the tool, a thermal imager, works by producing thermal (heat) pictures of the equipment, your customer can immediately see the benefits. In one pass through a facility, you can usually find at least one component about to fail. This makes for a powerful demonstration and an easy business builder.

Your advantage as a Contractor is having broad experience with many types of equipment and failure scenarios – just like any other troubleshooting situation, the person behind the imager needs to draw on experience to help analyze the readings. If this part of the panel is hot, should I investigate the connections or the load?

Last of all, if you're already signed-on for regular maintenance and troubleshooting, adding thermography makes sense. You already know the facility and which units are critical to performance. You can simply add thermal inspection to your regular visits and have the tool available during troubleshooting calls. Plus, as an electrician, you're uniquely qualified to work in live voltage situations – specialty thermographers are not and require client assistance.



## Typical Applications

Electrical Contractors typically use thermal imagers for predictive maintenance and troubleshooting, and sometimes during installation.

For predictive maintenance, the Contractor takes thermal images of key units (panels, drives, motors, etc.) at least once a year if not more often, and compares those to previous images. Hot spots that weren't seen previously indicate potential problems that should be investigated before they cause failure. Software on the thermal imager helps you align your images time after time, so that you're making consistent comparisons.

### When selling this idea to a customer, here are some additional things to consider:

- Most equipment's failure mechanisms involve a significant rise in operating temperature long before catastrophic failure occurs.
- Thermal images are best taken while equipment is operational. No shutdowns needed.
- Thermal images are taken at a safe distance. Minimal safety risk (except for live voltage – that still requires full electrical safety precautions).
- Thermal images can access components and units not otherwise measurable, such as ceiling runs.
- Thermal measurements help detect imminent failures in nearly all types of equipment, from electrical to mechanical, process, electronic, and so on.
- Because thermal inspections are fast, they can cover more ground and find problems in areas that would typically be ignored.

For troubleshooting, taking a thermal image of a malfunctioning unit can often identify the source of the problem – electrical hotspots can tell you which phase or connectors to check, motor hotspots can narrow it down to bearings, and so forth. Then, after repairs, follow up with another thermal image and verify that the component is no longer overheating – or that something else isn't now overheating, instead.

### Here's a summary of principle applications:

- **Electrical power distribution systems:** Three-phase systems, distribution panels, fuses, wiring and connections, substations, electrical vaults, etc.
- **Electro-mechanical equipment:** Motors, pumps, fans, compressors, bearings, windings, gear boxes, and conveyors
- **Process instrumentation:** Process control equipment, pipes, valves, steam traps and tanks/vessels
- **Facility maintenance:** HVAC systems, buildings, roofs and insulation

## How It Works

Today's entry-level thermal imagers are compact and easy to use with minimal training. The camera automatically scans the unit in range and produces a constantly updating thermal image on screen. To capture a specific thermal image, in most cases, simply squeeze the trigger. When you're done, connect the thermal imager to your computer, upload the images to the thermal software, analyze them more closely, and create a report documenting your findings.



Here are some of the more complicated concepts involved in taking a good image and analyzing it correctly.

### Emissivity

When you measure surface temperature, you're actually reading the infrared energy emitted by that object. Emissivity tracks how thoroughly the surface emits energy. The standard emissivity of most organic materials and painted or oxidized surfaces is 0.95. However, certain materials, such as concrete and shiny metals, are poorer emitters – their emitted energy doesn't accurately reflect their real surface temperature. To get an accurate thermal measurement of things like bus bars and any large metal electrical connectors, you need to adjust the emissivity value on the imager.



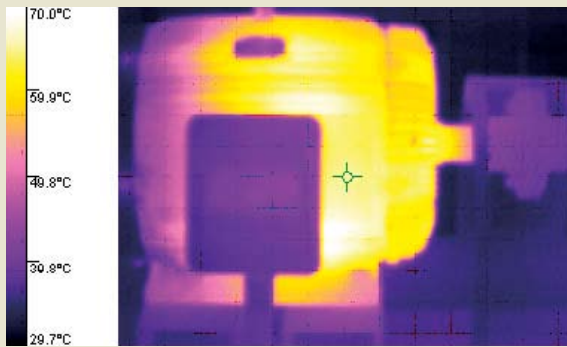
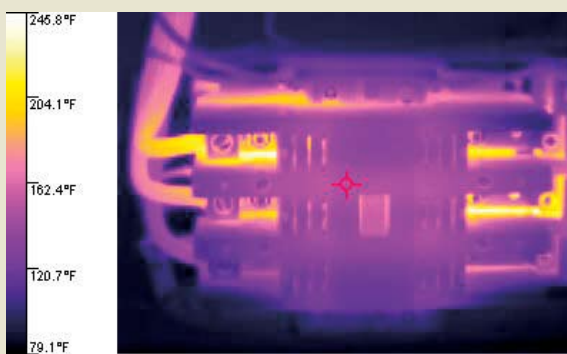
Emissivity values for many materials are published in charts. If you can look up that value for an object, you can adjust the imager appropriately. Or, you can learn to adjust the emissivity while you're taking the image. For example, for shiny fuse caps the emissivity might be only 0.6. If you know that, you can change the imager's emissivity from 0.95 to 0.6 and see the real temperature.



Thermal Imager  
Grainger No. 5YE66

Continued on page 7

**GRAINGER**  
FOR THE ONES WHO GET IT DONE



Motor bearing

### Level And Gain

When the image field includes a wide range of temperatures, level and gain help you focus on the most important temperatures.

Most users work in automatic mode, where the thermal imager automatically assigns a temperature range based on the thermal scene it sees. If the imager senses a range from 80° to 120°F, the camera will automatically display a temperature range between 75° and 125°F.

If, however, you look at a scene in automatic mode with something cool in the foreground and something very hot in the background, the color palette will be spread across a wide range of temperatures and the resolution will be poor. In such cases, you can manually adjust the level and gain to view just the temperatures of the hot or cool object.



### Choosing An Imager

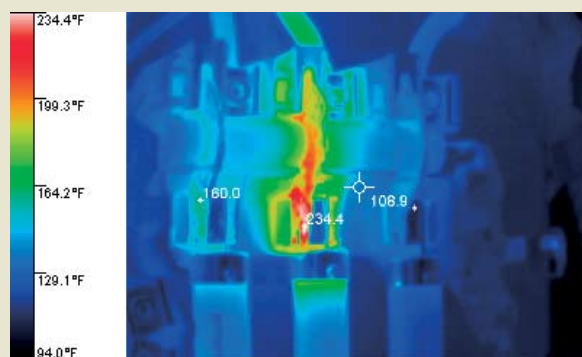
Obviously, there are many kinds of thermal imagers to choose from. Here are some factors to consider when deciding what kind is your best fit.

### Radiometric

When you look at an image on a digital screen, you're really looking at thousands of individual little points of color. In the same way, radiometric thermal imagers capture temperature data for each of the thousands of points in a thermal image. A non-radiometric imager only provides temperature data for a few focal points. Why does this matter? Well, back at the computer, you can zoom in and out of a radiometric image, exploring any part of the image in more detail, and you can also change the emissivity or temperature range, to better analyze the results. That means you don't have to get the perfect image on-site, which is a big time-saver.



Hot connection, pump



Disconnect unbalanced

### Thermal (Temperature) Sensitivity

Unless your customers produce very complicated, small components or have very heat sensitive applications, you very likely do not need the top models on the market. Most Contractors do fine with a thermal sensitivity range of -10° to 350°C (14° to 662°F).

### Pixel Resolution

A high-resolution screen and image looks nicer and is more impressive. However, those pixels cost money – the higher resolution your image output, the more the thermal imager is going to cost. If you're primarily looking for hotspots in electrical and mechanical applications, chances are, you don't really need the highest resolution available. You need enough resolution to compare one unit to another or to

previous images, and that's what the entry-level units are designed to do.

### Other Basic Features

Any imager you buy should offer the following:

- Adjustable emissivity
- Selectable temperature (C or F),
- Level and gain control
- Accuracy within  $\pm 2\%$  or  $\pm 2^\circ\text{C}$
- Repeatability within  $\pm 1\%$  or  $\pm 1^\circ\text{C}$
- Rechargeable battery pack (minimum 3 hour life)
- Laser sighting and a protected lens
- One year warranty

Many imagers also include the ability to set alarms for problematic temperature levels and to upload previous images for on-site comparison.

### Training

Most entry-level imagers come with a user manual and some form of interactive training, and that's usually all you'll need to get started on an entry-level imager. Medium to high-end imagers are more complicated and should therefore include at least two days of in-person training from a reputable training firm. Beyond that, you can take full training courses to become certified in thermography – Level I is basic, and at Level II and III you can start calling yourself a thermographer. For more information on training contact your Grainger Representative.

### Software

You're going to need software with any thermal imager you buy, so here are the key points to consider. Is the software included in the price? Are future updates free of charge? Do you have to buy licenses for multiple team members to load it? Is it easy to create good-looking reports for customers? Is it compatible with your computer operating system?

### Summary

Really, there's nothing holding you back. Contractors can readily purchase affordable thermal imagers, quickly train on the basics, and immediately start using the tool to improve their customer services. The more you use it, the more skilled you become.

### Want to learn more?

Go online to [grainger.com/contractor](http://grainger.com/contractor) or contact your Grainger Representative for additional information on the featured products and other items in the Test Instrument category.

## Measure Twice. Cut Once.

# Don't Mess With Propane

Several years ago, when I was younger and less cautious, I went to work in a jewelry factory to repair a broken propane unit heater. The heater served an area where 30 women were doing bench work and a radio was playing. I turned on the unit to see what the problem was and couldn't hear the flow of propane from the gas valve because of the radio, but suddenly smelled it. I reached up to shut off the power switch and saw the igniter try to ignite with a tick and then I was in the middle of an explosion.

Two maintenance guys helped me down from the ladder and the 30 women were screaming from

the event. I could not see or hear. I had an instant sun burn and my hair was burnt off my head. I had specks of rust in my eyes and all over my face. I was taken immediately to the emergency room and luckily began to see and hear after a half hour.

A week later and some recovery time, my boss sent me back to fix that same heater. I very reluctantly went and very, very cautiously found the ignition control faulty and replaced it. A lesson well learned, don't mess with propane.

Allan Partington

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Racine, WI 53403

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# Unearthing New Profits In Tight Spaces

Information courtesy of Ridge Tool Company, Manufacturers of RIDGID Branded Products

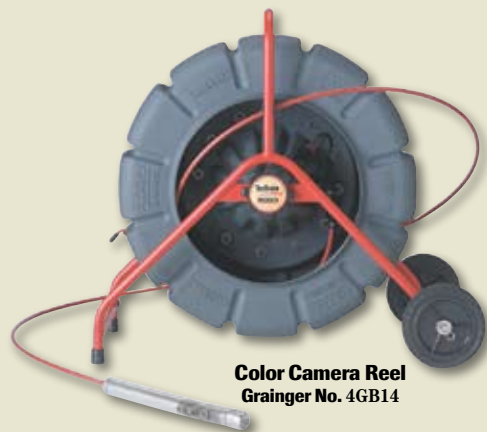
## Camera inspection systems can open new sources of revenues in the most unlikely places – clogged pipes.

Using a camera to visually inspect the inside of a pipe is extremely valuable in helping you quickly and accurately diagnose problems. Cameras are a great way to increase your efficiency on the job and can also identify other problems that exist in the pipes, which can lead to additional service and profits for you.

There are three main components to a pipe inspection system: the Camera, Push Cable and Control Unit. These components provide you with an invaluable tool that enables you to effectively perform a wide variety of inspection services.

### Camera

The camera is located at the end of the push cable and provides an image from inside the pipe. Cameras on the market today now come with stainless steel shells, spring assemblies and sapphire crystal lenses for added durability, since they receive the most abuse from frequent impacts inside the pipe.



Color Camera Reel  
Grainger No. 4GB14

In choosing a camera's diameter size, consider the average diameter of pipes you inspect most often. For example, if you typically inspect 2" lines, a camera diameter of 1.4" or less will work best. If you inspect smaller lines, a camera diameter of 1.2" or less is a better choice. Cameras are also equipped with a light source to illuminate the pipe. Selecting a camera with a dimmer function gives you the ability to control the light intensity for better viewing.

Another feature to consider is the self-leveling camera option, which provides a continually upright image from the camera. This is important because as the camera snakes around corners and bends, the view shown is upright, so you always know where the bottom of the pipe is. Transmitters used in conjunction with the cameras and above-ground locating equipment, allow you to pinpoint the location of the problem quickly. This takes the guesswork out of isolating the damaged area.

### Push Cable

Stored within a drum of the camera system, the push cable is used to manually push the cable down the line of the pipe, and contains the wiring to operate the camera. It's important that the push cable be rigid enough to allow you to propel the camera down the line, yet flexible enough to navigate through any bends in the pipe.

Many drums include a distance counter to show how far the camera has been pushed out, making locating its position easier.



Signal Clamp  
Grainger No. 4GB20

Line Transmitter  
Grainger No. 4GB19

### Monitor/Control Unit



Color Monitor VCR  
Grainger No. 4GB15

Every pipe inspection system uses a monitor that helps you operate the system and view the camera's image simultaneously. Because they're frequently used outdoors, a sunshade to minimize glare is a necessity. Many monitors also include recording devices. An audio recording option

gives you the ability to provide an explanation or narration of what is being seen on the video.

### Benefits for Contractors

Using camera inspection systems can lead to additional work with a higher profit margin than just a simple drain-cleaning job. In fact, some Contractors don't even charge for the service, rather, they use it to identify other problems in the piping system. When a problem is found, such as a collapsed section of pipe, bad root infiltration or belly in the pipe, you can show your customer the nature of the problem right away, which can lead to additional work.

That was the case for Country House Doctor, a Wellington, Ohio-based plumbing and heating Contractor, who successfully diagnosed a restaurant's drain line problem using a camera inspection system.

The restaurant complained that the toilets in the restrooms weren't flushing properly. Country House Doctor initially used a drum machine to snake out a mass of paper towels lodged 16 feet down the pipe. A few days later the same problem occurred again. Another mass of paper towels turned up 20 feet down the line this time.

A short while later the same problem began again. That's when Country House Doctor took a closer look at the pipe with a camera inspection system. They found that a portion of the 4-inch pipe had deteriorated. The washed-out cavity had been collecting mud and paper towels. The debris was not flowing out of the system on its own until the plumbing company removed it. Precise identification of the problem's source helped the Country House Doctor enhance its credibility with the customer.



Transmitter/Sonde  
Grainger No. 4GB21

Navitrack Pipe and Line Locator  
Grainger No. 4GB18

### Application Tips

- If a pipe is obstructed or filled with murky water, run an auger through the line to clear obstructions and facilitate the flow of water. After a viewing area is cleared, you may begin the inspection.
- If there is any reason to believe that the pipeline or electrical conduit has an electrical charge from improper wiring or grounding, do not use your camera.
- If the pipe system you are inspecting has multiple bends (90°, 45°, etc.), you can run some water through the pipe as you are pushing the camera to help the camera and push rod negotiate the bends. This also gives you a good point of reference as the view of the pipe turns as the camera travels through bends.
- You can use Armor-All®, or a similar vinyl cleaning product, over the length of the push rod to protect the outer covering and help the rod negotiate bends.
- If the camera is pushed into an obstruction that covers the lens, you can push the camera back and forth quickly to try to wash it off of the lens if there is clear water in the pipe. If not, you will have to pull the camera all the way back to clean the lens.
- When pushing the camera into a pipe, keep as little of the push cable between your hands and the inlet of the pipe as possible (1 to 2 feet). This will minimize kinking or snapping the rod as you are trying to get the camera to go through a tight spot.
- If you aren't using a self-leveling camera, run some water through the pipe as you're watching the monitor so you can tell which way is up. Your point of reference can become distorted as you push the camera through multiple bends in a piping system.
- When locating a camera in a pipe, push the camera out 10 feet or so and locate – then another 10 feet at a time, rather than pushing it out 100 feet and trying to hunt for it.

Purchasing a camera inspection system is a big investment. However your costs can be quickly recovered and your profits increased through job efficiencies and additional work that is identified as problems are uncovered and diagnosed.

### Want to learn more?

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Chain Vise  
Grainger No. 2TE40

Tank & Extinguisher Kit  
Grainger No. 2TE39



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Grainger No. 6YB12

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- 175W Metal Halide – Grainger No. 2WA33
- 250W Metal Halide – Grainger No. 2WA34
- 400W Metal Halide – Grainger No. 2WA35



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8' Ladder  
Grainger No. 3W142

10' Ladder  
Grainger No. 3W183

**Save on Werner® Fiberglass Ladders**

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No rebate form necessary.



**FREE** by mail-in rebate



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**Bosch® Rotary Hammer!**

Receive a FREE Bosch 3/4" SDS-plus® Rotary Hammer (retail value \$199) by mail-in rebate with the purchase of either:



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Grainger No. 4WN49

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# A New Way To Make Up Profit

**Everyone is concerned about rising energy costs and poor indoor air quality. Contractors can provide solutions that decrease their customer's energy consumption while improving indoor air quality, and build their business at the same time.**

A well-designed ventilation system with roughly equal amounts of air entering a building as leaving it, results in a more comfortable environment. There is a big opportunity for Contractors to grow their business if they are familiar with make-up air application standards\* (International Mechanical Code 508 and ASHRAE 62), and know how to properly install and maintain these units.



**Make-up Air Heater**  
Grainger No. 2TE33

New Dayton® Make-Up Air Units can meet your customers' year-round requirements. These Direct-Fired Gas Units deliver building solutions that replace exhaust air with tempered outside air.

## Selection and Installation

Air volume is typically sized to match the exhaust volume. General rules of thumb include:

- **Industrial applications**  
Supply CFM = Exhaust CFM + 10%
- **Kitchen applications**  
Supply CFM = Exhaust CFM

Industry standards say make-up air should be brought into a space equal to the amount of air that is exhausted. In the summer typically un-tempered make-up air can be provided into a space. However in the fall and winter, many areas of the country require it to be heated before it's delivered into a space. Direct-fired gas units are a good choice.

Keep in mind the make up air heater's CFM may be sized a little higher than the exhaust CFM in industrial applications to control infiltration. In commercial kitchen applications, ventilation rates are sized for odor control. The ratios of air through a dedicated make up air unit and the air that is transferred from the dining space could vary from 10-50%. However, the total supply air to the building must be equal to the exhaust.



**Gas Pressure Regulator**  
Grainger No. 4E225



**Upblast Exhaust**  
Grainger No. 4YY15

## How to Install a Dayton® Make-Up Air Unit

### Step 1 – Install Curb and Unit

Install curb and ductwork. Attach unit to curb. The unit is constructed of 18 gauge-galvanized steel with standard lifting lugs for easy installation. The cabinet is lined with 1" foil faced insulation and includes a motorized damper and a weather hood with washable aluminum filters completely mounted.



**12" Fixed Curb**  
Grainger No. 2RB78



**Vented Curb**  
Grainger No. 4HX55

### Step 2 - Install Electrical Wiring

The UL listed electrical control center includes a motor starter, control transformer and a disconnect switch. Simply determine the size of the main power lines using the unit nameplate and label inside the unit and connect the main power.

Be sure to turn off the power prior to installing any electrical wiring and to use proper lock-out/tag-out procedures to ensure safe working conditions for you and your crew. See OSHA standard 1910 for additional guidance on electrical safety.

### Step 3 - Install the Direct Gas Piping

Begin installation by determining the supply gas requirements as shown on the unit nameplate. Then, connect the supply gas line and test the system before start-up. The direct gas-fired system includes a direct spark ignition system with dual safety shut off valves and an electrical modulation system. The burner is cast aluminum and capable of a 25:1 turndown ration.

## Frequently Asked Questions

**Q: What is turndown ratio and is it different for direct vs. indirect gas heaters?**

Turndown ratio compares the maximum to minimum heat output. Turndown ratio for direct gas burners is 25:1, which means that the burner can modulate from 4% to 100% of full fire. Indirect gas turndown ratio changes based on the controls. Example based on a single furnace unit (< 400 MBH). 4:1 electric modulation limits the heat output from 25% to 100% of full fire.

**Q: What is the Maxitrol 14 control?**

Maxitrol 14 uses a discharge air sensor and a discharge temperature selector to control air temperature at the point of discharge for direct gas-fired units only. Maxitrol 14 is commonly found in kitchens, restaurants, paint spray booths and general industrial applications.

**Q: What is included in a Control Center and where is it located?**

Control Centers include a factory pre-wired disconnect switch, transformers, and starters. A Dayton® Control Center provides the benefit of a single point wiring connection in the field.

**Q: What does ETL stand for?**

Intertek Listed, formally known as Edison Testing Laboratories (ETL). The ETL mark is an alternative to American Gas Association (AGA). It is a listed mark and is accepted and recognized by jurisdictions across the US and Canada. ETL certification is nationally recognized by the major building code agencies which most municipalities and states adopt as their own.

**Q: Where is direct gas-fired heat not permitted?**

According to National Fire Protection Association (NFPA 54), direct gas-fired heat cannot be used in sleeping quarter areas. Please be aware that local authorities may have different interpretations or further restrictions. If you are not sure, please contact your local authorities for interpretation.

**Q: What does an Inlet Air Sensor do?**

An Inlet Air Sensor consists of an on/off duct stat that automatically de-energizes the burner when outside air temperature is near or equal to the desired discharge air temperature. Typically, this option is used to prevent the burner from firing on mild days.

**Q: Can Make-Up Air Units that have direct gas heat be mounted indoors?**

Yes. Typically C channels are used, one on each end of the unit. From that a threaded rod is run to the ceiling joist. Sometimes, you may also want to install isolators between the rod and the joist.

**Q: What side of the unit are the controls located on?**

When you are looking into the intake of the unit with the air hitting you in the back of the head, the controls and connections will be on the right side of the unit.

**Q: What is the recommended minimum service clearance for Make-Up Air Units?**

The recommended minimum for the units shown are 42 inches on the control's side of the unit.

Dayton® Make-Up Air Units provide your customers with a compact, efficient and economical solution to common make-up air issues. Once installed they provide you with the opportunity to win the maintenance contract and earn year-round revenue.

*\*Consult your local code authority for the exact requirements in your area.*

### Want to learn more?

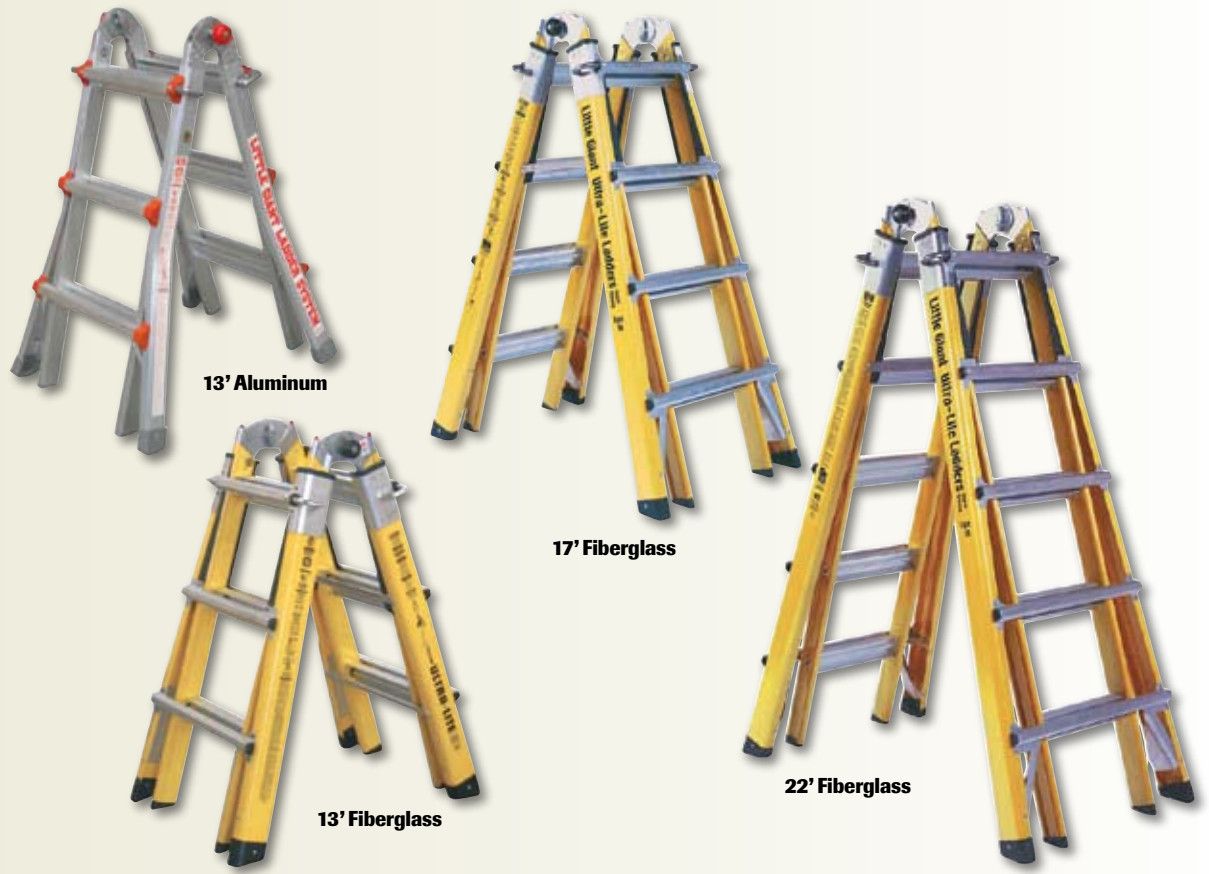
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## Telescoping Multipurpose Ladder System

Multipurpose model comes with four ladder styles (extension ladder, A-frame stepladder, staircase ladder and two scaffold trestles) and 34 different configurations – all in one ladder. Available in sturdy fiberglass or aluminum frames. Wide flare base and skid-resistant feet increase safety. Ladder heights available in 13-, 17-, 22- and 26-foot models (26-foot model in aluminum only). ANSI type 1A ladder has 300-lb. load capacity.

- Aluminum –  
Grainger No. 4DB26, 4XN30, 4XN31, 4XN32
- Fiberglass –  
Grainger No. 4DB23, 4DB24, 4DB25



## COOPER Bussmann Fuse Service Kit

RK5 Branch Circuit Fuse Service Kit contains assortment of commonly used fuses in easy-to-carry case. Ideal for service trucks, storeroom or near critical pieces of equipment. Comes with fuse puller and 6" wire strippers. Voltage rating 250/600 VAC.

Grainger No. 4YY91



## DMM/IR Combo

Non-contact infrared thermometer measures surface temperature of objects unsafe to contact or difficult to reach. 8:1 distance to target ratio with 0.95 fixed emissivity. Input fuse protection and mis-connection warnings with audible and visual signals. Cat III test leads, multi-position tilt stand, hanging strap, holster with test lead storage, bead wire temp probe. Powered by 9V battery.

Grainger No. 1GUH1



## Clamp Meter

Non-contact infrared temperature measurements with laser pointer. Peak hold captures inrush currents and transients. AC/DC voltage, resistance, capacity, frequency, diode and continuity. 1.7" jaw opening for conductors up to 750MCM or two 500MCM. 4,000 count backlit dual display. Comes with test leads, type K probe and belt holster. Powered by 9V battery.

Grainger No. 1GUH4



## Markal Lumber Crayons

Ideal for marking concrete blocks, lumber, metal, plastic, rubber, paper, cardboard and ceramics. Able to mark on smooth or rough surfaces. Marking range between -50° to 150°F. 12 per box.

- Grainger No. 5W542 Yellow
- Grainger No. 5W543 Red



## 12V Grease Kit

Piston-type 12V DC grease gun has durable, cast-iron pump head. Heavy-duty follower spring ensures positive priming and uninterrupted pumping. Measuring 19-1/2" in length, grease gun comes with 30" hose. 6,000 maximum PSI. Easy cleaning without gun disassembly. Fits 14-1/2 or 16 ounce grease cartridge.

Grainger No. 6WB10



## Stealth Torpedo® Level

Oversized 10" heavy-duty level has both top-read level and unique plumb vials. Two V-groove working edges and three strong rare-earth magnets are five times stronger than traditional strip magnets. High visibility orange polymer frame for added durability. SurroundView® vials for easy viewing.

Grainger No. 3KU73

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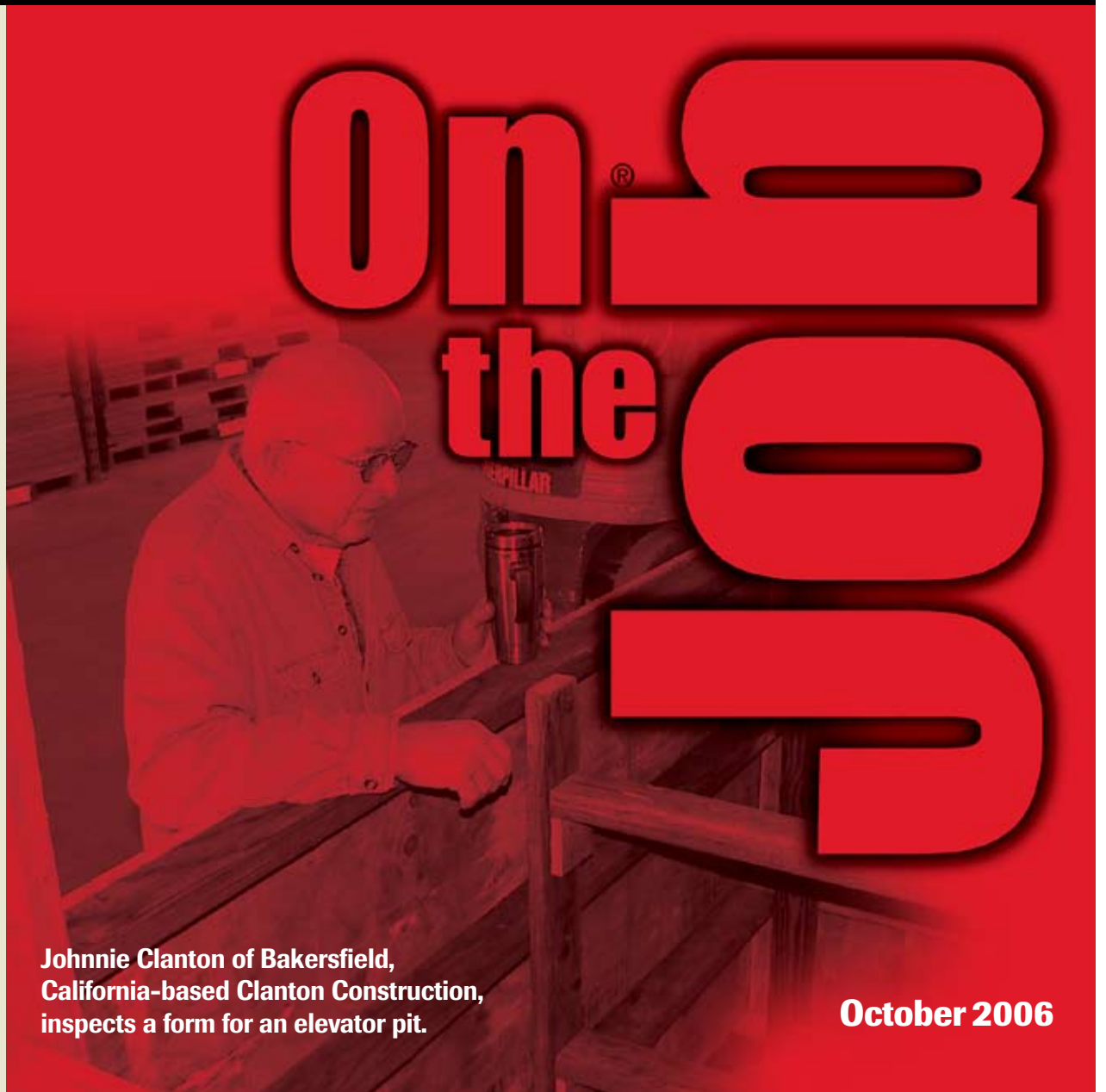
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Johnnie Clanton of Bakersfield, California-based Clanton Construction, inspects a form for an elevator pit.

October 2006

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The manufacturers have reviewed all product information recommendations provided herein. However, proper product operation requires individual user accuracy, skill and caution. W.W. Grainger, Inc. does not guarantee the result of product operation or assume any liability for personal injury or property damage resulting from the user's reference to the product instructions.

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Upon selection of your story, we'll provide a Release Form that you'll have to complete. If you provide a photo, high resolution digital images are preferred, but we can work with almost any clear, well-focused photo. Photos will not be returned. Employees of Grainger, its subsidiaries, affiliates and members of their immediate families or households are not eligible. You will be notified if your entry has been selected. The approximate retail value of the premium is \$18.99. Grainger reserves the right to substitute another product of equal or greater value. This offer is not valid with any other Grainger offer or promotion. Valid in the USA except where prohibited, taxed, or restricted by law. Grainger is not responsible for postage-due, illegible, mutilated, lost, late, or misdirected requests, or for items lost, damaged or delayed in the mail. Limited time offer. Valid 10/1/06 - 10/31/06. Not available to government customers. © 2006 W.W. Grainger, Inc. All rights reserved.

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